

**5ESS®-2000 Switch
Administration and Engineering Guidelines
5E11 and Later Software Releases**

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Acknowledgment

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1. INTRODUCTION

1.1 PURPOSE

These guidelines assist the switch administrator and traffic engineer in performing local switch administration functions for the Lucent Technologies 5ESS®-2000 Switch. These functions include:

- Data Administration
- Switch Surveillance
- Capacity Management
- Switch Resource Utilization
- Transition Management.

To perform these functions, the administrator must have a thorough understanding of the 5ESS®-2000 switch architecture and its call processing operations. Additionally, the administrator must understand how to interpret the traffic measurements provided from the 5ESS®-2000 switch and be able to react to developing trends in traffic patterns to prevent traffic blockage and to avoid equipment over-engineering.

This manual describes the administrative facilities provided, and the administrative functions necessary to administer the 5ESS®-2000 switch. Additionally, the operations and administrative interfaces which may be used to perform the administrative functions are described.

This manual is also used by the traffic and equipment engineer for an overview of system architecture, engineering, and administration. Toll, Operator Services Position System (OSPS), commercial automatic call distribution (C-ACD), and attached processor (AP) services features administration details are beyond the scope of these guidelines.

NOTE: Be aware that not all administration and engineering information applies to each service provider. It is up to the individual switch administrator or traffic engineer to be aware of his/her area of concern.

1.2 UPDATE INFORMATION

Along with other Lucent Technologies network switching products, the 5ESS® switch product line is being positioned to support Service Net-2000 (SN-2000). Therefore, effective with the 5E9(1) software release, the name of the 5ESS® switch was changed to 5ESS®-2000 switch. The 5ESS® switch name remains valid for all prior software releases [5E9(1) and earlier]. It should be noted that these name changes have not been carried forward into software influence items such as input and output messages, Master Control Center screens, Recent Change/Verify screens, etc.

National ISDN is an evolving platform in which new features will continue to be introduced for new revenue opportunities, improved operational efficiencies, and support for specific applications. NI 1, NI 2, and NI 3 represent specific features as documented in Bellcore SRs 1937, 2120 and 2457. The industry is migrating to an additional terminology to more specifically denote the availability of National ISDN features: NI 95, NI96, etc. A feature is included in a specific version (such as NI 96) if it is available by the switch vendors by the first quarter of the year.

NOTE: The 5ESS®-2000 Switch Administration and Engineering Guidelines, Issue 14.00, 235-070-100, is completely reorganized to support Software Releases 5E11 through 5E14. The information for earlier software releases is deleted. If your system operates on one of these earlier software releases, you may elect to disregard the instructions for inserting this change in the binders but retain this issue separately for reference purposes.

1.2.1 5E14 SOFTWARE RELEASE

This manual is updated to provide coverage for the 5E14 Software Release as follows:

Section 2 This section is updated with text changes describing new 5E13 Software Update (SU) features, and 5E14 software release features.

1.3 ORGANIZATION

This manual is organized by sections, and separated by tabs labeled with the section numbers. Each section has a table of contents providing a complete view of the subjects covered. Within the sections, references are frequently made to figures and tables. The figures are found at the end of each section and, in most cases, the tables are as close as possible to the table reference. In most cases where full-page or multipage tables are presented, these tables are placed at the back of the section.

To avoid duplication, some references are made to other manuals and documentation provided in the 5ESS®-2000 switch documentation plan. These documents provide additional information that may be of interest to the administrator.

Traffic and Plant Measurements, Appendix 1, 235-070-100, is available from the Lucent Technologies Customer Information Center. See "Distribution", Section 1.5, for ordering information.

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Technical assistance for the 5ESS®-2000 switch can be obtained by calling the North American Regional Technical Assistance Center (NARTAC) at **1-800-225-RTAC**. This telephone number is monitored 24 hours a day, 7 days a week. During regular business hours, your call will be answered at a centralized technical assistance center where service-affecting problems will be dispatched immediately to your local NARTAC. All other problems will be referred to your local NARTAC on the next regular business day.

1.7 REFERENCES

The following documents are recommended to assist the administrator:

235-100-125	<i>5ESS®-2000 Switch System Description</i>
235-080-100	<i>Translation Guide</i>
235-190-XXX	<i>Feature Descriptions</i>
235-190-103	<i>Business and Residence Custom Services Features</i>
235-190-104	<i>ISDN Feature Descriptions</i>
235-900-11X	<i>Product Specifications</i>
235-120-010	<i>Compact Digital Exchange (CDX) Reference Manual</i>
235-120-020	<i>Compact Digital Exchange (CDX) User's Guide</i>
235-120-110	<i>Very Compact Digital Exchange (VCDX) Reference Manual</i>
235-120-120	<i>Very Compact Digital Exchange (VCDX) User's Guide</i>

2. NEW FEATURES AND SOFTWARE UPDATES

The modular design of the 5ESS[®] switch allows for the ongoing development of features and services expected in the telecommunications marketplace. For a complete description of all the features in each software release, refer to the 5ESS[®] *Switch System Description*, 235-100-125, *5ESS Traffic and Plant Measurements* 235-070-100A and the feature manuals in the 235-190-XXX series.

Only features impacting switch administration and engineering that is applicable to administration tasks are discussed in this document. Because this document is primarily intended for use by local/domestic switching applications, and to avoid duplication of text, the following packages are not covered in these guidelines:

- Toll features
- OSPS features
- AP Service features
- VCDX
- Wireless.

Guides to documents which cover these and other subjects, as well as the 5ESS software release features not covered in this Information Product, may be found in the *Master Subject Index* 235-000-005.

2.1 SOFTWARE RELEASE AND FEATURE AVAILABILITY

Table 2-1 shows all listed features by feature number, and all software releases and software updates in which they are available.

Table 2-1 Software Release and Feature Availability

FEATURE	SOFTWARE RELEASE				
	12	12 SU	13	13 SU	14
97-5E-4286 PH22 (PH20-16 Base)					X
97-CP-4246.K SS7/PSU Link Enhancements					X
99-5E-3850.V					X
Distinctive Remote Module					
99-5E-4340					X
Increase 5ESS TRFC30 Buffer Size					
99-5E-4720					X
5E14 Flexible Assignment of DCTU/PMU Ports to MMSU Shelves					
99-5E-7011 MultiService Switching Module				X	
99-5E-4300 400 Hertz Carrier Tone				X	
99-5E-4740 ASP STOR Interworking with Originating Busy/No				X	
Answer Office Triggers with Extended Ringing					
99-5E-4209 Remote Switching Module on DNUS				X	
99-5E-3738 Real-Time Call Detail			X		
99-5E-4387 Real Time Call Detail Expansion Package A			X		
99-5E-3630/3635/3945/4008 GETS HPC			X		
99-5E-4007 Three Fully Loaded DNU-S on SM-2000			X		
99-5E-4425 DNU-S Path Trace			X		
99-5E-3261 Two B-Channel Transfer (TBCT) on PRI			X		
99-5E-2741 TRFC30-Section 143 Increase Maximum Collection Units			X		
99-5E-3706 Enhanced Location Routing Number Operations, Administration and Maintenance		X			
99-5E-3730 Number Portability - NXX Growth to 8000	X	X			
99-5E-3561 Integrated Metallic Testing for AIU		X			
97-5E-2894 97-5E-2895 Technology Upgraded LDSF		X			
99-5E-4421 BALANCE		X	X		
99-5E-3730 Number Portability NPA-NXX Growth	X				

99-5E-3260 AIN Toll Free Service	X				
99-5E-4035 ASP Provisioning of Originating Busy/No Answer Triggers as Subscribed	X				
99-5E-3338 /3739/4184 Line Time Slot Bridging Feature Enhancement	X				
97-5E-4169 MCTU3 On CM1	X				
99-5E-2844 /2845 MLPP on SS7					
99-5E-2371 Enhanced Professional Office					
99-5E-3529/3749/3760/3761 ASP Originating Busy/No Answer With Extended Ringing	X				
99-CP-3749 Repeat Dial Interworking With ASP Originating Busy Trigger	X				
99-5E-3760 Inhibiting Originating Busy/No Answer Office Triggers	X				
99-5E-3761 Call Screening for Originating Busy/No Answer Office Triggers with Extended Ringing	X				

2.2 5E12 SOFTWARE RELEASE

2.2.1 Significant Features

For more detailed information concerning feature descriptions, retrofit information, or recent change, consult the Master Subject Index, 235-000-005.

2.2.1.1 (99-5E-3260) AIN Toll Free Phases 1 & 2

2.2.1.1.1 Feature Overview

The Subscriber is the "owner" of the Toll Free number, typically a business which advertises that number to customers or potential customers and pays the charges for calls made to the Toll Free number. Individual (non-business) subscribers may also "own" Toll Free numbers and assume the charges for calls placed to them. This feature provides capabilities that allow the switch to handle the call according to the subscriber's service arrangement, as indicated by the SCP's instructions in reply to the Query. To provide AIN-based Toll Free service, the service provider must equip one or more switches within the Local Exchange network with AIN SSP capabilities, including the enhancements provided by this feature. The LEC may equip some or all End Offices with SSP capabilities, or may equip only tandem switches. In any case, the LEC network must be arranged such that when a caller dials a Toll Free number, Toll Free service is either provided at the originating end office, or the call is routed to a tandem office where Toll Free service is provided.

To provide Toll Free service in an SSP office, an AIN Dialed Number Trigger (DNT) must be assigned to the SAC code(s) defined for Toll Free calling. This assignment must be done in all of the "Office" Dialing Plans in the switch such that calls originated at lines homed on the switch and on incoming trunks from other switches can be determined to be Toll Free calls.

Once the DNT is detected for a Toll Free Call, the AIN SSP capability formulates a Query and launches it over the SS7 network. This query is routed to the Service Toll Free SCP by way of Global Title Translation (GTT) at a Signal Transfer Point (STP). The receiving SCP's service logic determines how the call should be completed based on the dialed Toll Free number, the Caller's Charge Number (ANI), time of day, day of week, or other arrangement made with the Toll Free number subscriber. It replies to the SSP with routing instructions.

The SSP receiving routing instructions from the SCP completes the call either within the LEC network to a POTS number provided by the SCP, or completes the call via the IXC specified by the SCP, using either the dialed Toll Free Number or a POTS number as provided by the SCP.

The SCP can request Termination Notification (TN) from the SSP. A TN message is sent from the SSP to the SCP when the call ends. If the call was answered, the TN includes the duration of the call. If not answered, or killed due to error, the TN message indicates the disposition of the call.

The SCP can also instruct the switch to install an Automatic Call Gap control if it is experiencing overload. Future Queries to the SCP may be throttled by the control to alleviate the overload condition.

AMA recording for AIN TF calls is provided, as is currently done for ASP DNT triggers. An AMA record for the "access leg" is created if ASP DNT triggers. An AMA record for the "access leg" is created if normal switch routing and charging translations indicate that the portion of the call from the originating facility to the TF DNT is chargeable. (It is unlikely that the service provider will provision switch data to insure that calls to TF DNTs are marked "free" and, thus, no access leg record would be produced.) For the leg of the call from the TF DNT to the final destination, AIN Structure Code 0220 AMA records are created upon request of the SCP. These records will typically not be used to charge the caller, but are used by the LEC for Access Charge billing to IXC's and billing to the Toll Free Subscriber. Note that if AMA recording is not explicitly requested by the SCP, no AMA record are created for the leg of the call from the TF DNT to the final destination (including when the call is completed via an IEC).

A variety of AIN and Toll Free-specific measurements are collected and reported on a 5 or 30-minute basis.

2.2.1.2 (99-5E-2949) ASP Interworking with Circuit Switched Data

Currently, Circuit Switched Data calls can not get reorder. With this feature, a reorder is allowed.

When first applied to the office, this feature adds a new field to the NS Trig view (9.35) which controls on a per-trigger number basis whether only voice calls, only data calls, or both can encounter triggers referencing the trigger number. On first application, this field will default to voice-only, thus preserving the current behavior.

In order to allow Circuit Switched Data calls to hit any given trigger, the service provider must update the View 9.35 for the trigger number associated with the trigger to allow data calls.

2.2.1.3 (99-5E-3730) Number Portability NPA-NXX Growth to 8000

2.2.1.3.1 Feature Overview

This feature offers two capabilities:

- (1) It increases the number of NPA-NXXs that can be assigned DNs on the 5ESS® switch from 250 to a maximum of 8,190.
- (2) It allows the same NXX code to be assigned to more than one NPA, with the multiple NXX codes, all populated with DNs.

This feature is intended to increase the numbers of NPA-NXXs available on the switch. Individual lines and Terminal Group lines are affected. Both analog and ISDN lines are affected. This feature may be used to support NPA splits and Local Number Portability allowing DNs with the same NXX value to exist in different NPAs. This feature is available on the following platforms:

- 5ESS® switch
- 5ESS® switch CDX
- 5ESS® switch VCDX
- 5ESS® switch Long Distance Platform.

2.2.1.3.1.1 Administration

2.2.1.3.1.1.1 Dial Plan

This document defines "dial plan" as the digits a subscriber is required to dial to reach other telephones. Included in a dial plan are whether seven or ten digits are required, and whether a 1+ prefix digit is required, to reach other numbers.

The dial plan administration supported by the 5ESS® switch, and by NPA NXX Growth, is data dependent; it is, driven by the translations in the switch. When this feature is turned up, this feature does not require changes to the dial plan of the LATA or the switch where this feature is deployed.

The rules for administering the dial plan are not altered by this feature. This feature does introduce the ability for the 5ESS® switch to populate DNs in the same NXX in multiple NPAs on the same 5ESS® switch. Populating DNs in the same NXX in more than one NPA on the switch is called making the NXX non-unique. When an NXX is added to the switch, the dial plan administrator must define the dial plan to reach telephones assigned to that NXX. Adding non-unique NXXs to a switch is an extension of adding non-unique NXXs to other switches elsewhere in the local network. The dial plan administrator must consider whether a direct extension of the existing dial plan adequately identifies the DNs in that NPA-NXX uniquely, or whether changes to the dial plan are required or desired for clarity in stating the dial plan to subscribers.

Note that the routing plan for a network may change if non-unique NXXs are added on a switch. The routing plan consists of the digit streams that are sent between switches to complete telephone calls over trunk facilities.

2.2.1.3.1.1.2 Traffic Counts

For this feature, traffic count Section 128 is replaced by Section 235. Section 199 is also replaced in function by Section 236.

2.2.1.3.1.1.3 Local Number Portability NPA NXX Memory Consumption

This feature is intended to increase the numbers of NPA-NXXs available on the switch. Individual lines and Terminal Group lines are affected. Both analog and ISDN lines are affected. This feature may be used to support NPA splits and Local Number Portability allowing DNs with the same NXX value to exist in different NPAs. Table 2-2 shows the amount of AM memory consumed by NPA NXXs.

Table 2-2 NPA NXX Growth Memory Consumption

Number of NXXs	AM SODD KBs Used	CMP SODD KBs Used	SM RODD KBs Used
83	23/33	35/50	34/49
258	57/81	83/119	79/ 113
1008	257/ 367	645/493	349/ 498
2008	505/ 723	685/979	659/ 941
3008	731/ 1004	672/ 1389	942/ 1346
4008	955/ 1363	1779/ 1827	1211/ 1730
5008	1100/ 1571	1600/ 2285	1400/ 2000
6008	1300/ 1857	1800/ 2571	1600/ 2285

2.2.1.4 (99-5E-3529) Originating Busy/No Answer Office Triggers with Extended Ringing

2.2.1.4.1 Feature Overview

The Originating Busy/No Answer Office Triggers with Extended Ringing feature provides incremental functionality to that provided in Advanced Service Platform Release 0.1B. The Extended Ringing capability allows the calling party to be connected to the called party if the called party should answer the phone while the calling party is listening to an interactive announcement provided by a Send_To_Resource message from the SCP in response to a O_No_Answer Query launched from the SSP. The Extended Ringing capability is a feature that is available to both the called party and calling party. It should be noted that the Extended Ringing capability does not apply to final

announcements.

The service provider has the ability to provision the O_Called_Party_Busy and O_No_Answer triggers in a manner similar to the existing mechanisms used for provisioning of ASP triggers. The service provider currently has the ability to set the value of the Default (Originating) O_No_Answer timer (used for Busy/No Answer Subsequent Event Detection feature). There is no other effect on provisioning due to this feature.

The service provider is impacted with respect to the ability to make use of the Originating Busy/NoAnswer Triggers and associated capabilities when creating or deploying AIN-based services.

The service provider is able to define the O_Called_Party_Busy and O_No_Answer triggers (using RC/V view 8.49 in 5E12 and later releases), and turn the trigger on or off using RC/V view 9.35. The service provider may also turn the feature off by turning the trigger number off.

This feature is secured separately from all other ASP Generic and Special features. This feature requires feature 126 (ASP 0.1B) to be purchased and unlocked before this feature may operate.

2.2.1.4.2 Administration

Operations Systems which support data provisioning, such as Recent Change Operational Support Systems, must be made aware of the existence of the O_No_Answer timer office parameter, and the new fields associated with the new triggers (O_Called_Party_Busy and O_No_Answer).

2.2.1.4.3 Service Changes

New fields need to be incorporated into RC View 8.49 to allow the provisioning of the new O_Called_Party_Busy and O_No_Answer triggers. The new RC fields must be like existing trigger definition fields in that the trigger number are defined (with a range from 1-255 where "blank" means that the trigger is "off") and not populated. The default value is "blank." Before the O_No_Answer and O_Called_Party_Busy triggers can be defined on RC View 8.49, the triggers must be defined on RC View 9.35 with the protocol set to ASP0.1 (AIN REL=R0D1) and the application set to ASP. The office triggers can apply to circuit switched voice, circuit switched data or both, based on the setting of SERV ALWD on RC/V 9.35 for the given trigger. Use of the option Circuit Switched Data or BOTH requires that the ASP Interworking with Circuit Switched Data secured feature be unlocked.

This feature is secured using the feature lock mechanism. It will be controlled by a lock separate from any other ASP Generic and Special Feature. The ASP Rel 0.1B feature must be unlocked in order for this feature to be unlocked. The Busy/No Answer Subsequent event Detection feature is not required to be unlocked for the Originating Busy and No Answer triggers feature.

2.2.1.4.4 Capacity and Performance

Since the new triggers are Office-Based triggers as opposed to provisioned triggers, engineering personnel must be aware that all calls originating on a switch have the potential to encounter the O_Called_Party_Busy and O_No_Answer triggers. The Extended Ringing capability requires that the called party continue to be rung while the switch interacts (play announcement, collect digits) with the calling party. This requires additional resources on the switch (time slots) analogous to the amount of resources used when engineering a switch for a feature such as Call Waiting. Switch engineering personnel must take into account the number of calls that are expected to encounter the No Answer trigger (and potentially use the Extended Ringing Capability) when determining the hardware needs for their switches.

When using office-based triggers for an application, there is the potential that the switch (or SCP) may become overloaded with Query/Response traffic (or Application Processing power in the case of the SCP) such that call processing performance may be negatively impacted. It is expected that the Automatic Call Gapping (ACG) capabilities, defined as part of AIN, would be used to control SCP overload conditions. For switch overload conditions, Telephone Maintenance personnel may use RC/V capabilities on the 5ESS® switch to "turn off" triggers

(by either turning off the trigger number or the feature) in order to eliminate any negative performance impact that either an unexpected query rate or malfunctioning SCP application might induce.

SCP link capacity may also be impacted by this feature due to the fact that a number of queries may be generated by these new office-based triggers.

When the new O_Called_Party_Busy trigger is implemented and activated by the service provider, callers on lines in the supported classes of service may experience an increase in the time required for them to hear a busy signal. This delay is due to the fact that the SCP is interacting with the switch, and the switch is not providing busy tone until instructed by the SCP to do so. The service provider can circumvent this difference by playing an announcement recorded with a busy tone in the background.

2.2.1.4.4.1 Processor Occupancy

For every 200 new calls, representing a mixture of scenarios, that make use of this feature, processor occupancy for SMP20 will increase by approximately 1%. Mixed call occupancy per processor is shown in table 2-3

Table 2-3 Mixed Call Occupancy

NUMBER OF BLNA CALLS PER 1% OCCUPANCY					
SMP 20	SMP 23	SMP 23 CDM	SMP 40	SMP 60	SMP 60 MM
200	250	300	870	1230	1500

2.2.1.4.5 Busy Line No Answer Add-On Extension Features

As an alternative to unprovisioning the office-wide triggers or making the triggers' statuses inactive, the 5ESS[®] switch offers additional Extension features to the Originating Office Busy No Answer Triggers with Extended Ringing Feature. These features individually allow the service provider to inhibit triggering of the O_No_Answer and O_Called_Party_Busy events, screen the types of calls that are monitored for these events, or allow the triggers to be subscribed to on a line-by-line basis instead of office wide. Similar performance limitations to those noted for office-wide triggers will be encountered with subscribed triggers as well. These can be alternatives to limit the number of calls that can be monitored for busy and no answer events are as follows:

- **99-5E-3760** Inhibiting Originating Busy/No Answer Office Triggers
- **99-5E-3761** Call Screening for Originating Busy/No Answer Office Triggers with Extended Ringing
- **99-5E-4035** ASP Provisioning of Originating Busy/No Answer Triggers as Subscribed.

Table 2-4 BLNA SMP Occupancy

1000 Scenario Calls /SM/Hour						
	SMP 20	SMP 23	SMP 20DC	SMP 40	SMP 60	SMP60 MM
1000 Scenario 1 Calls /SM/Hour	7.4	6.0	4.9	1.7	1.2	1.0
1000 Scenario 2 Calls /SM/Hour	7.1	5.8	4.7	1.6	1.1	.9
1000 Scenario 3 Calls /SM/Hour	.86	.70	.57	.20	.14	.11
1000 Scenario 4 Calls /SM/Hour	.14	.11	.09	.03	.02	.02
1000 Scenario 5 Calls /SM/Hour	17.0	14.0	12.0	4.0	2.8	2.3
1000 Scenario 6 Calls /SM/Hour	12.0	9.9	8.0	2.8	1.9	1.6

1000 Scenario 7 Calls /SM/Hour	9.4	7.6	6.2	2.2	1.5	1.3
1000 Scenario 8 Calls /SM/Hour	13.0	10.0	8.5	3.0	2.1	1.7
1000 Scenario 9 Calls /SM/Hour	27.0	22.0	18.0	6.2	4.3	3.5

Table 2-4 can be used to determine the impact of adding various BLNA scenarios. The percent of SMP occupancy values in this table represent the increase in occupancy due to 1000 Scenario calls per SM per hour. This increase is above and beyond what is already being processed on the SM without the BLNA feature.

The scenarios are as follows:

- Scenario 1: originating line, BLNA trigger (ASP TP created), terminate to outgoing ISUP trunk, terminator1 doesn't answer, no answer timeout, SCP query, analyze_route and "forward" to 2nd outgoing ISUP trunk, terminator 2 answers, originator disconnects 1st
- Scenario 2: originating line, BLNA trigger (ASP TP created), terminate to outgoing ISUP trunk, terminator1 busy, SCP query, analyze_route and "forward" to 2nd outgoing ISUP trunk, terminator 2 answers, originator disconnects 1st.
- Scenario 3: originating line, BLNA trigger (ASP TP created), terminate to outgoing ISUP trunk, terminator 1 answers, originator disconnects 1st
- Scenario 4: originating line, BLNA trigger (ASP TP created), terminate to outgoing ISUP trunk, terminator 1 doesn't answer, originator abandons before no answer timeout
- Scenario 5: originating line, BLNA trigger (ASP TP created), terminate to outgoing ISUP trunk, terminator 1 doesn't answer, no answer timeout, SCP query, STR to RAF, RAF collects digits (originator accepts "forward"), SCP query, analyze_route and "forward" to 2nd outgoing ISUP trunk, terminator2 answers, originator disconnects 1st
- Scenario 6: originating line, BLNA trigger (ASP TP created), terminate to outgoing ISUP trunk, terminator1 doesn't answer, no answer timeout, SCP query, STR to RAF, during RAF announcement terminator1 answers, originator disconnects 1st
- Scenario 7: originating line, BLNA trigger (ASP TP created), terminate to outgoing ISUP trunk, terminator 1 doesn't answer, no answer timeout, SCP query, STR to RAF, during RAF announcement originator abandons
- Scenario 8: originating line, BLNA trigger (ASP TP created), terminate to outgoing ISUP trunk, terminator 1 doesn't answer, no answer timeout, SCP query, STR to RAF, RAF announcement timeout, originator disconnects
- Scenario 9: originating line, BLNA trigger (ASP TP created), terminate to outgoing ISUP trunk, terminator 1 doesn't answer, no answer timeout, SCP query, STR to RAF, RAF collects digits SCP query, STR to RAF, RAF collects digits (originator accepts "forward"), SCP query, analyze_route and "forward" to 2nd outgoing ISUP trunk, terminator2 answers, originator disconnects 1st.

Table 2-5 BLNA CMP/AM/DLN Occupancy

Percent Occupancy Due to 10000 BLNA					
	CMP	3B20 AM	3B21	SSI DLN	DLN
		(No DLN)	(no DLN)		30
10000 Scenario 1 Calls /SW/Hour	.94	2.1	1.4	1.3	.45
10000 Scenario 2 Calls /SW/Hour	.94	2.1	1.4	1.3	.45
10000 Scenario 3 Calls /SW/Hour	0	0	0	0	1.4

10000 Scenario 4 Calls /SW/Hour	0	0	0	0	0
10000 Scenario 5 Calls /SW/Hour	2.1	3.1	2.1	1.9	.65
10000 Scenario 6 Calls /SW/Hour	1.2	1.2	.82	.75	.26
10000 Scenario 7 Calls /SW/Hour	1.2	1.2	.82	.75	.26
10000 Scenario 8 Calls /SW/Hour	1.2	1.2	.82	.75	.26
10000 Scenario 9 Calls /SW/Hour	3.3	4.3	2.8	2.6	.89

Table 2-5 can be used to determine the impact of adding BLNA upon the CMP, AM or DLN/DLN30. The percent occupancy values in this table represent the impact of 10,000 BLNA Scenario calls per hour for the entire switch. A query to the SCP will only impact the AM processor occupancy if no DLN/DLN30 is present. (No DLN)

2.2.1.5 (99-5E-3338 /3739/4184) Line Time Slot Bridging Feature Enhancement

2.2.1.5.1 Feature Overview

The current Line Time Slot Bridging (LTSB) service does not allow assignment and operation of the voice features listed in the two feature packages. For high-runner features, this creates a problem for the service provider offering LTSB service to their customers. Customer lines with any of the features not allowed on LTSB lines can not be offered LTSB service. This impacts basic telephony service of providing two separate lines to customers in the process of moving from one location to another, providing dual service in a home and office environment, and more advanced services such as Broad-band using SLC[®] hardware.

2.2.1.5.2 Feature Installation and Growth

The 5ESS[®] switch makes use of tone transceiver circuits (or Voice Band Services (VBS) circuits for SM-2000) for analog visual Message Waiting Indicator (MWI), Incoming Call Line Identification (ICLID), and CND features, which will now be allowed on LTSB lines. Transceiver (or VBS) circuits are needed when applying an analog visual MWI or providing an ICLID or CND display. For LTSB lines, both the associate and the lead modules need to have transceiver (or VBS) circuits available for each line which may increase the number of circuits normally needed for a single non-LTSB line. The engineering rules may be modified so that there are enough transceiver (or VBS) circuits to support LTSB and other features, which require the use of the HW unit, depending on the feature penetration in the field.

2.2.1.6 (97-5E-4169) MCTU3 On CM1

In software release 5E12, the MCTU3-on-CM1 feature adds the capability of using an MCTU3 on the CM1. The MCTU3 on the CM1 now has the same interactions and dependencies as the SMP20 on the CM1, and as the MCTU3 on CM2. Traffic capacity for the MCTU3 is limited to the normal maximum for the CM1.

2.3 5E12 SOFTWARE UPDATE

2.3.1 Significant Features

2.3.1.1 (99-5E-3706) Enhanced Location Routing Number Operations, Administration and Maintenance

This feature enhances the Number Portability - Basic Location Routing Number (LRN) feature (99-CP-3169.A) by providing additional measurement capabilities. The Basic LRN Feature provides measurements for the number of calls encountering an NP trigger that results in an SCP query. The additional measurements provide peg counts for the number of NP query failures, the number of calls to ported numbers and the number NP data inconsistencies. Also measurements are collected at the terminating switch for NP unallocated number calls and NP data inconsistencies. A new Traffic-30 measurements section provides the NP measurements. The additional measurements are compliant with the Illinois Generic Requirements for Number Portability. This feature is provided as an enhancement to Basic LRN, but needs to be ordered separately.

2.3.1.2 (99-5E-3561) Integrated Metallic Testing for AIU

This feature provides a test Application Pack for the Remote AIU that allows the testing of subscriber lines in the remote. The functionality it provides is similar to the SLIM2.

2.3.1.3 (97-5E-2894, 97-5E-2895) Technology Upgraded LDSF

The Technology Upgraded LDSF feature for SM and SM-2000 is available in the 5E12 Software Update.

2.4 5E13 SOFTWARE RELEASE

2.4.1 Significant Features

For more detailed information concerning feature descriptions, retrofit information, or recent change, consult the Master Subject Index, 235-000-005.

2.4.1.1 (99-5E-4421) BALANCE

2.4.1.1.1 Feature Overview

The BALANCE feature provides data for blocked call identification on Analog Line Units. The data is delivered to the AM through HM messages, but the responsibility for retrieving the data resides with the customer. The customer may, using RC view 8.31, turn on or off the BALANCE feature. *UNIX*® RTR Recent Change and Verify may also be used to make the appropriate modifications to the ECD and direct the data to:

- A dedicated TTY port
- An existing ROP port (that is rop0)
- Log file.

This feature provides the capability to identify the users which are causing the most blockage on a given ALU and move them to the AIU or to another line unit and, thus, manage network traffic effectively.

2.4.1.2 (99-5E-741) TRFC30-Section 143 Increase Maximum Collection Units

2.4.1.2.1 Feature Overview

Switch administrators often need traffic data on a large number of Remote Terminals in an office. The data is required for switch engineering and line assignment purposes. The present capability, which allows monitoring of only 256 RTs at a time, is not sufficient. This feature increases the number of RTs which can be monitored at one time to 800 collection units, which is more than three times the current study capacity.

TRFC30 - Section 143 is a "special study" section. A "special study" section is "limited for collection". "Limited Collection" implies that not all of the possible data which exists for that section is collected and reported. The limitation is based on the fact that the maximum number of records which can be stored in the EADAS buffer is less than the theoretical maximum number of records which the switch could generate. This feature enables the service provider to request and obtain traffic data on 800 Remote Terminals served by IDCUs. That information is used for traffic engineering and load distribution. The service provider is able to specify individual RTs, for which data is to be reported, or IDCUs for which data on all RTs served by that IDCU is to be reported. The user of this feature is the switch administrator who gathers traffic data for engineering and for assigning lines to Digital Loop Carrier Remote Terminals.

2.4.1.2.2 Administration

If customer complaints or other traffic reports indicate that the traffic on particular RTs may be heavy, the service provider can target specific RTs to be closely monitored. The TRFC30 Section 143 report is activated for those RTs by entering the ALW:TRFC30,CLCT,IRT,UNIT=SM-IDCU-RT command for each RT to be studied. In other situations, the service provider may wish to monitor a large number of RTs to discover traffic congestion problems before complaints are received. The number of RTs may be all of the RTs in the office, if that can be accommodated by the study section. In such a case, the TRFC30 Section 143 report is activated for large groups of RTs by entering the ALW:TRFC30,CLCT,IRT,GROUP=SM-IDCU for each IDCU whose RTs are monitored. The data on TRFC30 Section 143 can indicate that a particular RT has very high usage and is encountering blockage. This may prompt a re-assignment of lines on the RT to another co-located RT which is not as heavily used. The use of TRFC30 Section 143 data is not changed by the expansion of the number of collection units. However, the ability to monitor more RTs provides a broader perspective of office traffic which may help to identify trouble spots more quickly. Further details concerning the use of this feature may be found in *Traffic and Plant Measurements*, 235-070-100, Appendix 1.

2.4.1.3 (99-5E-3261) Two B-Channel Transfer (TBCT) on Primary Rate Interface

2.4.1.3.1 Feature Overview

The Two B-Channel Transfer (TBCT) on Primary Rate Interface (PRI) allows a user (controller) on a PRI to request the switch to connect two independent calls on the user's interface. If the switch accepts the request, the controller is released from the calls and the users are directly connected. TBCT has two B-channels in use during the transfer request. Both B-channels are released when the switch accepts the request. The billing for the original two calls continues in the same manner as if the transfer had not occurred and the controller of the transfer was still connected to both calls. TBCT saves the PRI user from double trunking a call after the transfer is completed by the switch. This is a Secured/Restricted feature, SFID 214, with associated right-to-use charges.

Note the impact this feature will have on conference circuits. Like other transfer features, this feature employs the use of a conference circuit under certain conditions i.e., while one of the transferred parties is in a "ringing" state, both transferred parties originated the calls to the PBX, etc. The same rules apply when a conference circuit is needed by other transfer features as well. The traffic engineer should evaluate capacity to determine if sufficient circuits are available to support TBCT.

2.4.1.4 (99-5E-3338/3799/4184) Internally Bridged Dual Service - Package One, Two, and Three

2.4.1.4.1 Feature Overview

Note that the feature name for these three feature packages uses the term, Internally Bridged Dual Service (IBDS), which is synonymous with LTSB. These feature packages build upon the current 5ESS®-2000 switch LTSB service by providing the requirements for adding feature interaction functionality to the current LTSB service. The LTSB feature interaction modifications are an enhancement to the current 5ESS®-2000 switch Line Time Slot Bridging (LTSB) feature. This enhancement will allow the following features to be assigned to and used on one DN LTSB lines. These features do not modify the two DN LTSB service.

Package 1

- MultiLine Hunt Group (MLHG) - Regular, Circular, and Uniform Call Distribution (UCD) hunt types only.
- Series Completion
- Call Forwarding Busy Line (CFBL) - all analog CFBL sub-features
- Call Forwarding Don't Answer (CFBL) - all analog CFBL sub-features
- Message Waiting Indication (MWI)

- Incoming Caller Line ID (ICLID) - all Line ID sub-features
- Calling Name Display (CND)
- Directory Number Privacy (DNP) - per call privacy only

Package 2

- Distinctive Ringing (DR) - all DR sub-features
- Terminal Group Station Restriction (TGSR) - all TGSR sub-features
- Private Facilities Access (PFA) - all PFA sub-features
- Caller ID on Call Waiting
- Dial Call Waiting
- Call Waiting Origination
- Individualized Dialing Plan (IDP) - all IDP sub-features
- Customer Originated Trace (COT) - line feature only, LTSB line can access and use generally available version
- Message Detail Recording - all MDR sub-features

Package 3

- Account Codes
- Authorization Codes
- Automatic Route Selection (ARS)
- Call Waiting Deluxe (CWD)
- Direct Connect
- Access to Trunk Queuing
- Time of Day (TOD)
- Advanced Services Interface (ASI) Proxy
- Bulk Calling Line ID (BCLID)

In addition, this feature does not change the current originating Class of Service requirements for LTSB lines. The switch allows LTSB service only on lines with an INDIV originating class of service. These features add to the allowed terminating classes for LTSB lines (INDIV or AGING). Terminating classes of MLHG and INWATS are now allowed. The INWATS class can be applicable to an LTSB MLHG member or a non-MLHG LTSB line. The service provider is the target customer for sales of these features. The main application is for residence and small business. This feature package increases feature functionality allowing additional dual service applications, e.g., serving a customer who is in the process of moving from one location to another but still served by the same switch. This feature package allows the service provider to offer and support more dual service applications.

2.4.1.4.2 Operations, Administration and Provisioning Information

2.4.1.4.2.1 Service Changes

The following text pertains to the provisioning of features to LTSB lines (assignment allowed on the lead port only) and to the assignment of LTSB service to a line with one or more of the features in the feature packages. The term "assignment" is used, unless otherwise specified, to specify input into ODA and/or Recent Change insert, update, delete, review activities, where such activities are allowed and applicable. ODA and RC are modified to allow normal provisioning of the Package 1, Package 2 and Package 3 set of features to LTSB lines. However, there are currently combinations of features that Recent Change and ODA do not allow LTSB to be assigned to a line. It is not the intent of these LTSB Feature Packages to modify these assignment restrictions. These current restrictions need to be continued. For example, Caller ID on CW can not be assigned to a MLHG member. Thus, Caller ID on CW will continue to not be allowed assignment to a MLHG member, regardless if that member is an LTSB line. These requirements do allow Caller ID on CW to be assigned to an LTSB line that is not a MLHG member. Other examples of provisioning restrictions which will continue to be enforced include the following:

- For MLHGs, CFBL can only be assigned to member one of a MLHG
- For MLHGs, Series Completion can only be assigned to a no-hunt DN
- For MLHGs, Caller ID on CW cannot be assigned to any member.

In addition, note that BRCS features can be assigned to LTSB lines only via the 1.11 BRCS Feature Assignment Recent Change View. Non-BRCS line parameter data can be assigned to LTSB lines only via the 1.6 Recent Change Composite Line View. BRCS Features and line parameters can not be assigned to LTSB lines using the 1.8 Recent Change View. These are existing provisioning guidelines that will continue to be applicable.

2.4.1.4.3 Feature Installation and Growth

The switch makes use of tone transceiver circuits or Voice Band Services (VBS) circuits for SM-2000 for analog visual MWI, ICLID, and CND features which will now be allowed on LTSB lines. Transceiver (or VBS) circuits are needed when applying an analog visual MWI or providing an ICLID or CND display. For LTSB lines, both the associate and the lead modules need to have transceiver (VBS) circuits available for each line which may increase the number of circuits normally needed for a single non-LTSB line. The engineering rules may need to be modified so that there are enough transceiver circuits to support LTSB and other features which require the use of the hardware unit, depending on the feature penetration in the field.

2.4.1.5 (99-5E-4425) DNU-S Path Trace

The path trace byte (J1) in the SONET path overhead is used to verify the continuity of the endpoints (where the STS-1 payload is demultiplexed) in a SONET connection. Path trace is required by TR-782 for intra-office SONET applications. The DNU-S is an intra-office trunk interface. Therefore, the DNU-S is required to support path trace. Currently, the DNU-S hardware defaults the value of the 64-byte path trace value to 62 NULL characters (00) followed by a (OD) and an (OA). There was previously no provision in the 5ESS software to set the path trace to other values or to dump and/or check the received value. This feature adds support for the path trace byte.

2.4.1.6 (99-5E-4007) Three Fully Loaded DNU-S on SM-2000

The "Three Fully Loaded DNU-S on an SM-2000" feature increases the trunk capacity of the SM-2000 beyond the current limit of 16128 and extends the trunking capacity limit for DNU-S applications on an SM-2000 by using three fully equipped DNU-S for a total of 24,192 trunks. The assignment of three DNU-S units to an SM-2000 will exhaust all time slots and preclude further assignment of line side equipment to the same SM-2000.

2.4.1.7 (99-5E-3630/3635/3945/4008) Government Emergency Telecommunications Service High Probability of Completion (GETS HPC)

This feature, Government Emergency Telecommunications Service (GETS) High Probability of Completion (HPC) is applicable to the 5ESS[®], CDX and VCDX switches.

2.4.1.7.1 Features Included In This Group

GETS HPC is one feature comprised of four capabilities used as part of the GETS HPC capability. The following capabilities are available in the 5E13 software release:

- **99-5E-3630** HPC Trunk Queuing.
- **99-5E-3635** HPC Exemption from Network Management Controls
- **99-5E-3945** HPC Detection
- **99-5E-4008** ISUP Trunk Signaling and Measurement.

These features are used in 5ESS[®] Class 4 and Class 5 switches providing local exchange service in the United States and United States Territories. Support is provided for narrow-band voice and circuit-switch data. Wide band is not supported.

2.4.1.7.2 Feature Overview

The Office of the Manager, National Communications System (OMNCS) has been charged by the United States government with providing a survivable and enduring telecommunications capability for the purposes of National Security and Emergency Preparedness (NS/EP). To this end, a set of switch-based and Advanced Intelligent Network features have been requested to provide a High Probability of Completion (HPC) for critical users of the Public Switch Telephone Network (PSTN) before, during and after a national security emergency. A National Security Emergency is defined as a natural disaster, military attack, technological emergency, or other emergency which degrades or threatens the security of the United States.

The HPC Network Capability is applied during call setup, and is intended to provide enhanced call completion capabilities to authorized Government Emergency Telecommunications Service (GETS) users during times of network stress and/or congestion.

GETS is an evolving service which allows authorized government users to gain access to enhanced call completion features. In its current form, GETS capabilities are offered in the networks of AT&T, MCI, and Sprint. A user dials 1-710-NCS-GETS to place a GETS call, which causes the call to complete to one of the Inter Exchange Carrier (IXC) networks, where authentication via PIN code and collection of the final routing number are performed. Within the IXC network, GETS calls are provided with special treatment to assure a high probability of completion.

Starting in 1995, GETS has been introduced into Local Exchange Carrier networks using AIN 0.1 capabilities. The 710-NCS-GETS number is defined as a Dialed Number Trigger (DNT), and causes a Query to be launched. The SCP's routing instructions include the same DN, and a set of three Carriers which the SSP attempts to use hierarchically.

During severe stress conditions, the completion of a call is influenced by blocking due to lack of circuits in trunk groups, or due to network management controls that may be implemented by the network operators. GETS service defines a set of features that allow these specially identified users to bypass network control restraints and queue for trunk circuits to become available increasing the probability of the call completing.

Many new traffic counts and modifications to existing traffic counts have been implemented in the Traffic 30, Section

6.17, to support the GETS HPC feature. Refer to 235-070-100 Appendix 1 *5ESS Traffic and Plant Measurements* for detailed information regarding these counts.

2.4.1.7.3 GETS HPC Scenario

This capability is invoked when a caller originates a call and dials a number of the form 710-NXX-XXXX, typically 710-NCS-GETS. This capability detects such originations and marks them as GETS-HPC calls, whether at the originating EO, or at a Local Tandem. Once the call has been marked HPC, other GETS-HPC capabilities will provide trunk queuing, network management exemption, etc., to attempt to give the HPC call a higher probability of completion than non-GETS traffic during times of natural disaster or local or national emergency, when network congestion is likely. In normal practice, an AIN Specific Digit String (SDS) trigger, known on 5ESS-2000 as a Dialed Number Trigger (DNT), is also assigned to the GETS number. This allows AIN-based capabilities such as Alternate Routing and Network Busy event detection to aid in the processing of the GETS call. Note that it is not required to have an AIN trigger assigned to the GETS number.

A typical scenario for an HPC call, after origination in a Local Exchange Carrier (LEC) End Office, is for the call to be routed to one of three IXCs (AT&T, MCI, or Sprint). Within the IXC network, the caller is prompted for an authorization code and destination address. Once the caller is authenticated, the IXC routes the call to the Local Exchange serving the true destination, and that LEC completes the call. At this time, all HPC calls are completed via an IXC, even when they are to be completed to a destination within the originating LATA.

2.4.1.7.4 GETS Interactions With ASP Dialed Number Triggers and Network Busy

A GETS user places a call to 1-710-NCS-GETS. This number is assigned as a DNT, causing a Query to be launched to the serving SCP. Service logic at that SCP processes the call, and returns a message to the switch composed of a Routing Component and a Request Component. The Routing Component contains instructions to complete the call to the dialed number (710-NCS-GETS), using a list of three IXCs. The Request Component contains a Next Event List (NEL) with the Network Busy Event armed. In this example, a Request Component is received which arms the Network Busy event. While receipt of this component is not a mandatory part of GETS service, it may be received in order to provide the GETS Retry capability. When attempting to complete the call, the SSP determines that the direct trunk group associated with IXC 1 is busy, and overflows to the indirect (via Access Tandem) route. An outgoing trunk is seized but, at the Access Tandem (AT), no trunks are available to IXC 1. The AT sends the SSP a RElease message with Cause value indicating a Network Busy condition. The SSP invokes Enhanced Alternate Carrier Routing, and overflows to IXC 2, skipping any remaining routes associated with IXC 1 since the Network Busy condition was detected remotely.

All members of the direct trunk Group to IXC 2 are busy, but the Trunk Group has an HPC queue assigned to it. The call is placed in queue, but does not receive an idle trunk before timing out of the queue. The call overflows to the indirect route through an AT and no idle trunks to the AT are found. Therefore, ACR is invoked leading the switch to attempt routing via IXC 3. When attempting IXC 3, if the SSP determines that all trunks in the direct route to IXC 3 are busy, and that an HPC queue is assigned to the trunk group, the call is placed in queue, but does not receive an idle trunk before timing out of the queue. The call overflows to the indirect route via an AT. No idle trunks are available to the AT, but an HPC queue is assigned and the call is placed in queue. While in queue, a trunk becomes idle and the call is routed to the AT, and at the AT, no idle trunks to IXC 3 are found, the AT sends the SSP a RElease message with Cause value indicating Network Busy. The SSP invokes EACR, skipping any additional routes associated with IXC 3 since the Network Busy condition was detected remotely, and there are no more carriers to try. Since the Network Busy event is armed, the SSP sends a Network_Busy message to the serving SCP reporting the Network Busy event and requesting additional instructions.

The SCP instructs the switch to attempt routing to the same DN, with the same carrier set. This time the SSP finds a member of the direct TG to IXC 1 available, and completes the call to IXC 1. Within IXC 1's network, additional GETS capabilities are invoked to authenticate the caller and collect the destination address, and to complete the call using GETS features within the IXC network to provide a high probability of completion.

2.4.1.7.5 HPC Detection Capability Scenario

The HPC Detection capability allows a 5ESS switch that provides Local Exchange service to detect Government Emergency Telecommunications Service (GETS) HPC calls by means of digit analysis. These calls are marked so that enhanced functionality provided by other HPC capabilities of this feature (for example, Trunk Queuing, ISUP Signaling, Exemption from Network management Controls) can be invoked. This allows HPC calls a greater probability of completion than that of non-HPC call. Once a call has been recognized as an HPC call, its Calling Party's Category value in the ISUP IAM message is set to "NS/EP." Calls received with this Calling Part Category (CPC) value will also be recognized as HPC calls, but such recognition is provided by the HPC Trunk Signaling Capability. The HPC Detection Capability only provides the ability to detect an HPC call by way of digit analysis before any other switch has determined that it is an HPC call.

2.4.1.7.6 HPC Trunk Queuing

The HPC Trunk Queuing (HPC TQ) capability allows end-users' HPC calls to be placed in an HPC trunk group queue when trunk facilities are not available to complete the call.

2.4.1.7.7 HPC Exemption from Network Management Controls

When a call encounters a trigger after being detected as a GETS HPC call (either via digit analysis or recognition of the "NS/EP" CPC value), it is exempted from normal network traffic controls.

2.4.1.7.8 ISUP Trunk Signaling and Measurement

When GETS/HPC Queuing is encountered at the Access Tandem (AT) for a GETS call, the maximum timer value for trunk queuing at the AT cannot be employed. GETS/HPC trunk queuing can be provisioned to last for a maximum of 4095 seconds per trunk group, or provisioned to never time out. However, timer Tiam is initialized at the Equal Access End Office (EAEO) when the EAEO launches an Initial Address Message (IAM) towards the AT. Timer Tiam is settable on a per switch basis to a value in the range of 20 to 30 seconds. This timer is canceled when either an ACM message, an ANM message, or a REL message is received in response to the IAM, or the originating subscriber hangs up. If timer Tiam times out at the EAEO the EAEO will tear down the call. Timer at the EAEO will time out when there is a long duration queue on a single trunk group at the AT, or when the queue timers at the AT are set for shorter duration (e.g., 10 seconds) on each trunk group but several trunk groups with queues are traversed looking for an idle trunk.

The queuing time for GETS trunk queuing is allowed to be greater than the 20- to -30 seconds since when GETS trunk group queuing is encountered at an EAEO there is no timer Tiam to be activated. The limit in this case is essentially how long the originating subscriber will stay off-hook waiting for their call to go through.

Based on the above discussion, operations personnel should set the length of the queue timer(s) at the AT for GETS trunk queuing to ensure that the call completes when trunk queuing is encountered. The EAEO timer does not time out. When trunk queuing is encountered at the AT on multiple trunk groups in the route list, the additive value of the timer(s) must be considered to ensure the call completes. When determining how much time is available for setting these timers, some time must be allowed for the actual traditional call set-up time, including all the time required for the receipt at the EAEO of the SS7 ACM message launched in the backward direction in the toll network as part of the database query. Consideration should also be given that when the GETS/HPC feature is needed the most, there may be congestion in the network, so larger than nominal values for these numbers may be appropriate. A switch may be a combined office, serving as both an EAEO and an AT. The GETS/HPC trunk queue timer(s) in a combined office should be set at values adequate to support the AT function.

2.4.1.7.9 GETS HPC Administration

Operations personnel are responsible for providing the resources - administration, provisioning, maintenance and billing for customers who desire to change their current subscriber arrangement due to service, service provider or

location changes. This process should be as transparent as possible to the end user with minimal disruption of service. The operations personnel or third-party administration are responsible for updating the databases promptly as numbers get ported. GETS HPC features are secured by a single Secured Feature ID (SFID), and will require that the service provider enter a feature ID and password to allow the feature to become functional in the office.

2.4.1.7.9.1 HPC Trunk Queuing

The Switch Administrator needs to be aware that GETS second scan processing (and therefore queueing) only occurs when the routing chain is set up properly. See GETS HPC Administration for details. The Switch Administrator provisions the GETS HPC Trunk Queuing (HPC TQ) capability by assignment of a HPCTQ feature defined on RCV 12.40. This feature is then assigned to a trunk group via RCV 5.1. Switch administrators should set the length of the queue timer(s) at the Access Tandem (AT) for GETS trunk queueing to ensure that the call completes when trunk queueing is encountered, and that the Equal Access End Office (EAEO) timer Tiam does not time out. See Section 2.4.1.7.8 for details.

The use of HPC Network Capabilities is restricted in the United States and U.S. Territories to National Security/Emergency Preparedness (NS/EP) users authorized by the Office of the Manager, National Communications Systems (OMNCS). Service provider deployment of these HPC Network 4936 Capabilities must be co-ordinated with the OMNCS at the following address:

Office of the Manager National Communication System, Attn: GETS Program Office, 701 South Courthouse Road , Arlington, VA, 22204-2198, email: gets@ncs.gov

2.4.1.7.9.2 HPC Route Provisioning

The operations personnel must provision the route chain so that when all trunk groups in the route chain have been exhausted during the first scan, a secondary route index attached to the last route index in the route chain must point to REORDER. If the secondary route index attached to the last route in the route chain points to an announcement trunk group, the call will not receive busy treatment. Instead, the call is considered complete and no second scan processing will occur. GETS HPC trunk queueing and post-hunt network management controls are applied only during second scan processing.

2.4.1.7.9.3 Message Priority for GETS HPC

Operations personnel can effectively raise the priority of GETS HPC traffic via a new office parameter on RCV 8.15 called IAM_CRM Priority. All GETS traffic is assigned a priority of "1". If the office view indicates that non-GETS traffic will receive a priority of "0", GETS traffic automatically receives a higher priority.

2.4.1.7.9.4 HPC Assignment in LDIT

Assignment of HPC to an address is conceptually very simple. Once it has been determined how the address will be defined as HPC - whether at the 3-digit level on the NPA for all addresses within the NPA, at the 6-digit level on the NPA-NXX for all addresses with the NPA-NXX, or on a specific 10-digit address - it is only necessary to go to the appropriate Recent Change view and mark the HPC field as YES. No other changes are needed for calls to the address(es) to receive HPC treatment. It may also be desirable to provision an ASP Dialed Number Trigger (DNT) at the same time if the GETS service is being provided. See Lucent 235-190-126, ASP 0.1B Feature Document, for detailed ASP provisioning information).

The use of HPC Network Capabilities is restricted in the United States and U.S. Territories to National Security/Emergency Preparedness (NS/EP) users authorized by the Office of the Manager, National Communications Systems (OMNCS). Service provider deployment of these HPC Network 4936 Capabilities must be co-ordinated with the OMNCS at the following address:

Office of the Manager National Communication System, Attn: GETS Program Office, 701 South Courthouse

Road , Arlington, VA, 22204-2198, email: gets@ncs.gov

2.4.1.7.9.5 HPC Assignment on RDIT

Assigning HPC at the 7-, 8-, 9-, or 10-digit level is done on appropriate RDIT views, and is performed in a manner similar to the LDIT example given above.

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Office of the Manager National Communication System, Attn: GETS Program Office , 701 South Courthouse Road , Arlington, VA, 22204-2198, email: gets@ncs.gov

2.4.1.7.9.6 HPC Assignment on INDIT

Assigning HPC for dialing plans associated with incoming trunks can be input using appropriate INDIT recent change views in a manner similar to the LDIT example.

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Office of the Manager National Communication System, Attn: GETS Program Office , 701 South Courthouse Road , Arlington, VA, 22204-2198, email: gets@ncs.gov

2.4.1.8 (99-5E-3738) Real-Time Call Detail

2.4.1.8.1 Feature Overview

Real Time Call Detail (RTCD) Secured Feature ID 245, is a secured" feature available for purchase on toll/LDP 5ESS[®] switch offices. The Real Time Call Detail (RTCD) feature adds the capability to the 5ESS[®] Long Distance Platform (LDP) switch to generate per call information in the form of RTCD records. The RTCD feature also adds the capability to the LDP to transmit these records from the switch in near real time via a standard data interface. All SMs now have a portion of memory designated for RTCD, regardless of whether this feature is activated or not. Service providers using the RTCD feature may use the records for subscriber billing, network planning and maintenance, rapid fraud detection, etc.

Service providers will recognize much of the initial content of the RTCD records as being similar to that delivered in Automatic Message Accounting (AMA) records, such as calling number, called number, answer time, carrier connect time, etc. The content of the RTCD records is driven by existing 5ESS[®] switch capabilities and customer input, and is expected to grow with new features and customer needs in the future.

While AMA records are usually only generated at the first switch in a provider's network, sufficient for subscriber billing, RTCD records may be generated on a per trunk group basis anywhere in a service provider's network. A service provider may decide to activate the RTCD feature nominally on all Network Access Trunks (NATs) for those calls entering their network, but will occasionally activate the RTCD feature on their Intra-Network Trunks (INTs) to pinpoint network problems. Other network providers may elect to have the RTCD feature active all the time on all of their toll trunk groups.

A 5ESS[®] LDP switch currently advertises a completed call capacity at 750,000 high day busy hour calls. Incomplete attempts would add an additional 2% to 4% for a total of approximately 800,000 records per high day

busy hour. The initial release of RTCD will guarantee 99.9% of the RTCD records generated by the switch are accurately transmitted from the switch. Future enhancements may improve that reliability.

For those service providers currently using AMA, the RTCD feature does not affect the 5ESS® LDP's ability to format and generate AMA records. Both AMA and RTCD could be active for the same calls.

2.4.1.8.2 Administration

AMA and RTCD recording can coexist on a switch with no impact to AMA record generation and formatting.

NOTE: Switch administrators should be aware that any global billing SM-2000 must be engineered at 75% of real-time capacity. Failure to allocate 25% of real-time capacity to RTCD billing activity will result in an overload condition during peak traffic hours, and loss of billing records

2.4.1.8.2.1 Measurements

Measurements are provided for Traffic 30, Sections 6.122, and 7.1:

- Count of "RTCD Records Generated" per SM (new count in Traffic 30)
- Count of RTCD records lost due to Real Time Billing Memory (RTBM) overflow (new count in Traffic 30)
- Message Handler (MH) Messages Processed (existing count in Traffic 30)
- MH Base Level Loop Cycle (existing Traffic 30)

The MH counts pertain to all MHs, including MHEIBs.

The "MH Messages Processed" count is the total number of messages handled by a specific Message Handler (MH) in a SM-2000. For the RTCD feature in 5E12, it is a measurement of the number of RTCDs transmitted. This count will include messages retransmitted after an error occurs as the switch attempts to ensure that all records are sent.

The "RTCD Records Generated" is pegged at the time the RTCD record is generated. The count for each SM can be added together to obtain the total number of RTCD records generated for all SMs.

2.4.1.9 (99-5E-4387) Real Time Call Detail Expansion Package A

2.4.1.9.1 Feature Overview

The 5E13 software release Real Time Call Detail (RTCD) Expansion Package A feature builds upon the RTCD platform by adding the following enhancements :

- Support for RTCD recording on calls originating on EDSLHM trunks. EDSLHM (Extended Digital Subscriber Loop Hotel/Motel) is the name given to a trunk that enters the 5ESS switch from a hotel or motel, and uses the Primary Rate Interface (PRI) version of ISDN signaling.
- Recording of network information (Terminating Switch, etc.) not otherwise available at the recording office.
- Permits the service provider the option of generating additional records to capture information from SCP transaction(s), especially when more than one SCP transaction is triggered for the call. The option is activated through the use of a new office parameter (which determines how a SCP-generated AMAslpID is to be interpreted), and on a per-transaction basis by having the SCP return an AMAslpID parameter in a response message. A maximum of seven RTCD records can be generated per call at a given office, if this option is exercised on all six SCP transactions in addition to the RT_05 record.

- Simplifying the task of correlating all RTCD records generated for any given call, regardless of what office produced each record and regardless of how many records per call are generated at a specific office.
- Expands the set of measurements and I/O messages provided, thereby enhancing the operations component of the feature.

2.4.1.9.2 Administration

With the increase in size of the RTCD record, the service provider traffic engineer will need to ensure that the engineered RTBM is sufficient to handle the storage needs specified for each switch. The updated engineering rules should be used to determine what the impact is on the RTBM. The amount of memory to increase reliability is determined by the following formula :

Number of billed calls x number of bytes x number of hours (four hours recommended) = RTB. See following examples:

No use of LDP LNP feature and no SCP-Transaction records:

- Classic RTB Size: $((4K \text{ calls per hour}) \times (193 \text{ bytes per call}) \times 4 \text{ hours}) / 1048576 = 2.950 \text{ MBs}$
- SM-2000 (CORE 40) Size: $((100K \text{ calls per hour}) \times (193 \text{ bytes per call}) \times 4 \text{ hours}) / 1048576 = 73.623 \text{ MBs}$
- SM-2000 (CORE 60) Size: $((100K \text{ calls per hour}) \times (1.45 \text{ calls}) \times (193 \text{ bytes per call}) \times 4 \text{ hours}) = 106.754 \text{ MBs}$

Use of LDP LNP feature (221 bytes per record)

- SM-2000 (CORE40) Size: $((100K \text{ calls per hour}) \times (221 \text{ bytes per call}) \times 4 \text{ hours}) / 1048576 = 84.304 \text{ MBs}$. (increase of 14.5% from 73,623)

Mix with 20% additional SCP-Transaction records (112 bytes per record)

- SM-2000 (CORE40) Size: $((100K \text{ calls per hour}) \times (193 \text{ bytes per call}) \times 4 \text{ hours}) / 1048576 = 73.623 \text{ MBs} + ((20K \text{ calls per hour}) \times (112 \text{ bytes per call}) \times 4 \text{ hours}) / 1048576 = 8.544 \text{ MBs} = 82.167 \text{ MBs}$. (increase of 11.6% from 73.623 MBs)

Mix with LDP LNP and 20% additional SCP-Transaction records

- SM-2000 (CORE40) Size: $((100K \text{ calls per hour}) \times (221 \text{ bytes per call}) \times 4 \text{ hours}) / 1048576 = 84.304 \text{ MBs} + ((20K \text{ calls per hour}) \times (112 \text{ bytes per call}) \times 4 \text{ hours}) / 1048576 = 8.544 \text{ MBs} = 92.848 \text{ MBs}$. (increase of 26.1% from 73.623 MBs)

2.4.1.9.3 Measurements

Measurements for RTCD recording are enhanced to include the following:

2.4.1.9.3.1 Traffic 30 Measurements

- Count (one per Originating SM) for the total amount of RTCD generated (in kilobytes).

2.4.1.9.3.2 24 Hour Plant Measurements

- Count for the total number of RTCD records generated by all Originating SMs.
- Count for the total number of RTCD records received at the GBSM from all Originating SMs.
- Count for the total number of RTCD records transmitted from the MHEIB (both sides).
- Count for the total number of RTCD records lost due to RTBM overflow.
- Count for the total-time transmission over the Ethernet link was unavailable due to an out of service condition..
- Count for the total number of Long Duration Call RTCD records generated by all Originating SMs.

2.4.1.9.4 Plant Month

All measurements for Plant Month are identical to 24 Hour Plant Measurements.

2.4.1.9.5 Additional Measurements

Other counts, that may be beneficial to the service provider, may be available from the Data Server. For example, the Data Server can maintain a count of the number of RTCD records generated per trunk group, the number of RTCD records received on each Ethernet link, etc.

2.5 5E13 SOFTWARE UPDATE

2.5.1 Significant Features

2.5.1.1 (99-5E-4209) Remote Switching Module on The Digital Networking Unit — SONET

2.5.1.1.1 Feature Overview

This feature preserves the RSM capability to remote switch modules whose umbilicals are terminated on DNU-S at the host office, and a DLTU at the remote site. The user of this feature needs to only be familiar with existing RSMs.

2.5.1.1.2 Administration

There are no RSM functional changes brought about by the introduction of this feature. The feature provides the customer with the additional capability of terminating RSM umbilicals on a DNU-S unit. In all other respects, the customer will not be impacted by the fact that the host end of the RSM umbilical is terminated on a DNU-S instead of a DLTU2. With this feature, the DNU-S must be capable of supporting RSM umbilicals.

2.5.1.2 (99-5E-4300) 400 Hertz Carrier Tone

2.5.1.2.1 Feature Overview

Many Inter-Exchange Carriers (IECs) have elected to use a steady, 400Hz signal (known as Carrier Tone) in the voice path for communicating with end-customer equipment. Carrier Tone lets Customer Premise Equipment (CPE) know that it has reached an IEC and that additional dialed digits will be required. Carrier Tone has become a "de facto" standard in the long distance marketplace. An existing IEC, electing to put a new toll switch into its network, will require that Carrier Tone be an alternative to the standard tones or announcements, so that it will not have to ask customers to re-program their CPE. Prior to this feature, the 5ESS switch did not offer a 400Hz tone.

2.5.1.2.2 Administration

This feature is used by the Switch Administrator or Switch Engineer. The operational user is responsible for setting the values in the appropriate Recent Change profiles, and linking the profile to the trunk group in question. Some new attributes in existing RC Views 5.1 (trunks) and 8.1 (office), and View 10.17 (Network Announcements) are defined. There are no new measurements, reports, or input/output messages.

NOTE: For the sake of this description, Standard Tones and Announcements are meant to be the set of tones and announcements that are currently provided by and/or used by the Switch or requested by the SCP for the scenarios identified. When a specific tone or announcement becomes important, it is identified as such.

Carrier Tone is added to the 5ESS switch as a system tone. Therefore, it is provided via tone generator circuits (i.e., the LDSF/LDSF2 on SM-2000's and the LDSU/LDSF2 on SM's). It is not added as an announcement via the system announcement units (e.g., the SAS, RAF, 13A, etc.). The list of Network Announcements available to the Service Control Point (SCP) for AIN controlled calls are expanded to include carrier tone as a possible choice. The desired level of programmability (i.e., provisioning) for selecting which tones or announcements are used for various call scenarios is on a trunk group basis.

When the SCP is in control of a call, all prompting for collection of information is under its control. The prompt used (i.e., Network Announcement) is under control of the SCP. The SCP can be programmed to provide the appropriate Network Announcement is available on the switch with which it is interfacing. The level of programmability available on the SCP (i.e., ANI based, trunk group based, service based, etc.) is a function of the particular SCP being used. No switch based override has been provided for SCP Network Announcement requests. AIN based call services continue to be programmed and controlled at the SCP. Carrier Tone can be used as a prompt in the following Advanced Intelligent Network (AIN) Service Control Point (SCP) controlled Long Distance call scenarios:

- As a prompt tone when collecting authorization codes, account codes, or dialed numbers on DAL originated calls.
- As a prompt tone when collecting authorization codes or dialed numbers on Feature Group D cut through calls.
- As a prompt tone when collecting authorization codes or dialed numbers on calling card calls.
- As a prompt tone when collecting a dialed number for Feature Group B calls.

All of the above scenarios are implemented using the AIN. All service intelligence is programmed into and controlled by the SCP. The SCP informs the switch what announcements to play and when to collect digits. As such, Carrier Tone is made available for SCP based requests as one of the valid "Network Announcement Types" supplied by the switch.

Trunk Group provisioning options are provided for the switch controlled call scenarios (i.e., collection of account codes for the LDP Account Code feature and applying dial tone for Dedicated Access Links (DAL's) and Feature Group D (FGD) cut through calls), as mentioned above. Carrier Tone can be used as a prompt tone when collecting account codes for Long Distance Feature Group D calls (the LDP Account Code feature is activated based on the incoming ANI). Currently, a two-beep tone or an announcement is provided as a prompt. Which prompt is used is provisioned on a switch wide basis. Carrier Tone is added as one of the possible options for this prompt. The switch wide option will remain and a per trunk group override option has been added. The trunk group option, when set, overrides the global switch based setting for all calls on that trunk group. Carrier Tone can be used as a possible option for switch applied dial tone in the following call scenarios:

- Originating, off-hook, dial tone for DALs.
- Collecting a dialed number for the non-SCP implementation of Long Distance Feature Group D cut through calls.

On a trunk group basis, an option has been added for choosing which dial tone to use, either Standard Dial Tone

(350Hz + 440Hz tone) or Carrier Tone (400Hz), whenever dial tone is to be applied for calls on a trunk group.

This feature makes use of the secured feature ID of the Long Distance Basic Call Processing feature (SFID165). LDP SFID-165 must be purchased and unlocked via RCV View 8.22. Otherwise, Recent Change population rules will inhibit the use of any of the new attributes or new attribute values.

2.5.1.3 (99-5E-7011) MultiService Switching Module

This feature allows calls from a POTS line to connect to a data network service provider, e.g., Enhanced Service Provider (ESP), by means of a modem in a Remote Access Concentrator (RAC) integrated into the 5ESS switch. Each RAC is owned and operated by the network provider, but logically associates modems with particular ESPs. The output of the RACs is routed onto the internet over a 100BaseT ethernet link from the System Manager Module (SMM). The RAC service is provided by the Livingston PortMaster 4 integrated into the 5ESS switch. All detailed documentation is provided at www.livingston.com

2.5.1.4 (99-5E-4740) ASP STOR Interworking With Originating Busy/NoAnswer Office Triggers with Extended Ringing

2.5.1.4.1 Feature Overview

The Originating Busy/NoAnswer Office Triggers with Extended Ringing feature provides incremental functionality to that provided in Advanced Service Platform Release 0.1B as provided in the 5E9.1 software release. This additional functionality is defined in Bellcore's GR-1298 CORE document, and is being provided by this feature prior to the 5E11 software release. The AIN Office-Based Originating Busy/NoAnswer triggers allow the SSP to query the SCP upon detection of a busy or no answer condition for all calls originated by lines at the SSP. These new capabilities allow service providers to implement applications that are driven by the fact that callers have encountered busy or no answer when placing calls. Extended Ringing allows the called party's line to continue to receive ringing after the O_No_Answer trigger has been hit and the SSP is playing an announcement (Send_To_Resource) to the calling party. Extended Ringing also allows the calling party to be connected to the called party if the called party answers while the SSP is playing an announcement to the calling party. In other words, Extended Ringing allows the "called leg" of an AIN call to remain "up" while the "originating leg" of the call is involved with a Send_To_Resource interaction at the SSP. With the original development of this feature (99-5E-3529), the extended ringing capability was limited to those service providers that utilized switch based announcements. For those service providers that utilized Intelligent Peripherals (IPs) to perform announcements, extended ringing was not available. With the introduction of feature 99-5E-4740, Extended Ringing with Send to Outside Resource (STOR), extended ringing can now be performed whether the announcements played are switch based or provided via IPs. This new feature will apply to office-wide Originating Busy/No Answer and is not provisioned on a per line basis.

2.5.1.4.2 Administration

There is no requirement for the service provider to purchase (or unlock) the Busy/No Answer Subsequent Event Detection feature in order to use the Originating Busy/No Answer Office Triggers with Extended Ringing feature.

In order to detect User Busy when the Called Party subtends another office, the trunk connections between the SSP (containing the Originating Busy and NoAnswer office triggers) and the far end office must be end-to-end SS7 (or PRI), and the far end office must not provide its own tones and announcements. If either of these is untrue, the User Busy condition can not be detected at the SSP where Busy trigger was provisioned.

It should be noted that if the SSP where the call originates, and has the NoAnswer trigger provisioned, routes the call to another switch, and that switch plays an announcement without sending Answer Supervision, then the SSP will continue to run the NoAnswer timer, and the announcement may be interrupted.

Operations Systems which support data provisioning (i.e. RMAS, MACSTAR, MIZAR) must be made aware of the existence of the O_No_Answer timer office parameter, and the new fields associated with the new triggers

(O_Called_Party_Busy and O_No_Answer).

Service providers need to be aware that the office NoAnswer trigger fires when the T-O_No_Answer timer expires before the call has been "answered" (see requirement 140). Certain situations may arise where a caller has dialed a telephone number and is connected to an announcement in another switch. The other switch may not have sent answer supervision back to the SSP monitoring for the NoAnswer event. In this case, the SSP will fire the ONoAnswer trigger when the T-O_No_Answer timer expires, even though the caller may be interacting with a IVR system. Service providers should be aware that such a condition can occur, and take positive actions to prevent this from happening. Possible solutions include increasing the value of the T-O_No_Answer timer, and ensuring that announcements send answer supervision. This limitation is due to the definition of the NoAnswer condition, and the manner in which inter-office signaling works.

2.5.1.4.2.1 Capacity and Performance Requirements

There are a few guidelines that service providers and switch engineering personnel should consider when planning on using the O_Called_Party_Busy and O_No_Answer triggers and extended ringing capabilities.

Since the new triggers defined are Office-Based triggers as opposed to provisioned triggers, engineering personnel must be aware that all calls originating on a switch have the potential to encounter the O_Called_Party_Busy and O_No_Answer triggers. The Extended Ringing Capability requires that the called party continues to be rung while the switch interacts (plays announcements, collects digits) with the calling party. This requires additional resources on the switch (time slots) similar to the amount of resources used when engineering a switch for a feature such as Call Waiting. Switch Engineering Personnel must take into account the number of calls that are expected to encounter the No Answer trigger (and potentially use the Extended Ringing Capability) when determining the hardware needs for their switches.

When using office based triggers for an application, the switch (or SCP) may become overloaded with Query/Response traffic (or excessive demand for Application Processing power in the case of the SCP) such that call processing performance may be negatively impacted. It is presumed that the Automatic Call Gapping (ACG) capabilities, defined as part of AIN, would be used to control SCP overload conditions. For switch overload conditions, it is suggested that Telephone Maintenance personnel should use RC/V capabilities on the 5ESS switch to "turn off" triggers (by either turning off the trigger number or the feature) in order to eliminate any negative performance impact that either an unexpected query rate or malfunctioning SCP application might induce.

SCP link capacity may also be impacted by this feature due to the fact that a number of queries may be generated by these new office based triggers

A "new" development implementation will cause an ASP TP to be created and destroyed for each line origination on the Service Switching Point (SSP). This new implementation impacts switch/office capacity/performance as compared to calls originated on SSPs without this new ASP feature.

When the new O_Called_Party trigger is implemented, and activated by the service provider, callers on lines in the supported classes of service may experience an increase in the time required for them to hear a busy signal. This delay is due to the fact that the SCP is interacting with the switch, and the switch is not playing busy until instructed by the SCP to do so (possibly by playing an announcement recorded with a busy tone in the background).

2.5.1.5 (99-5E-4720) Flexible Assignment of DCTU/PMU Ports to MMSU Shelf

2.5.1.5.1 Feature Overview

This feature adds new metallic network access capabilities to be used with the Modular Metallic Service Unit (MMSU) and the Directly Connected Test Unit (DCTU). By providing more flexible assignment of DCTU/Precision Measurement Unit (PMU) ports, MMSU MTIB utilization is reduced, thereby reducing the likelihood of MTIB blocking. The underlying problem that this feature addresses is the blockage of test setups in the MMSU because of the shortage of MTIB paths. Two specific blockage scenarios are addressed by this feature:

- A port on the Directly Connected Test Unit (DCTU) cannot be accessed. Customer experience indicates that blockage is due to the lack of an MTIB connection to an available DCTU port on another shelf more often than it is due to all DCTU ports being busy.
- Connections to and through a Pair Gain Test Controller (PGTC) cannot be set up. A PGTC is needed when non-integrated Digital Loop Carrier systems serve the line to be tested. The lack of MTIBs is the most common reason for the inability to setup a connection.

This feature allows a service provider to configure a switch such that each DCTU/PMU port is concurrently connected to MTBs on all Half-Shelves of an MMSU Service Group. There may be up to four such Half-Shelves, situated on one Basic Shelf and three Growth Shelves. When attached anywhere on the same MMSU Half-Shelf, a DCTU/PMU port and an LUT MTB can be connected without the use of an MTIB. They require only a simple MTB-Junctor-MTB connection. When not attached to the same MMSU Half-Shelf, a DCTU/PMU port and the LUT MTB must connect by the use of MTIBs. This results in an MTB-Junctor-MTIB-Junctor-MTB metallic path.

Prior to this feature, each DCTU/PMU port could be connected to only one MTB on one MMSU Half-Shelf. As a consequence, a simple MTB-Junctor-MTB connection could only be made between the DCTU/PMU port and the MTB to a Line Under Test on that one MMSU Half-Shelf. Connections between this DCTU/PMU port and the MTBs to the lines attached to any other MMSU Half-Shelf required the use of interconnecting MTIBs. Because of the limited number of MTIBs, the lack of available MTIBs could cause blocking for metallic testing requiring MTB-MTIB-MTB interconnection. Therefore, this feature increases, by a factor of four, the likelihood that a single DCTU/PMU port will be able to connect to a desired line by use of a simple MTB-Junctor-MTB connection. Reciprocally, the likelihood that an MTB-Junctor-MTIB-Junctor-MTB connection will be necessary is reduced by a factor of four. Consequently, the cumulative MTIB usage is reduced, so that when an MTIB is needed to complete a connection, it is less likely to be blocked because of full utilization. This improves the metallic testing system in such a way that simultaneous metallic tests are less likely to be blocked.

2.6 5E14 SOFTWARE RELEASE

2.6.1 Significant Features

2.6.1.1 (97-5E-4286) PH22 (PH20-16 Base)

This feature provides a PH22 base system which includes the PH22 hardware and necessary software to make the PH22 bootable and maintainable in a System Lab. PH22 adds another Protocol Handler (PH) type to the family of PHs available in the PSU environment. The PH20-16 version requires an I/O module with 64-time slot capability, a processor module with the 66 megahertz version of the 68060, and a memory module with 16 megabytes of RAM.

In the PHS project, there is a need for a PH20-16 acting as a QPH and a PH20-16 with an ISDN image for packet data. The addition of the QPH image to the PH20-16 allows improved engineering of this resource in the PHS environment as well as other large CCS offices. Likewise, addition of the ISDN image to the PH20-16 allows improved engineering for the expected packet traffic in the subsequent phases of the PHS project. The specific PH channel type for packet data is the External Packet Switch channel group. This work provides the CCS software image for the PH22 (PH20-16).

The requirements for this new image are the same as for the PH6. The PH22 must be able to co-exist with all previous PH images. This feature provides the same capabilities on the PH22 as are currently available on a PH6. Other work items will be used to enhance the image to support more links.

2.6.1.2 (97-CP-4246.K) SS7/PSU Link Enhancements

This feature adds enhancements to the SS7 PSU signaling platform. The feature achieves feature parity with capabilities offered on the Common Network Interface (CNI) signaling platform. These enhancements are as

follows:

- (1) Signaling Link Selector (SLS) code expansion: This feature enhances the SS7 PSU load sharing procedures to support the 8-bit code field and that traffic can be load shared evenly across the available links.
- (2) Increase link set size to 16 links.
- (3) Label A/E/F links: CNI provisioning allows the customer to label signaling links to a link type (A, E, or F) as defined in ANSI specifications. The labeling of the link affords two items:
 - The E and F link types can be secured and thus deployed by customers that purchase them.
 - The customer can easily identify the type of link and take appropriate action if problems arise.
- (4) ISUP Message Handling in the PSU: Existing CNI procedures allow Message Transfer Part (MTP) to respond with ISUP RELease (REL) messages to fail incoming call set-up requests when it determines it cannot route the message to the appropriate SM. ISUP code is introduced in the Signaling Terminal Protocol Handler (STHP) to support his capability.

This feature supports any SS7 PSU configurations and environments of the 5ESS, CDX, and VCDX switches. Since the SS7 PSU signaling platform is functionally transparent to the end user, no changes in the subscriber interface or the dialing plan are required. This signaling platform can be operated, administered, and maintained solely by service provider personnel. However, changes in areas such as Recent Change/Verify procedures, output messages, and maintenance tools that support these procedures will require additional training for service provider personnel.

2.6.1.3 (99-5E-3850.V) Distinctive Remote Module (DRM)

The Distinctive Remote Module (DRM) provides the customer with additional operating capability of a remoted SM, without the addition of expensive umbilicals. The DRM coexists with other 5ESS switch remoted modules (those remoted using the TRCU2 or TRCU3, RSMs, or ORMs). The functionality and capacity of the existing 5ESS switch are not impacted or modified by the introduction of this feature. At the DRM switch, all line-to-line calls are intra-switch, in the conventional sense. All outgoing calls from DRM to other network elements, including the host, must be carried on inter-switch trunks. The DRM feature addresses the configuration of the network for which all voice and user data traffic at the remote is essentially confined within the area near the remote switching equipment. Any other traffic, voice, or user data between the DRM and the host office or any other cp-node must be transferred over interoffice trunks. The DRM provides integration (Operation, Administration, Maintenance, and Provisioning) while also providing modular, non-integrated call processing capability. This feature introduces the concept of a call processing node, or cp-node, and a virtual switch, in the sense that it is administered as part of a host switch (the virtual switch), but otherwise, functions like an independent switch (the cp-node). As a result DRM may be deployed in the same manner as other remotes provided they do not share with any other network elements and are not part of a cluster. They can share administrative and maintenance functions and resources.

2.6.1.4 (99-5E-4340) Increase 5ESS TRFC30 Buffer Size

The TRFC30 report has encountered data limitations. This is a direct result of the 75,000 bytes limitation of TRFC30 buffer size and 32,000 bytes data limitation of the section size. The possible number of TRFC30 sections, which is 255, is also close to the limit. With the increase of Internet usage and wireless services, the ability to administer traffic loads for these switches needs to be increased. Expansion of the buffer allows for greater capacity to collect and transport information. This feature provides the capability to:

- (1) Increase the overall traffic measurement buffer size from 75,000 bytes to 390,016 bytes.
- (2) Provide the ability to increase the maximum number of sections created for the TRFC30 report from 255

sections to 65,535 sections.

- (3) Increase maximum section size for a TRFC30 report from 32,000 bytes to 390,016 bytes for newly created or modified sections.

This feature also expands Section 222 (DLINE) to a 390,016 bytes whole TRFC30 buffer space.

The service provider needs to support higher data link speeds in order to transfer the requested data within the required polling window. The minimum data link speed is 9600 bps. The external operating systems (OSs) need to use the new poll message 123 to send requests for TRFC30 data.

2.6.1.5 (99-5E-4720) 5E14 Flexible Assignment of DCTU/PMU Ports to MMSU Shelves

This feature adds new metallic network access capabilities to be used with the Modular Metallic Service Unit (MMSU) and the Directly Connected Test Unit (DTCU). By providing a more flexible assignment of DCTU/PMU ports, MMSU MTIB utilization is reduced, thereby decreasing the likelihood of MTIB blocking.

3. CALL PROCESSING MEASUREMENT RELATIONSHIP

3.1 GENERAL

The 5ESS®-2000 switch software release generates, collects, and reports traffic, plant, and service measurements used to monitor particular aspects of a switching system operation over a specific interval: 5 minutes, 15 minutes, 30 minutes, 1 hour, and 24 hours. Measurements for 30 second and 5 minute intervals are also available for network management use. These measurements provide a summary of events that have taken place within the switching system. The control of scheduling and printout of measurement data is also performed by the software release. There is no traffic matrix as provided by the 1/1A ESSTM switches for the 5ESS®-2000 switch; however, some measurements are automatic but others must be allowed. **Refer to 235-070-100, Appendix 1, Traffic and Plant Measurements for a complete discussion of Traffic 30 (TRFC30) reports.**

3.2 VALIDATION

The following measurements from Section 1 of TRFC30 (Figure 3-1) are collected to allow the system data user to judge the reliability of the data provided by the system:

- Validity - STATUS.
- Number of 10-Second Scans - SCN10.
- Number of 100-Second Scans - SCN100.

The purpose of data validation is to determine:

- The validity of measurements for use in switch engineering and administration.
- That no hardware or software problems exist in the switch data collection equipment.
- That the measurements are internally consistent.

Data validation in the 5ESS®-2000 switch comes in two forms: machine validation and manual validation. Machine validation is the automatic self-checks for possible errors by the switch. Manual validation is the process of calculation of the suspected measured data and the comparison of the results with the reported measured data. Manual validation is performed on the office basic call counts including originating, outgoing, incoming, and terminating calls. To perform this, worksheets are provided in Figure 3-2 by Lucent Technologies and recommended for use by the telephone companies (service providers).

3.2.1 MACHINE VALIDATION

When the 5ESS®-2000 switch makes self-checks ensuring that data collection was accomplished on time and that no hardware machine errors occurred, it is performing machine validation. No check is performed to compare the data with any other value. Machine validation measurements are reported in Section 1 (Data Lost and Scan Count Validity), Section 18 (Module Message Processor Measurements Validity), and Section 19 (Message Switch Controller Measurements Validity) of the TRFC30 report, and Part 1 (Office Call Volumes Validity) of the TRFC15 report.

The data validity field indicates whether the switch detected that the measurements for a given report are suspect or invalid. The 5ESS®-2000 switch detects incomplete and invalid measurements resulting from one of the following:

- Initialization in the switching module (SM) or administrative module/ communication module processor

(AM/CMP) or both

- Data base manager read failure message in the SM or AM/CMP or both
- Failure to send poll messages to an SM
- Failure to receive data from an SM
- Invalid previous report (due to all of the preceding).

If one or more of these conditions occurs, the affected report is marked ``DATA MAY BE INVALID". If none of these conditions occur, the report is marked ``DATA IS VALID".

3.2.2 MANUAL VALIDATION

Manual validation is the process of using worksheets to calculate the suspect measured data and to compare the results with the reported measured data. To do this, worksheets are provided and recommended for use by the service providers. Although the traffic reports do not include all the measurements that are needed to validate every individual measurement against other measurements, some validation of measurement data is possible.

Manual validation is performed on the office totals (basic call counts) which include originating, terminating, incoming, and outgoing calls. Office total measurements provide a picture of the system as a total environment and an indication of system performance in terms of the number and the types of incomplete activities.

Figure 3-2 provides the worksheets used to validate originating, incoming, outgoing, and terminating calls. The worksheet includes Integrated Services Digital Network (ISDN) and other measurements and improvements.

In validation of office totals, ISDN circuit switching counts should be taken into account because ISDN office totals are included in the existing TRFC30 Section 5 totals. However, this does not apply to ISDN packet switching counts because packet switching counts are not included in these totals.

3.2.2.1 Precautions

The worksheet is only a guideline. It is neither intended as a diagnostic tool, nor is it intended to provide exact measurement comparison. This is because the counts for many on-going or just-completed calls are not reported or overlapped on two reports. Also, in comparing the data of different sections of the traffic report, all sections are not reported to the AM simultaneously. As a result, the skewing of the data may result between the AM, CMP, and the SMs within the reporting time. The manual check requires a thorough understanding of the registers where basic call counts are pegged. Knowing the office characteristics is also necessary.

This validation part does not take showering lines, quick disconnects, and Business and Residence Custom Services (BRCS) features into consideration. This is because some of the BRCS features in the 5ESS®-2000 switch may peg more than one half call in certain cases. For example, a line with Shared DN feature pegs two terminating half calls and one originating half call when the lead DN is not the answering port. Therefore, caution is necessary when using the worksheet to validate the basic call counts of a heavy BRCS feature loaded office. Also, to have sufficient data for manual validations, more than a half hour of data must be considered.

Because of these reasons, the calculated figures and the reported measured data may not match exactly. The difference should usually be within 5 percent.

3.2.2.2 Procedures

Validation of originating, terminating, outgoing, and incoming calls is performed in four parts in the worksheet. The number in parentheses indicates the TRFC30 section numbers. Boxes should be filled with calculated figures (the sum of TRFC30 registers or calculations on the worksheet itself), and blank lines should be filled with figures taken

directly from the TRFC30 report.

To validate originating calls (Part 1 of Figure 3-2), the basic calculation procedure is to add all types of originating request service and compare the total with the sum of all calls that are sampled for dial tone delay. Then, subtract the ineffective originating attempts from this total to find the total system-valid originating calls. Thus, the result of adding touch-tone requests (TTORQ) from Section 3, dial pulse request (DPORQ) from Section 3, and ISDN requests (ORIGRQ) from Section 50, should be approximately equal to the sum of dial tone delay sample counts (DTDSC) from Section 4 (summed over all SMs) plus the sum of ISDN originating request (Section 53). By subtracting the originating false starts (FALST) and originating permanent signals (PERM) from Section 6 from this result, the difference should be approximately equal to the sum of originating half calls (ORIGHC) from Section 13 and the sum of originating calls count (ORIGINAT) from Section 5. Also, by subtracting all of the ineffective originating attempts from Section 6 (such as, PDABAN, PDTIMO, and ABAND) and customer dialed irregularities (CDIRR) count from Section 3 from that result, total system-valid originating calls are obtained.

To validate outgoing calls (Part 2 of Figure 3-2) add the end result of Part 1 to the tandem calls count from Section 5 and then compare the total to the sum of outgoing half calls from Section 13 over all SMs and also compare that result to the sum of trunk group outgoing attempts (Section 12) on all of the given trunk groups.

NOTE: The total system-valid outgoing calls value is the number of calls that is determined by the system to go out of the office. The sum of all outgoing half calls from Section 13 includes this count, but it also includes calls routed to intercept. The sum of all outgoing peg counts from Section 12 includes the total system-valid outgoing calls, but it also includes multiple retries to alternate trunk groups from the completion of a call. Therefore, when comparing the total system-valid outgoing call value with data from Sections 12 and 13, and unless there are no announcements or alternate trunk groups, the total values from Section 12 and 13 may be significantly higher.

To validate terminating counts (Part 4 of Figure 3-2) in an office, add the SLC[®] 96, EAIU/AUI, TR303, and DNU-S carrier blocked terminating attempts (TERMATT) from Section 21, the integrated services line unit (ISLU/ISLU2) terminating circuit call attempts (TMATT) of Section 49, line unit attempts (TMCALLS) from Section 11, and IDCU termination attempts (TMATT) from Section 139 to obtain the total termination attempts.

3.3 ORIGINATING CALL FLOW

3.3.1 NON-ISDN CALL PROCESSING

The call processing of a non-ISDN originating call is shown in Figure 3-3 . When a subscriber originates a call by lifting the receiver, the SMP determines the specific line that changed state. The number of off-hook conditions is pegged by the TTORQ (3) and DPORQ (3) (TT and DP originating requests) counters.

Under control of the SM processor (SMP), the high-level service circuit (HLSC) is then accessed to perform the following tests:

- False cross and ground test.
- Power cross test.
- Continuity test.

When there is an attempt to access the HLSC, the PEGCT (8) (HLSC peg count) counter is pegged. If an HLSC cannot be obtained to run an originating short job, the SHTOVF (8) (short job overflow) counter is pegged. After the HLSC is seized, performs its tests, and is released, then a universal tone generator (UTG) is connected.

Dial tone is connected to the peripheral time slot associated with the channel circuit connected to the subscriber. The DTDSC (4) (dial-tone delay sample count) counter is a count of the originating calls or attempts. If the dial tone

delay exceeds the 3-second threshold, the DTDPC (4) (dial tone delay peg count) counter is pegged. The number of attempts to access the tone decoder (TD) is measured by the PEGCT (TD peg count)(9) counter. If there was an unsuccessful attempt to access the TD, the OVFLOW (TD overflow) 9) counter is pegged.

When the originating party begins dialing, the channel that was previously connected to a UTG time slot is connected to a time slot for a universal tone decoder (UTD) in the local digital service unit (LDSU) or digital service unit model 2 (DSU2). If a LDSF or GDSU disconnect occurs before receipt of a digit, the FALST (6) [ORIGIN] (originating false starts) counter is pegged. If a time-out occurs before the receipt of a digit, the PERMSIG (6) [ORIGIN] (originating permanent signal) counter is pegged.

The PEGCT (5) [ORIGINAT] (originating calls peg count), ORGHC (13) (Originating Half Calls), and SMORIG (22) counter indicates the receipt of at least one digit for analog call originations. If a call is abandoned before enough digits are dialed, the PDABAN (6) [ORIGIN] (originating partial dial abandonment) counter is pegged or the PDTIMO (6) [ORIGIN] (originating partial dial time-out) counter is pegged if the interdigital timing was exceeded.

When the SMP determines that digit collection is complete, the digit scan of the UTD is disabled. If the digits are uninterpretable, the CDIRR (3) (customer dialing irregularities) counter is pegged. The digits are translated to determine if the call is interoffice or intraoffice. The PEGCT (5) [OUTGOING] (outgoing calls peg count) counter indicates calls to be sent to the network for completion including originating and tandem call attempts. The PEGCT (5) [INTRAOFF] (intraoffice calls peg count) counter indicates the number of calls to complete within the 5ESS®-2000 switch.

If a complete set of digits was received or was retrieved from the data base, but the phone went on-hook before the call completed or was rung, an ABAND (6) [ORIGIN] (originating calls abandoned) counter is pegged. If a call is sent to a reorder tone, the REORD (4) (calls to reorder peg count) counter is pegged. If a route request message cannot be sent to the AM/CMP the BLKOVD (4) (calls blocked during AM/CMP overload) counter is pegged and the call is sent to reorder. The CMP marks this field when the CMP cannot route a request message.

3.3.2 ISDN CALL PROCESSING

Figure 3-4 illustrates the call processing of an ISDN call. When an ISDN subscriber originates a call by lifting the receiver, the customer premises equipment (CPE) sends a Q.931 setup signaling message to the switch. The number of off-hook conditions for ISDN lines is pegged by the ORIGRQ (50 and 53) for Q.931 access lines, and DTDSC (4) for Z-cards and TR008/TR303 remote terminal (RT) lines. The HLSC is then accessed to perform the following tests for Z-cards and TR008/TR303 RT-lines only:

- False cross and ground test.
- Power cross test.
- Continuity test.

The Q.931 access lines do not access HLSCs on a per call basis. When an attempt is made to access the HLSC the PEGCT (8) counter is pegged. If an HLSC cannot be obtained to run an origination short job testing, the SHTOVF (8) counter is pegged.

For Z-cards and TR008/TR303 RT-lines only, after the HLSC is seized, tested, and released, a UTG is connected and PEGCT(9) TD is pegged. If access to the TD was unsuccessful, the overflow TD(9) counter is pegged. The Q.931 access lines use the CPE for tone generation or dial tone. The Z-cards and TR008/TR303 RT-lines follow the same originating call as a line in the LU.

Dial tone is generated at the CPE for Q.931 access lines when the switch sends a Q.931 setup acknowledge message to the CPE. Dial tone for Z-cards and TR008/TR303 RT-lines is connected to its PIDB time slot, and the DTDSC (4) counter is a count of Z-card originating calls. If dial tone delay exceeds 3 seconds, the DTDPC (4) is

pegged.

For Q.931 access lines, the ORIGRQ (50 and 53) counters is a count of the originating calls. If the dial tone delay exceeds 3 seconds, the setup delay (53) counter is pegged. When the originating party on a Q.931 access lines begins dialing, the ORIGINAT (5), ORGHC (13), ORIGPC (50), and SMORIG (22) pegs when the first digit is received. If on-hook is detected before any digits are dialed, FALST(6) is pegged. If predigit time-out occurs, PERMSIG (6) is pegged. After the switch receives the first digit, the switch sends a Q.931 message to the CPE to turn off dial tone. If a call is abandoned before enough digits are dialed, the PDABAN (6) [ORIG] counter is pegged or the PDTIMO (6) [ORIG] counter is pegged if the interdigital timing value is exceeded.

When the SMP determines that the digit collection is complete but the digits are uninterpretable, the CDIRR(3) counter is pegged. The dialed digits are translated to determine if the call is interoffice or intraoffice. The pegcount [OUTGOING] (5 and 50) counters indicate when the call is to be sent to the network for completion, and the pegcount [INTRAOFFICE] (5 and 50) indicates that the call completes in the same office. If a complete set of digits is received but the calling party goes on-hook before the call is completed or before the called party is rung, an ABAND (6) [ORIG] counter is pegged. If the call is sent to reorder tone, the REORD (4) counter is pegged. If the AM/CMP is in overload and the call is throttled, the BLKOVD (4) is pegged, and the call is sent to reorder.

3.3.3 VALIDATION

This worksheet does not take showering lines, quick disconnects, and BRCS features into consideration. The originating calls can be validated following the steps shown in Part 1 of Figure 3-2. The values are taken from the TRFC30 report. The number in brackets refers to sections on the TRFC30 report. Refer to 235-070-100, *Appendix 1, Traffic and Plant Measurements* for a complete discussion of TRFC30.

3.4 INCOMING CALL FLOW

3.4.1 CALL PROCESSING

The SMP determines the specific trunk that changed state. The number of off-hook conditions is measured by the C6INRQ (3), TUPRQ (3), ISUPRQ (3), (CCS 7), DPINRQ (3), MFINRQ (3), and RPINRQ (3) (dial pulse, multifrequency, and reverive pulse incoming requests) counters. The SMP determines that an incoming call was initiated.

If a reverive pulsing (RP) transceiver is needed, an attempt to connect an RP transceiver is measured on the PEGCNT (25) (RP transceiver attempt) counter. If an attempt to connect an RP transceiver is unsuccessful, the OVFO (25) (RP transceiver overflow) counter is pegged. Because common channel signaling (CCS) sets up the path for C6INRQ, TUPRQ, and ISUPRQ trunks, a tone transceiver (60) from the LDSU2 is recommended for voice path assurance.

When an MF, DP or RP incoming trunk begins sending address signaling, the channel is connected to a time slot for a UTD in the DSU2, LDSU, LDSF, or GDSU. If a disconnect occurs before receipt of a digit, the FALST (6) [INCOM] (incoming false starts) counter is pegged. If a time-out occurs before the receipt of a digit, the PERMSIG [INCOM] (6) (incoming permanent signal) counter is pegged.

For an incoming call, the TGIPC (12) (trunk group incoming) counter is pegged. The TGSILC (trunk group selective incoming load control) counter is pegged when there is a load control on a trunk group. The PEGCT [INCOMING] (5) (incoming calls peg count) counter indicates the receipt of at least one digit. The INCHC (13) (incoming half calls) counter per SM is also pegged at origination. The SMP performs digit analysis. If a call is abandoned before completion, the PDABAN (6) [INCOM] (incoming partial dial abandonment) counter is pegged or the PDTIMO (6) [INCOM] (incoming partial dial time-out) counter is pegged if the interdigital timing was exceeded. For a C6, ISUP, or TUP incoming call, the INCPEGCT (50), PEGCOUNT(INCOM) (5), and INCHC (12) pegs. If the call arrives on packet trunks, INCDMPC (93) and INCPC (69) pegs instead of INCPC (5, 12, and 50).

When the SMP determines that digit collection is complete, the digits are translated to determine if the call is

tandem or terminating. The PEGCT [TANDEM] (5, and 50) (tandem calls peg count) counter indicates calls to be sent to the network for completion. The PEGCT [TERMINAT] (5, and 50) (terminating calls peg count) counter indicates the number of calls to complete to lines within the 5ESS®-2000 switch including intraoffice call attempts. If the call arrives on packet trunks, PEGCNG [TANDEM] (93) and PEGCNT [TERM] (93) pegs instead of TANDEM and TERM in (5).

If an ABAND (6) [INCOM] (incoming calls abandoned) counter is pegged, a complete set of digits was received, but the call could not be completed because the incoming trunk abandoned.

3.4.2 VALIDATION

The incoming calls can be validated following the steps shown in Part 3 of Figure 3-2. The values are taken from the Traffic 30 (TRFC30) report. The number in brackets refers to sections on the TRFC30 report. Refer to 235-070-100, *Appendix 1, Traffic and Plant Measurements*, for a complete discussion of TRFC30.

3.5 OUTGOING CALL FLOW

3.5.1 CALL PROCESSING

Digits are received from the line or incoming trunk. For most cases, the digits are collected in a UTD in the DSU2 or LDSU. Digit translation is performed to analyze destination routing.

The AM/CMP determines the destination trunk for the call and reserves a path between the SMs of the originating line and outgoing trunk. At this point, the 5ESS®-2000 switch is ready to output destination digits over the outgoing trunk.

The PEGCT (OUTGOING) (5) counter is pegged when calls are sent to the network for completion (including tandem). The OUTHC (13) (outgoing half calls per SM) counter is also pegged at origination. The calls that obtain an outgoing trunk are pegged on the OUTGO (12) (outgoing attempts) counter. If there is no available member of a shared trunk group, the OVFL (12) (trunk overflow) counter is pegged. Packet switching calls outgoing on packet trunks cause OUTPG (93) to peg. If an ISDN call is to complete out of the office, OUTGPC (50) pegs.

After all digits are collected and the talking path is reserved, the AM/CMP processor prepares the digits to be outputted. Leading digits on the call can be deleted or prefixed as needed to change the digits on the call to those expected by the terminating office. The outgoing trunk is connected to a UTG. When a start signal is detected by the trunk, digit transmission begins. Digits are sent from the UTG over the outgoing trunk. After all digits are transmitted to the connecting office, the path to the UTG is idled.

3.5.2 VALIDATION

The outgoing calls can be validated following the steps shown in Part 2 of Figure 3-2. The values are taken from the TRFC30 report. The number in brackets refers to sections on the TRFC30 report. Refer to 235-070-100, *Appendix 1, Traffic and Plant Measurements*, for a complete discussion of TRFC30.

3.6 TERMINATING CALL FLOW

3.6.1 NON-ISDN CALL PROCESSING

The TERMHC (13) (terminating half calls per SM), TERMATT (21) SLC® 96 carrier terminating attempts), and the TMCALLS (11) (terminating attempts per LU) counters are pegged.

Once a path is established between the two SMPs, the terminating SMP checks the busy/idle status of the terminating line and informs the originating or incoming SMP. If the call cannot be completed, the associated tones are sent to the called party by the DSU2 or LDSU of the originating or incoming SM. The unsuccessful attempts to

access a concentrator A- or B-link is indicated by the TMBLK (11) (LU terminating blocking) counter. The unsuccessful attempts to terminate to the RT-lines because of the inability to access a time slot on the SDFI between the RT-lines and the DCLU or IDCUI is indicated by the TERMBLK (21 or 139) (DCLU or IDCUI terminating blocking counter).

Once the terminating call tests are completed, the terminating SMP sets the HLSC to provide ringing current for the terminating line. When an attempt is made to access the HLSC, the PEGCT (8) (HLSC) counter is pegged. The unsuccessful attempt to obtain the HLSC is indicated by the RINGOVF (8) (HLSC ringing overflow) counter. The calling party receives audible ringing tone from the terminating LDSU while the called party receives ringing under control of the terminating HLSC.

If a disconnect occurs after ringing was applied to the terminating line and audible ringing is returned to the calling party, the TCRNG (3) (terminating calls to ring with no answer) counter is pegged. If the line is busy, the TCBSY (3) (terminating calls to busy) counter is pegged. When a call is sent to intercept, the TCINT (3) (terminating calls to intercept) counter is pegged. If the called party answers, the TCANS (3) (terminating calls to answer) counter is pegged.

3.6.2 ISDN CALL PROCESSING

Figure 3-4 shows call processing of a terminating ISDN call. Once a path is established between the two processors, the terminating SMP checks the busy/idle status of the terminating line before informing the originating SMP. If the call cannot be completed, the associated tones are sent to the CPE of the calling party or to the trunk of the incoming SM. The unsuccessful attempts to set up a terminating path through the ISLU/ISLU2 or IDCUI pegs TMBLK (49 or 139).

Once the terminating call tests are completed, the terminating SMP sets the HLSC to provide ringing for lines terminating on Z-cards and TR008/TR303 RT-lines. The switch sends a Q.931 message to a line terminating on Q.931 access lines enabling the called party CPE to ring itself.

If a disconnect occurs after ringing is sent to the called party and audible ring is returned to the calling party, the TCRNG (3) counter is pegged. When a call is sent to intercept, the TCINT (3) counter is pegged. If the called party answers, the TCANS (3) counter pegs.

3.6.3 VALIDATION

The terminating calls can be validated following the steps shown in Part 4 of Figure 3-2. The values are taken from the TRFC30 report. Refer to 235-070-100, *Appendix 1, Traffic and Plant Measurements*, for a complete discussion of TRFC30. The number in brackets refers to sections on the TRFC30 report.

3.7 REMOTE SWITCHING MODULE CALL PROCESSING

The remote switching module (RSM) is an SM located remotely from a 5ESS®-2000 switch. The RSM configurations operate in either a linked or stand-alone mode.

Linked mode refers to the normal operating condition of the RSM. While in the linked mode, any feature available at the 5ESS®-2000 switch is also available at the RSM.

The stand-alone mode of operation is an optional feature that provides local service to the customer of the RSM when communications with the 5ESS®-2000 switch is lost. Most of the BRCS features available in the normal linked mode of operation are also available in the stand-alone mode.

The ORIG (22) (remote module originating calls) counter is pegged when an originating request results in the receipt of at least one digit. The number of outgoing calls that are completed through the host SM from the RSM is measured by the OTG (22) (remote module outgoing calls) counter. An attempt to allocate an umbilical time slot for use in an intermodule call is measured by the UMPC (23) (umbilical time slot peg count) counter. If an attempt to

allocate an umbilical time slot is unsuccessful, the UMOFL (23) (umbilical time slot overflow) counter is pegged. The INC (22) (remote module incoming calls) counter provides the number of incoming call attempts on the RSM through the host SM.

The SATIME (22) (remote module stand-alone time) counter provides the number of seconds the RSM was in stand-alone mode. If a call is blocked in the RSM because the RSM was in stand-alone mode, the OUTBLK (22) (remote module blocked calls) counter is pegged. The INCBLK (22) (RSM stand-alone call failures) counter measures the number of blocked calls in the AM/CMP because the RSM was in stand-alone mode.

3.8 KEY SERVICE INDICATIONS

The key service indicators are those indicators which give the administrator a quick view of the overall quality of service being provided to the subscribers. Refer to Section 15 , PRIMARY SERVICE INDICATORS AND MEASUREMENT THRESHOLDS.

OP TRFC30 VLD
TIME HH:MM:SS

SECTION 1: VALIDITY

PROC	STATUS	SCN10	SCN100
AM	XXXXX	0	XXXXX
XXXXX	XXXXX	XXXXX	XXXXX

OP TRFC30 OFC
TIME HH:MM:SS

SECTION 3: OFFICE TOTALS

DPORQ = XXXXXXXXX	TTORQ = XXXXXXXXX	DPINRQ= XXXXXXXXX
MFLNRQ= XXXXXXXXX	CDIRR = XXXXXXXXX	TCBSY = XXXXXXXXX
TCINT = XXXXXXXXX	TCANS = XXXXXXXXX	TCRNG = XXXXXXXXX
RPINRQ= XXXXXXXXX	C6INRQ= XXXXXXXXX	ISUPRQ= XXXXXXXXX
TUPRQ = XXXXXXXXX	MFOURQ= XXXXXXXXX	C6OURQ= XXXXXXXXX
ISUPOR= XXXXXXXXX		

OP TRFC30 SAD
TIME HH:MM:SS

SECTION 4: SYSTEM ACCESS DELAY

PROC	DTDPC	DTDSC	TDAD	TDASC	REORD	BLKQVD	TSMM
XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXX
XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXX

OP TRFC30 CT
TIME HH:MM:SS

SECTION 5: CALL TYPE INFORMATION

CALLTYP	PEGCT	USG	NOCKT	MACHLOS
ORIGINAT	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX
INCOMING	XXXXXXXX		XXXXXXXX	XXXXXXXX
INTRAOFF	XXXXXXXX		XXXXXXXX	XXXXXXXX
OUTGOING	XXXXXXXX		XXXXXXXX	XXXXXXXX
TERMINAT	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX
TANDEM	XXXXXXXX		XXXXXXXX	XXXXXXXX
O+T		XXXXXXXX		XXXXXXXX
IFFM				

OP TRFC30 1A
TIME HH:MM:SS

SECTION 6: INEFFECTIVE ATTEMPTS

CALLTYP FALST PERMSIG PDABAN PDTIMO ABAND BFMO

ORIGIN XXXXX XXXXX XXXXX XXXXX XXXXX
INCOM XXXXX XXXXX XXXXX XXXXX XXXXX XXXXX

OP TRFC30 HLSC
TIME HH:MM:SS

SECTION 8: HIGH LEVEL SERVICE CIRCUITS

PROC LU PEGCT TOTUSG SHTOVF MTUSG RNGOVF
XXX X XXXXX XXXXX XXXXX XXXXX XXXXX
XXX X XXXXX XXXXX XXXXX XXXXX XXXXX

OP TRFC30 TD
TIME HH:MM:SS

SECTION 7: TONE DECODERS

PROC PEGCT TOTUSG OVFLOW MTUSG
XXX XXXXX XXXXX XXXXX XXXXX
XXX XXXXX XXXXX XXXXX XXXXX

OP TRFC30 UCONF
TIME HH:MM:SS

SECTION 10: UNIVERSAL CONFERENCE CIRCUITS

3-PORT: CCPC = XX CCUSG = XX CCOFL = XX CCMTU = XX
6-PORT: CCPC = XX CCUSG = XX CCOFL = XX CCMTU = XX

Figure 3-1 Office Total Sections on the TRFC30 Report

PART 1 - ORIGINATING CALLS

TTORQ (03)		_____			
Plus					
DPORQ (03)	+	_____			
ORIGRQ (50)	+	_____			
			=		$\approx \Sigma$ DTDSC (04)
Minus					
FALST (06)	-	_____			
PERM (06)	-	_____			
			=		$\approx \Sigma$ ORIGHC (13)
					$\approx \Sigma$ ORIGNAT (15) _____
Minus					
PDABAN (06)	-	_____			
PDTIMO (06)	-	_____			
ABAND (06)	-	_____			
CDIRR (03)	-	_____			
TOTAL SYSTEM-VALID ORIGINATING CALLS			=		
Minus					
INTRAOFF (05)	-	_____			
			=		$\approx$ TOTAL ORIGINATING CALLS to OUTGOING

PART 2 - OUTGOING CALLS:

PART 3 - INCOMING CALLS:

C6INRQ (03)		_____			
TUPRQ (03)	+	_____			
ISUPRQ (03)	+	_____			
Add					
MFINRQ (03)	+	_____			
DPINRQ (03)	+	_____			
RPINRQ (03)	+	_____			
Minus			=		$\approx \Sigma$ IPC (12)
FALST (06)	-	_____			
PERM (06)	-	_____			
Minus			=		$\approx \Sigma$ INCHC (13)
PDABAN (06)	-	_____			$\approx$ INCOMING (05)
PDTIMO (06)	-	_____			_____
ABAND (06)	-	_____			
BFMO (06)	-	_____			
ISIPDTO (50)	-	_____			
TOTAL SYSTEM-VALID INCOMING CALLS			=		
Minus					
TANDEM (05)	-	_____			
INCOMING CALLS TO TERMINATNG			=		

Figure 3-2 Call Processing Worksheets

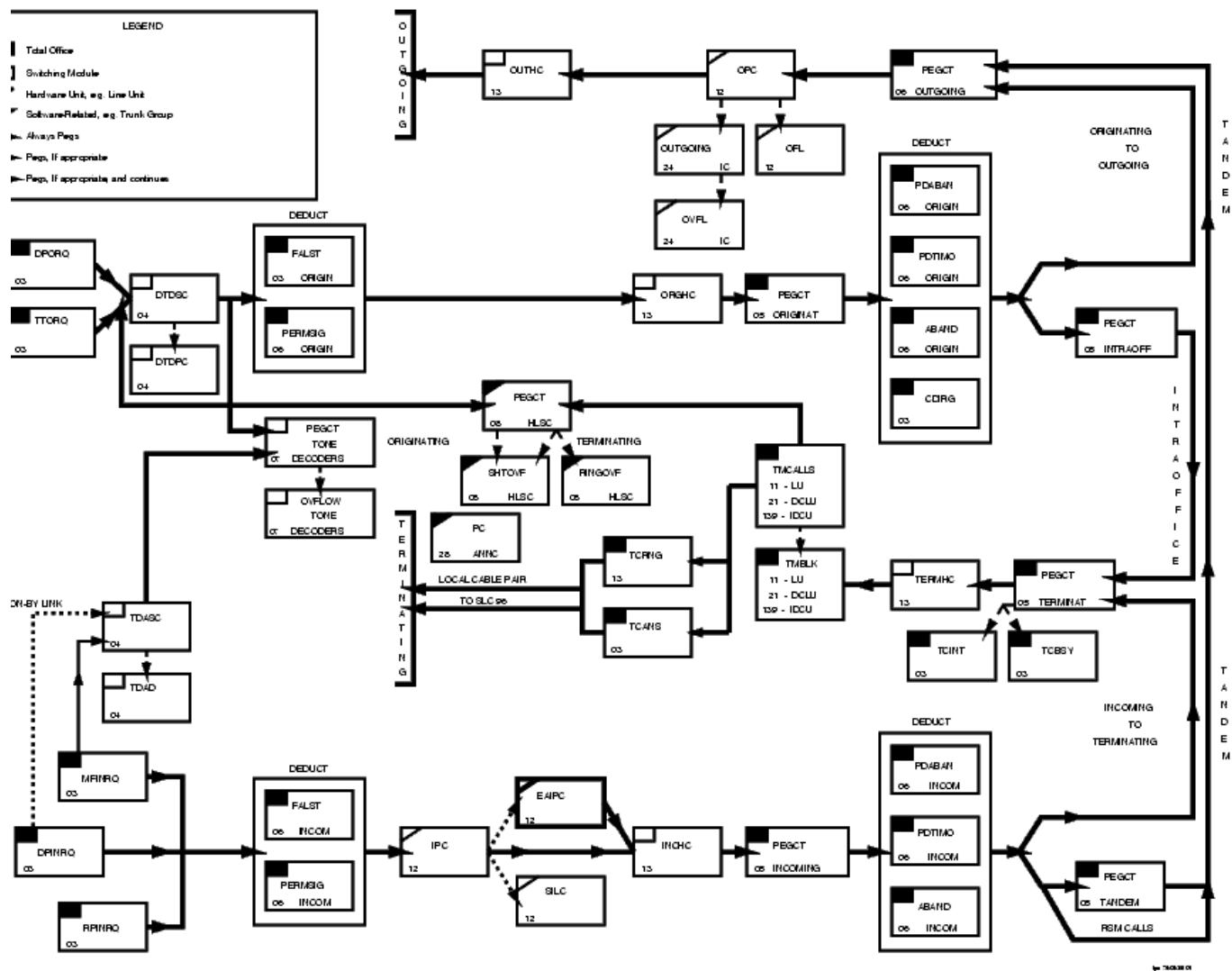


Figure 3-3 Basic Call Processing Peg Counts

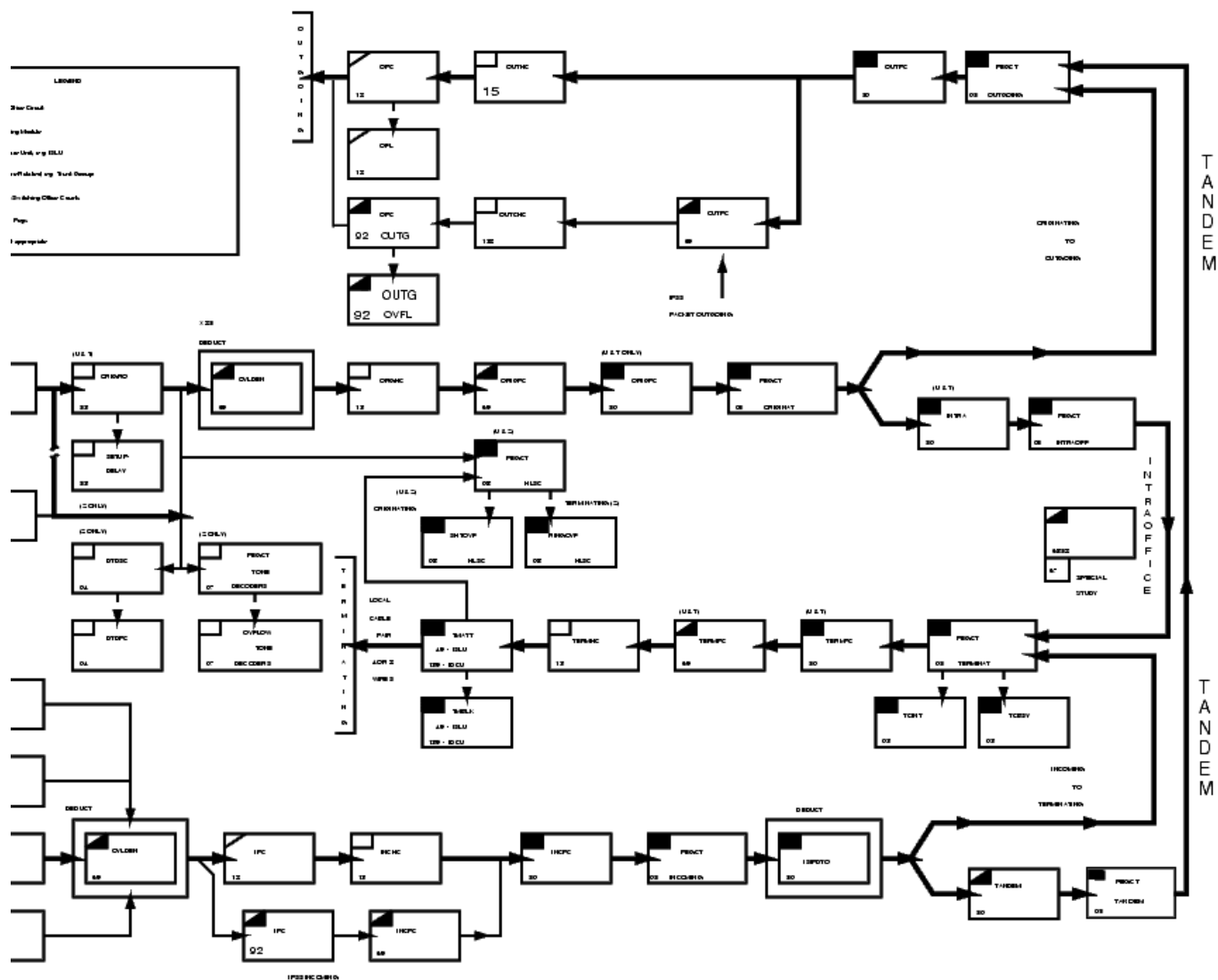


Figure 3-4 ISDN Call Processing Peg Counts

4. MEMORY OVERVIEW

4.1 GENERAL

The 5ESS®-2000 switch contains many processors distributed throughout its various modules. Each processor requires memory space to perform its function.

In the following description, the memory requirements are defined in several different terms. The definitions of these terms are as follows:

- **Byte:** The byte is the basic unit of storage, and it is composed of eight binary digits or bits.
- **Kilobyte:** A kilobyte is 1,024 bytes. This term is commonly written as "K" or "KB" following the number. An example would be 256 KB that is actually 262,144 bytes.
- **Megabyte:** A megabyte is 1,024 kilobytes. This term is often written as "M" or "MB" following the number. For example, 16 MB is actually 16,777,216 bytes of memory.
- **Gigabyte:** A gigabyte is 1,024 megabytes. This term is often written as "G" or "GB" following the number. For example, 16 GB is actually 17,179,869,184 bytes of memory.
- **Page:** A page of memory contains a specific number of bytes of contiguous physical memory. The size of the page is variable, but it is always a power of 2 from 256 bytes to 8,192 bytes.

4.2 MEMORY TYPES

This section describes the two types of memory and provides the information needed to monitor and administer their usage. The information provided applies to all software releases. Throughout the following paragraphs, the term "memory," unless otherwise specified, applies to random access memory (RAM).

Generally, there are two types of memory that must be engineered and monitored: RAM and disk memory. Main processor memory (also referred to as Main Store or MAS) is the RAM contained in the administration module (AM), communication module processor (CMP), and switching module (SM). Disk drive memory is the relatively long-term memory storage attached to the AM.

4.2.1 RANDOM ACCESS MEMORY

Random access memory stores the programs and data for its associated processor (i.e., AM, CMP, SM).

The processor in the communication module (CMP), has a fixed amount of memory and usually does not need engineering or administration attention. The AM and SM processor memory, however, does require engineering and/or administration support activities.

4.2.2 DISK DRIVE MEMORY

This storage is used to provide backup of data and programs contained in the AM, CMP or SM in the event of data loss. Although the disk drives are associated with the AM and CMP, programs and data required by the SM are transmitted via the CM to the SM.

4.3 MEMORY STRUCTURE

The AM, CMP and SM contain protected and unprotected memory areas. Programs and data in the protected areas are backed up on disk; programs and data located in the unprotected areas are not. The protected memory is subdivided into static and text areas. The unprotected memory portion is also called dynamic memory. These

memory areas are illustrated in Figure 4-1 .

The static and dynamic areas of memory make up the 5ESS®-2000 switch data base. This is a relational data base that is distributed among the various modules making up the switch. Data may reside on all processors (AM, CMP, and SM) individually, redundantly, or partitioned among the various processors. Initial memory sizing assumes an even distribution of data in a community of 5ESS®-2000 switch equipment. These communities are defined as groups of SMs with similar hardware and feature characteristics.

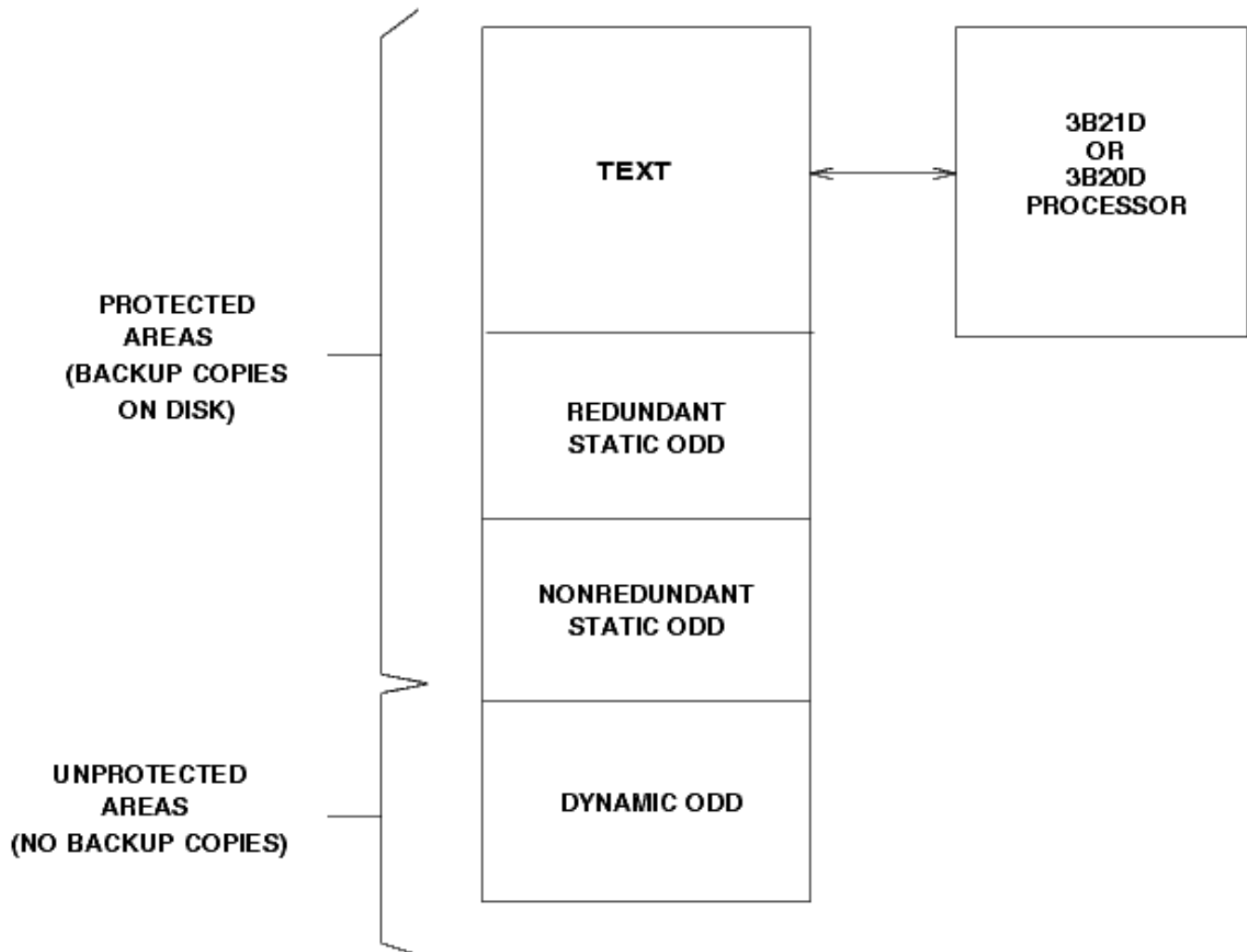


Figure 4-1 Protected and Unprotected Memory Areas

4.3.1 STATIC MEMORY

Static memory (or static office dependent data) contains information that describes the equipment and feature characteristics of a particular telephone office. Static data is also called static office dependent data (SODD). Static data changes infrequently, and the initial contents of the static ODD are provided to the 5ESS®-2000 switch through the office data assembler (ODA) facilities. The static ODD data can then be changed only through Recent Change (RC) or Customer - Originated Recent Change (CORC). Static data resides in the SM, AM and CMP, and is backed up on disk. The static memory area has the following actual and physical limits.

Actual Limit: This is the limiting point of the memory allocated for use in the AM, CMP, or SM.

Physical Limit: This is the total amount of memory equipped in the AM CMP, or SM. Additional memory may be equipped through the addition of memory boards. Each SM processor has a limit for the amount of memory that may be addressed. Refer to Section 10.1, "Switching Module Processor," in Section 10, "SM RESOURCE UTILIZATION."

Static memory is provided in this manner to improve the packing of memory as well as minimizing the amount of data that must be backed up on disk.

Static memory is growable within certain limits. Refer to Section 10 for the individual processors for this information and 5ESS®-2000 Switch Digital Ordering and Planning System (DOPSMOD) for engineering. Additionally, an in-service monitoring procedure (also described later in this section) is available to monitor memory usage.

4.3.2 DYNAMIC MEMORY

Dynamic memory (or dynamic office dependent data) consists of equipment status, call status, work queues, etc. Dynamic ODD is initialized by various processes at initialization. The data is generated by programs such as call processing programs and typically includes information read from static data. Dynamic ODD changes frequently, and is changed mostly by the call processing and other related programs. It is affected by RC (for example, through the addition of new multiline hunt groups, etc.).

Some dynamic ODD is created when a process (usually a terminal process) is created and exists only for the life of the process. Other dynamic ODD exists from one initialization (bootstrap) to the next. It is re-created on each initialization. Since this data resides in unprotected areas of memory, software application programs provide direct access to this data and may change the data as often as necessary. These changes can occur many times during the duration of a telephone call. Dynamic data is not backed up on disk but may be recovered through a system of audits and reinitializations from static data.

The amount of memory space provided for dynamic memory in the AM is fixed by the software release and is not growable except by Lucent Technologies. These space allocations are engineerable and field adjustable. A portion of this dynamic memory is for dynamic ODD. The amounts of AM, CMP and SM dynamic ODD available in each software release are provided in the descriptions of AM, CMP and SM memory.

4.4 MEMORY INPUTS

There are several inputs required to perform memory management, planning, engineering and administration activities. These are:

- **Memory Concepts** include knowledge of switch architecture (hardware) and software as it pertains to memory.
- **Guidelines/Rules/Requirements/Limits** are rules of the road for memory that are provided in the Memory SEIs, and 235 series of documents.
- **Feature** use and penetration that impacts the consumption of memory.
- **Applications** implemented that will impact memory, e.g., unbundling, Long Distance Platform.
- **Philosophy/Policy/Procedures** pertain to memory that the switch owners have instituted
- **Office Environment/Dynamics** regarding incumbent and competitive LECs and office growth.
- **Tools/Commands** that the 5ESS-2000 switch provides to monitor and perform memory related activities.

4.5 MEMORY PLANNING AND MANAGEMENT TRIGGERS

There are several events that often require attention to memory, and should always be considered as indicators that

new or reengineered memory may be required. These are:

- **New Start or Office Engineering** Memory planning is required for a new office. New switches come with enough physical memory to meet the requirements of the installed software release that comes with the new switch
- **Retrofits** Memory equipage is dependent on the software release program. If the software release program changes, there may, and usually will be, an impact on the amount of memory required in the AM, CMP, SM, SM-2000, and possibly the Disk.
- **Feature Growth** If features are added to the 5ESS-2000 switch, it may be necessary to allocate more Static ODD memory or to grow additional memory. A feature can be defined as an enhancement to basic telephone service (e.g., Speed Calling or Call Forwarding).
- **Hardware Growth** If hardware is added to the 5ESS-2000 switch, it may be necessary to add new memory. Examples are the addition of a new SM-2000 to an office, or additional peripheral images.
- **New Applications** If a switch must support new applications such as switch unbundling, memory may be impacted.
- **Output Messages** Output messages may indicate the need to grow memory. If, for example, ODD "MEMORY USED", conveyed through the OP:ODD command readout, is beyond a certain percentage, the administrator may wish to allocate more memory to the ODD.
- **Alarms** Minor alarms are engaged when OP:ODD "MEMORY USED" reaches 80, 85, and 90%. Major alarms are engaged when "MEMORY USED" reaches 95, 96, 97, 98, 99, and 100%.

Ideally, memory is provided based on the requirements for an office when the next growth is required. This is referred to as End-of-Period (EOP) engineering. However, in today's environment on-going memory monitoring is recommended due to the growth in features (particularly those with substantial memory impacts) and new applications.

4.6 DATA BASE AND PROGRAM DISTRIBUTION

The office data base and programs are located in the AM and CMP, and in individual SMs. Software is stored on processors (AM, CMP, and SM) individually, redundantly, or partitioned among the various processors. The data base in each SM contains all the information related to both customer lines and trunks that terminate on the particular SM. Tables of data that apply to functions done in the AM are located only in the AM. Worksheets for CMP and SM memory administration in terms of hardware or feature growth is provided in Subchapter 8.2 and 10.4 . The general distribution of the 5ESS[®]—2000 Switch database is shown in figure 4-2 .

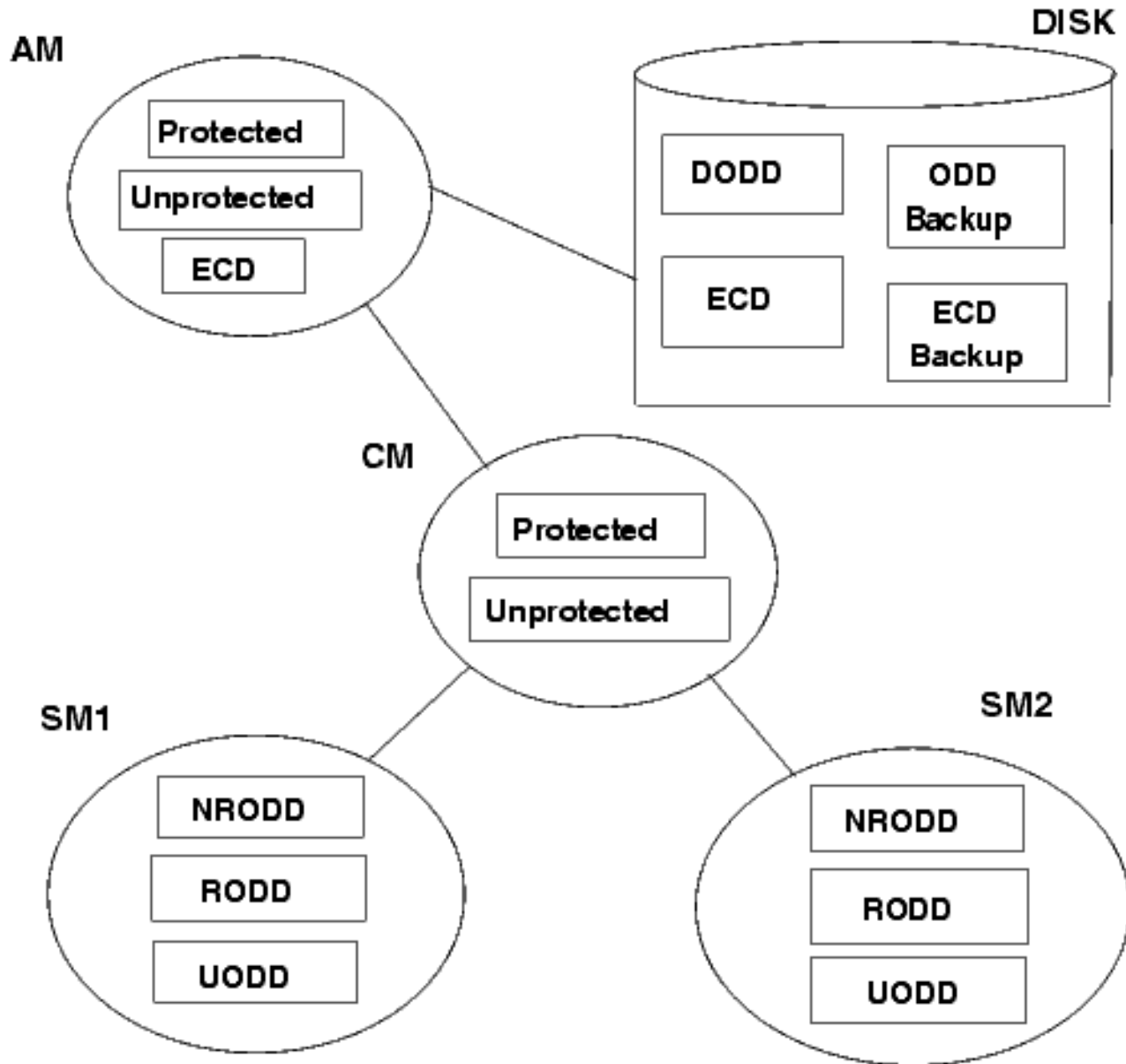


Figure 4-2 Data Distribution

4.7 OFFICE DEPENDENT DATA

The ODD is that portion of the data unique to a 5ESS®-2000 switch. This includes the static data (translations, parameters, etc.) and dynamic data (equipment and line status, work queues, etc). The size of the ODD data base is dependent on the number of lines, trunks, equipment, etc., and the amount and types of features provided. Additionally, the ODD memory space may be grown and allocated as necessary to support equipment and features required. Sizing of the ODD data base is done during the engineering and ODA processes. It may be done after turnover to determine the impact of line and/or feature and hardware growth.

The data required to build the 5ESS®-2000 switch office data base originates from two major sources: the switch owner (or the owner's designated switch manager) and the Lucent Technologies line engineer.

The switch owner is responsible for entering all information associated with the call processing function of the

5ESS®-2000 switch. This data (or translations) comes from various forms that are completed by the switch owner.

NOTE: These translation forms are part of the 5ESS®-2000 Translations Guide (TG5). Examples of translations provided by the switch owners are: lines and trunks, routing and charging, equal access, Business and Residence Custom Services (BRCS), etc.

The Lucent line engineer is responsible for "building" the hardware data (parameters) based on the switch owner's requirements from the equipment order. Other major responsibilities include:

- Establish the office registration
- Determine the translations start date
- Perform the data base validation
- Enter hardware equipment locations (parameters).

NOTE: As an option to the switch owner, Lucent Technologies may be responsible for all data entry. In this case, the switch owner will normally be requested to provide a magnetic tape with the data and Lucent will have responsibility for entering all this data.

4.8 INITIAL DATA BASE (VIA 5 ODA)

The 5ESS®-2000 Switch Office Data Assembler (5 ODA) is a software system developed by Lucent Technologies. The initial office data base is built through this system. The 5 ODA system allows both the switch owner and the line engineer to enter the data through a dial-up access after the office has been registered.

Following the entry, the engineer performs data validation and, if necessary, notifies the switch owner of any errors. The switch owner is responsible for making corrections. Office records are also produced by the 5 ODA system, both during and after data entry.

When data entry is completed the following occurs:

- The line engineer requests 5 ODA to produce an ODD tape
- The ODD tape is then used to load the 5ESS®-2000 switch office data base.

An overview of 5ESS®-2000 switch data generation responsibilities is depicted in Figure 4-3 .

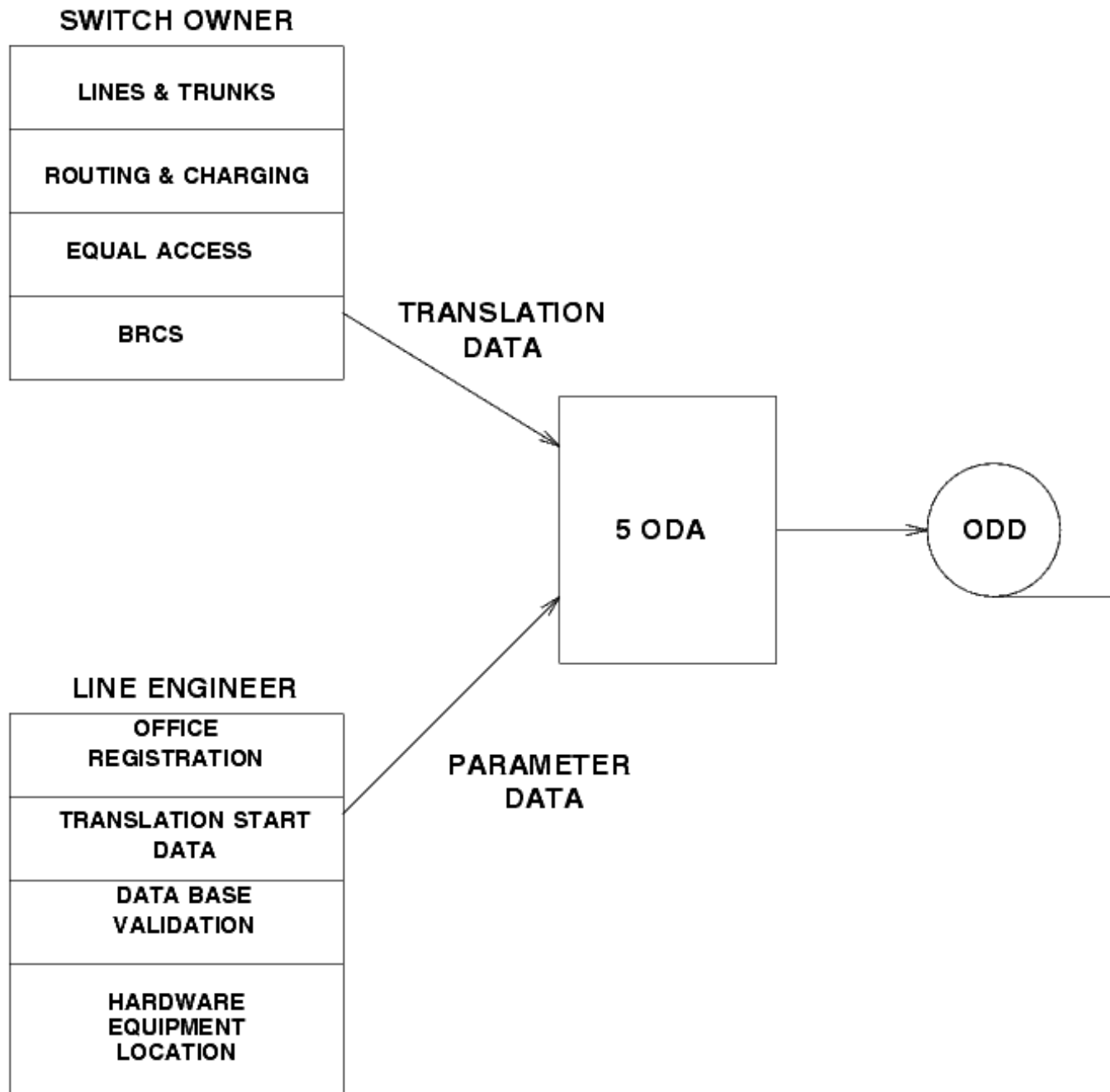


Figure 4-3 Data Generation Responsibilities

4.9 ODD DATA BASE

The ODD data base is based on a relational data base model. The word **relation** is the mathematical term for structures that may be thought of as tables. The data base is considered as a collection of relations. The relations are stored in fixed-length areas of memory called **pages**. The relation is a 2-dimensional table of related data. An illustration of a relation is given in Figure 4-4 .

Each data table is called a **relation**, and each row of a relation is called a **tuple**. The entries in a row (the columns) are called **attributes**. To provide access to specific tuples, one or more attributes are designated as the **key** for the relation. This means that not more than one tuple with the same key exists in the relation. When specific tuples are

to be accessed, the key must be given that will identify a unique tuple in the relation. A key may consist of more than one attribute and, here, all attributes of the key must be provided to access the tuple.

A relation can have only one key. However, as previously described, more than one attribute may be used to represent the key. If a tuple must be accessed by the value of some nonkey attribute, then all tuples must be compared until the desired tuple is found. The set of allowable values that an attribute may have is called the **domain** of the attribute.

NOTE: The hypothetical relation given in the following example is intended to assist in the understanding of the relation concept. It is not intended to represent any actual data base relation within the 5ESS[®]-2000 switch.

As an example, a directory number might be the key to a relation containing line information. Contained in this relation could be certain information (attributes) related to the features privileges associated with the directory number. These features could include touch-tone capability, call waiting, call forwarding, speed calling, etc.

The key for this relation is the telephone number which is made up of the office code attribute and the 4-digit telephone number attribute. Therefore, the key must be a 7- or 10- digit number having only certain values. The office code is limited to only the particular codes available in the office, and the telephone number could range from 0000 to 9999. These allowable values represent the domain of the attribute. For the features and privileges allowed for the line, the tuple could contain a "yes" or "no" value for each one. This represents the domain of those attributes. Further, the telephone number could not be represented by a "yes" or "no" value, because it is not in the domain of that attribute. Likewise, the feature privileges attribute could not contain a 7- or 10- digit number.

KEY ATTRIBUTE		ATTRIBUTE (COLUMN)			
	DIRECTORY NUMBER	TOUCH TONE	SPEED CALL	3-WAY CALL	CALL WAIT
5551234567	YES	NO	YES	YES	

DOMAIN

NOTE:

1. THIS EXAMPLE IS INTENDED TO ASSIST IN THE UNDERSTANDING OF THE RELATION CONCEPT AND IS NOT INTENDED TO REPRESENT ANY REAL RELATION IN THE 5ESS-2000 SWITCH.

Figure 4-4 A Data Relation

4.9.1 DATA ACCESS

When a program needs a specific piece of information (a tuple within a relation), the relation name and the key attribute for the desired tuple are provided to the data base manager (DBM). The DBM then locates a set of information about that relation in data **dictionaries**. These dictionaries provide information such as access-type, relation and attribute identifications, number of subattributes, domain identifications, etc. With this information, the DBM can identify the head table for the relation that, among other things, identifies each data page associated with the relation. Finally, using the key attribute and the access type, the DBM can locate the desired tuple on a data page.

Figure 4-5 is an example of the way several relations interact. In this example, the Port ID (a converted line equipment number) is a key attribute and it relates to the telephone number (TN). The TN, in turn, is the key attribute to a relation that specifies how call processing is to treat this call. Another relation uses the line class code (LCC) as a key attribute and defines other attributes associated with it.

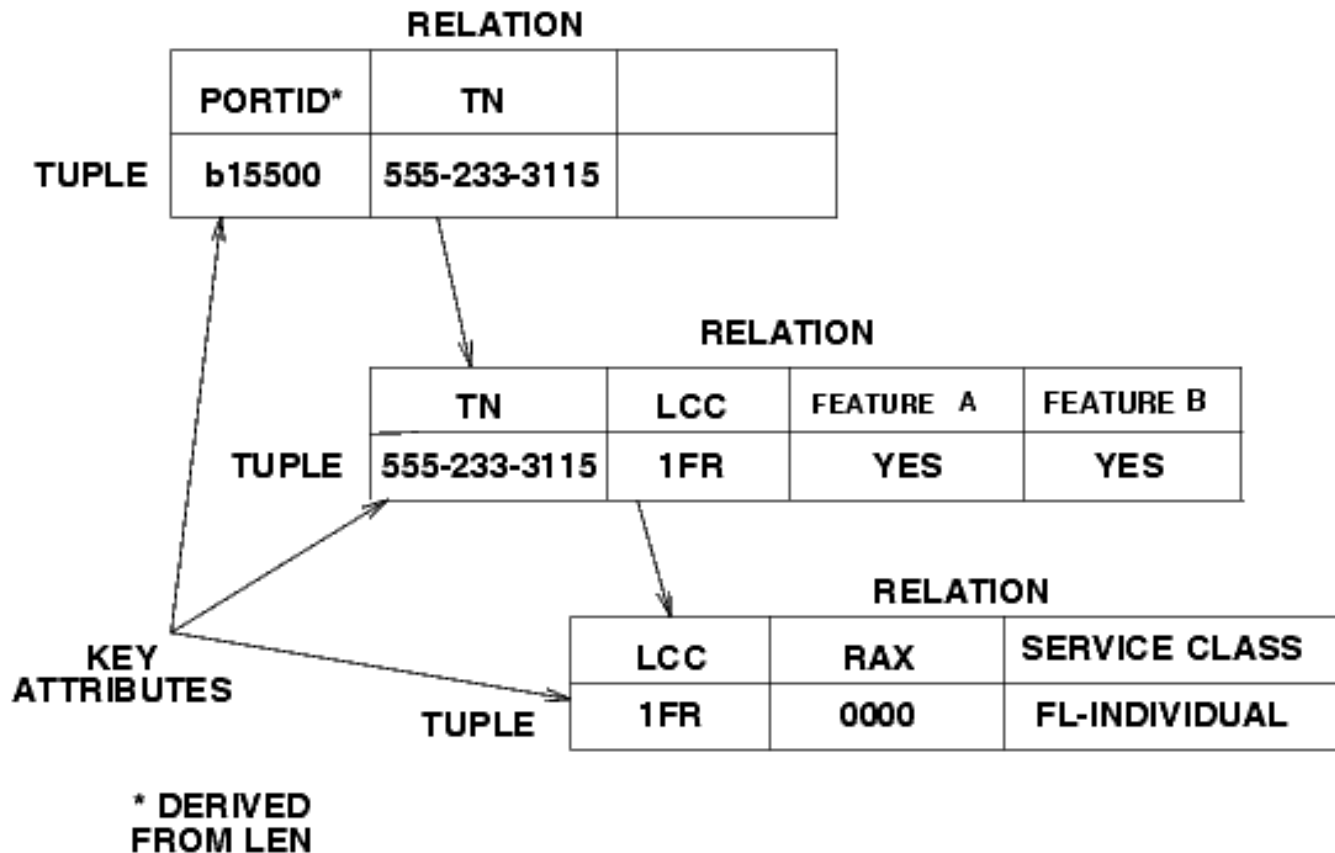


Figure 4-5 Relation Interaction

Four different methods are automatically used by the 5ESS®-2000 switch to store and access information in the data base relations. These access methods are: sequential, indexed, hashed, and compacted indexed. The different methods are necessary to provide the most efficient access to data in the various sized relations. For details about the names and access methods for each of the data base relations, refer to 235-600-10X, *Translations Data Manual*. The access methods are described in the following paragraphs.

4.9.1.1 Sequential Access

The sequential access method (used for short lists) uses a head page and several data pages to contain the necessary information. When a particular tuple is desired, the DBM locates the appropriate head table, which provides the location of the data pages for the relation. The keys on these data pages must then be read sequentially, from top to bottom, until the desired information is located. Figure 4-6 depicts an example of a relation that is accessed sequentially in the office code relation.

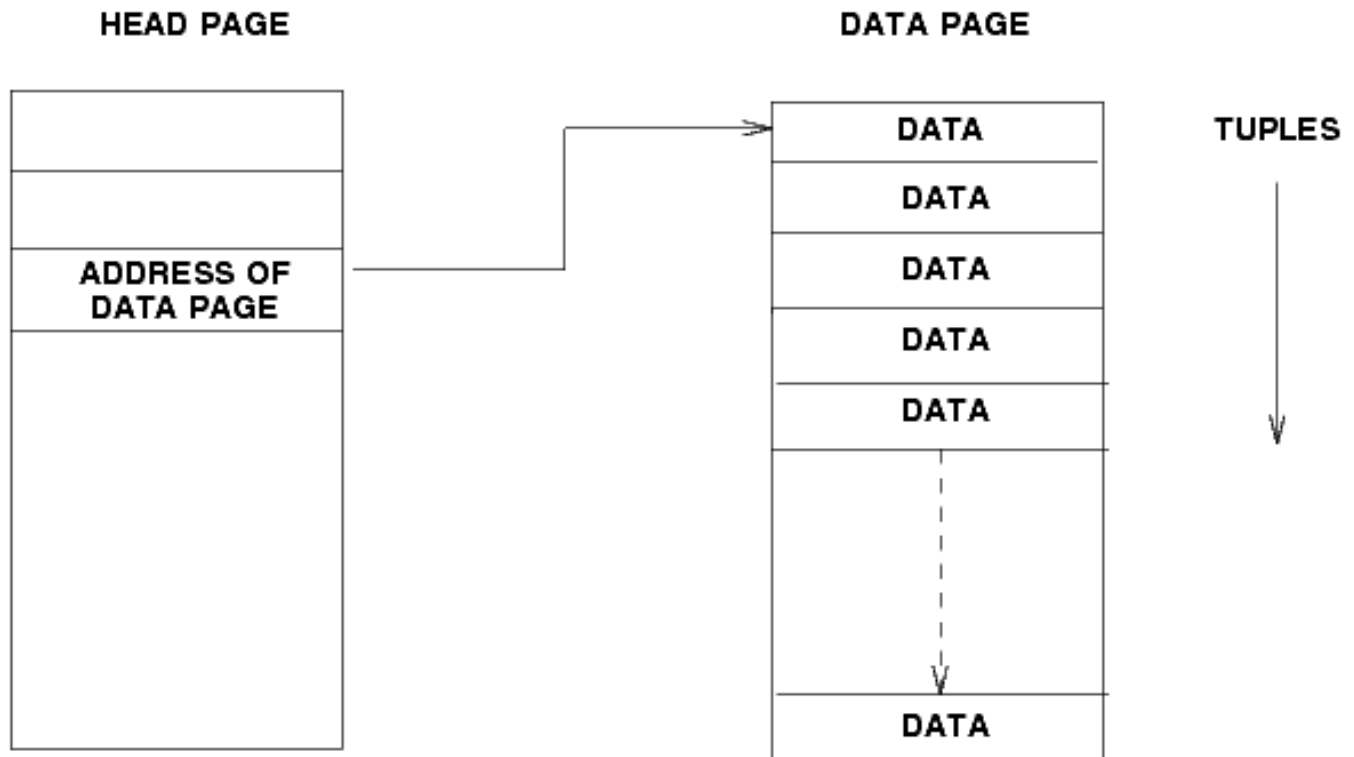
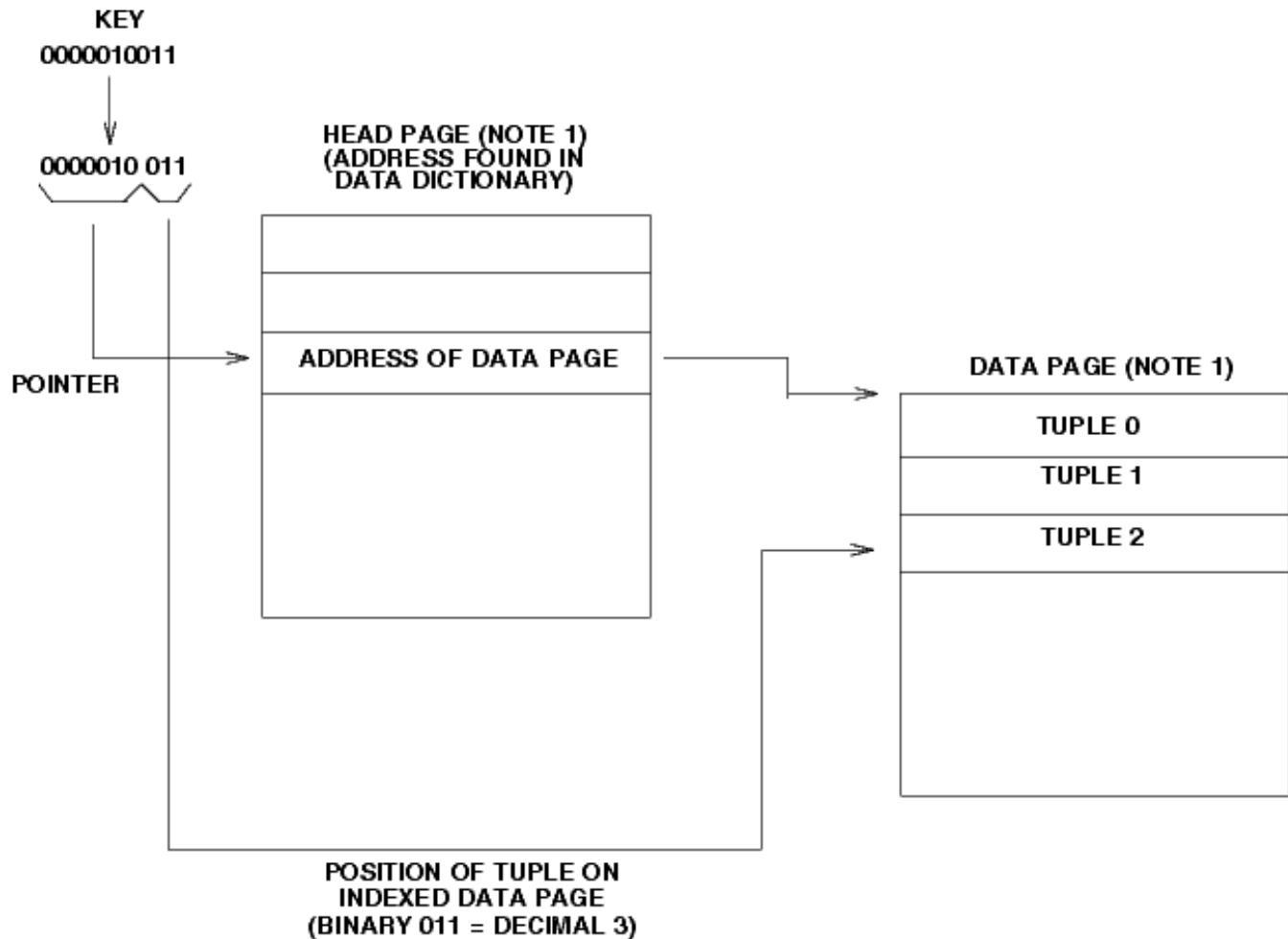


Figure 4-6 Sequential Data Access

4.9.1.2 Indexed Access

For the indexed access method, the key is divided by a power of two. The quotient points to the position on the head page that provides the address of the data page containing the desired tuple. The remainder points to the position on the data page where the tuple resides. This method is used in cases where the number of tuples stored is relatively large. The indexed access method is shown in Figure 4-7. The indexed access method is used only for dynamic data relations. An example of an indexed dynamic relation is the trunk status relation.

**NOTE:**

1. THE POSITIONS ON THE HEAD PAGE AND DATA PAGES ARE NUMBERED CONSECUTIVELY BEGINNING AT 0

Figure 4-7 Indexed Data Access

4.9.1.3 Hashed Relations Access

The hashed relations use one head page and several data pages that are divided into primary and secondary pages. During RC operations, the size of the relations often needs to be changed to accept additional data. The new data must be stored in such a way that the key can be used by the DBM to locate the data. A mathematical operation is done on the key to obtain a new key called a folded or hashed key. The folded key is treated as in the indexed method (except that the division is not necessarily a power of two). This operation provides two pointers. The first pointer is used to index into the head page to obtain a pointer to the primary page, and the second points to the position on the primary page. Since the folding operation for different keys may result in the same folded keys, and hence same pointers, the desired information may not be selected directly. The key resides with the tuple and is compared to the key that was used to initiate the search. If the keys match, then the desired data has been located. If the desired tuple is not found at the selected location in the primary page, then up to three more tuples are read in sequence from the primary page. If the desired data is still not located, then the four primary overflow tuples at the end of the primary page are read sequentially. If the desired tuple is still not found, then the DBM must access the

secondary overflow page and read it sequentially. An example of a hashed relation is the speed call list relations. The hashed method is illustrated in Figure 4-8 .

The hashed relations are the ones of primary interest to the administrator. During periods of heavy RC activity, these relations may require some secondary overflow. More processor time is required to search the overflow pages for data to do the necessary call processing functions. Also, more time is required to enter the RC data. A memory reorg (reorganization) is required to repack the primary data pages and to release the secondary pages for future use. Additional memory space must be available to do the reorg operation. The space available for reorg should be about 50 percent larger than the largest hashed relation.

Memory reorgs may be allowed to occur automatically at a specified time each day. If this is allowed, the reorg occurs only at that specified time. All relations in this condition (secondary overflow) are then reorged. Also, a reorg may be requested to occur at any time; note that the reorg will not occur unless it is "allowed." Therefore, it may be necessary to first enter the command to allow the reorg, and then request the immediate reorg operation. The procedures required to do the reorg functions are provided in 235-105-220 - *Corrective Maintenance Procedures*. This manual also contains information concerning data base maintenance and repair.

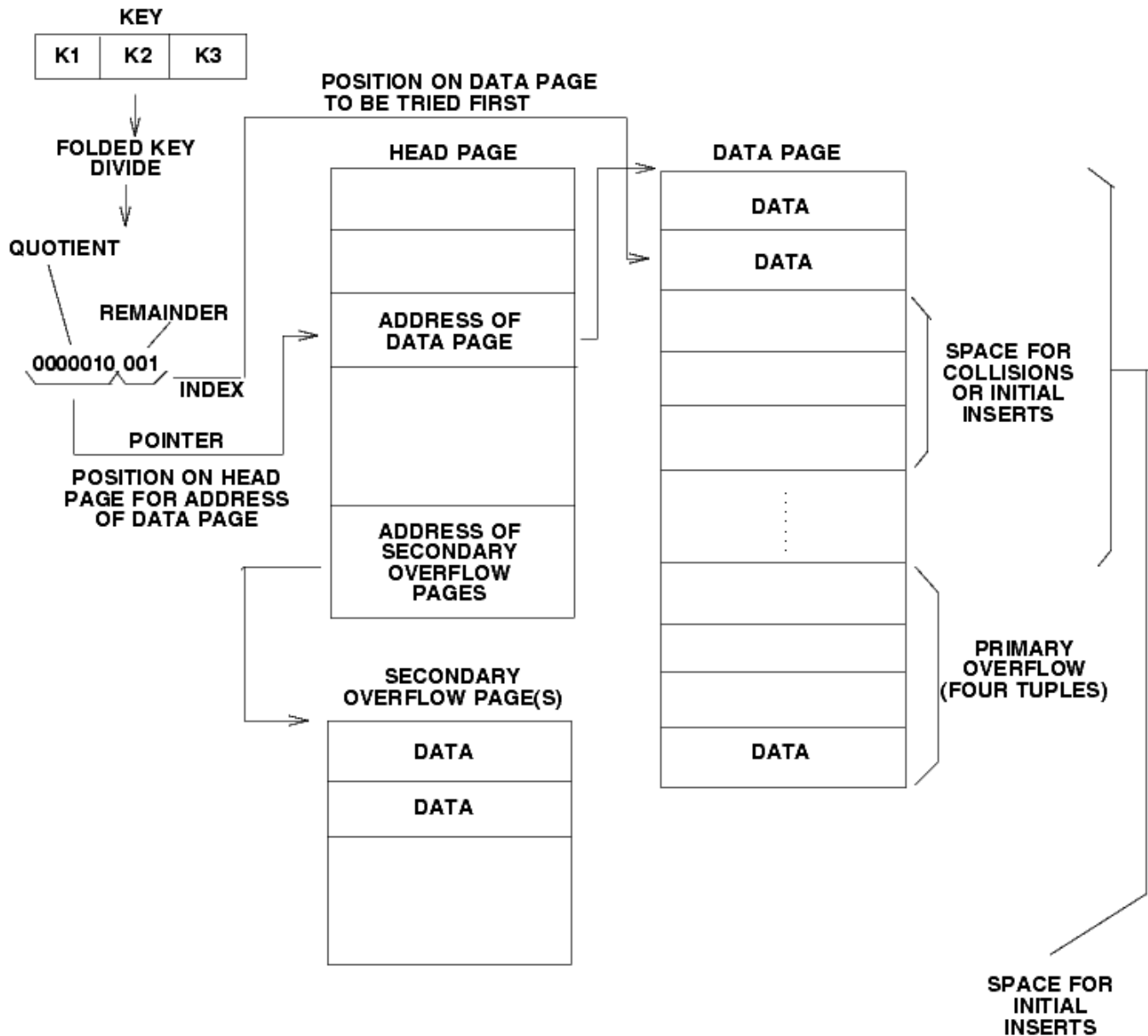


Figure 4-8 Hashed Data Access

4.9.1.4 Compacted Index Access

A compacted index data access method is employed for certain static relations that previously used the hashed access method (i.e., digit analysis and screening translations). The compacted index method may use one, two, or three levels of indexing allowing a key of up to 32 bits in length (in the 3-level method) as compared to the 16-bit key for the 2-level access method. This allows indexing on larger relations instead of using the hashed method. Additionally, data can be accessed much faster since secondary overflow pages are not required. Therefore, less memory space is required for reorg.

With the compacted index method, the key can be used to index into 1-, 2-, or 3-level relations, as determined by the size requirements for the relation. For single-level relations, the key points directly to the position in the memory page where the desired tuple resides.

For 2-level relations, the key may be divided by a power of two. The quotient and remainder are used as pointers to the data page and desired tuple as described for the indexed method. For some relations, the key may be divided by the tuple length (which is not a power of 2) to obtain the two pointers. Since the key represents a direct pointer to the desired tuple, it is not necessary to store a duplicate of the key with the tuple for comparison as is required with the hashed index method. This provides an additional memory space savings. Sometimes the size of the relation will not be less if the key is not stored and, in these cases, the key may be stored.

The 3-level compacted index method is like the 2-level method except that an extra division step is done. The first-division step locates the tuple in an intermediate data page that contains the address of the final data page. The second-division step provides a pointer to the position in the final data page that contains the desired tuple. The 3-level compacted index method is used only for static relations and is shown in Figure 4-9

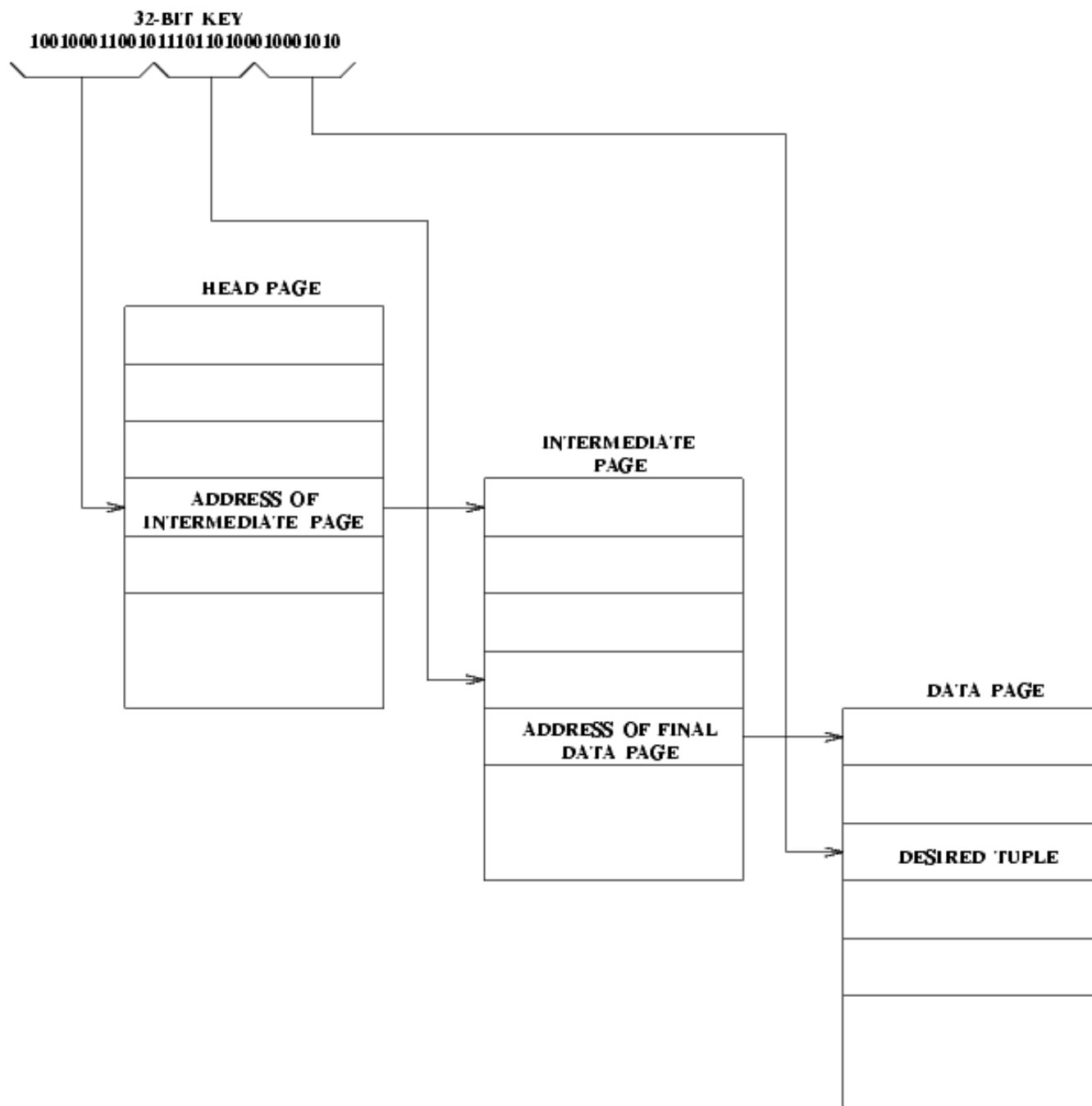


Figure 4-9 Compacted Index Data Access.

4.9.1.5 Data Base Reorganization Enhancements

The data-base reorganization enhancements feature incorporates a new hashing algorithm and new overflow strategy into the data-base manager. It also uses an existing off-line data base hashing simulator tool (HSHIM) to enhance data base reorganization. The simulator is used when manual reorganization is necessary and provides a memory checking mechanism to determine if a growth needs to be performed before a reorganization can proceed.

4.9.1.5.1 Operational Views for ODD and Memory Optimization

The Operational View capability decouples the "static" ODD storage format in every processor (AM, SM, and CMP) from the user's [RC/V, office data administration (ODA), other 5ESS®-2000 application code] operational/conceptual view of data. Decoupling the storage format from the user's operational view of the data (virtual tuples) achieves something similar to normalization for some of the existing relations by splitting up virtual tuples into two or more groups of attributes. Each group of attributes is physically stored in other relations called storage relations. All storage relations are accessible only by internal Data Base Manager (DBM) code.

The operational view access method (DBACC_OPV) translates a primitive operation on a virtual relation into an ordered sequence of operations on the storage relations that make up the virtual relation. Virtual relation tuples do not have a corresponding physical tuple stored in the ODD. A virtual relation can be represented using a tree diagram, where each node represents a storage relation. All the primitives invoked on the virtual relation traverse the tree.

4.9.1.5.2 Generated Key Access Method

An access method in a software release is the generated key access method (DBACC_GK) that optimizes both read access time and memory utilization. The DBACC_GK access method assigns (or generates) a key whenever a unique tuple is inserted. The generated key (GK) value for a tuple is determined by finding the first unused tuple slot in the relation. If an insert of a tuple with the same data content as an already existing GK tuple occurs, a new key is not generated for the second tuple. Instead the DBM returns the GK of the original tuple. The fast access time is achieved by using the compacted index access method for reading GK tuples.

4.9.1.5.3 Storage Relations

In addition to the virtual relation, a physical relation exists in a software release. Physical relations are defined as having physical tuples stored in the ODD matching the user-defined structure in the global header relation definition file.

Another type of physical relation called storage relations is added by this feature and uses the relation type of DBSTORAGE. Storage relations are only known and manipulated by the DBM code in support of virtual relations. Storage relations are the only relation type that can take advantage of the new generated key access method in addition to the existing access methods. There are two logical types of storage relations:

- Root Storage Relations - have the same key as the corresponding virtual relation. A root storage relation is at the top of the virtual relation tree. Therefore, Root Storage does not have any parent nodes. However, the root storage relation contains the key information (a generated key) necessary to access its one or more child storage relations.
- Child Storage Relations - are accessed either by generated key or by a foreign key (in the case of Read Only and Read Only with Batch Review Inhibited).

A generated key (GK) is an attribute whose value is generated by the DBM to facilitate efficient storage of that relation's tuples. The value of a GK is determined by the position chosen for its storage in the relation. The GK for a generated key child is stored in its required parent relation's tuple. A GK relation can have multiple parent storage relations whose tuples may point or share the same GK child tuple. A child storage relation keyed using generated keys cannot be a root relation because root relations must have the same key as its virtual relation, but it can store the generated keys of 0, or more GK storage relations as its children.

A foreign key is defined as an attribute or set of attributes stored in one or more parent storage relations that uniquely define the primary key of a child storage relation tuple. The term foreign indicates that the key is located within a separate or foreign storage relation. In addition to only being allowed in read only types of relations, foreign keys are different from generated keys in that they are user defined values that are not system generated.

For additional details, refer to 235-600-107, *Translations Data Manual document*.

4.10 MEMORY MANAGEMENT

Memory management in the 5ESS[®]-2000 switch involves monitoring the memory requirements for the AM, CMP, SM/RSM, and disk drives to insure that the requirements do not exceed the equipped capacities. In the AM, CMP and SM, it is important to monitor the ODD requirements. For disk drives, it is important to monitor the total ODD requirements for all SMs and RSMs and the AMA billing data space requirements. The total disk space requirements should be compared to the space provided by the disk configuration employed and the total number of disk drives (base and optional).

Memory management involves knowing how much memory is equipped in the AM, CMP, and SMs/RSMs. This can be determined by examining the telephone equipment order (TEO), by actually looking at the circuit packs installed in the cabinets, by RC Views 18.1 and 18.4, and the OP:MEMSIZE command output. It is also important to know how much of the equipped memory is allocated and, further, how much of the allocated memory is used. This is determined by using the OP:ODD input message. All memory requires monitoring on a regular basis, especially in dynamic offices (e.g., line growth, new features etc.). Additional details, about memory management for the AM, CMP, SM/RSM and disks, are found elsewhere in these guidelines. Further details concerning the use of the OP:ODD message and the resulting output message can be found in *Input Message Manual*, 235-600-700 and *Output Message Manual*, 235-600-750, respectively.

Memory in the 5ESS[®]-2000 switch is allocated in one of seven block sizes: 128, 256, 512, 1,024, 2,048, 4,096, and 8,192 bytes. The status of these memory blocks (busy or available) is continually changing in the switch. A memory status map maintained in the switch is used to continually monitor the status of the memory blocks. This bit map contains memory status information for each 256-byte block of equipped memory. This minimizes the search for a memory block in any of the defined block sizes.

Initially, memory searches are done for the exact size of the block needed. If the block cannot be located, the next larger sized memory block is selected. When this occurs, the unused portion of the memory block remains in the status map as available. If a free memory block cannot be found, the appropriate output messages are printed, and a growth function may need to be invoked by the maintenance personnel. This function moves the actual memory limit so that an additional block is available. The procedures for memory growth operations can be found in 235-105-23X, *Hardware Change Procedures*. The procedures for allocating memory can be found in 235-105-210, *Routine Operations and Maintenance*.

Periodic audits are done to ensure that blocks of memory are not lost. These audits establish a new audit bit map that is compared to the original map to locate and correct any discrepancies.

At some time, it may be necessary to change information contained in the data base. An office data base editor (ODBE) is provided to allow this type of change to be done. These changes should be coordinated with the maintenance personnel as this editor has no error checking, and mistakes can be extremely disruptive. For information about the use of this tool, refer to 235-600-10X, *Translation Data Manual*.

4.11 ASSOCIATED MEASUREMENTS AND KEY SERVICE INDICATORS

There are no plant or traffic measurements for memory usage. The OP:ODD command provides the means for determining how static memory is being used. This command, entered from the master control center (MCC) or the Switching Control Center System (SCCS), provides the following information for the AM, CMP, and SM memory:

- The amount of memory space used.
- The amount of memory space allocated.
- The amount of SM memory space unallocated.
- The percent of allocated memory space used.

- The amount of stand-alone billing space allocated.
- The amount of Real Time Billing memory allocated.

A sample of the OP:ODD output message is shown in Figure 4-10. The amount of static memory required for ODD space increases due to recent changes (new lines, feature assignments, etc.); therefore, it is necessary to monitor the utilization of this memory. The output of the OP:ODD command may be used to monitor the use of static memory. In addition to the manual use of this command, automatic reports and alarms are generated when certain memory utilization thresholds for AM, CMP, SM, or disk are exceeded. Minor alarms are provided when static memory usage exceeds 80, 85, and 90 percent of the allocated space. Major alarms are generated when usage reaches 95, 96, 97, 98, 99, and 100 percent. To conserve disk backup space, allocated memory is often less than the amount of physically equipped memory that may be made available.

For further details about the use of the OP:ODD command and the resulting output messages, refer to *Input Message Manual*, 235-600-700 and *Output Message Manual*, 235-600-750.

```
op:odd,sm=1&&48,am;PF
```

```
S570-52 90-05-01 01:50:28 000446 ODD C1 K23.Oswa
```

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OP ODD

AM	SODD	USED=530	AVAIL=3053	PCT USED=14
AM	UODD	USED=43	AVAIL=661	PCT USED=6
AM	DISK	USED=1752	AVAIL=12248	PCT USED=12
SM	RODD	USED=186	AVAIL=261	PCT USED=41

		NRODD USED	AVAIL	PCT USED	UODD USED	PCT AVAIL	USED	UNALLOC	SABM	RTBM
SM 1	1047	705	59	1340	707	65	3902	56	8	
SM 2	1063	728	59	1296	751	63	3264	56	8	
SM 4	1043	708	59	1190	857	58	3902	56	8	
CMP 0	717	5506	11	79	1880	4				

Note:

1. All memory values are in terms of K-bytes.

Figure 4-10 Example of OP:ODD Output Message

4.12 TRANSITION IMPACT

Memory is engineered to be adequate at the end of the engineering period. Memory adjustments may be required for retrofits to new software release to support feature or hardware growth.

Growth procedures can have a significant impact on SM memory. Adding lines, features, trunks, RSMs, etc., will require additional memory space for ODD.

Increases in the allocated ODD space within the SM memory can be done through craft commands. Physical

memory growth may be done using growth and RC procedures. For more information about these procedures, refer to the following documents:

- 235-105-23X, *Hardware Change Procedures*
- 235-118-XXX, *Recent Change Procedures*
- 235-600-30X, *Equipment Configuration Data*.

Certain memory items are used to determine the utilization of memory. In some cases, these items are measured in different sized blocks that are identified as follows:

- GLPMEM_SIZE is the term used in parameters to provide the total amount of **equipped** memory in an SM or RSM. It is provided in terms of the number of 1K-byte blocks available.
- DBPHYSBLKS is another parameter that is measured in 256-byte blocks. This parameter represents the amount of **allocated** memory in the SM or RSM.
- The number of growth blocks available is measured in terms of 1K-byte blocks.
- The output of OP:ODD is in terms of kilobytes of memory.

4.12.1 OP:ODD COMMAND

The static ODD is separated into redundant and nonredundant ODD. The nonredundant ODD contains all information specific to a particular SM (such as features assigned and characteristics of lines and trunks served by that SM). The redundant ODD contains information that is the same on every SM such as routing information, and division of revenue data. Additionally, the unprotected ODD (dynamic ODD) is now contiguous to the nonredundant ODD. The redundant and nonredundant ODD, as well as the stand-alone billing memory (the section of memory dedicated to AMA data), continue to reside at the end of memory. See Figure 4-11 .

For each of the following allocated ODDs, OP:ODD report prints the used memory and available memory, in K-bytes and the percentage of memory currently used:

- AM SODD (AM static ODD) - growable but requires rebooting
- AM UODD (AM dynamic ODD) - not growable
- AM DISK (AM disk ODD) - not growable
- SM RODD (SM redundant ODD) - growable
- SM NRODD (SM nonredundant ODD) - growable
- SM UODD (SM dynamic ODD) - growable
- SM SAB (Stand Alone Billing- growable
- SM RTB (SM Real Time Billing)- growable
- CMP UODD (CMP dynamic ODD) - not growable
- CMP SODD (CMP static ODD) - not growable.

When the thresholds are met for the nongrowable memory areas, memory growth is required. When thresholds are exceeded for the growable areas of memory, additional memory may be allocated (assuming there is unallocated memory available).

The OP:ODD report also provides the size of unallocated and the stand-alone memory available. All memory sizes are reported in K-bytes. The unallocated section of memory resides at the end of SM memory and is available for ODD growth.

Text is base data that comprises the current, installed software release.

The SM UODD memory growth is done by moving the starting address of SM NRODD into higher memory. The ending address of NRODD remains unchanged. Because of this, the UODD growth is limited in size by the amount of space available in the NRODD. The SM UODD growth should be done only if necessary because the SM UODD is engineered to be adequate for most offices.

The NRODD growth increases the amount of memory allocated to the NRODD by shifting the entire RODD and stand-alone billing areas into higher memory.

Finally, the RODD growth operation moves all the stand-alone billing area into higher memory. Growth of RODD occurs simultaneously on every SM.

PO is memory is allocated for code in text of only the peripheral units equipped on the SM. No memory is used for peripheral units not equipped.

RTB is a default allocation of memory for Real Time Billing that will be provided for every SM whether or not the Long Distance Platform, Real Time Call Detail feature is utilized.

Stand Alone Billing refers to memory space allocated for the storage of billing information when the SM/SM-2000 is in stand-alone mode.

The unallocated memory reported by OP:ODD is free for growth of NRODD or RODD. When the unallocated space has been used, no further RODD or NRODD growths can occur without memory hardware growth or a reduction of stand-alone memory area (if the feature is turned on) in an RSM. Degrowth of an RSM results in a shorter stand-alone billing period in the RSM, if the RSM is forced into stand-alone operation, and may, therefore, result in lost revenue. If the unallocated space (SAB not turned on, SAB degrown) is not enough to grow the SM NRODD or RODD, hardware memory growth is required. Detailed ODD growth procedures can be found in 235-105-210 - *Routine Operations and Maintenance Procedures*.

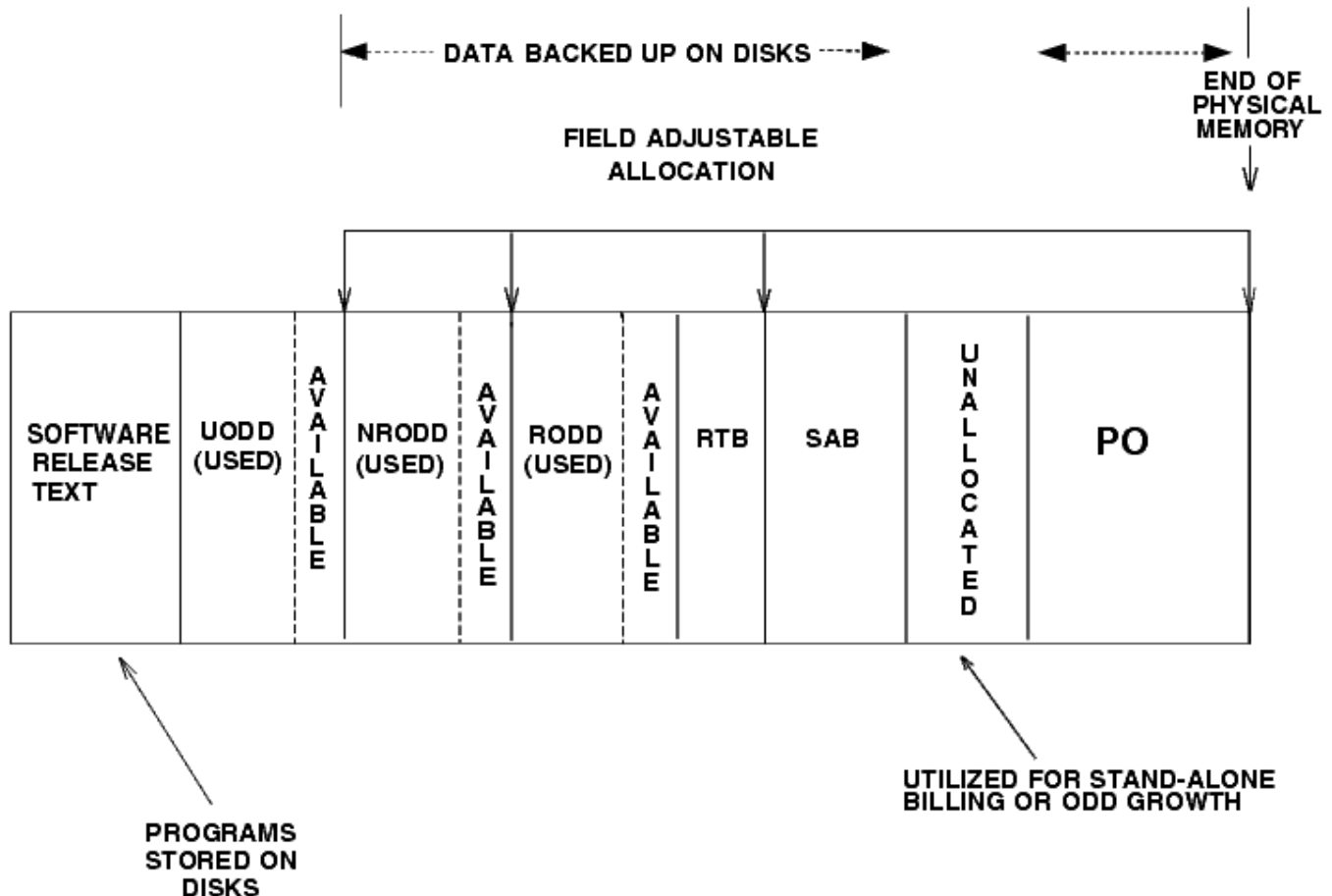


Figure 4-11 SM/RSM Memory Structure

4.13 Memory Related Documentation

Table 4-1 shows Lucent Technologies information products that are available that contain information on some aspect of memory.

Table 4-1

AREA	DOCUMENT NUMBER	DOCUMENT NAME
General	235-070-100	5ESS-2000 Switch Administration and Engineering Guidelines
	235-100-125	5ESS-2000 Switch System Description
	235-600-700 235-600-750	5ESS-2000 Switch Input/Output Messages Manual
Procedure	235-060-110	5ESS-2000 Switch Engineering Procedures
	235-105-231	5ESS-2000 Switch Hardware Change Procedures-Growth
	235-106-xxx	5ESS-2000 Switch Software Release Retrofit Procedures 5Exx
	235-105-210	5ESS-2000 Switch Routine Operations and Maintenance Procedures
Specific	Memory SEI	Switch Engineering Information

Remember You should always check on-line documentation or the NAES external web site at <https://lucent-naes.com> to see if any Engineering Information, or Switch Engineering Information bulletins have been issued that impact memory related hardware or software. Contact your Translation Switch Administration (TSA) or Enhanced Network Engineering Committee (ENEC) representatives for a NAES password.

5. ADMINISTRATION AND ENGINEERING SUPPORT SUBSYSTEMS

5.1 ADMINISTRATIVE AND OFFICE DATA BASE SUBSYSTEM

5.1.1 TRAFFIC AND ENGINEERING DATA

Most equipment for a 5ESS®-2000 switch is provided by using traditional traffic engineering methods: number of lines, number of trunks, and usage. Engineering methods follow closely the modular architecture of the system. Traffic parameters are used to determine the number of interface units required. Unit quantities are then used to define the office size in switching modules (SMs). The number of SMs determines the engineering for the communication module (CM).

The basic building block of the 5ESS®-2000 switch is the SM. An SM can serve varying numbers and types of interface units [for example, line units (LUs), trunk units (TUs)] up to its time slot interchange unit (TSIU) capacity of 512 time slots for the SM, and 1024 for the SM-2000.. The general algorithm for sizing a 5ESS®-2000 switch and accommodating individual variabilities is as follows:

- Given traffic characteristics, calculate interface units required
- Given interface units required, calculate time slots required
- Given time slots required, calculate SMs required.

Figure 5-1 shows the interfaces that are of particular importance to the switch administrator, and illustrates how the administrative data collected by the 5ESS®-2000 switch is provided to the various operations system (OS) and work group locations. Included in the collected data are traffic and plant measurements, division of revenue data, and Business and Residence Custom Services (BRCS) feature data. This information allows the administrator to monitor the switch and determine if component capacities will exhaust before the end of the engineering period.

The standard method for engineering and ordering a 5ESS®-2000 switch is the 5 Digital Ordering and Planning System (DOPS), a mechanized engineering tool. Detailed traffic engineering information, as well as full 5ESS®-2000 switch DOPS documentation, can be found in 235-060-110, *Engineering Procedures*. The DOPS supports time-consistent busy hour (TCBH) and extreme value engineering (EVE) as engineering user options.

5.1.2 NETWORK MANAGEMENT REPORTS

When call attempts in a telephone network rise beyond the capacity of that network, the overall performance of the network degrades. Network management provides real-time surveillance and control techniques to minimize this degradation, improve call-carrying capacity, and maintain network integrity during periods of stress caused by either traffic overload or failure conditions. Network managers use the Engineering and Administrative Data Acquisition System/Network Management (EADAS/NM) system to do this function.

The 5ESS®-2000 switch network management feature provides an interface to process messages from the on-site capability. The on-site capability allows NM requests to be made if the links between the EADAS/NM, EADAS, and the 5ESS®-2000 switch are not operating.

The following requests are allowed from either EADAS/NM or on-site:

- 30-second discrete report (a subset of the discretely are displayed automatically on the master control center (MCC) and cannot be specifically requested from on-site)
- 5-minute package list command messages

- 5-minute surveillance data report
- Dynamic overload control demand audit and command messages
- NM - schedule audit and command messages
- Manual code control demand audit and command messages
- Manual trunk group
- Selective incoming load control (SILC) demand audit and command messages.

The following requests are only allowed by the EADAS/NM:

- Remote Switching System (RSM) outage list demand audit
- Interexchange carrier data location demand audit
- Trunk group reference data demand and change audit.

The following requests are only allowed by on-site:

- Trunk group control demand audit, by type [that is, reroute, SKIP, cancel reroute overflow (CRO), cancel to, or cancel from]
- Trunk group control demand audit by trunk group number
- Dynamic overload control demand audit by trunk group number.

The primary interface for NM is the network management center (NMC) via EADAS/NM using a data link through EADAS. There are also interfaces to the network administration center (NAC) channel via the Switching Control Center System (SCCS) and to the local MCC. The NMC has full control capability while the NAC and MCC only have the ability to request the status of controls and to remove all controls that are in effect.

The network management software for the 5ESS[®]-2000 switch accepts commands from and outputs data to the following:

- NMC via the EADAS interface
- NAC channel via the SCCS
- MCC at the switch.

Both the EADAS and SCCS data links use BX.25 protocol. The format of the data on the EADAS link is binary, and on the SCCS link, the format is American Standard Code for Information Interchange (ASCII). The NAC channel, or SCCS when the NAC channel is unstaffed, will function as a backup for the NMC if the EADAS link is down.

5.1.3 TRUNK GROUP LIST AUDIT

This feature provides a listing of all trunk groups (TGs) by their trunk group numbers (TGNs) and associated CLLI codes, as used in the switch data base at any given instant. The switch issues a 30-second discrete to indicate that the TGN/CLLI assignments have changed in the switch data base due to TG additions, deletions or modifications.

This listing enables the user to specify the type of listing of all TGs currently assigned in the switch data base or only those TGs that have been changed, added, or deleted since the last audit. Note that the Network Traffic Management Operations System (NTM OS) user is able to request this audit manually or set up the NTM OS to request this audit listing automatically.

The Trunk Group List Audit feature encompasses the TG List Demand Audit and TG List Change Audit. TG List Demand Audit provides a list of all the TGs and associated far-end CLLIs currently assigned in the switch data base. The TG List Change Audit provides a list of only those TGs and associated far-end CLLIs that have been changed, added, or deleted from the data base since the last audit.

This feature impacts the NTM OS, such as NetMinder and RNMS. If a trunk group has been changed, added, or deleted from the switch data base, the Network Management Operations Systems are used to request the Trunk Group List Audit. A Network Traffic Manager can manually request a list of all the TGs and associated far-end CLLIs in the office, usually after a Software Release Retrofit, via the Network Management Operations Systems.

This feature is used by a Network Traffic Manager to keep the Operations Systems data base synchronized with the switch data base. The Network Traffic Manager is able to use the Trunk Group List Audit capability to obtain a list of all TGs and associated far-end CLLI currently assigned in the switch data base.

The Data Collection-Traffic and Network Management Operations Systems does not request a large amount of information through the Data Collection-Traffic Operations Systems often because this can cause problems during traffic or five-minute data collection. Therefore, the Trunk Group List Demand Audit is not triggered more than once during a 15-minute interval.

5.2 DATA BASE MANAGEMENT TOOLS

5.2.1 RECENT CHANGE AND VERIFY TERMINAL

The Recent Change and Verify (RC/VFY) terminal can be used for performing RC functions and to verify data base information residing in the 5ESS®-2000 switch. These terminals may be located at the 5ESS®-2000 switch, or at other remote locations such as the switching control center (SCC) or other work group locations.

Two types of RC/VFY applications are available: text mode and menu mode. The text mode is used at TTY terminals that print on paper, while the menu mode is for video display terminals. The menu mode provides formatted screens to be completed by the user to do the RC/VFY functions. For further information about RC/VFY operations, refer to 235-118-200 *Recent Change Procedures Menu Mode* or 235-118-202 *Recent Change Procedures Text Mode*.

5.2.2 REMOTE MEMORY ADMINISTRATION SYSTEM

The Remote Memory Administration System (RMAS) is a computer-controlled facility that interfaces with the 5ESS®-2000 switch Recent Change system to perform automated RC/VFY, and office record activities. The RMAS system is arranged so computer operators can input the changes for customers during the day. The computer can be scheduled to input these changes over the RMAS link at any time.

The RMAS supports the RC memory administration work group (for line translations) and the SCCS work group (for trunk and complex translations). The RMAS prints office records, provides automatic translation of many service orders, provides a history of transactions for backup purposes, and provides an on-line error checking capability. The RMAS features and operations, that are unique to the 5ESS®-2000 switch, can be found in Section 12, Using RMAS (1RM4), *Administrator User Guide* (OPA-5P650-01, Issue 1) and in 235-118-300, *Recent Change Procedures*.

5.2.3 MACSTAR® COMPUTER PROGRAM

The manual customer station rearrangement capabilities are expanded to include customer control over the Integrated Services Digital Network (ISDN) feature. Inputs by the customer station rearrangement user result in RC/VFY actions being performed by the switch.

The customer activates the *MACSTAR*[®] computer program and submits requests to the *5ESS*[®]-2000 switch for certain RC/VFY actions to be made. The RC/VFY capabilities extended to ISDN features are as follows:

- Move directory numbers (DNs)
- Enable/disable service
- Feature verification
- Assign/remove features
- Change/display data
- Display feature definitions
- Activate/deactivate features
- Station verification.

5.2.4 MULTIFUNCTIONAL OPERATIONS SYSTEM

The Multifunctional Operations System (MFOS) is an operations system which provides centralized integrated operations, administration, and maintenance support. The MFOS provides data base administration, switch maintenance, billing, and traffic reports by emulating the RMAS, EADAS, SCCS, and automatic message accounting teleprocessing (AMATPS). The MFOS is designed in modules to permit easy growth to support new network elements.

5.3 TRAFFIC AND PLANT MEASUREMENTS

Traffic, plant, and service measurements are intended to be used to view a particular aspect of *5ESS*[®]-2000 switch system operation over a specified period of time: 15 minutes, 30 minutes, hour, and 24 hours. These measurements provide a summary of events that have occurred. For example, traffic measurements provide the current status of the switch as well as an indication to support the switch with additional resources. Refer to 235-070-100, *Traffic and Plant Measurements*, Appendix 1, for further details.

5.3.1 REPORTS

Four measurements reports are generated by the *5ESS*[®]-2000 switch. The contents and interval of each report are specified on a per-software release basis and cannot be altered by operating telephone company (service provider) personnel. Some reports are automatic and others are demand only. Also, some measurement information is available only to OSs and not as output to the switch.

5.3.1.1 15-Minute Traffic Report

This report contains the machine integrity data that is used for real-time monitoring of the switching system. The report is generated by the *5ESS*[®]-2000 switch every quarter-hour and is sent to the SCCS, the MCC, and the NAC channel on a scheduled basis. The latest report may be requested at any time during the 14-minute interval following initial issue of the message. The 15-minute traffic report can be inhibited via an input message at the MCC.

The 15-minute traffic report is run in 15-minute intervals, from 23:59 to 00:14, from 00:29 to 00:44, from 00:59, etc.

5.3.1.2 30-Minute Traffic Report

This report contains the bulk of the switching system data and, as such, supports most of the functions of the network administration and network engineering functions. The size of this report is closely linked to office size because much of the data is collected and reported on a per-component [for example, SM, high-level service circuit (HLSC), LU, trunk group (TG)] basis rather than strictly office totals.

The 30-minute traffic report is generated every half-hour and is sent to the EADAS in response to a polling request. If a traffic channel is in place, the 30-minute report can be made available on that channel. This report can also be requested by the MCC, the SCCS, and the NAC channel. Report sections may be selected by traffic types such as BRCS, ISDN, and Operator Services Position System (OSPS).

5.3.1.3 Separation Reports

Division of revenue is the process by which revenues are shared among the telephone companies based on the resources used. The hourly division of revenue report assists in the development of call-holding time factors and toll-calling volumes by incoming separations class (INSEP) and destination separations class (DESEP). For traffic separations purposes, every incoming and originating call is assigned an INSEP or DESEP based on the following criteria:

- Geographical area in which the line or trunk originates
- Ownership (Lucent Technologies or independent telephone company)
- Class of service
- Type of traffic (local exchange, toll, etc.).

If enabled, the hourly separations report is sent to EADAS in response to a request or to the local traffic channel.

The 24-hour division of revenue report is sent to the EADAS at 24:00:00. This report is also available at the local traffic channel.

5.3.1.4 Plant Reports

The 24-hour plant report (hourly and 24 hours) contains data regarding originating, incoming and outgoing calls, call connect setup troubles and, as such, reflects the maintenance effect on traffic during the past period.

The 24-hour plant report is generated and issued by the 5ESS®-2000 switch once a day at 02:00:00. The report is sent to the SCCS and the MCC and is saved for the next 24 hours to fulfill additional requests initiated by an SCCS.

Performance measurements provide counts of events such as outages, errors, or faults that are related to the maintenance condition of the office.

5.4 LOCAL TRAFFIC CHANNEL

The local traffic channel provides a means of recording traffic information. It may be connected to an automated data collection system or printer. This traffic channel may be used in cases where EADAS is not used, or it may be used in addition to EADAS. The traffic information (30-minute traffic report) is automatically transmitted by the 5ESS®-2000 switch to the data collection device via the local traffic channel interface. Additionally, the hourly and daily division of revenue report may be sent to the local traffic channel.

5.5 MASTER CONTROL CENTER

The primary I/O interface for maintenance functions is the MCC. The MCC consists of a terminal with keyboard and a receive-only printer (ROP). These facilities provide the ability to enter various input messages, to do emergency actions and RC functions, to request reports, and do the functions of the trunk line work station (TLWS). A data link arrangement is optionally provided to the remote SCCS location so that the functions of the MCC may be performed by the SCCS personnel.

The MCC may be used to request and print traffic data to be used by the switch administrator. This facility provides traffic data in human-readable format for use if EADAS support is not available. No data processing or manipulation is provided for data analysis as is provided by EADAS.

5.6 ENGINEERING AND ADMINISTRATIVE DATA ACQUISITION SYSTEM

The No. 1A and 1B EADAS are centrally located computer systems that provide an automatic traffic collection facility for the 5ESS®-2000 switch (as well as other types of switching systems). Both EADAS systems request the traffic output data from the 5ESS®-2000 switch at predefined times.

The No. 1A EADAS is the earlier version of EADAS that collects traffic data, performs calculations, generates exception and summary surveillance reports, and formats and distributes data for use by downstream systems such as central office equipment reports (COER). The No. 1B EADAS performs the same functions with more memory storage capability. Traffic data can still be sent to other downstream systems if desired.

The 5ESS®-2000 switch EADAS interface is a dedicated synchronous binary data link that supports the BX.25 protocol and operates at a 2400-baud transmission rate. The EADAS requests the following types of data from the 5ESS®-2000 switch:

- Network management measurements
 - Audits - on an EADAS/NM specified interval
 - Discretes - typically a 30-second interval
 - Trunk data - on a 5-minute interval
- Traffic measurements
 - Office totals - 30-minute interval
 - Trunk traffic - 30-minute interval
 - BRCS traffic - 30-minute interval
- Division of revenue measurements
 - Hourly separations - on an hourly interval
 - 24-hour separations - on a 24-hour interval
- Plant maintenance measurements
 - 24-hour interval.

Data is requested by interval not by data type. For example, the 30-minute traffic report contains office totals, trunk traffic, and BRCS traffic data.

The EADAS provides the following surveillance reports:

- Load service summary report
- Service exception report
- Component exception report
- Measurement apparatus surveillance summary report
- Service performance summary report
- Multiline hunt group (MLHG) overflow exception report
- MLHG overflow summary report
- Trunk overflow exception report
- Trunk overflow summary report
- Modular features customization capability summary report
- BRCS customer group reports
 - Individualized dialing plan (IDP) report
 - Attendant group report
 - MLHG report
 - Alternate route selection (ARS) group report
 - Private facilities access/simulated facility group (PFA/SFG) report
 - Terminal group.

The EADAS forms and writes to magnetic tape the following schedules, and sends them downstream (if desired by the user).

- H schedule - contains office totals and component data
- C schedule - contains trunk data
- P schedule - contains processor capacity data
- E schedule - contains extreme value engineering (EVE) data
- S schedule - contains hourly separations data
- D schedule - contains separations data.

For further information, refer to the EADAS user documentation series: OPA-3B000-01 through OPA-3B003-01 for 1A EADAS, and OPA-3B501-01 through OPA-3B509-01 for 1B EADAS implementation.

5.7 EADAS/NETWORK MANAGEMENT

The 5ESS®-2000 switch provides the basic trunk group control capability without common channel interoffice signaling related options. The EADAS/NM can activate, remove, and audit the 5ESS®-2000 switch trunk group controls. Also, the EADAS/NM facilities can activate code controls and select trunk groups for SILC.

Every 5 minutes the EADAS sends a request and polls the 5ESS®-2000 switch for these counts. The request indicates which of these packages should be sent.

- Delayed Readiness Counts
- Overload Counts
- Call Direction Counts
- Basic Failure to Match and No Circuits Counts
- Critical Service Circuit Counts
- Additional Ineffective Machine Attempts
- Network Management Control Counts.

Each package consists of several counts. For example, the "call direction" package consists of counts for the following:

- Originating calls
- Incoming calls
- Outgoing calls
- Terminating calls
- Intrasystem calls
- Tandem calls.

Additional 5-minute counts and discrettes are provided for direct signaling CCS features [originating screening office/inward wide area telecommunications service (OSO/INWATS)]. These counts are sent to EADAS.

5.8 CENTRAL OFFICE EQUIPMENT REPORTS

The central office equipment reports (COER) system is used to help with 5ESS®-2000 switch engineering. The COER system will process traffic data for electronic switching system offices; screen the data for completeness, consistency and format; flag and report on suspect data items; store the processed data; and produce engineering and administrative reports. These reports can be generated on-line or scheduled to run in a low-cost batch processing (background) mode. These reports may be used for monitoring service levels or for determining future equipment requirements.

The EADAS system produces traffic schedules, containing traffic value measurements, which are sent to COER.

Upon receipt of the traffic schedules, the COER system will process the data and store the processed results in the office's data base.

The COER system provides features that assist the switch administrator in the management, administration and long-term surveillance of the 5ESS®-2000 switch. These features include:

- User COER System - User definable specifications (calculations, validations, busy hour engineering (TCBH).
- Capacity determination (CAPFIT) for all 5ESS®-2000 switch processors.
- Busy hour determination (BHD) for all 5ESS®-2000 switches.
- Automatic reporting of exceptions and flagging of data items where exceptions are found based on the user-defined validations.
- Condensed and detailed monthly, intermediate and machine load and service summary (MLSS) reports for any combination of component, hour, and day.
- Presentation and summation of data by user-defined communities of interest (COI).
- Reports can be generated on-line or scheduled to run in an off-line (background) mode. Reports can be routed to multiple destinations. Valid destinations are a terminal, printer, tape, and data link.
- Timely access to all information for early problem detection and correction: on-line record base validations and queries to data availability and processability.
- On-line access to large quantities of traffic data statistics and related traffic engineering calculations.
- On-line access to COER user documentation for the operations and use of the COER system features.

5.9 SWITCHING CONTROL CENTER SYSTEM

The No. 2 SCCS provides facilities to administer, monitor, control, and maintain the 5ESS®-2000 switch units from a centralized remote location. The capabilities provided by the SCCS and the equipment requirements are discussed here. Additionally, a NAC channel is provided on a virtual channel of the SCCS interface. The capabilities provided by this channel are also discussed.

5.9.1 SCCS INTERFACE

The No. 2 SCCS interface to the stored program controlled systems (SPCSs) is duplex, and is used for performing various administration and maintenance functions.

The 5ESS®-2000 switch interfaces to the No. 2 SCCS through a pair of BX.25 links. The data is transmitted from the maintenance teletypewriter (MTTY) PC located in both IOPs of the 5ESS®-2000 switch to the protocol converter (T-cabinet) at the SCCS. These MTTY PCs, consisting of a TN983B (previously TN83B) circuit pack and resident firmware, operate in an active/standby configuration during the normal operation.

Four types of information are transmitted over the data channel: emergency action interface (EAI) information, critical indicator (CI) information, control and display (C&D) information, and TTY messages. The CI information is presented on both the display pages and the critical indicator panel (CIP). With the Control Equipment No. 3 (CE No. 3), the same CI information is presented on the critical indicator display (CID), which is a color video monitor. The TTY messages are logged in the SCCS, and the alarmed messages are displayed on the SCCS monitor. The SCCS interface is unique and separate from the other OS interfaces, as it must provide a working communications channel in the face of a duplex system failure. Therefore, the channel bypasses most system hardware and

software in an emergency. The only system blocks that must be functional at that time are AM EAI hardware, part of the MTTY PC firmware, and the data link.

The SCCS CC2A (control console 2A) can be used to control the switching machine remotely. With the CE No. 3, the work station CRT is used to do the CC2A functions. Furthermore, the work station CRT provides the capabilities similar to the MCC at the 5ESS[®]-2000 switch.

In the T-cabinet application, the 5ESS[®]-2000 switch uses 2 of the 18 input ports in the T-cabinet and 3 ports in the computer subsystem for maintenance TTY, network administration channel TTY, and control and display information. For further details about the SCCS capabilities, refer to PA 5P738-02, (5ESS[®]-2000 Switch Man Machine Language), PA 5P141-02, (5ESS[®]-2000 Switch Program Documentation Standard), and OPA 3P692 (synchronous subsystem portion of the CE No. 3).

5.9.2 NETWORK ADMINISTRATION CENTER CHANNEL INTERFACE

A virtual administrative input/output channel is provided on the link to the SCCS and may be accessed via the SCCS/NAC work station. This I/O channel allows the administrator to query the 5ESS[®]-2000 switch for information stored in the 5ESS[®]-2000 switch data base, to activate or deactivate essential service protection controls, and to receive notification of service-affecting traffic conditions and control status information. The channel enables the administrator to obtain 30-minute traffic data output from the 5ESS[®]-2000 switch on demand.

When the 30-minute traffic report is requested from the NAC channel, the output reflects exactly the contents of the message normally reported to EADAS. It is generated over the NAC channel by request only, and the user is allowed to specify all or selected traffic measurements sections. This enables the administrator to obtain data to isolate traffic-related problems.

The 5ESS[®]-2000 switch restricts NAC channel command capabilities to only those required to do administrative functions.

By using the SCCS work station, the administrator has access to the SCCS computer and may access information that has been stored there. The functions available to the administrator include:

- Receive warnings of office overloads
- Verify translations
- Obtain half-hourly reports of traffic measurements
- Perform network management functions
- Request output messages from the 5ESS[®]-2000 switch.

Table 5-1 provides a list of the input-message requests available on the NAC channel and describes the associated functions. For further details about these messages and the related output messages, refer to *Input Message Manual*, 235-600-700, and *Output Message Manual*, 235-600-750. Additionally, messages associated with the verification functions are found in 235-118-202, *Recent Change Procedures*, Text Mode.

Table 5-1 NAC Channel Capabilities

FUNCTIONS	MESSAGES	DESCRIPTION
Essential Service Protection	ALW:ESP INH:ESP	Allow essential service protection Inhibit essential service protection
Alarms	ALW:RBPSC INH:RBPSC	Allow alarming from the NAC Inhibit alarming from the NAC
30-Minute Traffic Report	ALW:TRFC30 INH:TRFC30	Activate specified sections of 30-minute traffic report Turn off specified sections of the 30-minute traffic report

	REPT:TRFC30 OP:STATUS, TRFC30	Request status (off or on) of all sections of 30-minute report Request status (off or on) for all sections of 30-minute report. [Replaces message REPT:TRFC30 for 5E2 (2) and later software releases]
Network Management	ALW:NM CLR:NM INH:NM STP:NM	Allow various NM functions Clear NM control functions Inhibit various NM functions Stop NM report generation
VERIFY	RCV:APPTXT	Access Recent Change/Verify text mode Recent Change portion not allowed. (See 235-118-202.)
Output Requests	OP:	All requests for output from the 5ESS [®] switch. (See 235-600-750.)
TASC QUERY: LINE TRUNK IDP	OP:RTSLN OP:RTSTK OP:RTSIDP	Line report lists BRCS telephone numbers in response to request. Trunk report lists BRCS term group numbers with features. All significant digits and/or features of the BRCS IDP (individual dialing plan).

These functions are useful in analyzing exception reports and other service problem indications. Additionally, users of the SCCS work station may extract specified messages from the message log file, store messages in a file, and schedule functions for execution on specified days or hours.

Remote dial-up capabilities are provided to allow the work-station user to do most tasks from a location distant from the work station. This is especially useful where line assignment work groups are not co-located with administrative work groups.

To aid in identifying service-affecting 5ESS[®]-2000 switch problems, the NAC alarm message routing group of the No. 2 SCCS provides single message alarm routing for selected 5ESS[®]-2000 switch output messages.

5.10 DOPS

The DOPS is an interactive computer software system developed by Lucent Technologies. It provides for the entry of traffic data, switch parameters, equipment options, and feature options needed by planners and traffic and equipment engineers to plan, configure, price, and order equipment associated with the 5ESS[®]-2000 switch, applications processor, and operator services center peripherals.

When used as intended, DOPS reduces the time, effort, and errors associated with the manual preparation of orders by automating the calculation of equipment quantities and capacities.

A variety of reports can be generated with DOPS. These tools provide the engineer with the means to determine the accuracy of traffic and equipment inputs and their calculated results to make reasonable projections and sound engineering decisions.

The DOPS aids with the preparation of traffic and telephone equipment orders for the 5ESS[®]-2000 switch. It enables orders to be stored for later retrieval and change. These orders can be transmitted electronically to the Lucent Technologies Consolidated Data Center.

With DOPS, three engineering systems are available. These are as follows:

- 5ESS[®]-2000 Switch Engineering (5EENG)
- Operator Service Center (OSCENG)
- Applications Processor Engineering (APENG).

The DOPS is supported by the following documents:

- 235-060-100, *DOPS User's Guide*

- 235-060-110, *Engineering Procedures*
- 235-060-120, *Engineering Procedures - Operator Services Position System*
- 235-060-130, *Engineering Procedures - Applications Processor*.

5.11 CURRENT CAPACITY PROJECTION TOOL

The current capacity projection tool (CCPT) program reports the current processor performance and the maximum call capacity of either the AM or the SM in a 5ESS[®]-2000 switch. The CCPT has a variety of uses including verification of the predicted capacity of a new module after cutover, determination of possibilities for hardware growth, determination of candidate SMs for new features, etc. The data file needed to run CCPT can be labor intensive to create; however, there are other programs that are included with CCPT that create the necessary data files needed to run CCPT.

Using the CCPT program requires a PC, MS-DOS[®] personal computer, or aMS-DOS[®] personal computer with at least 256 kB of main memory and, at least, one floppy disk drive. An additional hard disk drive, if available, is preferable. A printer is necessary for hard-copy output. LOTUS[®] 1-2-3[®], Version 2.0 or LOTUS[®] 1-2-3[®], Version 2.0 or later is required to run the program, although knowledge of LOTUS[®] 1-2-3[®] is not assumed. The user needs only a limited knowledge of PCs since step-by-step instructions are included when ordering the tool.

The CCPT is distributed by the Lucent Technologies Customer Information Center in Indianapolis, Indiana. Orders for copies may be placed by calling 1-800-432-6600. The *CCPT Programs* document number is 235-070-101D. Refer to the *Documentation Description and Ordering Guide*, 235-001-001, for detailed ordering information.

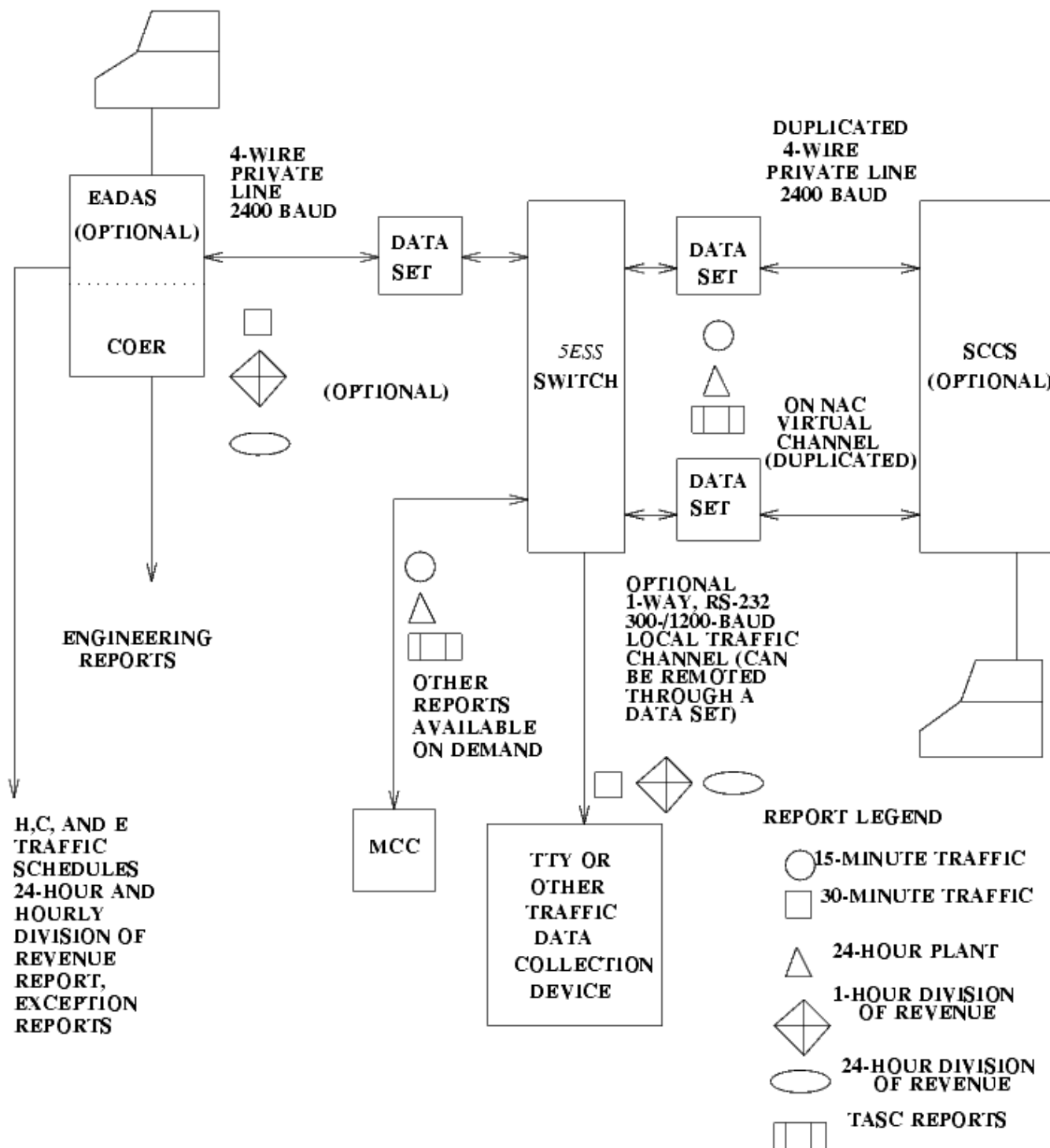


Figure 5-1 Administrative Input/Output Facilities

6. ENGINEERING AND ADMINISTRATIVE CONSIDERATIONS

6.1 ENGINEERING METHODOLOGIES

The equipment for the 5ESS[®]-2000 switch is provided using traditional traffic engineering practices; number of lines, number of trunks, and usage. Engineering methods closely follow the modular architecture of the system. Traffic parameters are used to determine the number of interface units required. Unit quantities are then used to define the office size in switching modules (SMs/SM-2000s). The number of SMs/SM-2000s then determines the engineering for the communication module (CM).

The basic building-block of the 5ESS[®]-2000 switch is the SM/SM-2000. An SM/SM-2000 can serve varying numbers and types of interface units [line units (LUs), trunk units (TUs), digital carrier LU (DCLUs), etc.] up to its time-slot capacity of 512 time slots (8 time slot sets). The general algorithm for sizing a 5ESS[®]-2000 switch and accommodating individual variabilities is as follows:

- Given the traffic characteristics, calculate the number of interface units required
- Given the interface units required, calculate the number of time slots required
- Given the number of time slots required, calculate the number of SMs/SM-2000s required.

Traffic engineers use telephone equipment traffic-sensitive measurements to forecast the need for new equipment. This section describes general traffic concepts and provides details for different methodologies and engineering philosophies.

Most engineers in telephony are familiar with time-consistent busy-hour (TCBH) engineering methods. These methods include average busy season (ABS), ten high-day (THD), and high-day (HD) projections. This methodology has been understood and used for many years and has benefits owing to its simplicity, widely understood concepts, and relatively small amounts of data collection required.

Traditionally, the TCBH engineering methodology was used for central office equipment provisioning. In TCBH engineering, the traffic load offered to a component is assumed at its maximum during a fixed clock hour, called the TCBH, in each (week) day of the ABS, and the equipment provisioning is engineered based on the average TCBH load. Although TCBH engineering is widely understood and used, it is inherently inadequate for engineering offices that exhibit a bouncing busy-hour (BBH) pattern or a noticeable day-to-day load variation.

In recent years the telephone switches and data collection systems have become more powerful and flexible. As a result, the collection and analysis of data on intervals as short as 30 minutes have become possible. This technology has opened up the opportunity for new statistical methods for forecasting telephone traffic. In the mid-1970s, Extreme Value Engineering (EVE) emerged from Lucent Technologies Bell Laboratories. The EVE method is the recommended way to engineer the 5ESS[®]-2000 switch.

The EVE engineering is different from TCBH engineering not only in procedures but also in philosophy. EVE is based on daily peak loads regardless of when they occur, and thus it naturally accounts for effects of the BBH and the day-to-day load variation. Also, EVE uses service criteria different from TCBH service criteria. In TCBH engineering, provision of equipment is engineered so that the average service meets a given standard. The EVE philosophy assumes that average service is not the service seen by an individual customer, who according to the time at which the call is placed, may experience service considerably below average. Therefore, service criteria in EVE are formulated so that an acceptable grade of service is provided the customer at least a certain percent of the time. The adoption of such service criteria in EVE, stemming from the average daily peak (ADP) averages, is a departure from the traditional philosophy of average performance, in the busy hour, underlying the telephone traffic theory and engineering practices. The basic engineering calculations in the EVE methodology are the once-a-month (OAM) and expected value high day (EVHD). Both OAM and EVHD are statistical projections. One benefit of the EVE methodology is the elimination of the need for busy hour determinations. These determinations

are both expensive and time consuming.

The introduction of distributed digital switch architecture and modular growth of new equipment is driving traffic engineers and administrators to reconsider the meaning of both service and traffic loading on this type of switching equipment. The EVE is expected to become the preferred method - not only for growth engineering and administration of existing switching equipment, but also for the engineering and administration of new services like Integrated Services Digital Network (ISDN). Understanding ISDN traffic variability for both voice and data is important to both the traffic engineer and administrator to make the most efficient use of their switching equipment.

6.1.1 TIME-CONSISTENT BUSY HOUR

Because the TCBH engineering has been widely understood and used for many years, this document addresses only the basic ideas. The objective of traffic engineering is to determine the least amount of telephone equipment required to provide a given grade of service. The time unit used for measuring the grade of service is usually an hour. Clearly, if a grade of service can be met for the hour with highest traffic load, then it will be met for any other hours during a day. Thus in traffic engineering, only those hours that have the potential of being busiest in a day are of interest. For this description, **hour** refers to 60 consecutive minutes starting at a clock hour, **week** refers to the 5 working days, and **month** refers to a service observing month (which may not be a calendar month). The hours that the daily peak loads usually occur are called candidate busy hours (CBHs). We assume that CBHs in each day are fixed, and the number of CBHs is an office parameter.

The three highest traffic months in terms of average traffic load per CBH per main station, not necessarily consecutive, are called the ABS or simply the busy season (BS). The hour among the CBHs having the highest average traffic load during the BS is designated as the average busy season busy hour (ABSBH), or the TCBH, or simply the busy hour (BH). The BS data excludes Mother's Day, Christmas, or extremely high traffic days that can be attributed to unusually severe weather or catastrophic events that are not reasonably expected to recur from year to year. The BH traffic load averaged across the BS is the ABSBH load.

The ten busiest days during ABS in terms of the observed TCBH load are called the THDs. The average traffic load in the TCBHs of the THDs is called the ten high-day busy hour (THDBH) load. The one day among the THDs that has the highest traffic during the TCBH is designated the HD. The traffic level in the BH of the HD is termed the high-day busy-hour (HDBH) load.

Three methods of engineering are available in TCBH according to the time frame used. They are ABS (or ABSBH) engineering, THD (or THDBH) engineering, and HD (or HDBH) engineering; the traffic loads used for engineering are, respectively, ABSBH, THDBH, and HDBH loads. In general, ABS engineering is used for components with low to moderate usage rate; HD engineering or THD engineering is used for components sensitive to traffic peaks.

There are generally two types of service criteria - blocking and delay. Service levels of these two criteria are expressed, respectively, as follows:

- The percent of demands for service that fail to receive service
- The percent of demands for service that are delayed, or the length of delay.

Given the traffic load and the service level, the provision of equipment can then be engineered using one of many available traffic capacity models (for example, Erlang B, Poisson).

Traffic data for TCBH engineering is collected on various units at a single consistent BH (for example, 9 to 10 a.m.) over time. One major job when administering this data collection is the determination of the office BH for each unit type. This BH determination requires a study of all hours or a set of candidate BHs in the office for the various unit types in the office. Some unit types will have BHs different than others. In practice, a single office BH is not always sufficient and side BHs are required (for example, an office community of LUs may have one BH and two side BHs). These BH determinations are performed at regular intervals to insure that data is being gathered on the

correct BH. Some offices may have seasonally changing BHs. Data collection on a non-BH can result in an underestimation of traffic loads and under engineering of added equipment. The BH data is collected at regular intervals, normally a daily interval, and averaged over a specified periodic interval (usually a month).

An optional method of TCBH engineering for the LU is Coefficient of Variation (CV). This method ensures that variation above or below the engineered load does not cause the office average blocking to exceed the chosen service criteria.

6.1.1.1 Data Manipulation

Typically the monthly averaged traffic is collected in a data base, and at the end of a yearly interval, the three highest months of traffic data are averaged together to produce the three high-month average for the year. This three high-month average, commonly called the BS, is the value used in trending the traffic over an engineering period. These values are used to project the life of the current switching equipment. Not all offices have a definite three months in their BS. In these cases, the traffic engineer must evaluate manually whether the office has one, two or three months in its BS. This can happen when one or two of the three highest traffic months are significantly lower than the other(s). Statistical methods for determining outliers can save the engineer time and provide improved accuracy. Typically, 20 days of TCBH traffic values are averaged together each month. The three high months of the year are averaged to produce the ABS traffic. This is one value used in trending for future growth or switch replacement engineering.

The ABS value is not enough to characterize the traffic. In addition to the three high-month average, TCBH engineering requires a measure of the peakedness of the traffic for engineering the desired grade of service. This measurement is made by collecting and charting HD traffic values and THD values. These values are just what they seem, the highest daily traffic loads in the year are collected. In practice the HD value is hard to determine because of the small amount of data collected and the necessity of outlier rejection. Traffic associated with natural disasters or radio call-ins would probably not be candidates for HD or THD traffic. The HD traffic is the highest daily traffic expected during the year, whereas the THD is the average of the traffic on the ten highest traffic days of the year. The TCBH engineering for the 5ESS[®]-2000 switch requires both HD and ABS traffic values. The most limiting case is used for equipment provisioning.

Outlier detection on HD and THD values is very important. For example, random radio call-ins can influence these traffic values. Outliers are evaluated by the engineer by sometimes tedious processes that require determining what happened on certain days to make the traffic unusually different than expected.

6.1.1.2 Engineering Considerations

For data averaging on the 5ESS[®]-2000 switch, it is desirable for the engineer to divide the office into communities containing SMs/SM-2000s with similar traffic characteristics. Basic communities might be remote switching modules (RSMs), RSM clusters, optically remote modules (ORMs), co-located ORMs, ISDN SMs, and so forth. For the 5ESS[®]-2000 switch, each community may have a different end of engineering period for its equipment. Poisson engineering criteria for the 5ESS[®]-2000 switch traffic-sensitive units are given in Table 6-1 for each of the three methodologies described here.

Table 6-1 Engineering Criteria for Switch Components

EQUIPMENT	EVE	TCBH	
		HD	ABS
Line Unit	4 ^b	7 ^b	1.5 ^b
Digital Carrier Line Unit	4 ^b	7 ^b	1.5 ^b
High-Level Service Circuit	.05 ^b	0.1 ^b	—
ISLU	—	7 ^b	—
Tone Decoders	.03 ^a	.05 ^a	.01 ^a
Conference Circuits: (3-port and 6-port)	.05 ^a	—	.001 ^a

RSM Umbilicals	.0005 ^a	.001 ^a	—
RSM ICL Links	.02 ^a	.04 ^a	—
Notes:			
a. Poisson Tables			
b. Capacity Tables			

The values provided in Table 6-1 have been selected to provide an equivalent grade of service. Note that conference circuits are not HD engineered, and umbilicals, intra-cluster spans, and high-level service circuits are not ABS engineered. Engineering values corresponding to these positions are not provided in Table 6-1.

6.1.2 EXTREME VALUE ENGINEERING

An important consideration in the engineering and administration of traffic-sensitive equipment on a distributed digital switch is the method used to forecast traffic loads. The EVE methodology provides a sound statistical alternative to traditional forecasting and administration methods.

Although the methodology has proven to be a good choice, the term "Extreme Value Engineering" has caused some administrators to erroneously believe that EVE engineers for extreme loads. The EVE method engineers for any grade of service by using tools from the branch of statistics called extreme value theory to characterize the traffic.

The basic engineering calculations in the EVE methodology are the OAM and EVHD. Both OAM and EVHD are statistical projections.

The EVE methodology originated as an attempt to rectify some of the deficiencies of TCBH engineering. To gain insight into EVE, it is necessary to understand how and why EVE differs from TCBH engineering.

The EVE methodology offers the following advantages over TCBH engineering:

- No TCBH determination study is necessary.
- Effects of day-to-day variation and BBHs are accounted for automatically.
- Consideration of load variation results in better use and more efficient allocation of switching equipment.
- The EVE OAM service criteria is compatible with switching system performance indexes, which are reported monthly. The OAM service criteria is better related to customer satisfaction than the average service criterion in TCBH engineering.
- Since only daily peak loads are needed, data processing costs are reduced and collection of side hours is unnecessary.
- Above all, EVE provides statistically more reliable peak load estimates than the HD and the THD engineering. Replacing the HD and THD engineering by EVE eliminates the tendency to overengineer peak load-sensitive components, and hence results in equipment saving.

In traffic engineering, there are three elements, namely:

- Traffic load for engineering
- Service criterion
- Traffic capacity model.

Accordingly, a traffic engineering method can be characterized by the following:

- How the traffic load for engineering is derived from available load data.
- What service criterion is to be used? The service criterion specifies the level of service, and how the grade of service is measured in actuality.
- Given the engineering load and the level of service, which of the available traffic capacity models is to be used to determine the proper amount of equipment.

The BBH method for administration of LUs is very effective. Administrators can look at reports generated by a support system collecting data from their digital switches and quickly assess the quality of service being provided. Line units that exceed either the 4 percent OAM blocking criteria or 1.5 percent ADP blocking should be flagged for further study. If the traffic levels in all LUs are below these two points, the office is providing a good grade of service in all LUs. Those LUs with less than 1.5 percent blocking in the BBH are assured to meet the 1.5 percent ABS blocking criteria.

The EVE data collection differs from TCBH data collection in two major ways. The first is that data collection is on a BBH basis rather than a consistent BH basis. This fact requires that the hour in each day with the highest traffic for a unit is collected and used in the calculations for data trending. Since the peak loads are always collected, in whichever hour they occur, it is not necessary to perform BH determinations. Collection of data on the BBH ensures that the busiest traffic loads are always selected. At the end of the month, typically 20 days of data are used to find the average daily peak and standard deviation values for the traffic in that month. A statistical quantity called the OAM load is calculated from these quantities. The OAM value is the traffic load that is expected to be exceeded once during the month. This value is the 95th percentile of the probability distribution for the traffic. Similar to the TCBH methods, the three highest OAM values during the year are used to form the BS and to trend the traffic data.

The peakedness and seasonal variability of office traffic are taken into account by the EVE-computed OAM values. The EVE simplifies the engineering as compared to TCBH: only one input is required for EVE (OAM) rather than the two for TCBH (ABS and HD). The engineering load in TCBH engineering is taken to be the average of TCBH loads in ABS (that is, ABSBH load) regardless of the load variation. The level of service is specified as percent of blocking at the engineering load. The measured grade of service is the average blocking of TCBHs. Since the blocking is a convex function of the load in virtually all applications, it can be shown that the blocking at the average OAM load is smaller than the average blocking at TCBH loads. The difference depends on the day-to-day variation of loads.

Many traffic capacity models are available. The two most popular ones are the Erlang B model and the Poisson capacity model. The Poisson capacity model is used for TCBH engineering, since it partially accounts for the day-to-day load variation and predicts the measured grade of service more accurately.

For EVE, assume that CBHs and ABS are given. The maximum of the CBH loads in a day is called the daily peak (DP) load. The CBH when the DP load occurs is called a BBH. The BBH load averaged across BS is termed the average bouncing busy hour (ABBH) or the mean daily peak (MDP) load.

The load data needed in EVE are DP loads. The DP load in BS is a random quantity, and it has a distribution $F(x)$. The distribution $F(x)$ was modeled as an extreme value distribution by Gershwin, et al. and Barnes, from which the name "Extreme Value Engineering" originated. Later Friedman showed that the normal-to-the-sixth distribution provides better agreement with empirical data than the extreme value distribution.

The 95th percentile of $F(x)$ is designated as the OAM load. The name "OAM load" signifies that the DP load is expected to exceed the 95th percentile only once in a month (20 business days).

In EVE, the engineering load is taken to be the (estimated) OAM load. Clearly, OAM load depends on both the average and the variation of DP loads. This is how EVE accounts for load variation.

The level of service is specified as percent of blocking at the OAM load. Note that OAM load is always larger than the ABSBH load. Thus, the blocking used in EVE should be higher than that in TCBH engineering if these two engineering methods are to give "comparable" amounts of equipment.

The grade of service is defined as the expected frequency that the blocking in BBH exceeds the level of service. When the office is properly engineered, the expected frequency should be 5 percent or once in a month.

The implementation of EVE in the 5ESS®-2000 switch Digital Ordering and Planning System (DOPS) employs the Poisson capacity model. Note that the Poisson capacity model predicts higher blocking, and hence gives more equipment, than the Erlang B model. In TCBH engineering, the Poisson capacity model is employed such that the additional equipment can be used to compensate for the day-to-day load variation and the retrial phenomenon. In EVE, however, the day-to-day variation has been accounted for by the use of OAM load; thus the Poisson capacity model will tend to overengineer, although this overengineering is somewhat compensated for by the choice of service level in EVE.

6.1.2.1 EVE Variables

The EVE has three basic variables for describing loads: ADP, OAM, and EVHD. The ADP load is the average of the highest loads each day averaged over a period typically 20 business days. The equation is as follows:

$$ADP = \sum_{i=1}^n \frac{DP_i}{n}$$

where n is the number of days in the sample (typically 20), and DP is the daily peak load on day i. The DP load, in turn, is by definition the highest BBH load on day i. Since the ADP load is calculated from the BBH loads, it will always be greater than or equal to the ABS loads across the same period. The standard deviation of the DP loads is calculated as follows:

$$S_{DP} = \left\{ \sum_{i=1}^n \frac{(DP_i - ADP)^2}{n-1} \right\}^{1/2}$$

This quantity provides a measure of the dispersion or spread of the traffic loads over the typical period of 20 days. This is an important quantity that allows us to engineer units having steep load service curves under widely varying traffic loads without having to guess at the HD loads as in TCBH engineering.

The basic engineering quantity is the OAM load. This is defined as the 95th percentile of the DP distribution. When a sample of 20 business days in a month are used, the OAM load is the load that will be exceeded on the average once a month. Most of the units on the 5ESS®-2000 switch are engineered on the OAM loads. The OAM load has been empirically derived as follows:

$$OAM = ADP + 1.74 S_{DP}$$

The standard deviation factor represents the traffic to be served such that equipment can be engineered to a desired level of blocking. This is the variable that shows whether the traffic is fairly constant or widely variable.

The last important variable in EVE is the EVHD load. This represents a statistical equivalent to the traditional HD criteria and is based on the three high-month BS data. The EVHD load is typically used to engineer processors where the highest loads are important. The EVHD has been empirically derived as follows:

$$EVHD = ADP + 2.6 S_{DP}$$

6.1.3 TCBH TO EVE DATA CONVERSIONS

Techniques for TCBH to EVE conversion have been previously published for precutover engineering of 5ESS®-2000 switches when EVE data is not available. For completeness, this information will be reviewed in this section. The following equations have been empirically derived for ABS loads that are found to be greater than or equal to 200 CCS:

$$ADP = ABS + \left[0.334 + \frac{157}{ABS} \right] S_{ABS}$$

$$OAM = ABS + \left[1.80 + \frac{138}{ABS} \right] S_{ABS}$$

$$EVHD = ABS + \left[2.62 + \frac{54.4}{ABS} \right] S_{ABS}$$

$$EVHD(calls) = ABS_{calls} \left[1 + 1.85 \left(\frac{THD_{calls}}{ABS_{calls}} - 1 \right) \right]$$

Figure 6-1 Estimating the ABS Standard Deviation

when

THD_{calls} is the THD load in calls. The major problem of converting this data is in finding the ABS standard deviation (S_{ABS}). There are three basic methods that can be employed:

- THD method - if THD load in CCS is known.
- Quantile method - if THD is unknown but at least 30 days of the BS BH loads in CCS are known.
- Similar office method - if data for the office to be engineered is insufficient but data is available from a similar office.

The THD method can be performed by looking at the graph in Figure 6-1 where the basic equation is as follows:

$$S_{ABS} = \frac{THD - ABS}{1.64 + \frac{29.4}{ABS}}$$

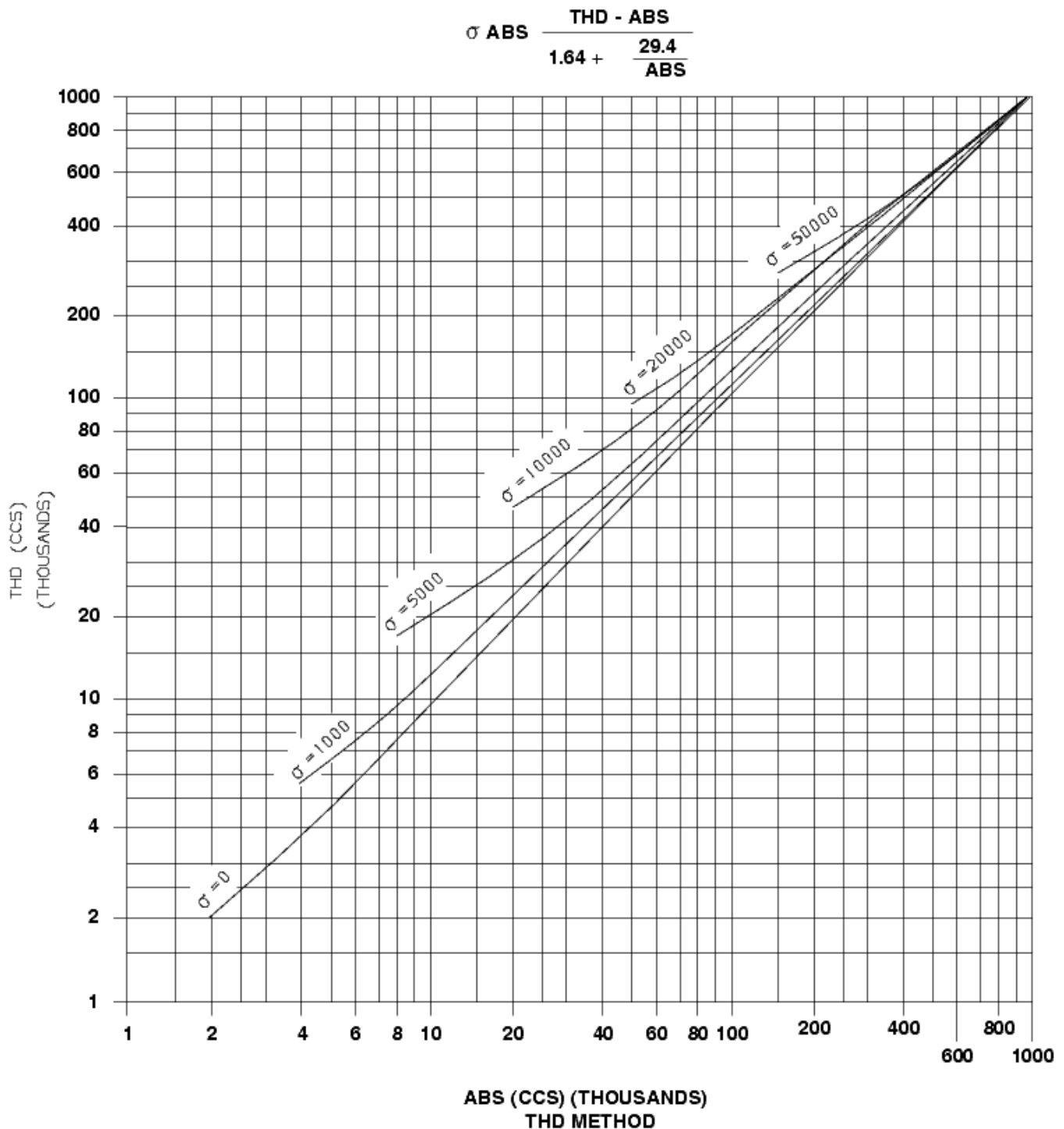


Figure 6-2 Estimating the ABS Standard Deviation

The THD CCS in thousands can be found on the y-axis, the ABS CCS in thousands on the x-axis and the ABS standard deviation, then interpreted from the curved center lines. The basic equations for the quantile method are as follows:

- (1) For $50 \leq D \leq 66$,

$$S_{ABS} = \frac{\left[4th \text{ Highest TCBH Load} \right] - \left[4th \text{ Lowest TCBH Load} \right]}{C_1}$$

Figure 6-3 TCBH-to-EVE Conversion for 30

(2) For $30 \leq D \leq 49$,

$$S_{ABS} = \frac{\left[3rd \text{ Highest TCBH Load} \right] - \left[3rd \text{ Lowest TCBH Load} \right]}{C_2}$$

Figure 6-4 TCBH-to-EVE Conversion for 40

where: D = days of data available. C_1 and C_2 are derived from Table 6-2 .

Table 6-2 Days to C Factor Conversion

D	C_1	D	C_2
66	3.21	49	3.24
65	3.19	48	3.22
64	3.18	47	3.20
63	3.16	46	3.18
62	3.15	45	3.15
61	3.13	44	3.13
60	3.11	43	3.11
59	3.10	42	3.08
58	3.08	41	3.06
57	3.06	40	3.30
56	3.04	39	3.01
55	3.03	38	2.98
54	3.01	37	2.95
53	2.99	36	2.92
52	2.97	35	2.89
51	2.95	34	2.86
50	2.93	33	2.83
		32	2.80
		31	2.77
		30	2.73

A graphical technique for estimating the ABS standard deviation using this quantile method is shown in Figure 6-3 , and 6-4 . The difference between the highest and lowest TCBH loads should be looked up on the y-axis and the days in the BS on the x-axis. The ABS standard deviation can then be found on the center lines by interpolation.

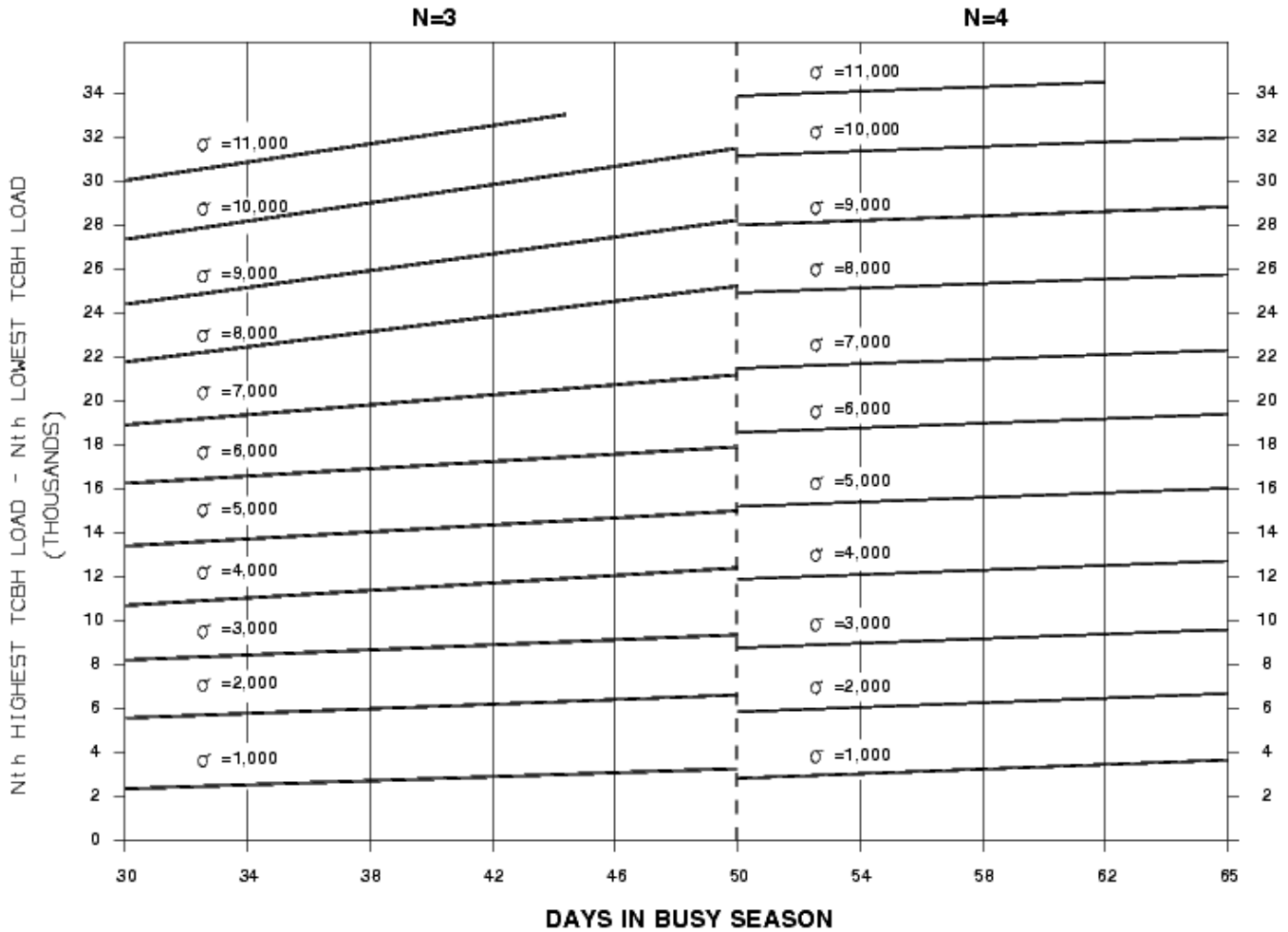


Figure 6-5 TCBH to EVE Conversion

The third method and the least dependable is the similar office method. One must choose an office with similar size, customer service mix, average usage, and demographics. The office must have TCBH data available for one of the previous methods. The standard deviation is then found using:

$$S_{ABS,o+T} = ABS_{o+T} \left[\frac{S_{ABS,o+T,similar}}{ABS_{o+T,similar}} \right]$$

If the THD call load is not known, then the following equations can be used:

$$THD_{o+T} = ABS_{o+T} \left[1 + 1.64K \frac{S_{ABS,o+T(CCS)}}{ABS_{o+T(CCS)}} \right]$$

where:

$$K = \begin{cases} 1.30 & \text{if } N_{NAL} \geq 10,000 \\ 1.30 + \frac{10,000 - N_{NAL}}{18,500} & \text{if } 10,000 \geq N_{NAL} \geq 2,000 \\ 1.73 & \text{if } 2,000 \geq N_{NAL} \end{cases}$$

and $N_{\{NAL\}}$ = Number of Access Lines in office to be engineered.

The similar office method can also be used for THD by:

$$\begin{aligned} THD_{O+T} &= ABS_{O+T} \left[\frac{THD_{O+T, similar}}{ABS_{O+T, similar}} \right] \\ &= ABS_{O+T} \left[1 + 1.64K \frac{S_{ABS, O+T, Similar(CCS)}}{ABS_{O+T, Similar, (CCS)}} \right] \end{aligned}$$

This set of equations provide all that is necessary for TCBH to EVE conversions.

6.1.3.1 Data Manipulation

6.1.3.1.1 Monthly and Busy Season Calculations

The OAM traffic values for each traffic-sensitive unit must be evaluated separately. This calculation is done by collecting the daily traffic loads for each unit and at the end of the month performing the OAM calculation:

$$OAM = 1.74 \sigma + ADP$$

Where ADP = Average Daily Peak

and σ = standard deviation of the ADP loads

The OAM values should not be calculated by averaging unit data on a daily basis across a loading division and then calculating the OAM value for the loading division at the end of the month. (Such an approach is statistically invalid.) At the end of the month, the individual LU calculated OAM values should be averaged to obtain a community average for each unit type.

The three months during the engineering year with the largest OAM values for a community comprise the BS. Some communities may have only a 1- or 2-month BS if the load(s) during the other busiest month(s) are significantly lower. For example, the current year's average BS LU traffic is calculated by:

$$LU \text{ OAM in CCS/NAL} = \frac{1}{3} \times \sum_{i=1}^3 \frac{\sum_{k=1}^{\# \text{ LUs}} (LU \text{ OAM CCS})_{k,i}}{(NAL)_i}$$

where $LU \text{ OAM CCS}_{k,i}$ is the OAM load for LU_k in CCS for month i and NAL_i is the number of analog network access lines in the office at the end of month i .

The preceding computed value is projected to the end of the engineering period and multiplied by the number of analog NALs in the community projected for the End of Period (EOP) to arrive at the total LU OAM CCS required at EOP.

6.1.3.1.2 Outlier Detection

Outlier detection in EVE is performed by first calculating the OAM, ADP, and standard deviation values for a unit. A check is made to see if there are any data points greater than + or -3 standard deviations of the ADP value. These values are removed from the data, and the OAM value recalculated. Although 20 days of data are desired, at least 12 days of data should be available for a valid OAM calculation.

6.1.3.2 Engineering Considerations

The EVE is done via the unit OAM values averaged for the BS. In rare instances, there may be offices with fairly constant BBH traffic. This shows that the standard deviation of the traffic will be small. In these rare cases where the OAM traffic is only slightly larger than the TCBH ABS traffic, a switch engineered to OAM levels could be providing higher than 1.5 percent ABS blocking. In these cases, it is necessary to provision more equipment if there is a requirement to bring the ABS blocking level down to 1.5 percent.

6.1.3.3 Administration Considerations

The introduction of modular digital telephone switches is forcing the service providers to reevaluate service standards. The components of these digital switches, including the 5ESS[®]-2000 switch, are virtually all sensitive to peak traffic loads. On the other hand, these same switches provide better service at average traffic loads. Many engineers have questioned how to use EVE for administration. The service criteria for ABSBH and HDBH varies, on the average, only slightly from the ABBH and EHD values. The more inconsistent the traffic BHs are the better ADP traffic values indicate the service being provided to the end customers. The ABS values will be missing many peak loads with higher blocking levels. The results of this should make the transition to EVE service standards relatively easy and desirable from a service standpoint.

6.1.4 ENGINEERING METHODOLOGY SELECTION FOR THE 5ESS[®]-2000 SWITCH

Before divestiture, EVE was selected by the Bell System to be the best method for 5ESS[®]-2000 switch engineering and for engineering step-by-step offices with Small Office Network Data System (SONDS). In this section, the most important concepts of the EVE methodology are discussed.

An important consideration in the engineering and administration of traffic-sensitive equipment on a distributed digital switch is the method used to project traffic loads. The EVE, used and for several years by Lucent and many telephone companies, provides a sound statistical alternative to traditional projection and administration methods. This section discusses EVE administration techniques and how they apply to service criteria in a distributed digital switching system. It has been found that a distributed digital switch can be providing adequate TCBH service and yet still have undesired blocking and customer complaints outside the office BH.

The introduction of distributed digital switch architecture and modular growth of new equipment is driving traffic engineers and administrators to reconsider the meaning of both service and traffic loading on this type of switching equipment. This section discusses the application of EVE to the 5ESS®-2000 switch for initial engineering, growth, and administration. Techniques found useful in applying EVE to a distributed digital switch are covered. Data analyzed from several offices is used to demonstrate the value of BBH versus time-consistent data collection and the relationship to service objectives in an office. The EVE methodology is expected to become the preferred methodology in the future - not only for growth engineering and administration of existing switching equipment, but also for the engineering and administration of new services like ISDN. Understanding ISDN traffic variability for both voice and data is important to both the traffic engineer and administrator to make the most efficient use of their switching equipment.

6.1.4.1 Background

The basic engineering calculations in the EVE methodology are OAM and EVHD. Both OAM and EVHD are statistical estimates. The OAM criteria is the level of traffic a unit should exceed, on the average, only once a month. The EVHD is a statistical equivalent to the traditional HD criteria. The following equations

$$OAM = ADP + 1.74\sigma$$

$$EVHD = ADP + 2.6\sigma$$

$$\sigma = \text{standard deviation of BBH traffic}$$

$$ADP = \text{Average Daily Peak}$$

These equations provide engineering and administration values that account for both the average traffic in the BBH and for the volatility of the traffic.

6.1.4.2 Data Collection

The CCS traffic data carried on 5ESS®-2000 switch LUs with a maximum of 512 line terminations and an 8:1 concentration ratio was collected from several switch offices. All offices studied were equipped in this way. These LUs reside on SMs/SM-2000s which, in this study, typically had four or five LUs per SM. In all cases, the CCS traffic was limited by the network and not by the processor. An SM/SM-2000 performs about 97 percent of all call processing in the 5ESS®-2000 switch with administrative functions being performed by an AM/CMP. Each SM generates traffic measurements; and each half-hour measurement collection from the SMs/SM-2000s is performed by the AM, that, in turn, prepares a report which can be printed or funneled downstream to an operational support system. The office data used for this study was collected both directly from the 5ESS®-2000 switch 30-minute traffic report and also from the COER engineering support system. In the study of TCBH and BBH traffic, the data was collected and analyzed from within communities of co-located equipment.

6.1.4.2.1 Line Unit Load Service Relationship

To tie an engineering methodology to an engineered unit, the load service relationship of that unit must be considered. Figure 6-6 shows a plot generated from field data of this relationship in the 5ESS®-2000 switch 8:1 LU. In this figure, the blocking within 50 CCS bands was averaged and plotted. The data for this figure was created from a sample of 80 LUs in two offices with a month's worth of one-half hour data. One office was under engineered, allowing the collection of many points in the higher blocking ranges. The published Lucent Technologies engineering values for the 8:1 LU are:

$$4\% \text{ OAM} = 1870 \text{ CCS}$$

$$1.5\% \text{ ABS} = 1700 \text{ CCS}$$

$$7\% \text{ HD} = 1960 \text{ CCS}$$

Figure 6-6 80 8:1 LUs - Blocking Averaged on 50 CCS Bands Blocking averaged on 50 CCS bands, LUs

These values are the EVE and TCBH criteria for both engineering and administration of the 5ESS®-2000 switch 8:1 LU and closely match the plot in Figure 6-6.

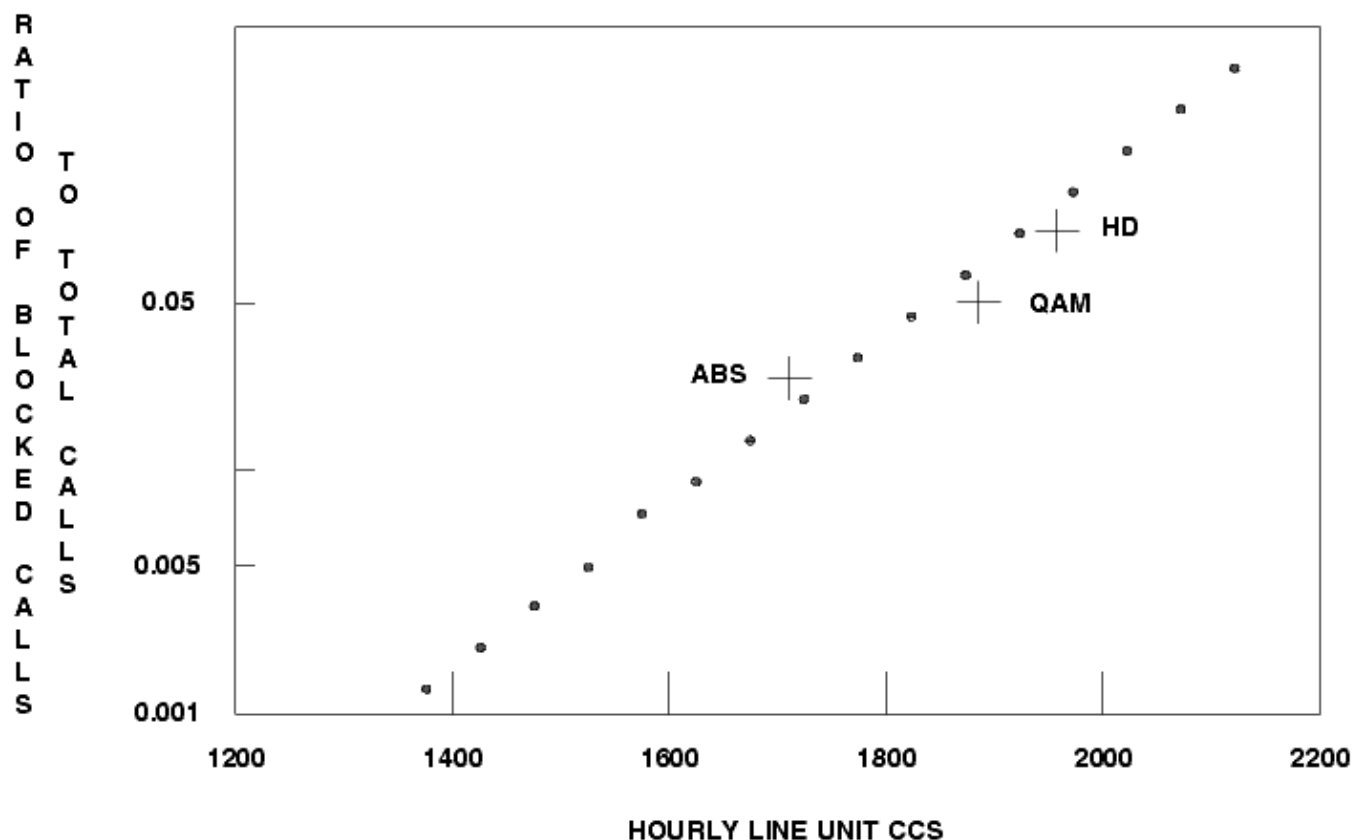


Figure 6-7 80 8:1 LUs Blocking Average on 50 CCS Bands

6.1.4.3 Traffic Behavior and Engineering

6.1.4.3.1 Busy-Hour Determination

An important benefit of the EVE methodology is the elimination of the need for BH determinations. These determinations are expensive and time consuming. Table 6-3 shows an analysis of the BHs for five offices. Even in study offices that have the most consistent BHs, C and D, only half the LUs, on the average, have their peak traffic in the office BH. Offices C and D are business metropolitan offices. Offices A, B, and E are residential offices with some business lines. The residential offices have the least consistency in their BHs, and provide the best opportunities for BBH engineering and administration methods. Selecting and using, for growth engineering, an office BH for any of the study offices will force the engineer to include fudge factors to account for traffic outside the

office BH to ensure that objective service is provided. The BBH data and EVE analysis takes the guesswork out of understanding the traffic in an office outside the office BH.

Table 6-3 Busy Hours for One Month's Data on Five Offices

OFFICE	# BBH REPRESENTED	MOST FREQUENT OCCURRENCE OF A BBH (PERCENT)	2nd MOST FREQUENT OCCURRENCE OF BBH (PERCENT)	3rd MOST FREQUENT OCCURRENCE OF A BBH (PERCENT)	ALL OTHER OCCURRENCES OF BBHs
A	11	29.8	15	14	41
B	8	30.3	23.1	22.2	24.3
C	11	52.3	27.3	7.7	12.7
D	6	48.6	30.8	9.7	10.9
E	10	30.8	24.4	23.5	21.2

If the traffic peaking outside the TCBH were within a few percent of the TCBH traffic, then the collection of BBH data would have a small impact on grade of service and future growth engineering. This has been found not to be the case, and specifically offices growing new SMs/SM-2000s can have distinctly different TCBHs on the growth SMs/SM-2000s as compared to the existing office TCBH. In a study office, not listed in Table 6-3, one-third of the SMs/SM-2000s in the office had traffic in the office TCBH that only averaged 60 percent of the traffic in the individual SM/SM-2000 TCBH. This condition can be common with the addition of new SMs/SM-2000s in an office when lines with characteristics different from the existing office are added. If the SMs/SM-2000s are divided into communities or loading divisions with similar BHs, additional equipment will be required due to trapped capacity. Additional communities will also involve more administrative effort.

6.1.4.3.2 EVE Engineering

Even though EVE provides more accurate engineering of an office, it is not always possible to EVE engineer an office because of the lack of EVE data. This is the case mainly for initial engineering; since previous to the 5ESS®-2000 switch, little EVE data was collected. These initial offices should be engineered using ABS and HD values. The engineer should attempt to determine the best HD and ABS ratio possible. After the offices cut over, it is possible to engineer growth jobs and monitor service with use of EVE data.

In engineering equipment in an office, the traffic engineer generates EOP traffic projections. After the cutover of an office, the switch should be monitored for the actual observed traffic to verify the capability of the office to handle the EOP loads. Global resources in an office, like conference circuits, should be monitored by calculating the BS OAM CCS/MS office load.

$$BS \text{ OAM CCS/MS} = \sum_{i=1}^3 \left[\frac{\text{office OAM load } (i)}{3 \times \text{total MS}(i)} \right]$$

where: *BS* = *Busy Season*

MS = *Main Stations*

where this equation assumes 3 months in the BS. The office EOP load is then:

$$BS \text{ OAM(EOP) CCS} = MS(EOP) \times (BS \text{ OAM CCS/MS})$$

For local resources that depend on traffic in an individual unit, such as the LU, calculate the BS OAM CCS/MS load for a community:

$$OAM \frac{CCS}{MS} = \frac{1}{(\#BM)} \times \sum_j \frac{\sum_i (OAM \text{ load for unit } i \text{ in } BM_j)}{\sum_i (\#MS \text{ of unit } i \text{ in } BM_j)}$$

where: BM = Busy Month of the Busy Season

(Traffic is assumed to be spread fairly evenly across the community. Communities are generally co-located equipment within an office or remote cluster of SMs.)

As for the global resource case, the EOP load to verify engineered equipage is verified by:

$$BS \text{ OAM CCS (EOP)} = MS \text{ (EOP)} \times (BS \text{ OAM CCS/MS})$$

(BS = Busy Season)

6.1.4.4 Administration

6.1.4.4.1 BBH Administration

The BBH administration of LUs is very effective. Administrators can look at reports generated by a support system collecting data from their digital switches and quickly assess the quality of service being provided. The LUs that exceed either the 4 percent OAM blocking criteria or 1.5 percent ADP blocking should be flagged for further study. If the traffic levels in all LUs are below these two points, the office is providing a good grade of service in all LUs. For example, look at the data represented by Figure 6-8. The dashed line represents the 4 percent blocking level to be exceeded on the average, at most, only OAM by any individual LU when considering BBH loads (not all loads). This figure represents 53 LUs, with a CCS traffic point plotted for each LU on each one-half hour of the 20 working days (Monday through Friday) in a month. An administrator would like to see, at most, 2×53 points above this line to meet customer service and engineering criteria. However, if all 16 points had been due to one or two LUs, the administrator would have had a service problem in those LUs. (The data collected for this study was charted on the one-half hour to provide better granularity of the traffic. The engineering and administration is typically done by using hourly data. The administrator, in this case, would expect only 53 points to exceed the 4 percent blocking criteria.) In this example, there are only 16 points above this threshold. This office meets the EVE criteria and was providing good service to its customers.

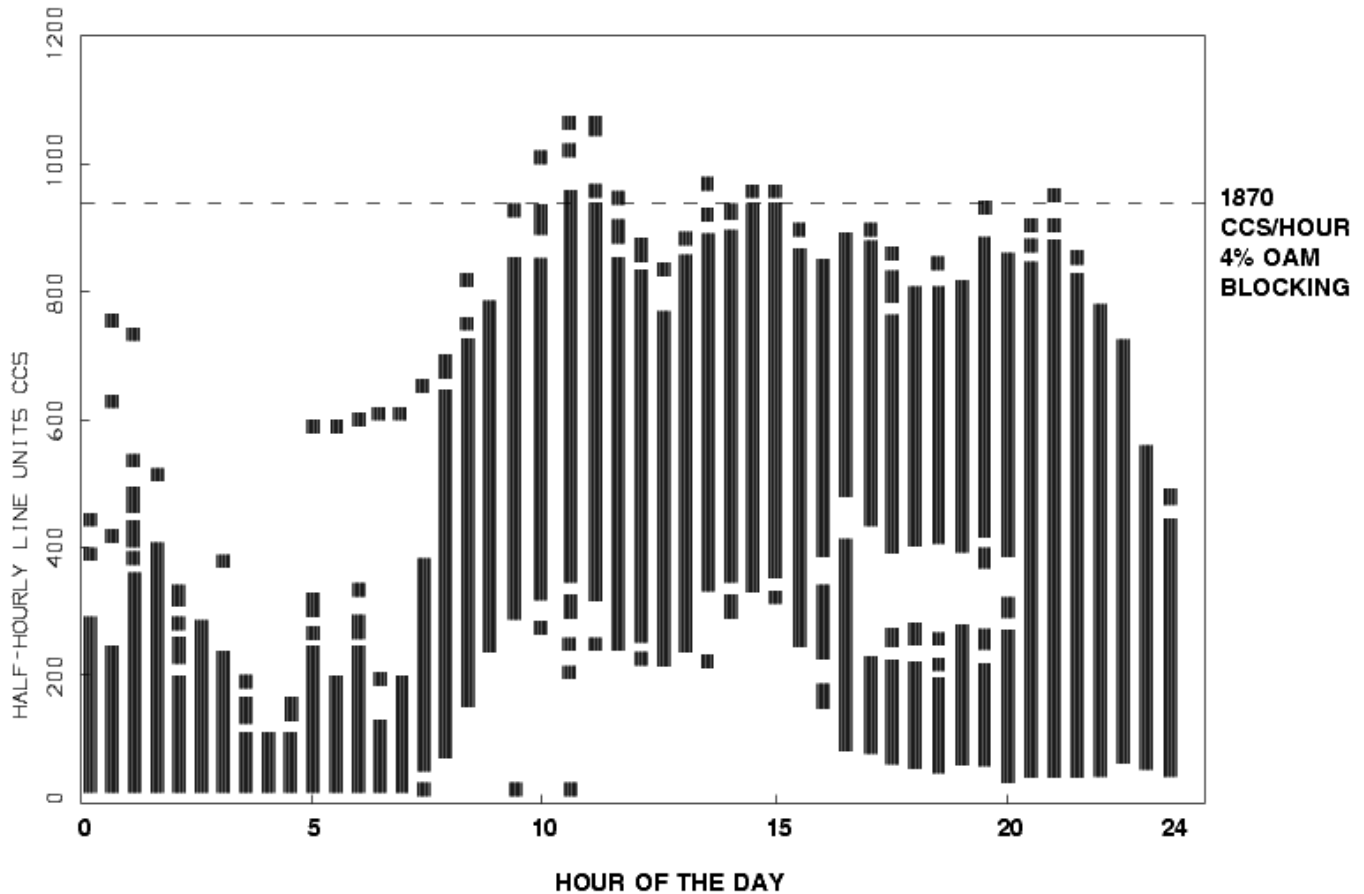


Figure 6-8 53 LUs - Data Points for Each LU Every Half-Hour for 4 Weeks Data points for each LU every half hour for 4 weeks

Additional lines being added to the office in Figure 6-8 should be assigned to those LUs with the smallest OAM CCS. If necessary an administrator can lower the traffic in the highest CCS LUs by moving lines with the highest usage from those LUs to LUs with the lowest OAM CCS. Using these two principles, an administrator can make the best use of the network capacity in an office. Administration by OAM load is important to account for variability in traffic.

Figure 6-9 presents another office with 30 LUs. Here, there are 119 points above the 4 percent blocking criteria instead of the expected 2×30 points. This office certainly has a service problem. 5ESS®-2000 switch LU has a steep load service curve with blocking increasing rapidly at higher CCS usage. In this office, there was not enough LU capacity to shift the traffic from heavy CCS LUs to light CCS LUs to meet service criteria.

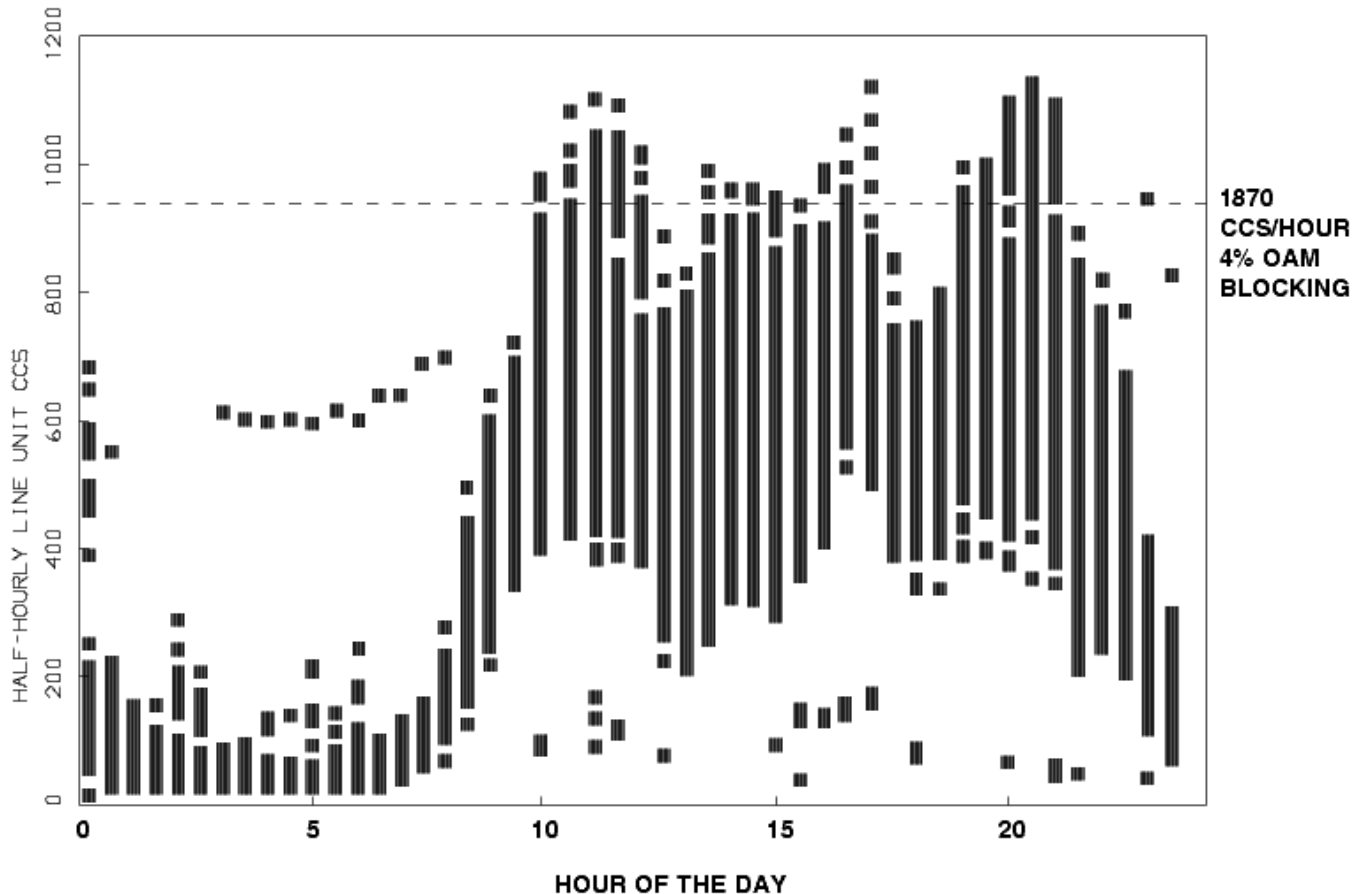


Figure 6-9 30 LUs - Data Points for Each LU Every Half-Hour for 2 Weeks

For this case, the administrator and traffic engineer must work together to add additional LUs and move the highest CCS lines from the heaviest OAM CCS LUs to the new LUs. In this way, the blocking during the BHs can be pulled under the 4 percent OAM level. The important point is to move lines from LUs with the heaviest OAM traffic rather than the heaviest BH traffic. This will insure good service for all LUs for all hours of the day and takes the traffic variability into account.

The office represented by Figure 6-9 was engineered with TCBH ABS data. Figure 6-10 is a plot of the data points in Figure 6-9 averaged by the half-hour. The office BH traffic in this plot meets the ABS engineered traffic level. The reason the office had service problems even though the ABS engineering was correct is because of the high variability of the traffic. The best way to understand this variability, which Figure 6-9 shows as two major BHs and one minor BH, is to study the BBH behavior of the LUs and to calculate the standard deviation of the traffic. The OAM traffic projection predicts the traffic loads seen in the office.

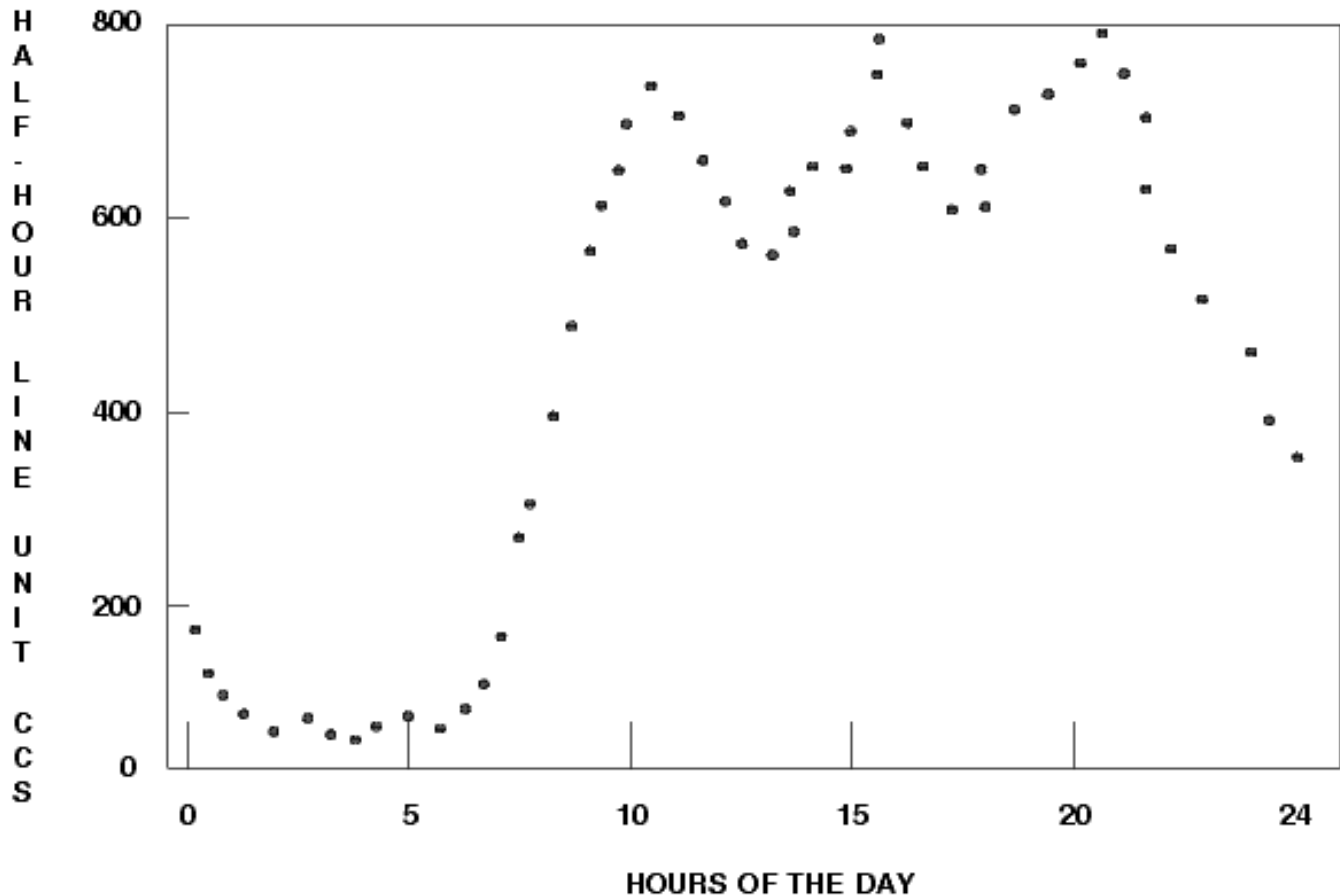


Figure 6-10 30 LUs - Data Points for Each LU Every Hour for 2 Weeks

6.1.4.4.2 Traffic Outside the TCBH

In a study office previously mentioned, the individual LU traffic carried by one-third of the LUs in the office BH was on the average only 60 percent of the traffic in the individual LU TCBHs. The main reasons that cause BBH traffic to be much greater than TCBH traffic are:

- Uneven class of service assignment of lines
- Growth of additional line and/or LUs after initial engineering
- LUs having no clear TCBH.

One philosophy is to treat groups of LUs as separate loading divisions based on their BHs, but this approach will cause the need for additional equipment provisioning due to trapped capacity. For example, if one loading division was business and another residential with a morning and evening BH, respectively, the best use of an LU would be to have a mix of both business and residential traffic on that LU, thus, shifting the traffic from one major peak to two smaller peaks.

If an office has widely fluctuating BBH traffic across its LUs but no significant blocking, it is enough to let the traffic balance evolve through OAM line assignments. The most lightly loaded LUs from an OAM perspective should always be given newly assigned lines. In this way, lines are assigned to lightly loaded LUs regardless of the BHs for the lines. Over a period of time, the mix of business and residential lines will tend to spread out evenly.

6.1.4.4.3 TCBH Administration

The use of TCBH administration has many drawbacks. Since each LU potentially has a different BH and the LU BHs fluctuate day to day, it may not be possible to load new lines to the most lightly loaded LUs. As an example, consider the previously mentioned office in which some LUs were at only 60 percent of their individual BH traffic in the office BH. Loading lines on these LUs with consideration only to the office, TCBH traffic could cause blocking problems in the individual LU BHs. When an administrator prepares to add additional lines to an office, it is probably not known at what hour these individual lines will peak; or, with only TCBH data on the LUs, it is not known when an individual LU peaks. Administering traffic across LUs is difficult because a line being moved may not be peaking at the LU BH where it is being moved from, but may peak at the BH on the LU where it is being moved to. When using BBH data, the administrator is always dealing with the actual heaviest and lightest LU loads; then it is less important in which hour the new or moved lines have a peak usage in the assignment process.

6.1.4.5 Service Criteria

The BBH reports provide the administrator a quick and efficient way to evaluate the service in an office. Typically, a monthly report from an operational support system will list LU identifiers along with the associated ADP and OAM values for those LUs. If all the ADP values are less than 1700 CCS, the administrator is assured that the blocking, at the average load, in each of the LUs is less than 1.5 percent both in the BBH and in the TCBH. The LUs with over 1700 CCS may be providing inadequate service and require administrative actions. The administrator should also glance down the column of OAM numbers to see if any are higher than 1870. If there are LUs with an OAM CCS greater than 1870, these LUs may also be providing inferior service. A LU can be over 1870 OAM and yet be less than 1700 ADP depending on the standard deviation of the traffic. The ADP and OAM calculations provide invaluable information to the administrators about the service in their offices.

The grade of service is dependent on the traffic within each LU. The LUs provide an excellent grade of service for CCS traffic below a threshold. Above that threshold, the blocking increases exponentially. Every 8:1 LU provides service for up to 512 customers. A customer on an individual LU sees his/her telephone service being sensitive mainly to the levels of traffic on the LU where he/she resides. Since the grade of service for each customer is primarily dependent on the LU where he/she resides, the service of an office should be based on the cumulative average BBH service of all the LUs. Measuring the service for this office by looking at a single BH tells an incomplete story. There may be groups of LUs with much higher individual BHs and higher blocking than that seen in the office BH. This was observed in the collected data for all seven offices within this study to varying degrees. An office can be within service guidelines for the office BH and yet be receiving excessive customer complaints due to blocking in hours outside the office BH. Recently EVE service criteria were included in the Local Switching System General Requirements (LSSGR) by Bellcore. A full understanding of service provided within individual LUs is best gained by scanning a BBH traffic report for those LUs.

Office BHs change in the seasons and even with the day of the week. It is much more efficient to let a support system select the BBH for each LU on a daily basis rather than try to keep up with a changing office BH, which may be providing only part of the story in analyzing the service for an office. The grade of service for an office should be measured as an office average of all the LUs ADP values. Monitoring the ADP traffic at 1.5 percent blocking in an office will ensure that the commonly used 1.5 percent TCBH blocking criteria is covered. An office with a true TCBH will have the same values for ADP and ABS. In the office where the ADP value is greater than ABS, the end customers will receive the same quality of service as the end customers on the office with a true TCBH. Single LUs with BBH traffic above 1.5 percent ADP or 4 percent OAM levels may require administrative actions. In this way, all end customers in the office will be provided an acceptable grade of service.

6.1.4.6 Conclusion

The OAM administration techniques are efficient, cost effective, and help to provide uniform service to customers throughout an office. Engineering by use of BBH data with statistical projections of traffic loads allows the engineer to more closely match the traffic and customer service to the engineered equipment. Traditional use of engineering judgment for the unknown traffic outside the BH is not required. Busy hour determinations are unnecessary; and

peak traffic for all hours in each LU is monitored for service, administration, and future growth engineering. In the past the use of TCBH methods was essential because of the difficulty in monitoring more than 1 hour of the day. Today, operational support systems are computerized, monitor traffic 24 hours a day, and can easily select BBH data for switch equipment like the 5ESS®-2000 switch LU. The BBH methods and statistics provide much more accuracy and understanding of office traffic with fewer reports and less overall effort than traditional time-consistent methods.

6.2 SPECIAL STUDIES

6.2.1 SUBSCRIBER LINE BUSY

6.2.1.1 Description

The Subscriber Line Busy (SLB) feature provides two separate peg counts on a terminating subscriber line: an SLB count that indicates the number of times the line is found busy on terminating calls, and an attempt count to indicate the total number of terminating attempts to the line. This feature studies 32 DNs per SM at a time. The data gathered with this feature is valuable for determining how many calls a subscriber is missing, thus giving a more accurate picture of the subscriber's need for additional lines. The SLB feature is intended for individual lines and for the last line of a series completion list. Similar counts are already available for lines in an MLHG; these MLHG counts are reported in TRFC30, Section 34.

From the service providers viewpoint, the SLB feature is primarily a marketing tool to identify subscribers who are missing calls because their lines are busy. This helps them to sell additional lines to those customers. Similarly, the SLB feature benefits the end customers by allowing them to choose the most efficient phone service for their call volume and by avoiding lost business due to insufficient line capacity.

The SLB feature is part of the TRFC30 Section 128 which can be used by the Engineering and Administrative Data Acquisition System (EADAS). However, this is not feasible for software updates deployed in the earlier software releases for several reasons, including the inability to make extensive global memory changes that are required and the inability to change the EADAS data formats for those software releases.

See the Directory Number Measurements (DNM) for the EADAS feature (99-5E-1235).

6.2.1.2 Activation and Deactivation

To use this feature, see TRFC30 Section 128 in 235-070-100 *Appendix, Traffic and Plant Measurements*.

6.2.2 DIGITAL SUBSCRIBER LINE MEASUREMENTS

6.2.2.1 Description

The digital subscriber line measurement (DSL) feature generates usage totals and blockage peg counts of originating and terminating ISDN calls and reports this information to the TRFC30 for each digital subscriber line allowed for collection. Section 77 is added to the TRFC30 reports for this feature.

The primary function of this feature is to collect, format, and report measurement data of individual users on DSLs for administrative load balancing of DSL lines in an ISLU/ ISLU2. The data is gathered from the SMs/SM-2000s every 30 minutes and formatted into reports sent to the Engineering and Administrative Data Acquisition System (EADAS) and, optionally, to the ROP, switching control center (SCC), or traffic channel (TRFCH).

Four input IDs are used by the craftsperson when allowing a DSL to be studied. These four IDs identify the line class equipment number (LCEN) for the ISLU, or (LCKEN) for the ISLU2. Six counts and the LCEN/LCKEN are contained in the TRFC30 Section 77 when this section reports to the EADAS, ROP, or TRFCH.

Section 77 of the TRFC30 report is a special study section and, by default, is inhibited for collection. There is a limit

of the number of DSLs that can be studied at one time and how many may be output to the ROP when Section 77 is allowed for collection and ROP output. All data collected for Section 77 is sent to EADAS and if allowed and equipped, to the TRFCH.

This feature has the following restrictions:

- ROP output for Section 77 is limited to six DSLs.
- The number of DSLs that can be studied at one time is 1024.

6.2.2.2 Limiting Collection and ROP Output for TRFC30 Section 77

There are three study sets associated with this special study Section 77, as follows:

- (1) ALW:TRFC30,CLCT:DSL=SM-ISLU
- (2) ALW:TRFC30,CLCT:DSL=SM-ISLU-LGC-LC.
- (3) ALW:TRFC30,CLCT:DSL=SM-LBD-LGC-LP-LC

The first set is an ISLU study of all DSLs (maximum of 1024) on a specified SM/SM-2000 and ISLU. The second set is called an arbitrary study of selected DSLs (maximum of 1024) on an ISLU on any SM. The maximum number of DSLs that data can be collected from. The second set is a study of one individual DSL. The third set is a study of an individual DSL on the ISLU2 (maximum 1024). This option involves changing the term (LCEN) to (LCKEN) when studies are done on the ISLU2 units. When any one of these sets is allowed for collection, the number of DSLs is limited to 1024. This limit is implemented because of the amount of real time and memory that would be needed to store data for more than 1024 DSLs, depending on the software release.

Besides the limit imposed on the number of DSLs from which data can be collected, the craftsperson is not permitted to use more than one set for collection at the same time. This means if the craftsperson were to allow set one for collection and then try to allow set two for collection, set two would not be allowed for collection until the craftsperson inhibits set one or vice-versa. Once the craftsperson inhibits set one, the craftsperson must type in the allow request for set two again or vice-versa.

A limit of six DSLs allowed or requested for ROP output is imposed regardless of which set is chosen. Also, when the craftsperson requests ROP output from studied DSLs based on the highest, lowest, or most extreme values of a specified count, the allowed number of DSLs is applied. The ROP output limit for Section 77 is implemented to help control the amount of data being sent to the ROP every 30 minutes for TRFC30 sections allowed for ROP output.

6.2.2.3 Activation and Deactivation

To use this feature, see TRFC30 Section 77 in 235-070-100 *Appendix Traffic and Plant Measurements*.

6.2.2.4 Unusual Events Handling

If the craftsperson attempts to allow Section 77 of the TRFC30 report for collection and there is no ISDN SM available, the system responds with the message "NO - FEATURE NOT AVAILABLE". If the craftsperson attempts to print Section 77 and it has not been allowed for collection, the system responds with the message "NG - NOT ALLOWED FOR COLLECTION".

When an allow request is made in the AM, and the SM never receives that request, no counters are pegged for those DSLs allowed during this request and no data is included in the next 30-minute report for those DSLs. If the craftsperson had allowed those DSLs for which the SM never received for ROP output, a "NO DATA" message is

printed for those DSLs. This problem is self-correcting, because at the next 30-minute report, a message is sent from the AM to the SM with all the DSLs that are allowed for collection. This ensures that all DSLs allowed for collection in the AM are allowed in the SM, and that counters get pegged.

If an inhibit request is made by the craftsperson and the SM never receives that request, then an assert may fire because the SM reports more DSLs than the AM has allowed for collection. If the assert fires, the craftsperson must inhibit Section 77 for collection, then reallow it for collection.

6.2.3 DEFAULT CELL GROUP REPORT

6.2.3.1 Description

The 5ESS®-2000 switch Division of Revenue Default Cell Group Report (DCGRPT) feature provides the craftsperson with origination and destination information for an INcoming SEParation class (INSEP) and/or DEstination SEParation class (DESEP) causing the zero cell group traffic separation count to be pegged.

Call origination and destination information to identify calls pegging the default cell group is needed in order to aid craft in identifying incorrect division of revenue (DOR) translations to ensure correct revenue sharing between the carriers and to ensure sufficient revenue collecting from the carriers by the operating companies.

Translation errors result in high peg counts in the default cell group number, and the DCGRPT assists the craftsperson in identifying the origination or destination that is in error in the DOR translations. Translations define the INSEP/DESEP combinations (for example, 0,0; 0,1; etc) to a default cell group. Translators usually choose to use the zero (default) cell group. When INSEP and/or DESEP values are not assigned and default to zero, the call type pegs the cell group defined in translations, usually the zero cell group.

When calls peg the (default) zero cell group, DOR cannot be correctly determined causing loss of revenue for the carriers and for the operating companies. This feature enables switching office personnel to identify the specific directory number (DN) that have not been assigned the correct value and to correct it.

This feature enables the administrator to identify calls pegging the (default) zero cell group because the DCGRPT prints a detailed error message when it encounters a call pegging the (default) zero cell group. The DCGRPT feature allows the craftsperson to request the next 32 calls pegging the (default) zero cell group to be printed at the ROP as often as desired. The commands to allow and stop the DCGRPT are as follows:

ALW:DCGRPT and STP:DCGRPT

The DCGRPT provides the 5ESS®-2000 switch the equivalent of the 1A ESS™ switch DOR feature. The 1A ESS™ Switch DOR feature is a periodic report collecting up to 32 call reports for calls pegging the default cell group. It then prints the report at a particular time each day with information required to identify translation assignments in error. It does not need to be reallowed after the report is printed.

The DCGRPT also has the limit of 32 reports but must be manually allowed, and it does not automatically run on a daily basis. The DCGRPT does not collect data and put it into one report, but it prints a report for each call pegging the DCG and prints 32 separate reports before terminating.

The limit of 32 reports of the zero cell group being pegged has three reasons.

- (1) This feature is a 1A ESS® switch transparency and the 1A ESS switch has the limit of 32.
- (2) Thirty-two is a manageable number for the craftsperson to use to get the translations fixed.
- (3) Without some limit, this feature can cause the ROP to be flooded.

There is, however, no restriction on the number of DCGRPT requests that the craft can manually request after waiting for the previous one to terminate.

6.2.3.2 Activation and Deactivation

Two input messages are provided to allow and to stop the reporting of the DCG peg counts. They are as follows:

ALW:DCGRPT

STP:DCGRPT

One output message, with three formats is provided. Format 1 is provided to report the origination and destination information of calls pegging the Default Cell Group. Format 1 of the new output message is shown in Table 6-4 :

Table 6-4 Output Message Format 1

REPT DCGRPT	DEFAULT CELL GROUPING	
	ORIGINATOR	TERMINATOR
DN:	a	b
SM:	c	d
PORT:	e	f
TG:	g	h

Formats 2 and 3 are termination reports. Format 2 is provided to report termination of the report due to a manual request to stop the report.

REPT DCGRPT MANUAL TERMINATION

Format 3 is provided to report termination of the report due to the limit being reached and the report automatically stopping.

REPT DCGRPT AUTO TERMINATION

Where:

- a = Originating DN for line originations
- b = Terminating DN
- c = Originating SM/SM-2000
- d = Terminating SM
- e = Originating port
- f = Terminating port
- g = Originating trunk group number for trunk originations (incoming trunk)
- h = Terminating trunk group number for trunk terminations (outgoing trunk).

The input messages ALW:DCGRPT and STP:DCGRPT allows and stops, respectively, the reporting of the next 32 calls with INSEP and DESEP values causing the DCG to be pegged. The reporting of the zero cell group peg counts automatically turns itself off after printing the 32 calls pegging the count, but the craftsperson can turn it off at any time by entering the STP:DCGRPT. Re-entering the ALW:DCGRPT command after 32 messages have been output or after the STP:DCGRPT message has been input allows 32 more. There is no restriction on the number of

times the DCGRPT can be requested by the craftsperson.

CAUTION: If this feature is allowed (ALW:DCGRPT) during periods of heavy ROP usage, the output of the default cell group report is subject to throttling. The impact of throttling is that from one to all of the reports, including the "auto terminating" message may not be printed. This report should not be used during these times.

6.2.4 BLOCKED CALL INDICATOR REPORT FEATURE

6.2.4.1 Description

The blocked call indicator (BCI) feature is used to help the switch administrator identify LENs which are experiencing A- or B-link blockage in an LU concentrator and is used to improve load balancing.

Once turned on, blockages are reported by output messages to the ROP and SCCs channel. (This report does not print as a section in the TRFC30 reports; therefore, it cannot be collected by EADAS.)

Blockages occurring in the 5ESS®-2000 switch are pegged as dial tone delay (DTDPC Section 4) and terminating blockage (TMLK Section 11) on a per SM/SM-2000 or per LU basis. Using the BCI ORIG command, the 5ESS®-2000 switch prints the LEN that experienced DTD at the time it occurred. Utilizing the BCI TERM command, the 5ESS®-2000 switch prints the LEN that experienced TMLK at the time it occurred.

For originating calls, the same LEN may be recorded and reported in successive 4-second intervals for a single origination. This occurs if the caller remains off-hook during two or more successive 4-second reporting intervals while an A- or B-link blockage exists. Because a path through the concentrator is repeatedly sought, the same port continues to be recorded as blocked until the caller hangs up or a path through the A- or B-links is obtained.

For a blocked terminating call, the affected port is recorded and reported only once because there are no retries by the switch of blocked terminating calls.

When activating either the BCI TERM or BCI ORIG report, the administrator can choose an SM/SM-2000 or a range of SMs/SM-2000s to study. Also, the administrator may specify the number of blockage messages (from 1 to 1024) that are reported prior to the feature turning itself off in a given SM/SM-2000 (the default is 64).

The maximum number of output messages that are reported per SM/SM-2000 can be manually set by using the MAX field of the input message. Since originating and terminating reporting are activated with separate input messages, different MAX values may be used for each. The use of system resources for BCI to report A- and B-link blockage negatively affects call processing capacity when frequent blockages occur. If a large amount of blocking is expected, it is recommended that the elected value for maximum messages (MAX) be kept small to avoid excessive message processing.

When an SM/SM-2000 reports the last of its maximum messages, reporting is halted for that SM/SM-2000 only. Originating and terminating blockage are treated as separate reports, and are halted independently.

If the BCI feature is activated and it becomes desirable to change the SM/SM-2000 range or the Max value, the feature (either ORIG or TERM) must first be turned off with a STP:BCI message before restarting the feature with the desired values.

The BCI feature can be teamed with Line Unit Concentrator Utilization Measurement (LUCUM) feature to study line usage in concentrators. The BCI can be used to indicate the concentrators in which blockage problem are occurring. The LUCUM feature can be turned on to study all of the lines in the identified concentrators in detail. Individual line usage, attempts, and blocked attempts are provided in LUCUM to help determine an appropriate course of action.

6.2.4.2 Activation and Deactivation

The BCI reporting is invoked by entering the following command (MML format):

```
ALW:BCI,{ORIG|TERM},SM=a[&&b][,MAX=c]
```

where:

ORIG | TERM The administrator must select either originating or terminating call blockage reporting. Both types of reporting can be active at the same time, but each must be activated with a separate input message.

SM The administrator must choose the SM(s)/SM-2000(s) to study by using the SM/SM-2000 keyword. One or a range of SM(s)/SM-2000(s) may be specified.

CAUTION: The potential for large numbers of output messages and the resulting effect on overall system performance should be considered before selecting a broad range of SMs/SM-2000s. If widespread blockage is suspected, it is advisable to activate this feature for a single SM/SM-2000 or a small range of SMs/SM-2000s at a time.

MAX The administrator may specify the maximum number (1 to 1024) of blockage messages to be reported prior to the feature turning itself off in a given SM. A separate MAX value may be specified for originating and terminating blocked calls. If the administrator does not enter a value, a default value of 64 is used.

CAUTION: The potential for large numbers of output messages in a short period of time and the resulting effect on overall system performance should be considered in selecting a value for MAX.

Manually stopping BCI reporting:

```
STP:BCI{ORIG|TERM}
```

NOTE: The originating and terminating BCI reporting are stopped independently of each other.

The following is an example of BCI (ORIG and TERM Reports):

```
S555-55 89-01-01 12:00:00 555555
```

```
A REPT BCI ORIG LEN=2-1-7-1-3-3 6/256
```

```
S555-55 89-01-01 12:05:30 555567
```

```
A REPT BCI TERM LEN=2-1-7-1-3-3 21/256
```

x/256 indicates the number of messages reported out of 256 MAX messages.

NOTE: These "BCI ORIG" or "BCI TERM" messages may be filtered at an SCC or equivalent data surveillance system.

6.2.5 LINE UNIT CONCENTRATOR UTILIZATION MEASUREMENTS

6.2.5.1 Description

The LU concentrator utilization measurements (LUCUM) feature enables the administrator to request traffic

measurements on individual lines to determine if they are experiencing blocking, to assist them in determining what lines are being affected, and how the call load may be redistributed to alleviate a high blocking situation.

The administrator is able to request traffic measurements of customer lines from 1 to 20 concentrators. Twenty concentrators (20 half grids) provide per-line usage information on up to 640 lines (full 10:1 LU).

The LUCUM report is reported at half-hour intervals with the capability to control the destination of the report. This report prints out as a Traffic 30 report in Section 90 and is automatically sent to the EADAS Channel.

6.2.5.2 Activation and Deactivation

The craftsperson is able to enable and inhibit this report for output to the ROP, SCCs, and the network administration center (NAC).

6.2.5.2.1 Input Messages

Activation via message mode:

ALW:TRFC30,{CLCT|ROP|TRFCH}:LINE[=SM#-LU#-CONCEN#]

INH:TRFC30,{CLCT|ROP|TRFCH}:LINE[=SM#-LU#-CONCEN#]

OP:TRFC30:LINE

Activation via recent change:

Recent Change View 13.4 to activate LUCUM

The allow message activates LUCUM for one concentrator at a time. Using the Recent Change View 3.4 or 13.4, activation of 20 concentrators can be input in one view at one time. Depending on the software release, the administrator can study up to 8 or 20 concentrators anywhere in the office at a time. The LUCUM report prints all 32 lines in the concentrator whether there is usage on the line or not. If the report is printed to the ROP, only the line with nonzero data prints.

Output Messages:

OP:TRFC30, LINE

The per-line measurements to be reported are total attempts, blocked attempts, and traffic usage in CCS.

LUCUMs column definitions:

ATMPTS Column

This column contains all originating and terminating attempts for the line being studied, and contains the following information:

Origination Attempts: Pegs when the line being studied goes off-hook.

Termination Attempts: Pegs when anyone tries to terminate to a line that is being studied is busy, ringing, off-hook, or blocked.

BLOCK Column

This column contains all originating (DTD) and terminating (TMLK) blocking that has occurred for the line being studied, and contains the following information:

Origination Blocked Pegs when the line being studied is blocked at the concentrator because of A or B link blockage (DTDPC in Section 4 should also peg).

Termination Blocked Pegs when someone trying to call the line being studied cannot get into the concentrator because of A or B link blockage (TMLK in Section 11 should also peg).

USAGE (ORIG & TERM) Column

Pegs every 100 seconds if the line being studied is off-hook.

An example of the LUCUM report to the ROP is shown in Figure 6-11.

S555-555555 88-09-08 10:01:40 001521

OP TRFC30 LINE

TIME 10:00:23

SECTION 90: LINE COUNTS

SM	TYPE	LINE ID	ATMPTS	BLOCK	USAGE
1	0	1-5-16	1	0	0
1	0	1-5-25	1	0	0
1	0	1-5-27	0	0	14

LINE ID
a-b-c

a= LU NUMBER b= CONCENTRATOR (GRID & BOARD) c= LINE NUMBER (SWITCH & LEVEL)

Figure 6-11 Example of LUCUM Report to the ROP

To manually determine the GRID & BOARD from the "CONCENTRATOR" (b-Column):

Divide the CONCENTRATOR number in the LINE ID (b) by 2.

The quotient is equal the GRID; if there is a remainder, then the LEVEL is equal to 1, otherwise 0.

To manually determine the SWITCH & LEVEL from the "LINE NUMBER" (c-Column):

Divide the LINE NUMBER in the LINE ID (c) by 4.

The quotient is equal the SWITCH; the remainder equals the LEVEL.

Tables 6-5 and 6-6 are contained in the software update and output manuals that shows the SWITCH & LEVEL and GRID & BOARD by the "LINE ID" numbers:

Table 6-5 LINE ID vs Grid & Board

LINE ID	GRID	BOARD
CONCENTRATOR b		
0	0	0
1	0	1
2	1	0
3	1	1
4	2	0
5	2	1
6	3	0
7	3	1
8	4	0
9	4	1
10	5	0
11	5	1
12	6	0
13	6	1
14	7	0
15	7	1
16	8	0
17	8	1
18	9	0
19	9	1

Table 6-6 LINE ID vs. Switch & Level

LINE ID LINE	SWITCH	LEVEL
NUMBER		
0	0	0
1	0	1
2	0	2
3	0	3
4	1	0
5	1	1
6	1	2
7	1	3
8	2	0
9	2	1
10	2	2
11	2	3
12	3	0
13	3	1
14	3	2
15	3	3
16	4	0
17	4	1
18	4	2
19	4	3
20	5	0
21	5	1
22	5	2
23	5	3
24	6	0
25	6	1
26	6	2
27	6	3
28	7	0
29	7	1
30	7	2
31	7	3

6.2.6 INDIVIDUAL LINE UNIT MEASUREMENT REPORT

6.2.6.1 Description

This feature allows the administrator to request traffic measurements of any 128 individual lines in the office. Both LUCUM and ILUM can be used at the same time provided that the total number of lines being studied does not

exceed 640. The ILUM feature reports at every half-hour interval and prints out in the same report as LUCUM (TRFC30 Section 90).

6.2.6.2 Activation and Deactivation

Activation via message mode:

ALW:TRFC30,{CLCT|ROP|TRFCH}:ILA[=SM#-LU#-CONCEN#-LINE#]

INH:TRFC30,{CLCT|ROP|TRFCH}:ILA[=SM#-LU#-CONCEN#-LINE#]

Activation via recent change view:

Recent Change view 13.5 to activate ILUM

The allow message activates ILUM for one or several lines at a time. Using the Recent Change View 3.9 or 13.5, activation of up to 128 individual lines can be input in one view at a time.

Output Messages:

SAME AS LUCUM

6.2.7 ADDITIONAL DATA ON CALLS ROUTED TO REORDER FEATURE

6.2.7.1 Description

This feature collects additional information for calls routed to reorder. The information provided assists the administrator in identifying switch-related problems or translation errors and in better engineering the switch resources to improve call completion performance of the 5ESS®-2000 switch.

A reorder peg count is presently provided on the 5ESS®-2000 switch TRFC15 and TRFC30 traffic reports. The count provides the number of calls that are not completed and are given a reorder tone treatment because of switch-related problems (such as, unavailability of switch resources), or other conditions for which the local office may not be responsible (such as, invalid digits dialed).

The intended uses of this feature are as follows:

- To provide information to differentiate whether a reorder is because of a switch-related problem or generated by user action.
- To provide information for identifying switch problems (such as, hardware failure, resource shortage, etc.), and in reengineering the switch resources.

Upon activation of the feature, per call data such as originating SM, port number, time of event, call state, and called DN etc. are collected for calls that are being given a reorder tone.

Depending on the call stage, a call that is being routed to reorder may not have all the preceding information available at that instant.

In addition to the TRFC outputs, information collected is output on the ROP at the end of a 15-minute interval or when 30 reorder calls are recorded, or upon request by the craftsperson at any time. It is also sent to "down stream" processing systems.

This feature provides the following additional information, if available, for each call that is routed to reorder.

- Time of event
- Originating SM/SM-2000 and port number
- Call state (such as, dialing, transient, audible ringing, etc.)
- Terminating DN
- Terminating SM/SM-2000 and port number if available.

Activation of the feature is by an input message from the craftsperson specifying an SM/SM-2000 or a range of SMs/SM-2000s to be covered by the feature. While active, this feature collects the pertinent information for each call routed to reorder as it occurs. At the conclusion of the feature or upon the request of the craftsperson to terminate the feature with a print option selected, the collected data is output on the ROP as one or more reports.

This feature can only be activated upon request from the craftsperson by an input message.

The 5ESS[®]-2000 switch stores the reorder data, and prints on the ROP when the feature is terminated automatically. When the feature is terminated by an input message from the craftsperson, the 5ESS[®]-2000 switch provides an option allowing the reorder data to be printed on the ROP. Default is termination without printing on the ROP.

This feature has the following limitations:

- This feature is limited to a maximum of 15 minutes or 30 reorder calls recorded on the reorder buffer per office.
- This feature does not allow multiple activations simultaneously. This feature must be terminated before it can be reactivated again.
- Depending on the call stage, this feature may not have all the information for a reorder call as described in Section 4. Usefulness of this feature for these cases relies on careful analysis of the available data as well as the TRFC15 and TRFC30 reports by the craftsperson.
- Information on the terminating end of a reorder call is probably unavailable for most of possible reorder scenarios. Therefore, except for the terminating DN, no other terminating information is included on the reorder reports.
- Reorder reports to the ROP are subject to throttling/brevity control of the human/machine interface subsystem; a reorder report can be lost under these circumstances.

6.2.7.2 Activation and Deactivation

Three new craftsperson input and output messages are created to facilitate the interfaces:

- (1) A message for conveying the craftsperson's activation or termination command, ALW:REORD,SM=a[&&b] INH:REORD[,PRINT]
- (2) A message for output reorder reports on the ROP

REPT REORD: PART a OF b

ORIG ORIG CALL CALL CALLED

TIME	SM	PORT	STATE	TYPE	DN
cc:cc:cc	d	e	f	g	h

(3) A special TTY message for indicating no reorder data to the ROP:

REPT REORD: {NO REORDER DATA COLLECTED | MANUAL TERMINATION W/O DATA REPORTING}

Where:

a = Instance number of a report.

b = Total number of reports.

c = Time of reorder, in the form Hours:Minutes:Seconds.

d = Originating SM number.

e = Originating port number in hexadecimal.

f = Call state as seen from the originating customer.

D - Dial

T - Transient

A - Audible Ringing

U - Others (unspecified)

g = Call Type

LL - Line to Line

LT - Line to Trunk

TL - Trunk to Line

TT - Trunk to Trunk

IW - OSPA Inward

NA - Not Available

*h = called DN. It is a switch translated
DN, not necessarily the dialed digit
string.*

6.2.8 VERIFY MULTILINE HUNT GROUPS

The verify multiline hunt group (MLHG) capability allows the service provider administrators to verify MLHG group and member information.

After the VFY:MLHG input message is typed, the ability to verify MLHG feature generates a report containing group and/or member information on a particular MLHG. The information is used to verify MLHG data. An example of the command is as follows:

VFY:MLHG,GROUP=89,DEVICE="ttya",REPORT=B

where:

VFY:MLHG = The input command.

GROUP = The identifying group number
of the MLHG. This is a required argument.

DEVICE = The output device where the
report is to be printed. Any device that is defined in the
ECD may be requested. By default, the output is the same
terminal where the VFY:MLHG input message was entered.
Values specified for this argument must be enclosed in
quotation marks. This is an optional argument.

REPORT = Indicates that the report
will consist of group information only, member information
only, or both group and member information. By default, both
group and member information is printed. This is an optional
argument.

REPORT=G|M|B where:

G = Report group information only.

M = Report member information only.

B = Report both group and member information.

The following are group and member reports for an example circuit MLHG having two members (In the group report shown in Table 6-7 for the example circuit, a DN is not listed).

Table 6-7 Verify MLHG=12 Group Report

MLHG FEATURE LISTED DN	/MHMBOV
Subgroup DN 1	2500801
Subgroup DN 2	2500802
Subgroup DN 3	2500803
Subgroup DN 4	2500804
Subgroup DN 5	2500805
Subgroup DN 6	2500806
Subgroup DN 7	
Subgroup DN 8	
Local or Global Group	G
Group Size	29
Actual Size	16
Hunting Module	15
Monitored	N
ISAT Group Monitoring This MLHG	0
Group Make Busy	N
Group Make Busy Scan Point	
Position 1 Make Busy Scan Point	047001413
Position 2 Make Busy Scan Point	
Position 3 Make Busy Scan Point	
Position 4 Make Busy Scan Point	
Position 5 Make Busy Scan Point	
Position 6 Make Busy Scan Point	
Position 7 Make Busy Scan Point	
Position 8 Make Busy Scan Point	
Position 9 Make Busy Scan Point	
Position 10 Make Busy Scan Point	
Position 11 Make Busy Scan Point	
Position 12 Make Busy Scan Point	
Position 13 Make Busy Scan Point	
Position 14 Make Busy Scan Point	
Position 15 Make Busy Scan Point	
Position 16 Make Busy Scan Point	
Queuing Active	N
Queuing Feature	
Queuing Module	0
Queue Basic Size	0
Queue Extended Size	0
Overflow Message Register	047000222

Table 6-8 is the member report for the same example circuit. Each member has two rows of information. The first row contains the member's data corresponding to the page header:

TERM NO	Terminal Number (Member Number)
MEMBER DN	
OE	Office Equipment Number
LCC	Line Class Code
PIC	Prescribed Inter-LATA Carrier Identification number
BILLING DN	
MEMBER MAKE BUSY	member make busy scan points (port information)
STOP HUNT SCAN POINT	
TERM TYPE	(A,B,C,D for voice and A,B,C,D,E for data)

The second row contains a series of flags describing each member. The possible flags are:

SUST	Suspend Terminations (Y/N)
SUSO	Suspend Originations (Y/N)
INTERCEPT	(ICP = Y/N)
NOHUNT	(member Y/N)
GST	Ground start (Y/N)
TTONE	Touch-Tone (Y/N)
SHARED	Shared DN (Y/N)
MULTIDN	Multiple DN (Y/N)
BRCS	(Y/N)
MULTIPOINT	Multipoint port for ISDN (Y/N)

If the flag appears, the member has that attribute.

Table 6-8 Verify MLHG=12 Member Report Page 1

TERM NO	MEMBER DN	OE	LCC	PIC	BILLING
Flags: 2	INTERCEPT	GST L04800143	TTONE ATN	SHARED	BRCS
Flags:	SUST	NOHUNT	TTONE	BRCS	

The group and member reports for an example packet MLHG having 2 members would be as shown in Tables 6-9 and 6-10.

Table 6-9 Verify MLHG=335 Group Report

MLHG Feature	/MHPS
Listed DN	9798000
Last Listed DN	9798050
Hunting Module	7
Local or Global Group	G

Table 6-10 Verify MLHG=335 Member Report

TERM NO	MEMBER DN	USER TYPE	LCC	CHANNEL CONFIG	Flags: INTERCEPT
1	7964532	PPD	102	PPD	
2	7964535	PPB	102	PPB1	

In the MEMBER REPORT shown in Table 6-10 for a packet MLHG, each member has one row of information corresponding to the page header and a flag indicating that this member has INTERCEPT set.

6.2.9 LU/ISLU LOAD ADMINISTRATION TRAFFIC MEASUREMENTS

6.2.9.1 General

Network administrators must constantly monitor the traffic load on switch resources to provide and maintain a specified grade of service. Lucent Technologies developed two TRFC30 section measurements (Sections 144 and 145), so that network administrators can identify specific LU half grids or ISLU LGCs with excessive high usage or low usage and take appropriate administrative actions. When new lines are being added, for instance, the new TRFC30 sections identify the highly loaded LU half grids and ISLU LGCs which can then be skipped for assignment, and identifies the lightly loaded LU half grids and ISLU LGCs which can then be used for assignment. In the case of balancing, highly loaded half grids or LGCs can be identified for deloading of high usage lines.

In line assignment, the objective is to maximize the number of assigned lines on an LU/ISLU without exceeding its usage capacity, expressed in CCS. For instance, under certain conditions, the recommended traffic capacity of an LU (with 8:1 concentration) which is engineered for 1.5 percent blocking in the 5ESS[®]-2000 switch is 1700 CCS. If the average usage for all lines in an LU is 5 CCS, then only 340 (= 1700/5) terminations, out of 512, are possible. However, if the average usage on each line is 2 CCS, then the total usage is only 1024 CCS (512 × 2) out of 1700. Yet no more than 512 lines can be accommodated in an LU with 8:1 concentration. So the task of the network administrator is to assign as many lines to an LU without exceeding its engineered capacity.

The network administrator can optimize the number of lines on an LU and ISLU through load administration by using the new TRFC30 Section 144 and 145. By using Section 144 and 145 for load balancing, a mix of "high" and "low" CCS load lines can be assigned to different LU/ISLUs to achieve the most efficient line administration scheme. If the LU/ISLUs are not properly administered, excessive blocking may occur in the unit, causing degradation in service.

To properly administer the LU/ISLUs, measurements on usage should be available for each load unit [load unit = switch group (half grid) for the LU and LGC for the ISLU]. The smallest load component in an LU is the switch group (SG) or half grid, and the smallest loading component within an ISLU.3 is the line group controller (LGC). Two new traffic counts have been added, one each, to two new TRFC30 sections. Section 144 provides statistics on usage per switch group and Section 145 provides statistics on usage per LGC.

Decisions on administration of LUs and ISLUs cannot be made on single data points from traffic measurements; meaningful analysis can be made only from data accumulated over time. In 1 ESSTM and 1A ESSTM switches, weekly statistics (total or average) on usage are used for efficient administration of LUs. Similarly, Sections 144 and 145 should be used in computing weekly statistics for administering LU/ISLUs in the 5ESS[®]-2000 switch.

The data for the two traffic counts is output to either the Engineering and Administration Data Acquisition System (EADAS) or the traffic channel. The 5ESS[®]-2000 switch passes the traffic counts to EADAS or to the traffic channel at the end of 30 minutes. EADAS also electronically passes the raw data daily to a downstream system.

6.2.9.2 Line Unit

One usage count is computed for the entire operational LU switch group (half grid) based on a 100-second scan of lines in the switch group. This count is available for LU1, LU2, and LU3. The switch group is also known as a half-grid. A switch group, shown in Figure 6-12, has up to 32 lines spread across eight switches (0-7) with four lines per switch.

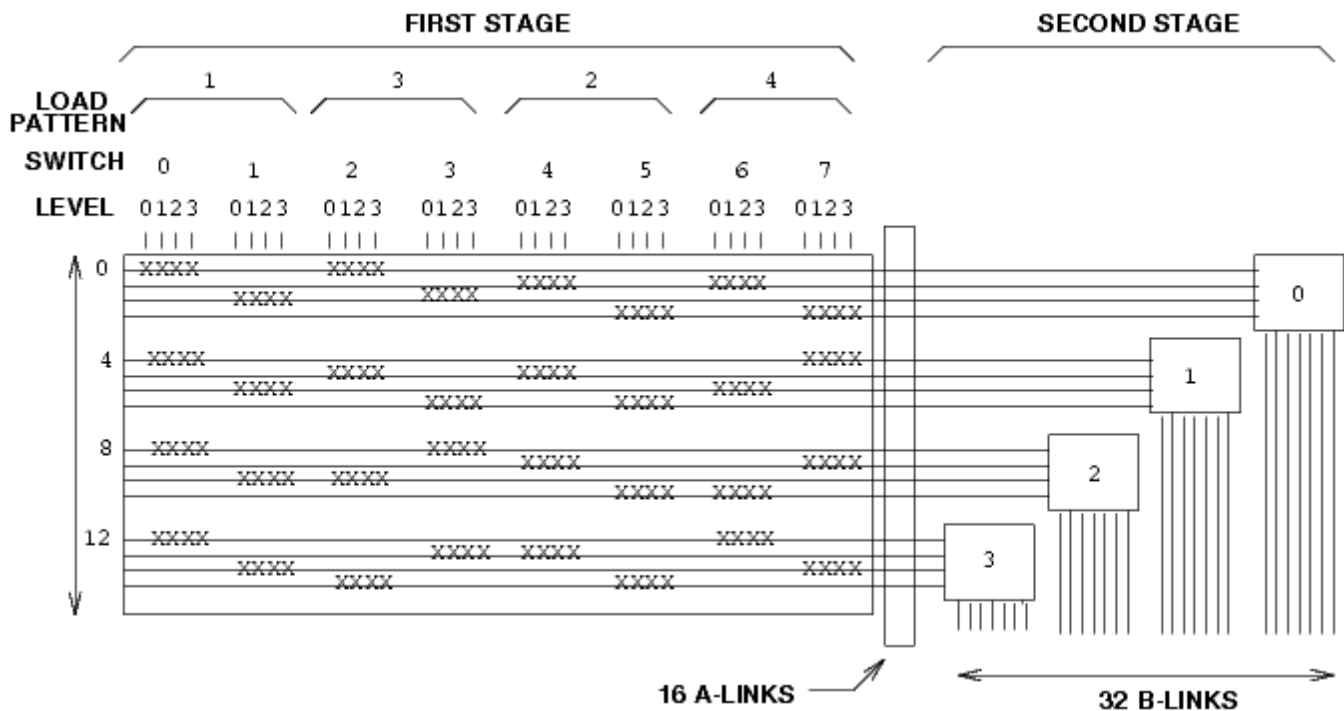


Figure 6-12 Switch Group Half Grid

The number of individual usage counts for one LU is twice the number of concentrators (or the concentration ratio)

in the LU as shown in Table 6-11 .

Table 6-11 Switch Counts per Concentration Ratio

CONCENTRATION RATIO	SWITCH GROUP
10:1	5
8:1	4
6:1	3
4:1	2

Traffic usage is computed for concentrator busy A-links. For each switch group, the traffic count reflects usage due to the following:

- Circuit-switched calls (voice and/or data)
- Terminal maintenance
- Network fabric exercise.

Any off-hook condition such as test calls reflects usage.

The traffic count does not reflect diagnostic maintenance.

This procedure is consistent with the way traffic and maintenance usage are measured and reported in other TRFC30 sections. Because there is a 2:1 concentration in the switch group, the theoretical maximum value per switch group is $16 \times 18 = 288$ CCS per half hour. Of course, the minimum value is 0.

NOTE: Line units with no traffic usage and Line Units that are operational but out of service will all report 0 (zero) traffic usage.

Usage data for the LU half grid is reported by TRFC30 Section 144. The network administrator selects specific LUs (not switch groups) for study through Recent Change/Verify Views 13.6 (Figure 6-13).

5ESS SWITCH RECENT CHANGE 13.6

SCREEN 1 OF 3 LU/(R) ISLU MEASUREMENTS

*1. UNIT TYPE

*2. STUDY GROUP

3.UNITS FOR DATA COLLECTION (DATA COLL)

ROW	SM	UNIT NO.	ROW	SM	UNIT NO.	ROW	SM	UNIT NO.	ROW	SM	UNIT NO.
1	—	—	8	—	—	15	—	—	22	—	—
2	—	—	9	—	—	16	—	—	23	—	—
3	—	—	10	—	—	17	—	—	24	—	—
4	—	—	11	—	—	18	—	—	25	—	—
5	—	—	12	—	—	19	—	—	26	—	—
6	—	—	13	—	—	20	—	—	27	—	—
7	—	—	14	—	—	21	—	—	28	—	—

5ESS SWITCH RECENT CHANGE 13.6

SCREEN 2 OF 3 LU/(R) ISLU MEASUREMENTS

3.UNITS FOR DATA COLLECTION (DATA COLL)

ROW	SM	UNIT NO.	ROW	SM	UNIT NO.	ROW	SM	UNIT NO.	ROW	SM	UNIT NO.
29	—	—	39	—	—	49	—	—	59	—	—
30	—	—	40	—	—	50	—	—	60	—	—
31	—	—	41	—	—	51	—	—	61	—	—
32	—	—	42	—	—	52	—	—	62	—	—
33	—	—	43	—	—	53	—	—	63	—	—
34	—	—	44	—	—	54	—	—	64	—	—
35	—	—	45	—	—	55	—	—	65	—	—
36	—	—	46	—	—	56	—	—	66	—	—
37	—	—	47	—	—	57	—	—	67	—	—
38	—	—	48	—	—	58	—	—	68	—	—

5ESS SWITCH RECENT CHANGE 13.6

SCREEN 3 OF 3 LU/(R) ISLU MEASUREMENTS

3.UNITS FOR DATA COLLECTION (DATA COLL)

ROW	SM	UNIT NO.	ROW	SM	UNIT NO.	ROW	SM	UNIT NO.	ROW	SM	UNIT NO.
69	—	—	77	—	—	85	—	—	93	—	—
70	—	—	78	—	—	86	—	—	94	—	—
71	—	—	79	—	—	87	—	—	95	—	—
72	—	—	80	—	—	88	—	—	96	—	—
73	—	—	81	—	—	89	—	—	97	—	—
74	—	—	82	—	—	90	—	—	98	—	—
75	—	—	83	—	—	91	—	—	99	—	—
76	—	—	84	—	—	92	—	—	100	—	—

Figure 6-13 RC/V View 13.6**6.2.9.3 Integrated Services Line Unit (ISLU)**

The maximum value for a LGC cannot be easily determined. It depends on the number of nailed-up time slots (PPB channels) assigned. The number may easily vary from one LGC to another. A PPB nailup uses up a dedicated TS on the LIDB, reducing the number of TSs available for CS calls. This affects the maximum value of the usage traffic count in TRFC30 Section 145.

For each LGC with U- or T-cards, the traffic count reflects usage due to the following:

- Circuit-switched calls (voice or data)
- On demand B channel (packet-switched) calls
- Dedicated or nailed-up B channels
- Terminal maintenance.

On demand B channel usage must be included in the usage because it competes with circuit-switched calls (voice or data) for time slots.

The traffic count will not include the following:

- Diagnostic maintenance usage
- D-channel usage
- Control time slot usage.

For each LGC with Z-cards, the traffic count includes the following usage:

- Voice
- Voice graded data service
- Terminal maintenance.

The LGC usage data is reported via TRFC30 Section 145 for the selected ISLUs. The network administrator specifies the selected ISLUs (not LGCs) through the Recent Change/Verify Views 13.6 (Figure 6-13).

NOTE: Neither the 5ESS[®]-2000 switch nor EADAS calculates weekly statistics on the usage measurement. The weekly statistics are computed in a downstream system, outside Lucent Technologies' domain (see Figure 6-14).

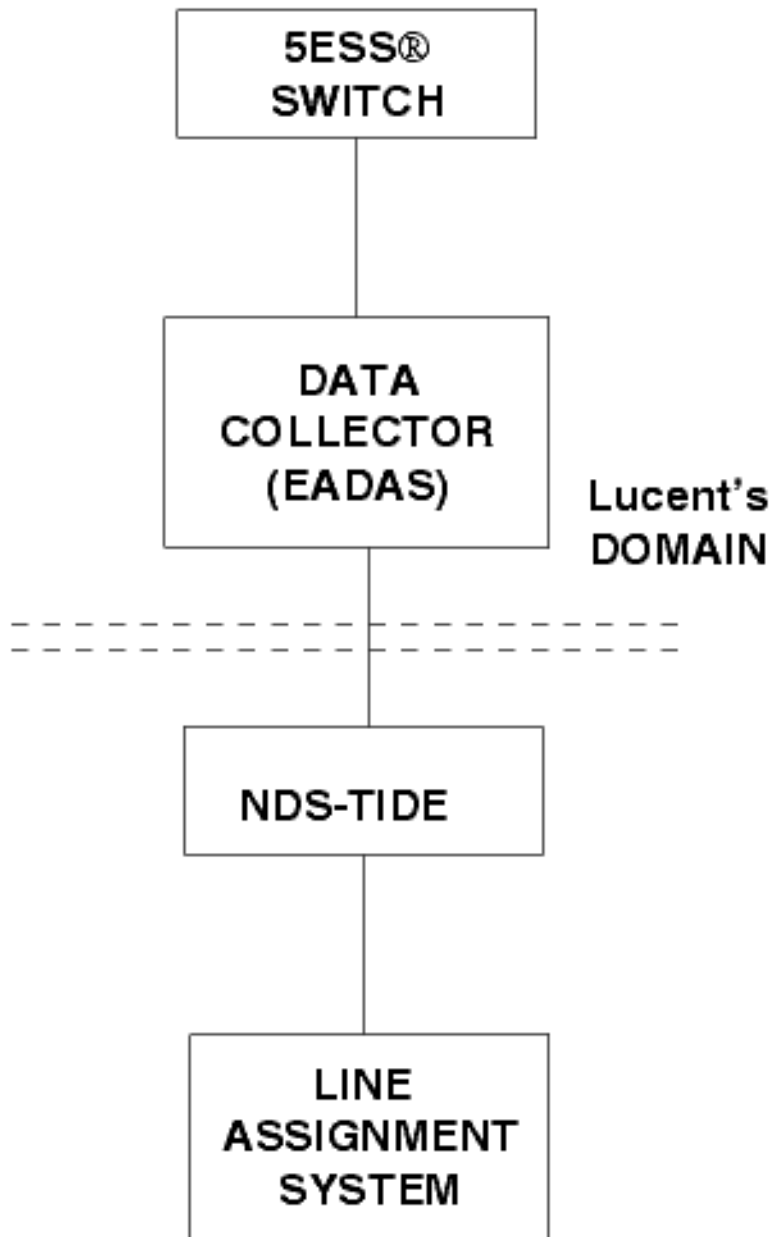


Figure 6-14 Various System Views

6.2.9.4 Output

TRFC30 Sections 144 and 145 (See Figures 6-15 and 6-16) are output to the traffic channel or to the EADAS channel. To avoid overloading the ROP, only six records may be sent.

OP TRFC30 SG

TIME HH:MM:SS

SECTION 144: SWITCH GROUP MEASUREMENTS

SM	LU	CONC	SG	USAGE
XX	XX	XX	XX	XX
XX	XX	XX	XX	XX

Figure 6-15 Section 144 Switch Group Measurements

OP TRFC30 SG

TIME HH:MM:SS

SECTION 145: LINE GROUP CONTROLLER MEASUREMENTS

SM	ISLU	LGC	USAGE
XX	XX	XX	XX
XX	XX	XX	XX

Figure 6-16 Section 145 Switch Group Measurements

6.2.9.5 Activation

These measurements are not automatically provided; they have to be activated for specific study groups. A network administrator may not want to collect data on all LU/ISLUs in the entire office; instead, the administrator may choose to focus only on overloaded or under loaded LUs. Therefore, network administrators must select the LUs and ISLUs on which data will be collected before the TRFC30 Sections 144 and 145 are activated. Each of the two TRFC30 sections can be activated individually.

To generate LU/ISLU traffic measurements the network administrator must do two things: first, set up a study group through Recent Change View 13.6 (Figure 6-13), and second, enter an input message for that study group. These two procedures are described next.

6.2.9.6 Recent Change/Verify 13.6

Recent Change/Verify (RC/V) 13.6 (Figure 6-13) has been added to specify the LUs and ISLUs on which data will be collected. Note that the same view will be used for the LUs and ISLUs as shown in Figure 6-13. (LUs and ISLUs are not mixed on a given view.)

Through RC/V view (Figure 6-13), the network administrator will set up a study group. For each LU/ISLU, up to five study groups (each study group containing not more than 100 LU/ISLUs) can be defined by the network administrator. To do this, the network administrator enters the study group number, unit type, and SM-LU/ISLU number (up to 100).

Recent change (RC) checks whether the SM/SM-2000 and the LU/ISLU are operational. An error message is returned if these checks fail. An error is also returned by RC if the network administrator makes a duplicated entry. However, duplicate SM-LU/ISLU entries are permitted across study groups. Each study group can be activated and deactivated independently.

NOTE: The study groups and the units specified within the study groups by the network administrator will be saved following a software release retrofit.

As stated earlier, measurements generation and collection do not begin until the appropriate input messages are entered by the network administrator.

In addition to study groups being specified by RC 13.6, ODA 5539 forms can also be used for new office starts.

When an LU is added to the RC/V 13.6, the study group is already allowed for collection, and if the maximum EADAS buffer is exceeded because of the additional SGs (LGCs), RC returns an error message. If, before the update is completed, the service provider allows another study group for collection or another TRFC30 section is allowed for collection, it is possible for the combination of this update and the newly allowed records to exceed the EADAS buffer. In this case, an assert prints and the view fails.

If the status of an LU or ISLU is changed from operational to nonoperational and the LU or ISLU is a member of a study group, the LU or ISLU is deleted from the RC/V View 13.6. No indication of this deletion is given to the service provider.

6.2.9.7 Input/Output Messages

The following type of Input and Output message is used for activating (that is, allowing for data generation and collection), deactivating (that is, inhibiting data generation and collection), and obtaining the output status and collection status of TRFC30 Sections 144 and 145. Section 144 output is also augmented by optional features which enhance the amount of data in output reports

To enable TRFC30 sections for collection, the following input messages are used:

For the LU Section 144:

ALW:TRFC30,CLCT:SG=study_grp# (up to 5 study groups).

When this command is entered, data is generated and collected for all SGs on the LUs which are members of the study group specified.

For the ISLU Section 145:

ALW:TRFC30,CLCT:LGC=study_grp# (up to 5 study groups).

When this command is entered, data is generated and collected for all LGCs on the ISLUs which are members of the study group specified.

To inhibit the two sections, the following messages are to be used:

INH:TRFC30,CLCT:SG=study_grp# (up to 5 study groups).

INH:TRFC30,CLCT:LGC=study_grp# (up to 5 study groups)

At system initialization, by default, sections are inhibited for ROP output. Due to the sheer volume of data, the entire data is not allowed to be printed on the ROP. To avoid overloading the ROP, no more than six records may be printed. Thus, the network administrator can look at the six highest, six lowest, or three highest and three lowest usage values (that is, records of six switch groups or six LGCs).

To output six records with the highest count values to ROP, during the next scheduled output, the following message can be used:

ALW/INH:TRFC30,ROP,SG/LGC,HIGH=1

To output six records with the lowest count values to ROP, during the next scheduled output, the following message can be used:

ALW/INH:TRFC30,ROP,SG/LGC,LOW=1

To output three records with the highest count values and three records with the lowest count values to ROP, during the next scheduled output, the following message can be used:

ALW/INH:TRFC30,ROP,SG/LGC,HILO=1

To output six specific records to ROP, during the next scheduled output, the following message can be used:

ALW/INH:TRFC30,ROP,SG/LGC,UNIT=sm#-lu#-concentrator#-sg(lgc)#

NOTE: The concentrator number needs to be specified only in the case of switch groups.

The following output message indicates the collection status of all sections of TRFC30:

OP:MEASTAT CLCT.

The trailer message following the preceding output message

ALW: MEASTAT:TRFC30.

indicates which study groups (rather than the SM/LU identifiers) are allowed for collection.

The following output message can be used (in response to the network administrator's request for the print status) to indicate the print status of the sections:

OP:STATUS:TRFC30

The trailer message following the preceding output message

ALW:STATUS:TRFC30

indicates which records of a section are sent to the ROP.

The following message prints when the specified data requested by the network administrator is not in the EADAS buffer and when the network administrator has allowed the sections for ROP output:

OP:TRFC30-ND.

When the network administrator allows the new sections for ROP or CLCT, this message responds with the valid and invalid identifiers that are entered:

ALW:TRFC30.

No traffic section can exceed 32,000 bytes of EADAS buffer size. Similarly the memory allocation for all of the TRFC30 sections cannot be greater than 75,000 bytes. Both of these limitations are due to the EADAS buffer size.

When the network administrator enters the allow for collection input message, the following checks are made:

- The total number of bytes per section is not more than 32,000 bytes, and
- The memory allocation for all of the TRFC30 sections is not greater than 75,000 bytes.

If any of these checks fail, no study group will be allowed for collection and an error message is printed on the ROP.

When the grids or LGCs are changed from nonoperational to operational and are in an LU or ISLU which is a member of a study group and is allowed for generation and collection, counts will not be generated or collected for the newly operational SGs or LGCs until the following message is entered:

ALW:TRFC30,CLCT:SG=study_grp#

When the message is entered, the EADAS buffer size is recalculated to include the additional SGs/LGCs. If the maximum EADAS buffer size is exceeded, an error message is printed.

When the two new TRFC30 sections are inhibited, the entered RCV data is not erased, and the data does not have to be reentered. However, the network administrators can update the data. As shown in Figure 6-13, the RC/V View 13.6 is designed so that multiple entries can be made for LUs and ISLUs.

If the network administrator action results in too many switch groups or LGCs, an assert to the ROP fires and the update fails.

6.2.9.8 Support Systems

The data flow from the 5ESS[®]-2000 switch is illustrated in Figure 6-14. (This data flow may vary depending upon the type of switch owned by a service provider for example, tandem, OSPS, end office, etc.). Once the new TRFC30 sections are activated, raw traffic data on usage is sent directly to EADAS, when requested, at the end of every 30 minutes.

From EADAS, only selected data is sent to the downstream systems: NDS-TIDE (Network Data System-Traffic Information Distributor/Editor). The network administrators can specify a busy hour with a side busy hour for dual areas: business and residential. Thus up to four full hours of data can be sent from EADAS to the NDS-TIDE downstream systems. The NDS-TIDE collection machine scheduling interface (CSMI) instructs EADAS to send a maximum of four predefined hours of usage data downstream. From NDS-TIDE, data is passed down to a Line Assignment System.

Usage data collected during the time consistent busy hour is used by administrators for load administration.

6.2.9.9 Time Consistent Busy Hour Data

Time consistent busy hour is the hour of the business day during which the highest traffic load usually occurs. The network administrators can specify the time consistent busy hour along with a side busy hour for dual periods: business and residential. Thus up to four full hours of data may be sent from EADAS to the NDS-TIDE downstream systems. These hours may be specified through the Collection Machine Scheduling Interface (CMSI). Once the hours are specified, the NDS-TIDE CMSI notifies EADAS of the schedule and hours of data to be sent downstream.

6.2.9.10 Capacities, Limits, and Restrictions

6.2.9.10.1 EADAS

The EADAS-TRFC30 buffer size of 75,000 bytes may limit the amount of data an office can collect in one 30-minute period. One TRFC30 section has a maximum size of 32,000 bytes of data. In the worst case, if both of the new TRFC30 sections are activated simultaneously, 64,000 bytes may be used, leaving only 11,000 bytes for other TRFC30 sections. In this case, the network administrators may choose to activate only one of the two TRFC30 sections.

NOTE: It is not a requirement that only one of the new TRFC30 sections is activated at a time.

6.2.9.11 LU

A maximum of 500 LUs can be simultaneously studied. (Data is provided for all switch groups within these LUs.) This amounts to studying 128,000 lines in groups of 32. Table 6-12 gives data on capacities:

Table 6-12 LU Line Capacities

CONCENTRATION RATIO	SWITCH GROUPS	MAXIMUM LINE UNITS	MAXIMUM LINES
10:1	20	200	128,000
8:1	16	250	128,000
6:1	12	333	127,872
4:1	8	500	128,000

If an office has a mixture of LUs with different concentration ratios, then the maximum number of switch groups that can be studied simultaneously can be estimated from the following equation:

Max switch groups = number of LUs with 4:1 concentration $\times$ 8 + number of LUs with 6:1 concentration $\times$ 12 + number of LUs with 8:1 concentration $\times$ 16 + number of LUs with 10:1 concentration $\times$ 20 $\leq$ 4,000.

NOTE: The maximum number of switch groups that can be studied simultaneously is 4,000.

6.2.9.12 ISLU

The maximum number of ISLUs that can be studied is 250 each with 16 LGCs. The maximum number of LGCs that can be studied simultaneously is 4,000 ($250 \times 16 = 4,000$). This amounts to studying 128,000 lines in groups of 32.

6.2.10 DIRECTORY NUMBER MEASUREMENTS (DNM) FOR EADAS (NON ISDN)

6.2.10.1 Description

This feature is a special study providing peg count and usage measurements to the switch administrators using the Engineering and Administrative Data Acquisition System (EADAS) reporting mechanism, as well as the receive only printer and the traffic channel. The DNM feature, referred to as CDN (for Customer Directory Number), works on all Switching Module (SM) configurations.

The data gathered with this feature is valuable in determining how many calls a subscriber is missing and it provides administrators the ability to address the additional needs of subscribers.

Collection of these measurements may be taken on a maximum of 250 DNs (not necessarily sequential) associated with individual analog lines, the last member of a series completion list, lines that terminate on Line Units (LUs) (types: 1, 2 or 3), Integrated Services Line Unit (ISLU) Z-card, or integrated Subscriber Loop Carrier *SLC*[®] Remote Terminals (RTs) on Digital Carrier Line Units (DCLUs) or Integrated Digital Carrier Units (IDCUs).

The standard data delivery path for switch administrators is by EADAS; however, Traffic Channel (TRFCH) output may be used and up to 20 DNs out of the possible 250 DNs undergoing data collection may be selected for output to the ROP during the next scheduled TRFC30 output. For additional information, refer to Section 128 in 235-070-100 *Appendix, Traffic and Plant Measurements*.

These measurements are as follows:

- (TERMC) Terminating Calls
- (TBUSY) Terminating Calls to Busy
- (NOANS) Terminating Calls to Ring with No Answer
- (TRMBLK) Terminating Blockages
- (ORG) Originating Calls
- (ORGBLK) Originating Blockages
- (USAGE) Total Usage (originating and terminating)

6.2.10.2 Definitions

The definitions of the blockage measurements are provided in 235-070-100, *Appendix Traffic and Plant Measurements*.

6.2.10.3 Activation and Deactivation

The input messages controlling activation of this feature are as follows:

- ALW:TRFC30,CLCT:CDN,DN=DN1 - DN6
- ALW:TRFC30,CLCT:CDN,DN=PREV
- ALW:TRFC30,CLCT:CDN,RANGE=DN1&&DN2

The input messages controlling deactivation of this feature are as follows:

- INH:TRFC30,CLCT:CDN,DN=DN1 - DN6
- INH:TRFC30,CLCT:CDN,DN=ALL
- INH:TRFC30,CLCT:CDN,RANGE=DN1&&DN2
- INH:TRFC30,{CLCT|ROP|TRFCH}:ALL

6.2.10.4 Limited-ROP Output

TRFC30 Section 128 is inhibited, by default, for Receive-Only Printer (ROP) output at system initialization. However, the system administrator may select up to 20 DNs, currently under study, for output to the ROP during the next scheduled output. Currently studied DNs that are allowed for ROP output is reported, including those DNs whose counts contain all zero data. The input messages to allow, or inhibit, ROP output for a DN that is under study are as follows:

- ALW:TRFC30,ROP:CDN,DN=DN1 - DN6
- INH:TRFC30,ROP:CDN,DN=DN1 - DN6.

To request immediate ROP output of the CDN section contained in the previous TRFC30 report, enter the following input message:

OP:TRFC30:CDN

To request immediate ROP output of any single DN within the CDN section, enter the following input message:

OP:TRFC30:CDN,DN=DN1

6.2.10.5 Traffic Channel Output

If Traffic Channel (TRFCH) output is allowed, all collected CDN data is sent to the TRFCH, including those DNs whose counts contain all zero data. The CDN section may be allowed or inhibited for output to the Traffic Channel, with the following input messages:

ALW:TRFC30,TRFC:CDN

INH:TRFC30,TRFC:CDN

6.2.10.6 Assignment Verification

To verify activation of this study set, enter the following input messages:

OP:MEASTAT:CLCT

6.2.10.7 Compatibilities

This feature is compatible with all other features which can exist in the 5ESS®-2000 switch.

6.2.10.8 Dependencies

There are no other features or services that must be operational in the switch or assigned to the subscriber before this feature can be implemented.

6.2.10.9 Limitations and Restriction

This feature can only be activated upon request from a system administrator by an input message.

This feature does not increase the number of study sets allowed, which currently is one.

A maximum of 250 DNs may be studied at a time. The 250 DNs can all be on the same SM/SM-2000 or across multiple SMs/SM-2000s.

The measurements for a maximum of 20 DNs, currently under study, may be selected for ROP output.

The range of DNs specified in the allow and inhibit input messages, using the RANGE option, is limited to 25 DNs.

This feature is limited to individual analog DNs with both their service class and terminating class of service set to "INDIV" (INDIVIDUAL), except for individual PBX and individual INWATS lines.

This feature may be used to study the following:

- The last member of a Series Completion list.
- The lead line of a Line Time Slot Bridging (LTSB) DN.
- The master DN of a Multiple DN Line (MDNL). Terminations to dependent DNs peg the master DN.

This feature may not be used to study the following:

- Integrated Services Digital Network (ISDN) DNs.
- Multi-Line Hunt Group (MLHG) DNs.
- Shared DNs.
- Multiparty Lines.
- The dependent DNs of an MDNL.

This feature does not provide accurate measurements for Precedence and Preemption DNs.

- Diagnostic and maintenance type activities do not peg these counts.

6.2.10.10 Interactions

6.2.10.10.1 Customer Dialed Account Recording (CDAR)

Calls blocked by CDAR do not cause the blockage counts to be incremented. Only the Originating Calls peg count (PC) is pegged for the originating DN.

6.2.10.10.2 Private Branch Exchange (PBX)

This feature excludes lines serviced by a PBX. No measurements are taken on DNs accessed by the PBX Direct Inward Dialing feature or the Direct Outward Dialing feature.

6.2.10.10.3 800 Service (INWATS)

If the operating telephone company requires peg counts on an 800 number, the craft must enter the regular DN associated with the 800 number. When reporting the counts, the regular DN, not the 800 number is used.

6.2.10.10.4 Home Intercom

No terminating peg counts are pegged.

6.2.10.10.5 Attendant Control of Voice Terminals

Both originating and terminating restrictions are determined at the terminating end. Therefore, terminating calls are not pegged; however, originating calls are pegged.

6.2.10.10.6 Terminal Group Station Restriction (TGSR)

Both originating and terminating restrictions are determined at the terminating end. Therefore, terminating calls are not pegged; however, originating calls are pegged.

6.2.10.11 Abnormal Events Handling

If the system administrator attempts to allow a DN for ROP output and it has not been allowed for collection, the system responds with the message "NG - NOT ALLOWED FOR COLLECTION".

When an allow request is made in the AM, and the SM/SM-2000 never receives that request, no counters are pegged for those DNs allowed during the request and no data is included in the next 30-minute report for those DNs. If the system administrator had allowed those DNs that the SM/SM-2000 never received, for ROP output, a "NO_DATA" message (refer to the OP:TRFC30-ND output message) would be printed for those DNs. This problem is self-correcting because at the next 30-minute report, a message(s) is sent from the AM to the SM with all the DNs that are allowed for collection on that SM. There is also the possibility that the SM/SM-2000 was power cycled or initialized due to retrofit and all data on the SM/SM-2000 was removed. If this is the case, the "NO_DATA" message is printed, for all DNs in the study set that reside on that SM, during each 30-minute report that follows. This problem requires manual intervention. The system administrator must inhibit from collection and then allow for collection, each DN that is both in the study set and resides on the SM.

If an inhibit request is made by the system administrator, and the SM/SM-2000 never receives that request, the SM/SM-2000 responds with measurements to more DNs than expected, and no data is included in the next 30-minute report for all DNs on that SM. If the system administrator had allowed DNs, on that SM, for ROP output, a "NO_DATA" message would be printed for all DNs on that SM. This problem is self-correcting, because at the next 30-minute report, a message(s) is sent from the AM to the SM/SM-2000 with all the DNs that are allowed for collection on that SM. There is also the possibility that the AM was initialized with a level 54 and all data on the AM was removed. If this is the case, 30-minute output for this section terminates. This problem requires manual intervention. The system administrator must reallow the entire study set for collection and ROP output.

The switch responds to the "activation/allow request" with an "ALLOWED FOR COLLECTION" message. This message specifies the DNs that were added to the study set (for example, DN1) from the input message, and the DNs that were in the input message but not put under study (for example, DN2), including the reason why they were invalid and their corresponding SM/SM-2000 number. This response message also indicates the quantity of DNs currently under study.

Example: ALW:TRFC30,CLCT:CDN,DN=DN1-DN2;

ALW TRFC30 CDN

ALLOWED FOR COLLECTION

ELEMENTS ALLOWED:

DN1

INVALID ELEMENTS:

DN2 <Invalid Reason> <SM Number>

ALLOWED ELEMENT COUNT: z (LIMIT= 250)

Table 6-13 is a list of "Invalid Reasons" and their definitions. Each "Invalid Reason," listed with the "(#)", indicates the number of the SM.

Table 6-13 Response Messages Example 1

INVALID REASON	DEFINITION
NOCCODE DATA READ FAILED	The specified Directory Number (DN) was not allowed because the read of the NOCCODE data base relation failed.
RTDNMOD DATA READ FAILED	The specified DN was not allowed because the read of the RTDNMOD data base relation failed.
DN DOES NOT EXIST IN OFFICE	The specified DN was not allowed because relational data for the specified DN could not be located, even though the data base reads were successful.
UNAVAILABLE ROUTING SM	The specified DN was not allowed because its routing SM was unavailable.
RT_DNTRAN DATA READ FAILED	The specified DN was not allowed because the read of the RT_DNTRAN data base relation failed.
TERMINATING CLASS NOT INDIVIDUAL(#)	The specified DN was not allowed because it is either assigned to a Multi-Line Hunt Group (MLHG) line, or to a Private Branch Exchange (PBX) line. Section 128 studies only individual lines.
ISDN OR SHARED LINE NOT ALLOWED(#)	The specified DN was not allowed because it is either assigned to a Digital Subscriber Line (DSL), or to an analog line whose DN is shared with Integrated Services Digital Network (ISDN) terminals. Section 128 studies only analog lines (except for analog shared DNs).
ALLOW LIMIT REACHED IN SM(#)	The specified DN was not allowed because the per-SM maximum of 250 studied DNs has been reached.
UNAVAILABLE TERMINATING SM(#)	The specified DN was not allowed because its terminating SM was unavailable.
FC_PORTTYP DATA READ FAILED(#)	The specified DN was not allowed because the read of the FC_PORTTYP data base relation failed.
SERVICE CLASS NOT INDIVIDUAL(#)	The specified DN was not allowed because the DN's Service Class was not INDIVIDUAL.
OFFICE ALLOW LIMIT REACHED	The specified DN was not allowed because the office maximum of 250 studied DNs has been reached. Will only accept those DNs from Input Message up to the point where the study set is filled.
DEPENDENT DN OF MDNL(#)	The specified DN was not allowed because it is a dependent DN of a Multiple DN Line (MDNL).

Changes may occur to a DN (that is, Recent Change modifications) after it has been placed in to the CDN study set, requiring the removal of the DN from the study set. Changes to the TERMCLASS, SERVCLASS, or

LTM_TYPE where either the TERMCLASS or SERVCLASS are no longer set to INDIVIDUAL, or the LTM_TYPE is no longer set to LTM_OTHER is detected by the CDN self-audit, run every 30 minutes, and removal of the DN from the study set is initiated. There are other types of changes that initiate the immediate removal of a DN from the study set. The DN may be deleted from the switch, the Office Equipment (OE) number assigned to a DN may be changed, the DN assigned to an OE may be changed, or two DNs may be swapped either intramodule or intermodule. When a DN is automatically removed from the CDN study set, for any reason, the switch notifies the system administrator with the following ROP message.

Example:

The system administrator uses Recent Change (RC) to convert DN1, currently in the study set, to a MLHG member. During the next 30-minute report cycle, DN1 is removed from the study set and the following message is output.

```
INH TRFC30 CDN          INHIBITED
```

```
ELEMENTS INHIBITED BY CDN AUDIT:
```

```
DN1      <Invalid Reason>    <SM Number>
```

Table 6-14 provides a list of "Invalid Reasons" and their definitions. Each "Invalid Reason," listed with the "(#)", indicates the number of the SM.

Table 6-14 Response Messages Example 2

INVALID REASON	DEFINITION
DN CANNOT BE STUDIED(#)	This reason is provided by the switch when a DN is removed from the CDN study set by some automatic operation in response to some administrator action that resulted in a status change to a DN, currently under study, which makes the DN invalid for study. This automatic operation may be the CDN audit run during the 30-minute report cycle, or an instantaneous request, to remove the DN, by an existing relational trigger.

7. INTRODUCTION TO RESOURCE UTILIZATION

The following sections provide information for administering 5ESS[®]—2000 switch resources. The assumption is that the reader has a basic knowledge of the 5ESS[®]—2000 switch architecture and operations. These details are provided in 235-100-125 - *System Description* and 235-100-10X - *Product Specification*. The following sections are divided into subsections providing resource utilization information on a physical group basis. Refer to the table of contents at the beginning of each section for complete description of the groups included. Each subsection provides information to administer the particular resource. The following subject areas are included in each of the subsections.

- **Description:** A description of the resource is provided from a switch administration point of view.
- **Engineering Considerations:** The capacity of the resource is described so that the administrator can monitor the resource on a daily basis and verify that the demand on that resource does not exceed its capacity.
- **Assignment Guidelines:** The assignment implications of the resource are described. The various assignment options and the possible consequences of those assignment options are provided.
- **Measurements and Primary Service Indicators:** The measurements and primary service indicators associated with the resource are described. These measurements are the means to monitor the capacity of the resource. Where appropriate, measurement thresholds are provided to indicate marginal performance or potential problems requiring manual intervention.
- **Feature Impact:** Describes the impact that the resource has on the hardware involved.

Worksheets are provided, where applicable, to assist long-term capacity monitoring. These worksheets enable the administrator to determine if the capacity of the resource will exhaust before the end of the engineering period.

7.1 GENERAL

7.1.1 INTRODUCTION

A primary objective of switch administration is to assure that the 5ESS[®]—2000 switch continually delivers high-quality service to the subscribing customers. This objective may be achieved by monitoring and evaluating the performance of the 5ESS[®]—2000 switch, on a daily basis, to identify potential problems that could cause service deterioration.

The 5ESS[®]—2000 switch resources are the key to the delivery of high-quality service. The capacity and maintenance status of the switching system resources may be monitored to assure that enough reserve capacity exists to provide a high standard of performance throughout the engineering period.

Generally, the performance level of the 5ESS[®]—2000 switch is dependent upon how well the switch is engineered, maintained, and administered. External factors such as severe weather conditions or equipment failure may also cause depressed service levels for brief periods. Changing traffic patterns and certain equipment failure may be identified through switch surveillance so that corrective actions may be initiated to improve service performance, or to avoid service deterioration.

7.1.2 CAPACITY ADMINISTRATION

To perform the switch surveillance function, the capacities of various hardware and software items must be known and monitored. When an item is approaching the limit of its capacity, some actions may be initiated to avoid unplanned overflow situations. This section provides descriptions of unit capacities.

The following definitions are provided to assist in the understanding of the capacity information provided in this section.

Terminal Process: Call processing functions are distributed between the switching module processors (SMPs) in the switching modules (SMs) and the administrative module/communications module processors (AM/CMP). Call processing functions performed by an SMP are performed by terminal processes. A terminal process is created and exists only as long as the line or trunk it controls is active. There are different types of terminal processes. In general, the type of terminal process created to control a line or trunk depends on whether the terminal is a line or trunk, and whether the terminal is originating or is being used for termination. For a typical line-to-line call, there is a line origination terminal process to control the originating end of the call and a line termination terminal process to control the terminating end of the call. Associated with each terminal process is a data block containing data about the line or trunk and the call. Each terminal type (line or trunk), based on the data in the data block, uses a different set of procedures to perform function(s) for feature control (FC), administrative services, and terminal maintenance.

System Process: A system process exists as long as the 5ESS[®]—2000 switch is functioning. System processes are associated with noncall processing tasks such as maintenance and billing functions.

Half-Call: A half-call is the establishment of a path (in either direction) between a peripheral unit and the time slot interchanger (TSI). Thus, the terminating part of a call represents a half-call and the originating part of the call represents the other half-call. Each half-call generates a terminal process.

Call: A call consists of two half-calls. The call count is represented by the sum of the originating peg count and the incoming peg count. Some features such as 3-way calling require more than two terminal processes. The originating peg count is incremented whenever a customer has received dial tone and dialed at least one digit.

Message: A message is used to pass information between processes. A message may consist of data, requests, commands, and/or acknowledgments. The message count represents the number of messages exchanged between processors. (Messages between processes are counted only if the processes are in different processors.)

7.1.3 MEASUREMENTS

The 5ESS[®]—2000 switch software release generates, collects, and reports traffic, plant, and service measurements which are used to monitor particular aspects of a switching system operation over a specified period of time: 5 minutes, 15 minutes, 30 minutes, 1 hour, and 24 hours. These measurements provide a summary of events that have taken place within the switching system. The control of scheduling and printout of measurement data is also performed by the software release. Some of the reports may be activated or deactivated for local output as desired.

The 5ESS[®]—2000 switch measurements are broken down so that an indicated trouble may be more precisely analyzed. Many call processing measurements are broken down into the following categories:

- Originating
- Terminating
- Connecting
- Incoming
- Outgoing.

An example of a call processing measurement is the ineffective attempts measurement which is broken down into originating and incoming ineffective attempts. Also, the call setup troubles measurement (a count of calls that encounter some kind of service-affecting equipment trouble) is divided into originating, incoming, terminating, outgoing, and connecting call setup troubles. The cutoff-call measurement is divided into switch and facility caused cutoffs.

7.1.3.1 Traffic Measurements

Traffic measurements, primarily used for engineering purposes and switch administration, provide the current status of the 5ESS[®]—2000 switch as well as external resources such as trunks. These measurements provide a means to evaluate the load offered by subscribers to the usage-sensitive components of the 5ESS[®]—2000 switch. This section is intended to aid the switch administrator in the management of the usage-sensitive components; therefore, the discussion concentrates on the traffic measurements.

7.1.3.2 Plant Measurements

Plant measurements provide data to evaluate equipment and craft performance, particularly to evaluate the impact of troubles on customer service. Plant measurements are divided into categories including base, plant service, and performance measurements. Base measurements provide counts of total service requests, billing volumes, and equipment quantities. Plant service measurements provide counts of customer perceptible service-affecting events related to the maintenance condition of the switching system. Performance measurements provide counts of events that, regardless of the effect on service, can be related to the maintenance condition of the switching system.

7.1.3.3 Service Measurements

Service measurements are used to evaluate the quality of telephone service to the customer. The main emphasis is on interruptions such as calls that fail to be switched or calls that are switched but fail to reach the talking state due to resource failures, and calls in the talking state which fail due to facility or switch cutoffs.

7.2 CAPACITY UTILIZATION WORKSHEETS

7.2.1 INTRODUCTION

Where necessary, reproducible equipment utilization worksheets are included in the resource utilization subsections. These worksheets may be used to determine the projected exhaust date of the traffic-sensitive equipment in the 5ESS[®]—2000 switch office. These worksheets can be completed and processed according to locally determined schedules and policies. Worksheets with instructions for the following 5ESS[®]—2000 switch resources are provided.

- Digital line trunk unit (DLTU) - terminations
- Global digital service unit (GDSU) - conference circuits
- Local digital service units (LDSU) - tone decoders
- Analog line units - hundred call seconds (CCS) load
- Analog line units - terminations
- Remote switching module (RSM) umbilicals
- High-level service circuits (HLSC)
- Trunk units - terminations
- Digital carrier line unit (DCLU)
- AM and SM real-time call capacity
- SM memory.

7.2.2 EQUIPMENT UTILIZATION TASKS

To ensure maximum utilization of the installed switching components, several switch administration tasks must be performed. These tasks include:

- Monitoring office data.
- Determining the main station (MS) capacity of traffic-sensitive items. This determination should be based on the customer service objectives.
- Calculating the exhaust date of each traffic-sensitive item.
- Determining the corrective action required when the projected exhaust date will occur before the next scheduled growth job.

The engineering interval varies between offices based on the telephone company engineering policies and the accuracy of the forecasted office growth. A 2-year engineering interval is common. The telephone equipment order (TEO) is often written a year before the start of the job. In this case, the total period from the start of the TEO to the end of the period is 3 years. The demands on the traffic-sensitive items in an office can change during this time.

To achieve maximum equipment utilization at the desired level of service, the office growth patterns should be tracked to the TEO engineering data. Equipment utilization determines if the office has enough switching capacity

to last through the next busy season and to the end of the engineering period. Normally, equipment utilization reports are completed after the busy season.

Proper equipment utilization practices may allow a growth job to be extended if the office has a surplus of switching capacity. If a shortage of switching capacity exists, the growth job may need to be rescheduled for an earlier date.

7.2.3 EQUIPMENT UTILIZATION TOOLS

In order to complete the necessary calculations and analysis, the following data, reports, and information are needed.

- Forecasts of lines, main stations, CCS usage per main station, trunks, and custom calling features
- Data on today's working lines, main stations, CCS usage per main station, trunks, and custom calling features
- Present TEO
- Current traffic and engineering data (summarization of 30-minute traffic data)
- Knowledge of changes in the office characteristics (including area transfers, scheduled growth jobs, new large business customers, and major trunking rearrangements)
- Data projections (projecting the known characteristics for today into the traffic characteristics for a future period).

7.2.4 EXHAUST DATE CALCULATIONS

Assuming the switch administrator knows the main station capacity for each of the traffic-sensitive items, an exhaust date may be calculated for each item. From the projected exhaust date, the administrator can determine if the office has the capacity to last until the next scheduled growth job. For each item, use the following steps.

- (1) Begin with the end of period (EOP) date.
- (2) From the forecast, read the equipment exhaust year.
- (3) Calculate equipment growth per month for the exhaust year:

Forecasted Equipment (End of exhaust year)	—	Forecasted Equipment (Start of exhaust year)	=	Growth per Month
12		12		

- (4) Calculate exhaust month:

Equipment Capacity	—	Forecasted Equipment (Start of exhaust year)	=	Equipment termination into year
Equipment termination into year	=	Months into exhaust year		
Growth per month				

7.2.5 PROJECTION OF OFFICE DATA

The EOP usage may be higher than the current office usage. After determining the limiting items in the office, each item should be analyzed. Knowing the present CCS/MS and MS capacity may indicate areas of potential risk such as:

- Possible service deterioration, or

- Inability to meet customer demands due to insufficient or overloaded equipment.

Several projection methods are available. Each company's recommended projection method should be used to determine the EOP CCS/MS and MS capacity for the most limiting items.

7.2.6 EQUIPMENT MONITORING

The most limiting items in the office should be closely monitored to detect potential problems with exhaust dates. Monitoring these items can verify the projected exhaust dates. The actual capacity may be more or less than projected. Only the most limiting items in the office need be tracked in this manner.

8. AM/CMP/CNI RESOURCE UTILIZATION

This section provides information for administering 5ESS[®]— 2000 switch administration module/communication module processor (AM/CMP). AM and CMP administration does not apply to the Very Compact Digital Exchange (VCDX) switching system. For more information, refer to 235-120-110 - *Very Compact Digital Exchange (VCDX) Reference Guide*. The assumption is that the reader has a basic knowledge of the 5ESS[®]— 2000 switch architecture and operations. These details are provided in the following documents:

- 235-900-111 - *Product Specification Software Release 5E10*
- 235-900-112 - *Product Specification Software Release 5E11*
- 235-900-113 - *Product Specification Software Release 5E12*
- 235-900-114 - *Product Specification Software Release 5E13*

The following subsections provide resource utilization information on a physical group basis. Refer to the table of contents at the beginning of each subsection for a complete description of the information included. Each subsection provides information to administer the particular resource. The following subject areas are included:

- AM/CMP Processor
- AM/CMP Real-Time Worksheets
- AM Memory
- AM Overload Control
- AM Disk Drive Facilities
- Common Network Interface Ring
- Local Area Signaling Services.

Worksheets are provided, where applicable, to assist long-term capacity monitoring. These worksheets enable the administrator to determine if the capacity of the AM/CMP will exhaust before the end of the engineering period.

8.1 AM/CMP PROCESSOR

8.1.1 DESCRIPTION

8.1.1.1 3B20D/3B21D

The AM is the central point for operations, administration, and maintenance (OA&M) activities on the 5ESS®-2000 switch. The Administration Module (AM) consists of a duplicated AM processor, a duplicated disk file controller, and an input/output processor. There is only one AM per office. The communication module processor (CMP) performs most of the call processing functions in the 5ESS®-2000 switch previously performed in the AM except for common channel signaling (CCS) message processing, which may be done in the AM if there is no direct link node (DLN). The AM processor architecture consists of:

- **Microstore** - This control section of the processor decodes and executes all instructions in the 3B20D.
- **Data Manipulation Unit (DMU)** - Performs rotating, masking (manipulating data) as well as arithmetic and logic functions.
- **Central Control Registers** - Represent the hardware control status of the processor. They contain the system status registers, error registers, and interrupt source registers.
- **Cache** - Provides a means of improving the real-time capabilities of the processor by reducing the access time of frequently used data. The cache memory can store 2048 words.
- **Main Store Update (MASU)** - Used to keep the standby processor's main store updated by way of the main store update bus. It also controls main store bus access in the event that both the processor and the direct memory access circuits try to access the main store simultaneously.
- **Direct Memory Access (DMA)** - An interface controlling the data flow between the main store and the module controller and time slot interchange unit (MCTU). Once the DMA is initiated by the processor, the DMA controls the data transfer. When the transfer is completed, the DMA notifies the processor. This process of allowing the DMA to control the data transfer enables the processor to perform other tasks. The DMA interfaces with the other units by way of the dual serial channel. This path is used for all data transfers.
- **Main Store (MAS)** - Also called Main Memory, contains all of the executable programs and data used by the processor to control the 5ESS®-2000 switch functions. These programs can be swapped into MAS from disk storage as needed.

The CMP architecture is described in detail in the section *CM Resource Utilization*.

The real-time capacity of the AM/CMP is measured in completed, full calls per hour. Ineffective attempts such as false starts, partial dials, showering lines, cut cables, etc., are restricted to SMs and are therefore not considered in the capacity of the AM/CMP.

The CMP takes over most of the call processing functions previously handled by the AM. Of the functions, only billing and authorization code processing remain in the AM. The AM spends a smaller fraction of its real time processing calls, but it still may be a limiting resource for call processing if the AM processes common channel signaling calls and there is no DLN, or if an applications processor is attached to the AM for message detail recording. In addition, the DLN is a limiting resource for high-volume CCS traffic. Each of these resources is potentially limiting on the overall call capacity of the switch, depending upon the switch configuration and the call mix.

8.1.1.2 3B21D

The 3B21D is introduced as the processor for the 5ESS[®]-2000 switch. The 3B21D processor is packaged in two cabinets: basic and growth. The basic unit include a duplexed Central Control (CC), Input/Output Processor (IOP), Disk File Controller (DFC), and Moving Head Disks (MHD). The growth units are optional and use a single-high unit and include IOPs, and MHDs.

The minimal configuration of 3B21D processor includes basic units without growth units and the growth cabinet housing for 9-track small computer system interface (SCSI) tape. The maximum configuration includes one or two growth units.

8.1.1.2.1 Central Control Unit

The 3B21D processor consists of two CCs. There can be a maximum of two DMA packs per basic unit available in the CU. The DMA packs are active and standby. One DMA per side is sufficient to handle all the assignment applications.

The CC provides the central processing unit (CPU), memory, cache and direct memory access (DMA) for the 3B21D processor. The physical address space of the 3B21D accommodates up to 40 MB of physical memory in . The CC is duplexed in the basic shelves.

The DMA and Dual Serial Channel (DSCH) provide the following functions:

- (1) Data transfer capabilities between peripheral devices and the memory
- (2) Data transfer capabilities between AM and CM
- (3) Data transfer capabilities between AM and common network interface (CNI)
- (4) Interface to the IOPs and DFCs.

The 3B21D DMA/DSCH provide the same interfaces and functions as their 3B20D counterparts. The 3B21D supports:

- 4 DSCHs per DMA
- 4 devices per DSCH
- a total of 32 devices per CU.

The 3B21D DMA/DSCH interface does not support the non-SCSI Storage Module Device (SMD) disks.

8.1.1.2.2 Input/Output Processor

The IOP is a processor that controls I/O between peripheral units and the CC.

The IOP complex in the 3B21D basic unit can contain up to 4 Peripheral Controller (PC) communities per side. If additional PC communities are needed, they will be equipped in the growth unit.

The 3B21D basic unit IOP can have up to four PC communities (PC0,PC1,PC2,PC3) per side. Each community can have up to 4 PC slots, with the exception of the PC3 which can contain up to 3 PC slots. As a result, a maximum of 15 PC slots are available per side of the basic unit. If additional PC boards are required, one or two growth units can be equipped. The service provider can decide whether to populate one or two growth units. One growth unit (located on top of the side 1 of the basic unit) supports CU 0 and CU 1. This unit can have up to four PC communities. Each PC community in a growth unit can have up to 4 PC slots. A maximum of 16 PC slots are available per growth unit.

The minimum PC slots available for IOP in the basic units (both side 0 and side 1) is 26 (2 slots in the PC3 could be used for one SCSI MHD). The minimum PC slots available for IOP in one growth unit is 8 (2 pairs of SCSI MHDs could be equipped in a place of PC2 and PC3). The minimum PC slots available for IOP in the growth units, including both side 0 and side 1, is 16. Five pairs of SCSI MHDs can be equipped.

The IOP supports most of the current PC boards with the same interfaces and components as the 3B20D IOP. It does not require redesign of the supported boards.

The PC boards supported by both 3B20D IOP and the 3B21D IOP are as follows:

- Scan Point and Signal Distributor
- Maintenance Teletypewriter Controller
- Synchronous Data Link Controller
- Terminal Controller.

8.1.1.2.3 Disk File Controller

The 3B21D has two DFCs (one per basic unit). The DFCs support the SCSI MHDs and one or two 9-track SCSI tapes. Each 3B21D must have at least one 9-track SCSI tape in the growth cabinet. The 3B21D can support up to three SCSI MHD pairs in the basic units and up to 5 additional SCSI MHD pairs in the growth units.

Each DFC can support up to two SCSI buses. If more than 3 MHD pairs are needed, both growth units should be equipped, and the disk pairs can terminate on both SCSI buses.

8.1.2 ENGINEERING CONSIDERATIONS

Switch call capacities are substantially greater because of the CMP. Most of the freed-up AM real time is available for operations, administration, and maintenance (OA&M) work. This increase of available real time for OA&M is required to support the higher call capacity provided by the CMP. Because of the limited amount of call processing performed by the AM, the emphasis on the AM limitation on call processing is shifted to the AM limitation on OA&M activities. This rated call capacity is in terms of calls which can be processed per hour. Call capacity is based on laboratory measurements using a specific traffic call-mix model. For example, the equivalent-plain-old-telephone service (EQPOTS) call capacity is based upon the following mix of non-feature calls with all originating calls billed:

Call Type	Percent of Total Calls
Line to Line (billed)	20
Line to 1-Way Trunk (billed)	36
Line to 2-Way Trunk (billed)	4
1-Way Trunk to Line	36
2-Way Trunk to Line	4
TOTAL	100

The SS7 POTS model differs in that all trunks are 2-way CSS7. The 5ESS[®]-2000 switch CMP call capacity is sensitive to traffic and feature mix. Therefore, the actual capacity of a particular switch as shown in table 8.1-1 will vary from the advertised capacity when these factors are introduced. Worksheets are provided to facilitate the estimation of call capacity based on a particular set of office parameters. In addition to the local traffic mix example previously given, examples of toll/tandem and rural traffic mixes are provided in this section. Assumptions regarding ineffective attempts are not required since the effects of such originations are confined to the SMs. Intra-remote switching module (RSM) calls are locally routed within the RSM and require no CMP processing.

Table 8.1-1 5ESS[®]—2000 Switch Capacity History

SOFTWARE	EQPOTS	METRO	TANDEM TOLL	TANDEM TOLL	OSPS

RELEASE			(DLN)	(NON-DLN)	
5E10	1100 K	650 K	750 K	90 K	350 K
5E11	1100 K	650 K	750 K	90 K	350 K
5E12	1500 K	850 K	750 K	90K	350 K

8.1.2.1 Traffic Mixes

Examples of the AM/CMP capacities are given in the following paragraphs using both toll/tandem and metropolitan traffic mixes. The traffic mix is the proportion of the following call types that exist in the office:

- Originating
- Incoming
- Intraoffice
- Outgoing
- Terminating
- Tandem.

Feature usage is the percentage of calls that use a particular feature. To estimate the capacity of an AM/CMP for a specific office based on the traffic and feature usage, the real-time worksheets should be used.

8.1.2.1.1 Metropolitan Traffic Mix

The metropolitan office traffic mix model is used to calculate the nominal capacity of the AM/CMP of the 5ESS®-2000 switch in terms of featured calls. A metropolitan traffic mix is derived from the metropolitan switch environments and is shown. Table 8.1-2 illustrate the percent of busy-hour calls using a given call type or feature.

National Integrated Services Digital Network (ISDN) features are not included under the assumption that they do not significantly differ in real time or messaging from the Lucent Technologies Proprietary ISDN features. Therefore, distinguishing between these ISDN feature sets is not necessary when calculating switch or SM capacity.

Table 8.1-2 5E10/ 5E11/5E12 Metro Feature Usage Model

LINE/TRUNK BILLING MIX	SWITCH CS/PS/AP	SWITCH CS ONLY	LINES ONLY SM-2000
Line-to-Line	18.0	20.0	33.0
Line-to-1-Way Trunk	0	0	0
Line-to-2-Way Trunk	32.0	36.0	32.0
1-Way Trunk to Line	0	0	0
2-Way Trunk to Line	33.0	36.0	32.0
1-Way Trunk to 1-Way	0	0	0
Trunk			
2-Way Trunk to 2-Way	4.0	4.0	0
Trunk			
PSD	5.0	0	0
AP\F1	4.0	0	0
Partial Dials	4.0	4.0	3.0
Sum	100.0	100.0	100.0
CCS 7 Trunks ^c	100.0	100.0	0
Billing ^d	50.0	56.0	65.0
Busy ^e	15.0	15.0	15.0
CALL TYPES			
Ineffective Attempts ^f	11.0	11.0	11.0
Partial Dials	4.0	4.0	4.0

Non-ISDN Voice	64.0	71.0	83.0
Non-ISDN Attendant	5.0	5.0	5.0
ISDN Voice g	17.0	19.0	8.0
NSDN to NSDN (MCA)	4.0	4.0	0
Small SDN < 16 members			
NSDN to SDN (lp)	3.0	3.0	3.0
NSDN to SDN (nlp)	1.5	2.0	0
SDN to NSDN	2.5	2.5	3.0
SDN to SDN (lp)	2.0	3.0	2.0
SDN to SDN (nlp)	1.5	2.0	0
Large SDN: SDN-SDN	0.5	0.5	0
(nlp)			
Large SDN >= 16			
members			
Attend. Call Split Bridge	2.0	2.0	0
CS Data (MLHG)	1.0	1.0	0
PS Data (MLHG)	5.0	0	0
Intraswitch	3.5	0	0
Interswitch			
(50% in, 50% out)	1.5	0	0
AP	4.0	0	0
Directory Query Display	2.0	0	0
Message Printout	1.0	0	0
Message Retrieval Display	1.0	0	0
BRCS FEATURES			
ACBC	2.0	2.0	3.0
ACD/BRCS Interworking	5.0	5.0	0
Account Code Call	5.0	5.0	9.0
Alternate Routing	8.0	9.0	0
ARS (1st Route)	20.0	20.0	0
Each Alt. Route for ARS	4.0	4.0	0
Attendant Call Forwarding	1.0	1.0	2.0
Auth. Code Call (AM)	1.0	1.0	2.0
Auth. Code Call (SM)	5.0	5.0	8.0
Auto Hold	1.0	1.0	0
Call Appearance	3.0	3.0	0
Preselection			
Call Fwd (BL/DA/VAR) +	8.0	8.0	16.0
CFPF			
Call Hold	2.0	2.0	3.0
Call Park	1.0	1.0	2.0
Call Pickup Assigned	30.0	30.0	30.0
Call Pickup Used	3.0	3.0	5.0
Call Transfer	5.0	5.0	9.0
Call Waiting	7.0	7.0	16.0
Carrier Interconnect	7.0	7.0	12.0
ICLID (within switch)	2.0	2.0	2.0
ICOM (ISDN)	1.0	1.0	0
Intercom Calling (4 dig.)	13.0	13.0	21.0
MLHG Regular/Circular	11.0	11.0	19.0
MLHG UCD	2.0	2.0	3.0
Modular Queuing - Line	1.0	1.0	2.0
Modular Queuing -	1.0	1.0	0
trk/rngbk			
Modular Queuing - trk/offhk	1.0	1.0	0
Multiway Calling	5.0	5.0	9.0
PFA (Basic)	5.0	5.0	9.0
Remote Access to CF	1.0	1.0	2.0
SDN Bridging	1.0	0	0
SFG ICR(CSD)	1.0	1.0	0
SFG INWATS (excl. ICR)	6.0	6.0	0
SFG OUTWATS	8.0	8.0	14.0
Speed Dialing	5.0	5.0	9.0
LASS FEATURES			
Auto Callback	2.0	2.0	3.0
Auto Recall	1.0	1.0	2.0
BCLID	1.0	0	0
Calling No. Display (ICLID)	2.0	2.0	2.0
Computer Access	5.0	5.0	14.0

Restriction			
Customer Orig. Trace	0	0	0
Interswitch Voice	2.0	2.0	3.0
Messaging			
Selective Call Features	6.0	6.0	10.0
Analog Calling Name	1.0	1.0	1.0
AP FEATURES			
Call Forward to MSS	3.0	3.0	5.0
Calling Name Display	1.0	1.0	1.0
Message Detail Recording	25.0	25.0	34.0
ISDN FEATURES			
Fractional DS1 Switching	1.0	1.0	0
Multipoint DSL	12.0	12.0	0
On-Demand B Setups	0.5	0	0
MISCELLANEOUS			
Advanced Service Platform	7.0	7.0	10.0
Centralized Attendant	0.5	0.5	0.5
E911	2.0	2.0	3.0
Home Intercom/SLVP	1.0	1.0	2.0
Line Time Slot Bridging	0.5	0.5	0.6
Multiple DNs/Line	1.0	1.0	2.0
SSP 800 Call	6.0	6.0	10.0
TOTAL FEATURE USAGE	261.5	260.0	324.1
j			

Notes:

- a. All table entries are in percent of O+I calls.
- b. Stressed SM do not contain trunks.
- c. Percentage of trunks (or trunk calls) using CCS7 signaling.
- d. Percentage of CSV calls that are billed.
- e. Percentage of CSV/CSD nonpartial dial calls terminating to a busy party.
- f. Ineffective attempts are not considered to be "good" calls. Thus, when adding up the percentages (to get 100%) they should not be included. However, they need to be included in model calculations because they use real time in the SM/SM-2000. This assumes 10% False Starts and 1% Permanent Signals.
- g. Includes analog shared DN.
- h. Assumes ISDN SMs are non-agent SMs. Average number of features used per call (multiplied by 100 to get percent).
- i. Assumes 70 percent originating triggers and 30 percent terminating triggers.
- j. This number is the average number of features used per call (multiplied by 100 to get percent).

As with Table 8.1-3, the sum of all Circuit-Switched Voice, Circuit-Switched Data, Packet-Switched Data, Application Processor, and Partial Dial calls is 100 percent. Although false starts are not counted as successful calls, their effect on real-time usage must be taken into account. Also, indented *features* are considered as *sub-features* under the associated general *feature* category. For example, ISDN Voice calls for a switch with CS/PS/AP has 17 percent total usage. This 17 percent is comprised of *sub-features* such as NSDN-to-NSDN (MCA); Small Shared Directory Number (SSDN) etc. Do not double count these features.

These tables assume 100 percent intermodule calls, including calls to or from RSMs, with no ineffective call attempts (for example, abandonments, partial dials). Ineffective attempts are handled entirely within the SM and therefore have no impact on the AM/CMP capacity. Intramodule calls require less AM/CMP real time than intermodule calls. The intra-RSM calls are locally routed within the RSM and require no AM/CMP processing.

Higher call capacities can be sustained with changes in the traffic mix such as having a smaller percentage of line-to-trunk and billed calls. These types of calls require more AM/CMP real time than incoming trunk-to-line calls and line-to-line calls. Since feature mix also has an impact on the capacity, it is recommended that the worksheets be used to estimate the capacity of any particular AM/CMP.

8.1.2.1.2 Toll/Tandem Traffic Mix

A toll/tandem traffic mix model for 5E10 and 5E12 is shown in Table 8.1-2 .

Table 8.1-3 Toll/Tandem Traffic Mix Model

CALL TYPES	PERCENTAGE OF TOLL CALLS	PERCENTAGE OF TANDEM CALLS
1-Way Trunk to 1-Way Trunk	0	0
1-Way Trunk to 2-Way Trunk	0	0
2-Way Trunk to 1-Way Trunk	0	0
2-Way Trunk to 2-Way Trunk	100	100
OTHER TOLL/TANDEM PARAMETERS	PERCENTAGE OF TOLL CALLS	PERCENTAGE OF TANDEM CALLS
CCS Trunks	100	100
Billing	50	30
TCAP Feature/TCAP message + acknowledgement	75	0
SSP 800	0	6

For this toll/tandem office model with a DLN30, the rated call capacity is 750,000 calls per hour for the 5E10 through 5E12 software releases. With the DLN, the rated call capacity is 240,000 calls per hour. Without a DLN, the rated call capacity is 90,000 calls per hour using 35 percent of the AM processor real time for call processing (5 percent for CNI ring overhead).

8.1.2.1.3 OSPS Traffic Mix

The capacity of an office is affected by office configurations that include Operator Services Position System (OSPS). Several types of offices are possible in an OSPS application. These offices include directory assistance (DA), toll and assistance (T&A), and commercial automatic call distributor (ACD) of the AM real time allocated to call processing. The following assumptions are used to determine these capacities.

DIRECTORY ASSISTANCE	
Calls receiving automated recorded announcement of directory number	90 percent
Calls receiving operator verbal announcement of directory number	10 percent
Calls receiving automated recorded announcement that recall to an operator	10 percent
Operator occupancy	90 percent
Average operator work time	20 seconds
TOLL AND ASSISTANCE	
Operator-assisted calls	78 percent
Automated calling card services	20 percent
Automated coin toll services	2 percent
Operator-assisted calls dialed 0+	50 percent
Operator occupancy	90 percent
Average operator work time	30 seconds
Collect calls*	20
Operator calling card, third party*	10
Operator calling card, station paid*	10
Operator calling card, person paid*	3
Coin calls with overtime collection*	100
Operator information*	15
Transfer CAMA*	5
COMMERCIAL ACD	
Agent occupancy	90 percent
Average agent work time	greater than 1 minute

The OSPS model assumes that no intraflow or interflow are used.

8.1.3 ASSIGNMENT GUIDELINES

8.1.3.1 3B20D

No assignments are required for the 3B20D AM/CMP processor.

8.1.3.2 3B21D

No assignments are required for the 3B21D AM processor.

The 3B21D processor consists of two CCs. There can be a maximum of two DMA packs per basic unit available in the CU. The DMA packs are active and standby. One DMA per side is sufficient to handle all the assignment applications.

8.1.4 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

Section 15 for circuit-switched calls, Section 69 for packet-switched calls and Section 126 for the CMP of the 30-minute traffic report and Part 2 of the 15-minute traffic report provide measurements related to processors. For the AM/CMP processor, the only measurement provided in these sections is the percent occupancy.

8.1.4.1 Percent Occupancy

The percent occupancy count is the percentage of time the processor spends doing call processing associated work (message handling, overload control, call processing data delivery, etc.). This measurement is a primary service indicator.

The percent occupancy measurement represents the total of the call processing occupancy and some portion of the occupancy related to overhead work. This overhead consists of nondeferrable, noncall processing functions (called no-load occupancy) as well as certain overhead functions related directly to call processing. The AM processor occupancy measurement includes the actual call processing and related work and the portion of overhead related to call processing. The CMP reports 2 percent occurrences, one for call processing and one for time spent processing all jobs except the low priority jobs.

As long as the percent occupancy of the CMP is less than 65 percent (call processing), the processor should not cause degraded service in terms of call processing.

8.1.4.2 Blockage Due to Overload

The calls blocked during AM/CMP overload (BLKOVD) count is incremented when it is determined in the SM that a route request message cannot be sent to the AM/CMP because the AM/CMP is in an overload condition. In this case, the call is routed to reorder tone. This count, which can be found in Section 4 of the 30-minute traffic report, should not normally exceed zero. This information is also found in TRFC15 Part 2.

8.1.5 FEATURE IMPACT

The AM/CMP is sensitive to the feature mix. This simply means that the capacity of the AM/CMP is reduced as feature usage increases. Although the SM handles more than 95 percent of the feature work for most calls, the AM/CMP processor still performs certain functions related to the use of features.

8.1.6 TRANSITION IMPACT

Module growth is the only form of growth that has any impact on the AM/CMP processor. Module growth is the

addition of one or more SMs. The growth of an SM adds additional terminal capacity to the office, ranging from up to 5,120 analog (using the 10:1 line unit)/4,608 integrated loop carrier lines to 512 trunks or a combination thereof. Examples include adding an SM in the host office or an RSM at a remote site.

8.2 SYSTEM CAPACITY REAL-TIME WORKSHEETS

8.2.1 INTRODUCTION

These worksheets are used to estimate the system real-time call capacity per busy hour of the system-wide limited resources and the percent of system capacity used by the offered load. For a current in-service office, the worksheets are applicable only when there is a change in traffic mix (area transfer, combined replacement offices, etc.). In cases where the office continues to have a stable traffic mix, the use of Central Office Equipment Reports (COER), capacity fit (CAPFIT), current capacity projection tool (CCPT) reports or some other linear regression tool is normally preferred.

For a new office, the worksheet inputs may be derived from previous switching system data; projections of load, feature assignment and feature usage; and "similar office" information. In the case of an existing office, the input data may also be obtained from the 30-minute traffic report.

Note that the 5ESS[®]-2000 switch call capacity is conservatively defined. The CMP processes only full-dial calls; ineffective attempts (for example, false starts, partial dials, nonsense phone numbers, showering lines, cut cables, etc.) are restricted to the SMs. Hence 5ESS[®]-2000 switch capacity, if stated as ATTEMPTS rather than CALLS, is the call capacity multiplied by the attempts/call ratio. Also, the rated capacity of the 5ESS[®]-2000 switch is an indefinitely sustainable operating point supporting normal craft personnel interface with sufficient processor reserve allocated for administrative, maintenance, and fault recovery functions and load demand peaking. Thus, for transient periods of time, with call processing taking precedence over lower priority functions, the 5ESS[®]-2000 switch can successfully handle loads well in excess of the rated call capacity. It is important to use the forecasted call mix for the time period under consideration rather than the current call mix. If a current estimate of load is used as a starting point, it must be adjusted for growth and network changes between the present time and the future point, typically the end-of-period (EOP).

The outputs from the model are the percent of AM/CMP/DLN real time available for call processing, system capacity in calls per hour, and the percent of system capacity used by the offered load. These calls represent the capacity for the actual traffic mix in the particular office under study.

8.2.1.1 Sources of Data

The selection of input data for the real-time call capacity model is clearly important. If a busy-hour determination has been completed for the office, the inputs may be based on the busy-hour reports. (It is suggested that at least 1 week of busy-hour data be reviewed.) If bouncing busy-hour data is used instead of specific busy-hour data, it is again suggested that at least 1 week of data be reviewed to determine the high load. In addition, input data applied to the worksheet should consider the engineering criteria for the office [for example, whether the source of the data is time-consistent-busy-hour (TCBH) or once-a-month reports]. Normally, processor engineering is based on high-day loads.

To perform a real-time capacity analysis for a current, in-service office, the 30-minute traffic reports (sections 3, 5, 12, 15, 24, 29, 30, 31, 32, 34, 35, 36, 40, 55, 57, 66, 126) and 24-hour plant reports (parts 1, 6, and 7) can provide data which reflects the current traffic mix. If these reports are to be used as input to the worksheets, adjustments should be made to reflect the expected changes in the traffic mix.

Recent change view 13.3 must be used to enable sections 29, 30, 31, 32, 34, 35, 40, 55, and 57 of the 30-minute traffic report. For example, to enable measurements for section 29, enter "KEY" as the key value on view 13.3. Make sure the DISCONF attribute is set to "N", and enter CONFT in the TYPE field. Finally, enter the name of the Business and Residence Custom (BRCS) feature ID in the NAME field, and enter "EN" in the STATUS field. For further details, refer to 235-118-200 - *Recent Change Procedures - Menu Mode*.

On the master control center (MCC), the command ALW:TRFC30 must be used to allow data to be collected for the previously listed sections of the 30-minute traffic report. To activate the BRCS feature from TRFC30 Section 29,

see 235-070-100 *Appendix Traffic and Plant Measurements*.

If the input data is not available in the 30-minute traffic report or the 24-hour plant report, refer to the following sources:

- Operational support systems [for example, Engineering and Administrative Data Acquisition System (EADAS), COER]
- Accounting records
- Translations
- Trunking records, trunking engineer.

For a new office, the worksheet inputs may be derived from: previous switching system data; projections of load, feature assignment and feature usage; and/or "similar office" information.

Note that for any section in the 30-minute traffic report, the maximum number of outputs from the receive-only printer (ROP) is five. For example, output may be obtained for up to five terminal groups; if data is needed for more than five terminal groups, EADAS data could be used. The limited memory and real-time resources may make it impossible, in heavily equipped offices, for all sections of the TRFC30 report to be allowed at the same time.

If the data is available from the 30-minute traffic report, two 30-minute intervals of data may be added to get 1 hour of data. Another alternative, which is more conservative, is to multiply the higher 30 minutes of data by 2 to get an hourly equivalent.

If the input data is available from the 24-hour plant report, 24 hours of data may be divided by 6 to approximate the busy-hour equivalent. (The traffic is not evenly distributed throughout 24 hours.)

"Lines" in this worksheet means "actual working lines."

8.2.2 USING THE WORKSHEET

The system capacity real-time worksheets provide spaces to enter the input data and the results of arithmetic calculations. In many cases, a "skeleton equation" is provided in the worksheets below the basic line for your convenience in making intermediate calculations to determine "**NUMBER OF CALLS**."

These worksheets allow for detailed analysis to determine inputs. However, the means of determining the input data may vary. As an example, input data for the item labeled **CALL TRANSFER** could be determined as follows:

- Data could be collected for all terminal groups in the office.
- Data could be collected on a selected subset of terminal groups and the results extrapolated to represent the office totals.

Nominal or "common-sense" values may be used to supplant the need for detailed analysis in many instances, particularly where low feature penetration exists in the office.

Also, note that the **MILLISECONDS PER CALL** coefficient is a measure of the relative importance of various inputs. For example, the item labeled **CARRIER INTERCONNECT** is much less significant than the item labeled **INWATS**.

8.2.3 5E10 AND LATER SYSTEM CALL CAPACITY WORKSHEETS

This worksheet estimates the 5ESS®-2000 switch call capacity per busy hour, and the percent of capacity used by the offered load, based on the capacities of the system-wide limiting resources. The limiting resources are the AM, CMP, and direct link node (DLN).

8.2.3.1 What Call Capacity Numbers Represent

The rated capacity of the 5ESS®-2000 switch is an indefinitely sustainable operating point supporting normal craftperson interface with sufficient processor reserve allocated for administrative, maintenance, and fault recovery functions and load demand peaking. Thus, for transient periods of time, with call processing taking precedence over lower priority functions, the 5ESS®-2000 switch can successfully handle loads far in excess of the rated call capacity.

8.2.3.2 Call Capacity Resources

The CMP handles most of the call processing functions previously handled by the AM. Of these call processing functions, only billing and authorization code call processing remain in the AM. The AM also processes common channel signaling (CCS) messages if there is no DLN, and message detail recording (MDR) if an attached processor (AP) is attached to the AM. The AM spends a smaller fraction of its real time processing calls, but may still be a limiting resource for call processing. In addition, the DLN is a limiting resource, for high volume CCS traffic.

Each of these resources (CMP, AM, and DLN) is potentially limiting on the overall call capacity of the switch, depending on the configuration of the switch and the call mix it is handling. Therefore, the capacity of each of these resources must be computed separately. Accordingly, the real time items are now grouped into three major sections to calculate the real time for each of the three limiting resources. (Note that some traffic items impact more than one resource, notably CCS, which consumes CMP real time, and DLN real time, or AM real time, if the switch is not equipped with a DLN.) Correspondingly, the capacity computation formulas at the end of the worksheet are divided into separate formulas for each of the three limiting resources. The projected switch capacity is the smallest of these three capacities.

This worksheet gives a conservative estimate of switch capacity, consistent with what Lucent Technologies has formally committed to and publicized for 5E10 and later. Actual system capacity is, for many offices, greater than these calculations indicate, but for some offices, the capacity may be less, due to limitations of still other limiting resources (types of offices affected are noted in the following paragraph).

8.2.3.2.1 Types of Offices for Which the Worksheet May Not Give Valid Results

In general, the capacity of an office can be assumed to be at least as great as the value calculated by this worksheet. However, for offices of the following types, the limitations of other resources must also be considered, as they may affect the capacity of these offices:

- ISDN offices with more than 75 SMs in which more than 10% of the calls originate or terminate to shared directory numbers. This does not impact all SM-2000 offices with QLPS.
- Toll/Tandem offices with more than 56,000 trunks on non SM-2000 SMs.

For these types of offices, contact the 5ESS®-2000 switch Digital Ordering and Planning System (DOPS) Assist Line.

8.2.3.3 Worksheet Inputs

Inputs to the worksheet are office configuration parameters and office call mix during the busy hour. The call mix is divided into two sections: The Basic Traffic Partition measures the resource usage for basic line-to-line,

line-to-trunk, trunk-to-line, and trunk-to-trunk calls, packet-switched data calls, and some Operator Services Position System (OSPS) calls. The Feature Traffic Partition measures the resource usage for Business and Residence Custom Services (BRCS), CCS, Local Area Signaling Services (LASS), and other miscellaneous features. For proper counting, a featured call should be counted as a basic call in the Basic Traffic Partition, and as feature usage in the Feature Traffic Partition.

The worksheet inputs may be derived from previous switching system data; projections of load, feature assignment and feature usage; and/or "similar office" information. It is important to use the forecast call mix for the time period under consideration, rather than the current call mix. If a current estimate of load is used as a starting point, it must be adjusted for growth and network changes between the present time and the future point, typically the EOP.

8.2.3.4 Worksheet Outputs

The outputs from the model are the AM and CMP capacities in calls per hour and the percent of AM and CMP capacities used by the offered load. These quantities represent the capacity for the forecast traffic mix in the particular office under study.

8.2.3.5 Real-Time Coefficients

The real-time coefficients (ms/call) in the worksheet are based on lab measurements or estimates. They have been scaled to give conservative estimates of system call capacity, consistent with what Lucent Technologies has formally committed to and publicized for 5E10 and later.

8.2.3.6 Changes to the 5E10-5E12 Worksheet in Issue 13.00

The following changes are made in the current version of the worksheet:

- The CMP real-time coefficients are reduced by a factor of 1.2 for the 5E12 software release based on TN1800 board optimizations.

"5ESS" SWITCH

SYSTEM CAPACITY REAL-TIME WORKSHEET

5E10 and 5E11 SOFTWARE RELEASE

```
|Please input call and feature usage during a 1-hour interval
|
|
|The general format of this worksheet is:
|
|
|                                     REAL-TIME   REAL-TIME
| TRAFFIC                           NUMBER   PER CALL CONSUMPTION
|
|PARTITION (NUMBER OF CALLS/HOUR)    OF CALLS    (MS)          (MS)
|
|                                     x          =
```


Note: A factor of 2 converts 30-minutes of data to its hourly equivalent

You may also add two 30-minutes of data to get an hour of data. If input data is obtained from the 30-minute traffic report or the 24-hour plant report, adjustments should be made to reflect expected changes in traffic mix.

CMP SECTION

This section applies whether the switch is equipped with CM1 or CM2.

BASIC TRAFFIC PARTITION

ANALOG VOICE AND ISDN CIRCUIT-SWITCHED VOICE AND DATA CALLS

1. NUMBER OF _____ x 0.8 = _____

LINE-TO-LINE CALLS

Number of calls per hour which originate and terminate in the office.

2. NUMBER OF _____ x 2.5 = _____

LINE-TO-1-WAY TRUNK CALLS

Number of calls per hour which originate in the office and go out on 1-way trunks.

3. NUMBER OF _____ x 2.4 = _____

LINE-TO-2-WAY TRUNK CALLS

Number of calls per hour which originate in the office and go out on 2-way trunks.

4. NUMBER OF _____ x 0.8 = _____

1-WAY TRUNK-TO-LINE CALLS

Number of calls per hour which come in on 1-way trunks and terminate in the office.

5. NUMBER OF _____ x 1.1 = _____

2-WAY TRUNK-TO-LINE CALLS

Number of calls per hour which come in on 2-way trunks and terminate in the office.

Note: In items 1 through 5, a "line" is either an analog line or an ISDN B-channel.

6. NUMBER OF _____ x 2.5 = _____

1-WAY TRUNK-TO-1-WAY TRUNK CALLS

Number of tandem calls per hour which are incoming on 1-way trunks and outgoing on 1-way trunks.

Note: Operator Services Position System (OSPS) items 42 through 54, 60 through 72, 81, and 82 are included in item 6.

7. NUMBER OF _____ x 2.4 = _____

1-WAY TRUNK-TO-2-WAY TRUNK CALLS

Number of tandem calls per hour which are incoming on 1-way trunks and outgoing on 2-way trunks in the office.

8. NUMBER OF _____ x 2.8 = _____

2-WAY TRUNK-TO-1-WAY TRUNK CALLS

Number of tandem calls per hour which are incoming on 2-way trunks and outgoing on 1-way trunks in the office.

9. NUMBER OF _____ x 2.6 = _____

2-WAY-TRUNK-TO-2-WAY TRUNK CALLS

Number of tandem calls per hour which are incoming on 2-way trunks and outgoing on 2-way trunks in the office.

BUSY LINE TERMINATIONS (INCLUDED PREVIOUSLY)

10. NUMBER OF _____ x -0.8 = _____

BUSY LINE TERMINATIONS

Number of partially-dialed, abandoned calls.

Note: The real time for this item is negative, representing an adjustment to the real time consumed for line-terminating calls. The adjustment is 0 for an outgoing trunk call not completed because of a busy line at the other end.

Permissible maximum: the number of line-to-line + trunk-to-line calls.

PARTIAL DIAL CALLS

Partial dial calls do not consume real time in the CMP, but they are included in the overall calling rate.

11. NUMBER OF _____ x 0.0 = _____

PARTIAL DIAL TIME OUT

Number of partially-dialed calls per hour (not included in previous call counts) which are partially-dialed abandons and time-outs.

Note: Reasonable maximum of 10 percent of line-originated analog and CSV calls.

ISDN PACKET-SWITCHED DATA

Intraoffice and incoming packet-switched data (PSD) calls consume no real time in the CMP, but they are included in the overall office calling rate.

12. NUMBER OF _____ x 0.0 = _____

INTRASWITCH PSD CALLS

Number of packet-switched data calls that originate and terminate in the office.

13. NUMBER OF _____ x 2.0 = _____

OUTGOING PSD CALLS

Number of packet-switched calls per hour that originate in the office and go out.

14. NUMBER OF _____ x 0.0 = _____

INCOMING PSD CALLS

Number of packet-switched calls per hour that come in and terminate in the office.

ISDN MESSAGE SERVICES

Message service calls consume no real time in the CMP, but they are included in the overall office calling rate.

15. NUMBER OF MESSAGES _____ x 0.0 = _____

RETRIEVED FOR DISPLAY

Number of messages retrieved for display on the user's telephone set per hour.

16. NUMBER OF MESSAGES _____ x 0.0 = _____

PRINTED OUT

Number of messages printed out per hour.

ISDN ELECTRONIC DIRECTORY SERVICES

Note: The EDS calls consume no real time in the CMP, but they are included in the overall calling rate.

17. NUMBER OF CALLS WHICH REQUEST _____ x 0.0 = _____

DIRECTORY QUERY DISPLAY

Number of directory query display session requests. This is regardless of the number of entries retrieved and displayed.

COMMERCIAL AUTOMATIC CALL DISTRIBUTION (C-ACD)

If your office does not have C-ACD calls, skip to the OSPS section.

18. NUMBER OF _____ x 3.8 = _____

C-ACD CALLS

Number of calls per hour which are C-ACD basic calls agent seizure count.

OSPS DIRECTORY ASSISTANCE (DA) CALLS AND LISTING SERVICES (LS)

If the office does not have OSPS calls, ignore these items.

OSPS DIRECTORY ASSISTANCE (DA)

DA calls received via CCS7 should be included in item 111 (in the AM section) and item 133 (in the DLN section).

19. NUMBER OF DA CALLS _____ x 3.8 = _____

WITH VERBAL ANNOUNCEMENT

Number of DA calls with verbal announcement by DA operator.

Default value: 10 percent of DA call load

20. NUMBER OF DA CALLS WITH _____ x 7.2 = _____

INTERNAL AUTO ANNOUNCEMENT

Number of directory assistance calls with auto announcement generated internally by recorded announcement facility in switch.

21. NUMBER OF CALLS USING DA WITH _____ x 7.1 = _____

EXTERNAL AUTO ANNOUNCEMENT

Number of initial DA calls with auto announcement generated by vendor's external audio response unit.

Default value: 90 percent of DA call load

OSPS INTERCEPT SYSTEM

Note: Intercept calls received via CCS7 should be included in items 112 and 134.

22. NUMBER OF CALLS USING _____ x 3.6 = _____

AUTOMATED INTERCEPT

Number of calls that are intercepted for an automated announcement about a changed or disconnected number.

Default value: 95 percent of DA call load

23. NUMBER OF CALLS USING _____ x 4.1 = _____

OPERATOR HANDLED INTERCEPT

Number of calls that are intercepted by an operator because of a changed or disconnected number.

Default value: 5 percent of DA call load

OSPS TOLL AND ASSISTANCE (T&A)

24. NUMBER OF CALLS _____ x 4.8 = _____

FOR INFORMATION

Number of 0- calls per hour made in the office for operator information.

Default value: 2.5 percent of DA call load

25. NUMBER OF CALLS _____ x 4.8 = _____

TRANSFERRED TO CENTRALIZED**AUTOMATIC MESSAGE ACCOUNTING (CAMA)**

Number of transfer CAMA calls per hour that are made in the office.

Default value: 6.7 percent of DA call load

26. NUMBER OF T&A CALLS WHICH A _____ x 4.8 = _____

RECEIVED INTERFLOW

Number of T&A calls per hour interflowed to your switch.

Sum of NUMBER OF CALL entries

(items 1 through 26) ==> A: _____

Sum of CMP REAL-TIME CONSUMPTION in the Basic

Traffic Partition entries

(items 1 through 26) ==> B: _____

FEATURE TRAFFIC PARTITION

27. NUMBER OF CALLS HANDLED BY _____ x 3.1 = _____

ANALOG ATTENDANT

Number of calls per hour handled by an analog attendant.

Permissible maximum: Total CSV calls

28. NUMBER OF CALLS USING _____ x 1.1 = _____

ALTERNATE ROUTING

Number of line-to-trunk or trunk-to-trunk calls per hour using alternate routing.

Permissible maximum: Total outgoing circuit-switched calls

COMMON CHANNEL SIGNALING

29. NUMBER OF OUTGOING CALLS USING _____ x 0.5 = _____

COMMON CHANNEL SIGNALING (CCS)

Number of line-to-trunk and trunk-to-trunk calls going out over CCS6 or CCS7 trunks.

Default value = [(line-to-trunk calls) + (trunk-to-trunk calls)] x (fraction of CCS trunks)

Permissible maximum: Total line-to-trunk and trunk-to-trunk calls.

ISDN CIRCUIT-SWITCHED VOICE

30. NUMBER OF CALLS WHICH _____ x 0.8 = _____

TERMINATE TO SHARED DIRECTORY

NUMBERS WITH NONLEAD PORT ANSWERING

Permissible maximum: Total CSV calls.

Note: Item 31 applies only to shared directory number groups spanning four or more SMs. Part of the CMP real time consumed for large shared DN groups depends on the number of SMs per group (item 31) as well as the number of calls to or from large shared DN groups (item 32). Therefore, the real-time factor given is the number of ms per SM per call. Items without real-time factors are given for recording the number of SMs per group. The CMP real-time consumption for large shared DN groups should be figured as:

31. NUMBER OF CALLS FROM OR TO _____ x 0.8 = _____

LARGE SHARED DN GROUPS

The number of calls originating from or terminating to shared DN groups spanning 4 or more SMs.

Permissible maximum: Total CSV calls.

The average number of SMs participating in large shared DN groups spanning 4 or more SMs.

Permissible maximum: 4-32

(shared DN calls) x (SMs per group - 1) x (item 32c)

Subtract 1 from the number of switching modules per large shared DN group.

32c. LARGE SHARED DN GROUPS --

_____ x 0.2 = _____

CALLS

The number of calls originating from or terminating to shared DN groups spanning 4 or more SMs. Multiply by the average number of SMs participating in the shared DN group(s) minus 1.

Permissible maximum: Total CSV calls.

33. NUMBER OF _____ x 3.1 = _____

ATTENDANT SPLIT/BRIDGE CALLS

The number of calls per hour with the split/bridge feature handled by the ISDN attendants.

Permissible maximum: Total CSV calls.

ISDN PACKET-SWITCHED DATA

34. NUMBER OF CALL FROM OR TO PACKET _____ x 3.4 = _____

MODE ISDN BASIC BUSINESS GROUP

Calls per hour originating from or terminating to a basic business group structure in the office.
COMMERCIAL AUTOMATIC CALL DISTRIBUTION (C-ACD)

If your office does not handle C-ACD calls, ignore these items.

35. NUMBER OF MUSIC OR _____ x 3.7 = _____

ANNOUNCEMENT DELAYS

The total number of delays for all C-ACD calls.

36. NUMBER OF QUEUE CHANGES _____ x 3.0 = _____

The total number of queue changes for all C-ACD calls (initial agent requests are not counted here).

37. NUMBER OF _____ x 1.5 = _____

CONDITIONAL GO-TO's

The total number of conditional go-to's per hour based upon team/queue status for all C-ACD calls.

OPERATOR SERVICES POSITION SYSTEM

If the office does not handle OSPS T&A calls, ignore these items.

OSPS DIRECTORY ASSISTANCE (DA)

38. NUMBER OF _____ x 3.8 = _____

DA RECALLS AFTER

AUTO ANNOUNCEMENT

Number of directory assistance recalls per hour after auto announcement.

39. NUMBER OF _____ x 4.5 = _____

DA CALL COMPLETIONS

Number of directory assistance calls per hour completed automatically.

Permissible maximum: Total DA calls.

Note: Call completions via CCS7 should be included in items 29, 113, and 135.
OSPS INTERCEPT SYSTEM

40. NUMBER OF _____ x 3.4 = _____
INTERCEPT CALL COMPLETIONS

Number of OSPS intercept system calls per hour completed automatically.

Permissible maximum: Total intercepts.

Note: Call intercepts should be included in items 29, 113, and 135.
NONINTERFLOWED OPERATOR-HANDLED T&A CALLS

Items 41 through 54, 60 through 72, 81, and 82 are included in the count of 1-way trunk to 1-way trunk calls (Item 6). Therefore, the real time given here is the excess over the real time for a 1-way trunk to 1-way trunk call.

41. NUMBER OF STATION PAID, _____ x 5.2 = _____
NONCOIN STATION CALLS
INCLUDING HOTEL/MOTEL

Number of station-to-station calls from noncoin stations, including hotels/motel.

Default value: 1.2 percent of T&A call load

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

42. NUMBER OF _____ x 14.0 = _____
STATION-PAID, COIN CALLS FROM
ACTS COMPATIBLE STATIONS

Number of station-to-station calls from ACTS compatible coin stations but handled by an operator.

Default value: 0.6 percent of T&A call load

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

43. NUMBER OF _____ x 5.2 = _____
STATION-PAID, COIN CALLS FROM
NONACTS COMPATIBLE STATIONS

Number of station-to-station calls from non-ACTS compatible coin stations.

Default value: 3.3 percent of T&A call load

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

44. NUMBER OF CALLS WHICH ARE _____ x 9.3 = _____

PERSON PAID, NONCOIN

INCLUDING HOTEL/MOTEL

Number of person-to-person calls from noncoin stations, but handled by an operator including hotel/motels.

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

45. NUMBER OF _____ x 13.5 = _____

PERSON-PAID, COIN CALLS FROM

ACTS COMPATIBLE STATIONS

Number of person-to-person calls from ACTS compatible coin station, but handled by an operator.

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

46. NUMBER OF _____ x 9.3 = _____

PERSON-PAID COIN CALLS FROM

NONACTS COMPATIBLE STATIONS

Number of person-to-person calls from non-ACTS compatible coin stations per hour.

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

47. NUMBER OF COLLECT CALLS _____ x 9.3 = _____

Number of collect calls per hour.

Default value: 24.1 percent of T&A call load

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

48. NUMBER OF OPERATOR-HANDLED _____ x 5.2 = _____

CALLING CARD CALLS

Number of calls per hour which are handled by operators and billed to calling cards.

Default value: 3.8 percent of T&A call load

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

49. NUMBER OF CALLS BILLED TO _____ x 5.2 = _____

THIRD NUMBERS WITHOUT**CONFIRMATION**

Number of calls per hour which are billed to third numbers without operator confirmation.

Default value: 1.2 percent of T&A call load

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

50. NUMBER OF CALLS BILLED TO THIRD _____ x 12.4 = _____

NUMBERS WITH CONFIRMATION

Number of calls per hour which are billed to third numbers with operator confirmation.

Default value: 1.6 percent of T&A call load

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

51. NUMBER OF _____ x 6.7 = _____

MISCELLANEOUS OPERATOR-**HANDLED T&A CALLS**

Number of operator-handled T&A calls per hour not included in previous items.

Default value: 0.9 percent of T&A call load

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

Note: The real time per call for items 41 through 53 is for 0- calls. Item 54 accounts for the additional real time used for a 0+ call over a 0- call.

52. NUMBER OF _____ x 4.3 = _____

OPERATOR-HANDLED 0+ CALLS

Number of T&A calls per hour that are dialed 0+ and handled by an operator.

Default value: 78.9 percent of T&A call load

53. NUMBER OF _____ x 4.8 = _____

OVERTIME COIN COLLECTIONS**WHICH ARE OPERATOR-HANDLED**

Number of times overtime collections are made on coin calls per hour from operator-handled coin stations.

Default value: 26.4 percent of T&A call load

54. NUMBER OF CALLS WHICH ARE _____ x 6.0 = _____

ELIGIBLE FOR MORE EFFICIENT

CALL HANDLING (MECH)

Number of collect and person-paid calls per hour that are eligible for MECH.

AUTOMATED ALTERNATE BILLING SYSTEM/AUTOMATED POSITION

Items 55 through 57 apply if the automated alternate billing system/automated position is active during the busy hour. Otherwise skip to item 60.

55. NUMBER OF _____ x 4.3 = _____

CALLING CARD HANDLED VIA

AUTOMATED POSITION

Number of calling card calls handled per hour by the automated position.

56. NUMBER OF 0+ CALLS _____ x -4.3 = _____

HANDLED VIA 1-STAGE PROTOCOL

Number of 0+ calls handled via the automated position with one stage protocol.

Note: The real time for this item is negative, representing an adjustment to the real time consumed for 0+ calls when handled via the automated position. However, this adjustment only applies for 1-stage protocol. The adjustment is 0 for 2-stage protocol.

59. NUMBER OF _____ x 4.8 = _____

AUTOMATED CALLS

SENT INTERFLOWED OPERATOR-HANDLED T&A CALLS

Items 58 through 71 are for the interflowed T&A calls sent by your switch to another switch during the busy hour. If the interflowed feature is not activated during the busy hour, ignore these items.

58. NUMBER OF _____ x 5.5 = _____

SENT INTERFLOWED, STATION-PAID

NONCOIN CALLS (INCLUDING HOTEL/MOTEL)

Number of station-to-station calls per hour from noncoin station, including hotels and motels, interflowed to another switch.

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

59. NUMBER OF SENT INTERFLOWED, _____ x 14.3 = _____

STATION-PAID COIN CALLS

FROM ACTS COMPATIBLE STATIONS

Number of station-to-station calls per hour made from ACTS compatible coin stations that are handled by an operator and interflowed to another switch.

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

60. NUMBER OF SENT INTERFLOWED, _____ x 5.5 = _____

STATION-PAID COIN CALLS

FROM NONACTS COMPATIBLE STATION

Number of station-to-station calls per hour made from non-ACTS compatible, coin stations that are interflowed to another switch.

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

61. NUMBER OF _____ x 9.6 = _____

SENT INTERFLOWED, PERSON-PAID

NONCOIN CALLS INCLUDING HOTEL/MOTEL

Number of person-to-person calls per hour made from noncoin stations, including hotels and motels, interflowed to another switch.

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

62. NUMBER OF SENT INTERFLOWED, _____ x 13.8 = _____

PERSON-PAID COIN CALLS

FROM ACTS COMPATIBLE STATIONS

Number of person-paid calls per hour made from ACTS compatible coin stations that are operator-handled and interflowed to another switch.

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

63. NUMBER OF SENT INTERFLOWED, _____ x 9.6 = _____

PERSON-PAID COIN CALLS

FROM NONACTS COMPATIBLE STATIONS

Number of person-paid calls per hour made from non-ACTS compatible, coin stations that are interflowed to another switch.

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

64. NUMBER OF _____ x 9.6 = _____

SENT INTERFLOWED, COLLECT CALLS

Number of collect calls per hour interflowed to another switch.

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

65. NUMBER OF SENT INTERFLOWED, _____ x 5.5 = _____

CALLING CARD CALLS WHICH

ARE OPERATOR-HANDLED

Number of calls per hour that are interflowed to another switch for billing to a calling card with operator assistance.

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

66. NUMBER OF SENT INTERFLOWED, _____ x 5.5 = _____

THIRD NUMBER CALLS

WITHOUT CONFIRMATION

Number of calls per hour that are interflowed to another switch for billing to a third party but not confirmed by the operator.

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

67. NUMBER OF SENT INTERFLOWED, _____ x 12.7 = _____

THIRD NUMBER CALLS

WITH CONFIRMATION

Number of calls per hour that are interflowed to another switch for billing to a third party and confirmed by the operator.

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

69. NUMBER OF SENT INTERFLOWED _____ x 4.6 = _____

OPERATOR-HANDLED 0+ CALLS

Number of operator-handled T&A calls per hour dialed 0+ that are interflowed to another switch.

70. NUMBER OF SENT INTERFLOWED, _____ x 5.1 = _____

OVERTIME COIN COLLECTIONS,

OPERATOR-HANDLED

Number of overtime collections interflowed to another switch for operator handling calls that are interflowed to another switch.

71. NUMBER OF SENT INTERFLOWED _____ x 6.3 = _____

CALLS WHICH ARE ELIGIBLE FOR

MORE EFFICIENT CALL HANDLING (MECH)

Number of collect and person-to-person calls that are eligible for MECH, interflowed to another switch.

OSPS SENT INTERFLOWED T&A

Answer items 72 through 74 only if the automated alternate billing system/automated position is active during the busy hour. Otherwise ignore these items.

72. NUMBER OF SENT INTERFLOWED _____ x 4.3 = _____

CALLING CARD CALLS

HANDLED VIA AP

Number of calls per hour sent interflowed calling card handled via the automated position.

73. NUMBER OF SENT INTERFLOWED _____ x -4.3 = _____

0+ CALLS HANDLED VIA

AP WITH 1-STAGE PROTOCOL

Number of calls sent interflowed 0+ and handled via automated position with 1-stage protocol.

Note: The real time for this item is negative, representing an adjustment to the real time consumed for 0+ calls when handled via the automated position. However, this adjustment only applies for 1-stage protocol. The adjustment is 0 for 2-stage protocol.

74. NUMBER OF SENT INTERFLOWED _____ x 5.1 = _____

CALLS TRANSFERRED

TO AN OPERATOR

Number of interflowed automated position calls transferred to an operator.

RECEIVED INTERFLOWED OPERATOR-HANDLED T&A

Answer items 75 and 76 only if this switch receives interflowed T&A calls during the busy hour.

75. NUMBER OF RECEIVED INTERFLOWED,

OVERTIE COIN CALLS WHICH _____ x 4.8 = _____

ARE OPERATOR-HANDLED

Number of overtime collections made on coin calls per hour interflowed to your switch during the busy hour and operator- handled.

76. NUMBER OF RECEIVED INTERFLOWED, _____ x 6.0 = _____

CALLS WHICH ARE ELIGIBLE FOR**MORE EFFICIENT CALL HANDLING (MECH)**

Number of collect and person-paid calls per hour that are eligible for MECH.

NON-OPERATOR-HANDLED T&A

Items 77 and 78 are included in the count of 1-Way Trunk to 1-Way Trunk calls (item 6) in the Basic Traffic Partition.

77. NUMBER OF ACTS CALLS _____ x 4.7 = _____

Number of calls per hour which are fully automatic ACTS calls.

Default value: 15.7 percent of T&A call load

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

78. NUMBER OF CALLS USING _____ x 4.7 = _____

ACCS (AUTOMATIC CALLING CARD**SERVICE)**

Number of calls per hour which are fully automatic from ACCS compatible stations.

Default value: 31.6 percent of T&A call load

Permissible maximum: Total 1-way trunk to 1-way trunk calls.

79. NUMBER OF AUTOMATIC _____ x 8.8 = _____

END-OF-INITIAL-PERIOD**ANNOUNCEMENTS**

Number of automatic end-of-initial-period announcements per hour which are made in the office.

Default value: 23.7 percent of T&A call load

80. NUMBER OF AUTOMATIC _____ x 4.3 = _____

OVERTIME COIN COLLECTIONS

Number of times per hour overtime collections are made on coin calls per hour from automatic coin stations.

Default value: 23.7 percent of T&A call load

ANALOG BUSINESS AND RESIDENCE CUSTOM SERVICES (BRCS)

AND INTEGRATED SERVICES DIGITAL NETWORK (ISDN) BRCS

81. NUMBER OF CALL TRANSFERS _____ x 0.9 = _____

Number of times per hour that calls are transferred to a third parties, including attendants.

Reasonable maximum: 10 percent of analog and CSV calls.

Note: Call forwarding consumes no real time in the CMP.

82. NUMBER OF _____ x 3.1 = _____

3-WAY CONFERENCE SETUPS

Number of 3-way conference call setups per hour in the office.

Reasonable maximum: 10 percent of analog and CSV calls.

Note: Call pickup consumes no real time in the CMP in 5E11.

83. NUMBER OF CALLS USING _____ x 2.6 = _____

SIMULATED FACILITIES

GROUP (SFG) FOR OUTWATS

Number of times that SFGs are used for OUTWATS.

Reasonable maximum: 16 percent of analog and CSV calls.

84. NUMBER OF CALLS USING _____ x 2.3 = _____

SIMULATED FACILITIES

GROUP (SFG) FOR INWATS

Number of times that SFGs are not used for OUTWATS.

Reasonable maximum: 12 percent of analog and CSV calls.

85. NUMBER OF CALLS USING _____ x 2.3 = _____

SFG INTERCOM CALL RESTRICTION

Number of calls that are intercom restricted per hour in the office.

Reasonable maximum: 2 percent of analog and CSV calls.

86. NUMBER OF CALLS USING _____ x 1.1 = _____

AUTOMATIC ROUTE SELECTION (ARS)

Number of line-to-trunk calls per hour in the office using the ARS feature, plus the number of alternate routes used or attempted.

Reasonable maximum: 48 percent of analog and CSV calls.

87. NUMBER OF CALLS USING _____ x 0.9 = _____

PRIVATE FACILITY ACCESS (PFA)

Number of line-to-trunk calls per hour in the office using the PFA feature.

Reasonable maximum: 10 percent of analog and CSV calls.

88. NUMBER OF CALLS USING _____ x 4.1 = _____

MODULAR QUEUING FOR

OUTGOING PRIVATE FACILITIES

Number of calls per hour in the office that queue and dequeue for private facilities.

Reasonable maximum: 4 percent of analog and CSV calls.

Note: Modular queuing for lines consumes no real time in the CMP.

89. NUMBER OF CALLS USING _____ x 0.1 = _____

CARRIER INTERCONNECT (CI)

Number of calls per hour in the office that use CI direct connect trunk or CI indirect connect (via access tandem) trunk.

Reasonable maximum: 14 percent of analog and CSV calls.

MISCELLANEOUS FEATURES

90. NUMBER OF CALLS TO _____ x 2.4 = _____

CENTRALIZED ATTENDANTS

Number of calls per hour in the office to attendants located outside this switch.

Reasonable maximum: 1 percent of analog and CSV calls.

Note: This item is applicable only when this switch is served as a branch location of a centralized attendant

service; that is, no attendant is located on this switch. All calls originating from this switch to attendants are forwarded to another switch that provides the attendant service.

91. NUMBER OF CALLS USING _____ x 0.4 = _____

LINE TIME-SLOT BRIDGING

Number of calls per hour in the office to time slot bridged lines.

Reasonable maximum: 1 percent of analog and CSV calls.

92. NUMBER OF CALLS USING _____ x 2.9 = _____

ENHANCED 911

Number of enhanced 911 calls per hour in the office.

Reasonable maximum: 4 percent of analog and CSV calls.

ADVANCED SERVICES PLATFORM

93. NUMBER OF ASP REQUESTS _____ x 1.6 = _____

FOR DIALED DIGITS

Number of requests per hour for dialed digits.

Reasonable maximum: 10 percent of analog and CSV calls.

94. NUMBER OF ASP ROUTING ATTEMPTS _____ x 1.1 = _____

Number of routing attempts per hour (if not included in the ARS item.)

Reasonable maximum: 10 percent of analog and CSV calls.

95. NUMBER OF ASP CALLS _____ x 1.6 = _____

ROUTED TO ANNOUNCEMENTS

Number of ASP calls per hour routed to announcements.

Sum of CMP REAL-TIME CONSUMPTION

(items 27 through 95) ==> C:

AM SECTION

Complete this section if the office has CNI but does not have DLN, or if the call load contains more than 100,000 authorization code calls per hour.

96. NUMBER OF _____ x 0.3 = _____

BILLED CALLS

Number of originating and incoming (O+I) including OSO/INWATS calls per hour which are billed in the office.

Reasonable maximum: total line - originating calls

97. NUMBER OF CALLS USING _____ x 1.6 = _____

AUTHORIZATION CODES

Number of authorization code calls per hour made in the office.

Reasonable maximum: 12 percent of analog and CSV calls

COMMON CHANNEL SIGNALING

Complete items 98 through 116 only if the switch is equipped with CNI but not with DLN.

98. NUMBER OF CALLS USING _____ x 11.6 = _____

CCS6 TRUNK-TO-TRUNK CALLS

Number of trunk-to-trunk calls per hour which use CCS6 on both sides of the call.

Default value = (trunk-to-trunk calls) x (fraction of CCS6 trunks)².

Permissible maximum: Total trunk-to-trunk calls.

99. NUMBER OF CALLS USING _____ x 5.8 = _____

LINE OR NONCCS TRUNK

TO CCS6 TRUNK CALLS

Number of line-to-trunk or trunk-to-trunk calls per hour using CCS6 on the outgoing side only.

Default value = (trunk-to-trunk calls) x (fraction of CCS6 trunks) + (trunk-to-trunk calls) x (fraction of CCS6 calls) x [1 - (fraction of CCS6 trunks)]

Permissible maximum: Total line-to-trunk + trunk-to-trunk calls.

100. NUMBER OF CCS6 TRUNK TO LINE _____ x 5.8 = _____

OR NONCCS TRUNK CALLS

Number of trunk-to-line and trunk-to-trunk incoming calls per hour using CCS6 only on the incoming side.

Default value = (trunk-to-trunk calls) x (fraction of CCS6 trunks) x [1 - (fraction of CCS6 trunks)] + (trunk-to-line-

calls) x (fraction of CCS6 trunks)

Permissible maximum: Total trunk-to-line + trunk-to-trunk calls.
CCS7

101. NUMBER OF CCS7/CCS (ISUP) _____ x 18.0 = _____

TRUNK-TO-TRUNK CALLS

Number of trunk-to-trunk calls per hour using CCS7/CCS (ISUP) on both sides of the call.

Default value = (trunk-to-trunk calls) x (fraction of CCS7 trunks)² .

Permissible maximum: Total trunk-to-trunk calls.

102. NUMBER OF _____ x 9.0 = _____

LINE OR NONCCS TRUNK

TO CCS7/CCS (ISUP) TRUNK CALLS

Number of line-to-trunk and trunk-to-trunk calls per hour using CCS7/CCS (ISUP) on the outgoing side of the call only.

Default value = (line-to-trunk calls) x (fraction of CCS7 trunks) + (trunk-to-trunk calls) x (fraction of CCS7 calls) x [(1 - (fraction of CCS7 trunks))]

Permissible maximum: the line-to-trunk + trunk-to-trunk calls.

103. NUMBER OF _____ x 9.0 = _____

CCS7/CSS (ISUP) TRUNK-TO-LINE

OR NONCCS TRUNK CALLS

The number of trunk-to-line and trunk-to-trunk calls using CCS7/CCS (ISUP) on the incoming side of the call only.

Default value = (trunk-to-trunk calls) x (fraction of CCS7 trunks) x [1 - (fraction of CCS7 trunks)] + (trunk-to-line-calls) x (fraction of CCS7 trunks)

Permissible maximum: the line-to-trunk + trunk-to-trunk calls.

NETWORK INTERCONNECT

104. NUMBER OF CCS7/CCS (ISUP) _____ x 19.0 = _____

TO NETWORK INTERCONNECT CALLS

Number of CCS7 tandem calls to equal access trunks.

Permissible maximum: Total trunk-to-trunk calls.

105. NUMBER OF NONCCS TO NETWORK _____ x 10.0 = _____

INTERCONNECT CALLS

Number of MF calls per hour to equal access trunks.

Permissible maximum: Total trunk-to-trunk + line-to-trunk calls.

106. NETWORK INTERCONNECT TO _____ x 18.0 = _____

CCS7/CCS (ISUP)

Number of incoming equal access tandem calls going out over CCS7 trunks.

Permissible maximum: Total trunk-to-trunk calls.

107. NUMBER OF NETWORK _____ x 9.0 = _____

INTERCONNECT TO NONCCS

Number of calls per hour interconnecting equal access calls to MF lines or trunks.

Permissible maximum: Total trunk-to-line + trunk-to-trunk calls.

CCS7 FOR OSPS

108. INCOMING CCS7 FOR OSPS DA _____ x 9.0 = _____

AND INTERCEPT OSPS DA

Number of calls per hour for OSPS directory assistance that come in over CCS7 trunks.

Default value = (DA + intercept calls) x (fraction of CCS trunks)

Permissible maximum: Total directory assistance calls + intercept calls.

109. NUMBER OF _____ x 9.0 = _____

OUTGOING CCS7 FOR OSPS DA

COMPLETION

Number of calls per hour for OSPS directory assistance that go out over CCS7 trunks.

Default value = (DA call completions + intercept call completions) x (fraction of CCS trunks)

Permissible maximum: Total directory assistance calls + intercept call completions.

Note: The real times for items 114 through 117 are for line information data base lookups, and are separate from the real-time consumed for trunk signaling for the base call. The call counts for these items include sent-interflowed calls as well as non-interflowed calls.

110. NUMBER OF COLLECT CALLS _____ x 3.3 = _____

Number of calls per hour that are collect.

111. NUMBER OF CALLING CARD CALLS _____ x 3.3 = _____

Number of calls per hour that use calling cards with operator assistance or via ACCS.

112. NUMBER OF THIRD NUMBER _____ x 3.3 = _____

CALLS WITHOUT CONFIRMATION

Number of calls per hour billed to a third party but not confirmed by the operator.

113. NUMBER OF THIRD NUMBER _____ x 3.3 = _____

CALLS WITH CONFIRMATION

Number of calls per hour billed to a third party and confirmed by the operator.

OTHER CCS

114. NUMBER OF _____ x 2.3 = _____

OSO (ORIGINATING SCREENING

OFFICE) / INWATS CALLS

Number of trunk calls per hour that use OSO/INWATS.

115. NUMBER OF CALLS WHICH ARE _____ x 1.4 = _____

SUBJECT TO NETWORK CALL DENIAL

Number of line-to-trunk and trunk-to-trunk calls per hour that use NCD.

116. NUMBER OF SERVICE _____ x 3.3 = _____

SWITCHING POINT (SSP) / 800 CALLS

Number of SSP/800 calls per hour in the office.

LOCAL AREA SIGNALING SERVICES

117. NUMBER OF CALLS USING _____ x 20.8 = _____

CALLBACK OR AUTOMATIC

AUTOMATIC RECALL

Interoffice automatic callbacks or automatic recalls originating in this office. Fill in this item only if the switch is equipped with CNI but not DLN.

Reasonable maximum: 6 percent of analog and CSV calls.

APPLICATION PROCESSOR FEATURES

118. NUMBER OF CALLS SUBJECT TO _____ x 0.2 = _____

MESSAGE DETAIL RECORDING (MDR)

Number of MDR records generated. This item is applicable only if the AP is attached to the AM.

Reasonable maximum: 50 percent of analog and CSV calls.

ASP

Fill in this item only if the switch is equipped with CNI, but not DLN.

119. NUMBER OF ASP QUERIES _____ x 2.8 = _____

TO SCP

Total number of queries to SCPs. Each query is assumed to be followed by a reply from the SCP. Fill in this item only if the switch is equipped with CNI but not with DLN.

Reasonable maximum: 20 percent of analog and CSV calls.

Sum of AM REAL-TIME CONSUMPTION

(items 96 through 119) ==> D:

DLN SECTION

Complete this section if the office has a DLN and more than 60 percent of the traffic involves Common Channel Signaling (CCS).

CCS6

120. NUMBER OF _____ x 9.5 = _____

CCS6 TRUNK-TO-TRUNK CALLS

Number of trunk-to-trunk calls per hour that use CCS6 on both sides of the call.

Default value = (trunk-to-trunk calls) x (fraction of CCS6 trunks)².

Permissible maximum: Total trunk-to-trunk calls.

121. NUMBER OF _____ x 4.8 = _____

LINE OR NONCCS TRUNK

TO CCS6 TRUNK CALLS

Line-to-trunk and trunk-to-trunk calls that use CCS6 only on the outgoing side of a call.

Default value = (line-to-trunk calls) x (fraction of CCS6 trunks) + (trunk-to-trunk calls) x (fraction of CCS6 calls) x [1 - (fraction of CCS6 trunks)]

Permissible maximum: Total line-to-trunk + trunk-to-trunk calls.

122. NUMBER OF _____ x 4.8 = _____

CCS6 TRUNK TO LINE OR

NONCCS TRUNK CALLS

Number of trunk-to-line and trunk-to-trunk calls per hour that use CCS6 on the incoming side only.

Default value = (trunk-to-trunk calls) x (fraction of CCS6 trunks) x [1 - (fraction of CCS6 trunks)] + (trunk-to-line calls) x (fraction of CCS6 trunks)

Permissible maximum: Total trunk-to-line + the trunk-to-trunk calls.

CCS7

123. NUMBER OF CCS7/CCS (ISUP) _____ x 9.8 = _____

TRUNK-TO-TRUNK CALLS

Number of trunk-to-trunk calls that use CCS7/CCS(ISUP) on both sides of the call.

Default value = (trunk-to-trunk calls) x (fraction of CCS7 trunks)².

Permissible maximum: Total trunk-to-trunk calls.

124. NUMBER OF CALLS USING _____ x 5.0 = _____

LINE OR NONCCS TRUNK TO

CCS7/CCS7 (ISUP) TRUNK CALLS

Number of line-to-trunk and trunk-to-line calls per hour using CCS7/CCS (ISUP) on the outgoing side of the call only.

Default value = (line-to-trunk calls) x (fraction of CCS7 trunks) + (trunk-to-trunk calls) x (fraction of CCS7 trunks) x [1 - fraction of CCS7 trunks]

Permissible maximum: Total line-to-trunk + the trunk-to-trunk calls.

125. NUMBER OF _____ x 4.8 = _____

CCS7/CCS (ISUP) TRUNK

TO LINE OR NONCCS TRUNK CALLS

Number of trunk-to-line and trunk-to-trunk calls per hour using CCS7/CCS (ISUP) on the incoming side of the call only.

Default value = (trunk-to-trunk calls) x (fraction of CCS7 trunks) x [1 - (fraction of CCS7 trunks)] + (trunk-to-line calls) x (fraction of CCS7 trunks)

Permissible maximum: Total trunk-to-line + trunk-to-trunk calls

NETWORK INTERCONNECT

126. NUMBER OF _____ x 10.3 = _____

CCS7/CCS (ISUP) TO NETWORK

INTERCONNECT CALLS

Number of CCS7 tandem calls to equal access trunks.

Permissible maximum: Total trunk-to-trunk calls.

127. NUMBER OF NONCCS TO _____ x 5.6 = _____

NETWORK INTERCONNECT CALLS

Number of MF calls per hour to equal access trunks.

Permissible maximum: Total trunk-to-trunk + line-to-trunk calls.

128. NETWORK INTERCONNECT TO _____ x 9.8 = _____

CCS7/CCSA (ISUP)

Number of incoming equal access tandem calls going out over

Permissible maximum: Total trunk-to-trunk calls.

129. NETWORK INTERCONNECT TO NONCCS _____ x 4.8 = _____

Number of calls per hour interconnecting equal access calls to MF lines or trunks.

Permissible maximum: Total trunk-to-line + trunk-to-trunk calls.

CCS7 FOR OSPS

130. INCOMING CCS7 FOR OSPS DA CALLS _____ x 4.8 = _____

Number of calls per hour for OSPS directory assistance that come in over CCS7 trunks.

Default value = (DA call + intercept calls) x (fraction of CCS trunks)

Permissible maximum: Total directory assistance calls + intercept calls.

131. NUMBER OF _____ x 5.0 = _____

OUTGOING CCS7 FOR OSPS DA CALLS

Number of calls per hour for OSPS directory assistance call completions and intercept call completions that go out over CCS7 trunks.

Default value = (DA call completions + intercept call completions) x (fraction of CCS trunks)

Permissible maximum: Total directory assistance call completions + intercept call completions.

Note: The real times for items 132 through 135 are for line information data base lookups, and are separate from the real-time consumed for trunk signaling for the base call. The call counts for these items include sent-interflowed calls as well as non-interflowed calls.

132. NUMBER OF COLLECT CALLS _____ x 2.4 = _____

Number of calls per hour that are collect.

133. NUMBER OF CALLING CARD CALLS _____ x 2.4 = _____

Number of calls per hour that use calling cards with operator assistance or via ACCS.

134. NUMBER OF THIRD NUMBER _____ x 2.4 = _____

CALLS WITHOUT CONFIRMATION

Number of calls per hour billed to a third party but not confirmed by the operator.

135. NUMBER OF THIRD NUMBER _____ x 2.4 = _____

CALLS WITH CONFIRMATION

Number of calls per hour billed to a third party and confirmed by the operator.

OTHER CCS

136. NUMBER OF OSO _____ x 1.8 = _____

(ORIGINATING SCREENING OFFICE)

INWATS CALLS

Number of trunk calls per hour that use OSO/INWATS.

137. NUMBER OF CALLS _____ x 0.6 = _____

SUBJECT TO NETWORK CALL DENIAL

Number of line-to-trunk and trunk-to-trunk calls per hour that use NCD.

138. NUMBER OF SERVICE _____ x 2.0 = _____

SWITCHING POINT (SSP)/800 CALLS

Number of 800 calls per hour in the office.

ASP

139. NUMBER OF ASP QUERIES _____ x 1.6 = _____

TO SCP

Total number of queries to SCPs. Each query is assumed to be followed by a reply from the SCP.

Reasonable maximum: 20 percent of analog and CSV calls.

Sum of DLN REAL-TIME CONSUMPTION

(items 120 through 139) ==> E:

PERCENT OF CMP CALL CAPACITY USED BY THE OFFERED LOAD

5E10-5E11

AVERAGE NUMBER OF CMP MILLISECONDS PER CALL:

$$\frac{B \text{ _____} + C \text{ _____}}{A \text{ _____}} = \text{_____} (CM)$$

65 percent of CMP real time is available for call processing.

PERCENT OF CMP CALL CAPACITY USED BY THE OFFERED LOAD:

$$\frac{B \text{ _____} + C \text{ _____}}{0.65 \times 3,600,000} \times 100 = \text{_____} \text{ percent}$$

SWITCH CMP CALL CAPACITY:

$$\frac{0.65 \times 3,600,000}{(CM) \text{ _____}} = \text{_____} (CC) \text{ calls per hour}$$

5E12

AVERAGE NUMBER OF CMP MILLISECONDS PER CALL:

$$B \text{ _____} + C \text{ _____}$$

$$\frac{1.2}{A} = \text{_____} (CM)$$

65 percent of CMP real time is available for call processing.

PERCENT OF CMP CALL CAPACITY USED BY THE OFFERED LOAD:

$$\frac{B \text{ _____} + C \text{ _____}}{1.2} \times 100 = \text{_____ percent}$$

$$0.65 \times 3,600,000$$

SWITCH CMP CALL CAPACITY:

$$\frac{0.65 \times 3,600,000}{\text{_____}} = \text{_____} (CC) \text{ calls per hour}$$

(CM) _____

Note:

A = Number of calls per busy hour

B = CMP real time for basic calls

C = Incremental CMP real time for feature calls

AM CALL CAPACITY CALCULATIONS

CALCULATION OF AM REAL TIME AVAILABLE FOR CALL PROCESSING:

Total number of lines _____ (**L**)

Total number of trunks _____ (**T**)

(analog trunks and T1 channels)

Total number of switching modules _____ (**S**)

(including RSMS and ORMs)

Note: The number of SMS can be estimated by the following:

L _____ $\div$ 3,000 + **T** _____ $\div$ 500 = _____ (**S**)

(round up to a whole number)

50 - (**L**_____ + **T**_____) $\times$ **CM** _____
 $\div$ 13,000 - **S** $\div$ 10)
 = _____ (**A1**)

Note: CM = average number of CMP
 milliseconds per call from the CMP
 capacity calculations.

Enter the value of **A1** or 35, whichever
 is less

_____ (**A2**)

If the switch is equipped with a DLN, enter 5,
 else _____ (**A3**)

Add A2 and A3 _____ (**A4**)

Enter the value of **A4** or 5,
 whichever is greater _____ (**AA**)

AA is the percentage of AM real time available for call processing.

3B20D

(Complete this section only if you filled in the AM items.)

AVERAGE NUMBER OF AM MILLISECONDS PER CALL:

D _____

_____ = _____ (AM)

A _____

Note:

A = Total calls per busy hour

D = Total AM real time used for call processing

PERCENT OF AM CALL CAPACITY USED BY THE OFFERED LOAD:

D _____

_____ = _____ percent

AA _____ / 100 x 3,600,000

AM CALL CAPACITY:

AA _____ / 100 x 3,600,000

_____ = _____ AC(calls per hour)

AM _____

3B21D

(Complete this section only if you filled in the AM items.)

AVERAGE NUMBER OF AM MILLISECONDS PER CALL:

D _____ /1.8

_____ = _____ (AM)

A _____

Note:

A = Total calls per busy hour

D = Total AM real time used for call processing

PERCENT OF AM CALL CAPACITY USED BY THE OFFERED LOAD:

D _____ /1.8

_____ x 100 = _____ percent

AA _____ / 100 x 3,600,000

AM CALL CAPACITY:

AA _____ / 100 x 3,600,000

_____ = _____ AC (calls per hour)

AM _____

DLN CALL CAPACITY CALCULATIONS

SSI-DLN

AVERAGE NUMBER OF DLN MILLISECONDS PER CALL:

E _____

_____ = _____ (DM)

A _____

70 percent of DLN real time is available for call processing.

PERCENT OF DLN CALL CAPACITY USED BY THE OFFERED LOAD:

E _____

_____ $\times 100 =$ _____ percent

$0.7 \times 3,600,000$

DLN CALL CAPACITY:

$0.7 \times 3,600,000$

_____ = _____ (DC) call per hour

DM _____

Note:

A = Number of calls per busy hour

E = Total DLN real time

DLN 30

AVERAGE NUMBER OF DLN30 MILLISECONDS PER CALL:

$$E \text{ _____} / 3.3$$

$$\text{_____} = \text{_____} (DM)$$

$$A \text{ _____}$$

70 percent of DLN real time is available for call processing.

PERCENT OF DLN30 CALL CAPACITY USED BY THE OFFERED LOAD:

$$E \text{ _____} / 3.3$$

$$\text{_____} = \times 100 \text{ _____ percent}$$

$$0.7 \times 3,600,000$$

DLN30 CALL CAPACITY:

$$0.7 \times 3,600,000$$

$$\text{_____} = (DC) \text{ calls per hour}$$

$$DM \text{ _____}$$

Note:

A = Number of calls per busy hour

E = Total DLN real time

SWITCH COMBINED CALL CAPACITY IS:

$$CC \text{ _____}, AC \text{ _____}, \text{ and } DC = \text{_____} \text{ calls per hour}$$

Note:

CC = CMP call capacity

AC = AM call capacity

DC = DLN call capacity

NOTE: Worksheets for the SM-2000 may be found in Section 12 of this manual.

8.3 AM/CMP MEMORY

8.3.1 DESCRIPTION

Figures 8.3-1 and 8.3-2 Show the basic partitions of the internal AM and CMP memory.

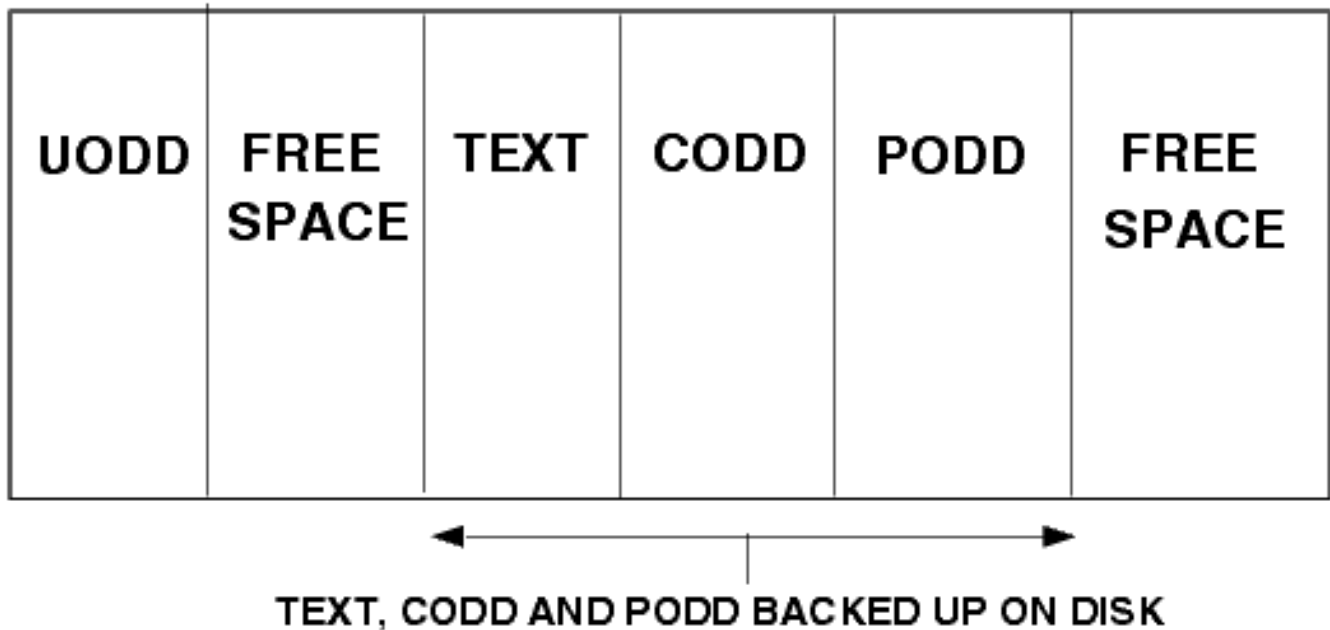


Figure 8.3-1 AM Memory Layout



Figure 8.3-2 CMP Memory Layout

8.3.1.1 AM Memory Types

8.3.1.1.1 Text

This is software release information.

8.3.1.1.2 Control Office Dependent Data

CODD contains administrative data for for redundant protected relations, for example: bit maps, dictionaries, global parameters, and ODA version information.

8.3.1.1.3 Unprotected Office Dependent Data

Unprotected Office Dependent Data contains: Dynamic data such as measurements for lines, Subscriber Line Instrument Measurement (SLIM) device information, and call processing information.

8.3.1.1.4 Protected Office Dependent Data/Protected Random Access Memory

Protected Office Dependent Data /Protected Random Access Memory contains: general trunk data, Local/Remaining/Primary/Incoming Digit Interpreter (PDIT, LDIT, INDIT, and RDIT) remarks. This memory is growable but requires AM initialization.

8.3.1.1.5 Free Space

Free space is physical memory space that is unused and available for allocation.

8.3.1.2 CMP Memory Types

8.3.1.2.1 Text

This is software release information.

8.3.1.2.2 Control Office Dependent Data

CODD contains administrative data for for redundant protected relations, for example: bit maps, dictionaries, global parameters, and ODA version information.

8.3.1.2.3 Unprotected Office Dependent Data

UODD contains dynamic data such as large/small Simulated Facilities Groups (SFG), and large/standard trunk group members.

8.3.1.2.4 Protected Office Dependent Data/Protected Random Access Memory

PODD contains trunk group and routing data, Line Class Code (LCC) and Digit Analysis Selector (DSS).

8.3.1.2.5 Free Space

Free space is physical memory space that is unused and available for allocation.

8.3.1.3 3B20D

The on-line memory of the administrative module/communication module processor (AM/CMP) provides a fixed amount of space for the call processing software. Swap space is provided in the AM for less speed-critical software release which may be brought in from the disk drive as needed (such things as diagnostic programs). (The swap area of memory is not dedicated to a particular program. Instead, it is shared by programs which are not needed on a continual basis and, therefore, need not be resident.) The AM/CMP memory also contains office dependent data (ODD) which is a function of the office characteristics.

8.3.2 ENGINEERING CONSIDERATIONS

8.3.2.1

The following is recommended as a guide for AM memory equipage for switches with the 5E10 through 5E13 software releases:

8.3.2.2 3B20D

Tables 8.3-1 and 8.3-2 show current memory requirements.

8.3.2.2.1 5E10 Software Release Changes

The AM must be equipped with 40 MB as ten TN2012 (4 MB) memory boards; mixing of these boards is not permitted. With Very Large Main Memory (VLMM) the physical capacity of the AM is 64 MB (4 MB x 16). Those offices equipped with TN56 (2MB) boards (physical maximum of 32 MB, must change out all the boards and replace them with ten TN2012 (4 MB) boards. Note that the TN2012s are the same 4 MB boards that are used in the SMP23 and SMP12. If the SMP23/12s add the TN1423, the surplus TN2012s can be used to grow the AM memory.

8.3.2.2.2 5E11 Software Release Changes

Existing offices on 3B20D will need to add memory. 3B20D offices add memory in 4 MB increments. The offices will need to add one TN2012 memory board. Memory is added on-site with an upgrade package of Single In-line Memory Modules (SIMMs) that are added to the one and only memory board. The AM must be equipped with 44 MB as eleven TN2012 (4 MB) memory boards. Mixing of these boards is not permitted. With Very Large Main Memory (VLMM) the physical capacity of the AM is 64 MB (4 MB x 16). Note that the TN2012s are the same 4 MB boards that are used in the SMP23 and SMP12. If the SMP23/12s added the TN1423 for software release 5E10, the surplus TN2012s can be used to grow the AM memory.

8.3.2.2.3 5E12 Software Release Changes

For software release 5E12, The 3B20D must be upgraded from 44 MB to 56 MB of memory. Three TN2012 boards must be added to the AM

8.3.2.2.4 5E13 Software Release Changes

64 MB must be equipped. This is significant as 64 MB is the addressable memory limit of a 3B20D. The 5E14 software release will require in excess of 64 MB of memory.

NOTE: RETROFITTING TO 5E14 WILL REQUIRE CONVERSION TO A 3B21D PRIOR TO RETROFIT..

8.3.2.3 3B21D

Tables 8.3-1 and 8.3-2 show current memory requirements.

8.3.2.3.1 5E10 Software Release Changes

The new offices are equipped with 40 MB of memory in the AM.

8.3.2.3.2 5E11 Software Release Changes

Existing offices on 3B21D will need to add memory. 48 MB of memory must be added, but only 44 MB will be required. New 3B21D offices can be ordered with 48 MB (KLW48) or 64 MB (KLW64). Growth of 3B21D offices with 40 MB are in 8 MB increments. Memory is added on-site with an upgrade package of Single In-line Memory Modules (SIMMs) that are added to the one and only memory board.

8.3.2.3.3 5E12 Software Release Changes

For the 5E12 software release, the 3B21D must be upgraded from 48 MB to a minimum of 56 MB of memory. Existing offices on the 3B21D are currently equipped with 48 MB of memory. New 3B21D offices are shipped with 64 MB. Existing 3B21D offices with 48 MB must remove the 2 - 8 MB Single In-Line Memory Modules (SIMMs) and install a 32 MB SIMM (KLW64). Memory is added on-site with an upgrade package of SIMMs that are added to the one and only memory board. The 8 MB SIMMs that have been removed may be used in retrofits to 5E10 or 5E11 software releases.

8.3.2.3.4 5E13 Software Release Changes

64 MB must be equipped. Existing offices on the 5E14 software release will require in excess of 64 MB of memory.

NOTE: RETROFITTING TO 5E14 WILL REQUIRE CONVERSION TO A 3B21D PRIOR TO RETROFIT.

8.3.2.3.5 AM Memory Requirements Summary

Table 8.3-1 3B20D

Software Release	MB of Memory	Slots Used/ Available	TN 2012 Boards
5E10	40	10/16	10
5E11	44	11/16	11
5E12	56	14/16	14
5E13	64	16/16	16

Table 8.3-2 3B21

Software Release	MB of Memory	Slots Used/ Available	Core Board	SIMM
5E10	40	1/3	32	+8
5E11	44 (48)	2/3	32	+8 +8
5E12	56 (64)	2/3	32	+32
5E13	64	2/3	32	+32
New offices are equipped with 64 MB of memory.				
The memory can be grown to 128 MB.				

8.3.3 ASSIGNMENT GUIDELINES

The word **parameters** is sometimes used to define resources which are used as key attributes in data base relations. These parameters [lines, screening indexes, business and residence custom services (BRCS) constructed feature identifications, interpreted digits, etc.] are used to describe the makeup of the 5ESS®—2000 switch. Some of these parameters are assigned by the operating telephone company (route indexes, code indexes, group assignments, etc.). Some parameters are office dependent [that is, number plan areas (NPAs)]; some are software assignable (that is, BRCS constructed feature identifications), and others are assigned as a function of another key. The parameter assignments made by the telephone company are of concern to the administrator because those are the assignments that most affect memory.

The most efficient way of utilizing memory is realized when care is taken to avoid wasted space on memory pages. To avoid wasting dynamic memory pages, it is best to number assigned items sequentially. It should be noted that assignment numbers always start with 0, yet some items such as multiline hunt groups (MLHGs) do not allow the assignment of group number 0. If break points are desired (for different types of trunks, or to provide businesses or assignment personnel with specific blocks of numbers), use multiples of 64, 32, or other numbers as indicated by the memory requirement for that particular item (Table 8.3-3). For example, if a particular item can be assigned in groups of 8 on a 1/4 K page, it would be best to use multiples of 8. Standard 2-way trunk group numbers are multiplied in this manner. These group numbers could be in the ranges of 0-7, 8-15, 104-111, etc.

Table 8.3-3 AM and CMP Dynamic Odd Usage - 5E6 through 5E8 Software Releases

ITEM	MEMORY NEEDED	
	LOCAL	TOLL/OSPS
Misc. and CORCS	120 K	150 K
Large SFGs (simulated facilities groups) (Member numbers higher than 95)	2 K per pair	-
Standard SFGs (Member numbers lower than 96)	2 K per 32	-
Large trunk groups (Member numbers higher than 95)	2 K per 4	2 K per 4
Standard trunk groups (Member numbers lower than 96)	1/4 K per 8 2 K per 64	1/4 K per 8 2 K per 64
QKEY ^a trunk groups		
QKEY trunks	1 K per 64	1 K per 64
Large preemption trunk groups ^b (Member numbers higher than 95)	2 K per pair	2 K per pair
Standard preemption trunk groups ^b (Member numbers lower than 96)	1/2 K per 4	1/2 K per 4
Waiting calls data for operators	-	1 K per 4
B-Channel ports for operators	-	1/4 K per 16
Notes:		
a. QKEY trunks are trunks which are either outgoing FIFO (first-in-first-out) hunted or outgoing rotate hunted.		
b. Applicable to AUTOVON offices only.		

Figure 8.3-3 provides an example of how assignments are grouped according to the memory requirements for particular items. If break points are desired or if assignment numbers are to be skipped, multiples of 64 numbers should be used. This is shown in Figure 8.3-4.

Figure 8.3-5 illustrates the assignment of group numbers for standard and large MLHGs. As shown in the figure, the large groups require 2 KB of memory per pair while the standard groups require 1/4 K per 8. (The information concerning large groups is stored in one relation and information for standard groups is stored in another.) If numbers are to be skipped or break points are desired, multiples of 8 groups should be used. This allows efficient assignment of both large and standard groups.

Table 8.3-3 provides an assignment sheet for use in assigning MLHGs. Also provided is a blank sheet (Figure 8.3-4) for use in assigning numbers above the ones provided. Similarly, Figure 8.3-5 provides an assignment sheet for SFGs and Figure 8.3-6 provides an assignment sheet for trunk groups. All of these items require the use of standard and large groups which makes the use of assignment numbers more critical. Other items (such as 1-way outgoing trunks, call pickup groups and others which do not require standard and large groups) do not require assignment sheets. Simply use multiples of numbers as provided in Table 8.3-6.

To use the assignment sheets, first determine if the groups are to be large or standard and then group them as indicated on the assignment sheets. Any group numbers may be used as large or standard as long as the multiples shown on the assignment sheets are maintained. Additionally, all groups in an assignment row should be the same size (standard or large).

The front of the assignment sheets have the group numbers clustered and may be used by marking the group size and the group numbers as they are assigned. The back of the assignment sheets are blank and can be used to assign group numbers higher than those on the front or to sequence the clusters differently (the group numbers in the cluster should be kept together).

Care should be taken to establish the appropriate sized groups initially. If more members are expected in a group over a period of time, and if the additional members will cause the group to cross the threshold from standard to large, then it should be assigned as a large group initially. This can be done by assigning a member of the group a member number that exceeds the threshold number. The switch will assign that group as large, even though the actual number of members would be in the range of a standard group. For example, if group A has four members numbered 1, 2, 3, and 4; then, it is assigned as a standard group. If group B has four members numbered 1, 2, 3, and 100, the switch assigns it as a large group.

Information for large and standard groups is maintained in separate data relations. When the size of a group changes, such that it crosses the threshold from standard to large or vice versa, the switch automatically reassigns the group to the new size. This causes data to be written into the other relation (the standard-group relation or the large-group relation, whichever the case may be). However, the space previously required in the first relation is not

released. Therefore, there is a certain amount of memory which cannot be used. Figure 8.3-7 illustrates the memory usage under these circumstances. If the group size is changed in this manner, it is best to assign a new group number and leave the old group number to be reassigned to a new group of that particular size. The size of any group can be determined by the verify (VFY) command. Refer to 235-600-700 for information concerning the use of this command.

Similarly, when assignments are terminated, such as MLHGs or SFGs that are no longer required, it is best to reassign those numbers so that memory space is reused instead of allocating new memory space for the new assignments. The space which is released as a result of terminating group number assignments is available for use only in making new group assignments; it is not available for any other use. It cannot be released from the relation except through the use of the access editor (ACCED) or any full initialization (for example, a retrofit procedure). In order to free a memory block for use by another relation, all associated assignments must be terminated or reassigned using different group numbers. The use of the ACCED utility should be coordinated with the appropriate maintenance personnel. Further information on the use of the ACCED can be found in 235-105-220 - *Corrective Maintenance Procedures*.

Another method of group number assignments would be to project the number of groups expected in each category and add 10 percent for growth. Determine the next higher cluster size and use that as the break point between types (that is, large and standard). For example, consider that the expected number of large MLHGs will be 17. Adding 10 percent to this number would provide a total of 19. Since large MLHGs are assigned in pairs beginning with number 2, the next higher cluster size would be 22. Breaks for standard group numbering should occur on multiples of 8. Therefore, group numbers 24 and higher could be used for standard groups.

It is important to maintain consecutive number assignments and to remember how the assignments affect memory. As an example, the assignment of large MLHGs 2, 3, 4, and 5 take the same amount of space as groups 10, 11, 38, and 39. However, the assignment of groups 11, 12, 37, and 38 requires twice as much memory. Since large MLHGs are assigned in groups of 2 (starting with group 2), groups 11 and 12 do not reside on the same page. Therefore, the memory associated with groups 10 and 13 is required but not used. The same is true for groups 37 and 38 since large groups are assigned in pairs starting with group 2. The use of consecutive numbering prevents populating new memory pages when assignments are available on previously used memory pages.

To assign MLHGs, first assign members to groups and then separate the groups into large and standard groups. (Large groups have one or more member numbers higher than 31.) Then cluster the groups into three types: regular hunt; circular hunt; and uniform call distribution (UCD), both queuing and nonqueuing. Cluster the multiple position MLHGs and separate the standard and large preemption MLHGs (large preemption MLHGs have one or more member numbers higher than 31). Finally, assign all MLHGs in clusters of 16, 8, 4, or 2 always using the largest cluster size possible.

When assigning trunk groups, first assign members to trunk groups as desired, then separate the large and standard groups (large groups are those with member numbers higher than 95). Next, cluster the groups into the five types: incoming, outgoing, 2-way, announcements, and logical test ports. Separate the standard and large preemption trunk groups (large groups have member numbers higher than 95). Finally, assign the trunk groups in clusters of 64, 16, 8, 4, or 2 and always use the largest cluster size possible.

Some MLHG parameters reside in both AM to the SM. Additionally, the standard groups now have member numbers lower than 64, while large groups have member numbers higher than 63. However, the same assignment strategies apply.

8.3.4 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

There are no dedicated measurements for monitoring AM memory usage. The OP:ODD command provides the necessary usage determination method as previously described.

8.3.5 FEATURE IMPACT

Some features may have impact on the AM. For example: Local Number Portability NPA-NXX Growth will increase AM and SODD growth. Refer to chapter 2 for new features that may impact AM memory.

8.3.6 MEMORY MANAGEMENT

8.3.6.1 Dynamic ODD

Dynamic Office Dependent Data is temporary in nature and exists only for the length of the processing task involved such as equipment status, work status, or work queues. The space requirements for AM/CMP dynamic ODD can be determined by using the guidelines listed in Table 8.3-3 for AM/CMP.

There is no specifically assigned memory area for the relations corresponding to these features. An office with few call pickup groups has more dynamic ODD space for other items. The dynamic ODD space cannot be used for static ODD.

8.3.6.2 Static ODD

Static Office Dependent Data is information that is infrequently changed, such as characteristics of a particular telephone office or features associated with telephone numbers. Much of the data resides in the CMP rather than in the AM.

GROUP SIZE		GROUP ASSIGNMENT NUMBERS							
LGE	STD								
	X	0	1	2	3	4	5	6	7
	X	8	9	10	11	12	13	14	15
	X	16	17	18	19	20	21	22	23
	X	24	25	26	27	28	29	30	31
MORE GROUP ASSIGNMENTS OR UNASSIGNED GROUP NUMBERS									
X		104	105	106	107	108	109	110	111
X		112	113	114	115	116	117	118	119
	X	120	121	122	123	124	125	126	127
	X	128	129	130	131	132	133	134	135

(1/4 K PER 8)
(1/2 K PER 8 IN 5E5)

NO PENALTY IN
SKIPPING GROUP
NUMBERS AS
LONG AS
MULTIPLES OF
8 NUMBERS ARE
SKIPPED

(2 K PER PAIR)
(4K PER PAIR IN 5E5)

(1/4 K PER 8)
(1/2 K PER 8 IN 5E5)

↑

NUMBERS IN
THIS COLUMN
ARE DIVISIBLE
BY 8

Figure 8.3-3 MLHG Assignment Example

GROUP SIZE		GROUP ASSIGNMENTS: MULTILINE HUNT GROUPS							
LGE	STD								
		0	1	2	3	4	5	6	7
		8	9	10	11	12	13	14	15
		16	17	18	19	20	21	22	23
		24	25	26	27	28	29	30	31
		32	33	34	35	36	37	38	39
		40	41	42	43	44	45	46	47
		48	49	50	51	52	53	54	55
		56	57	58	59	60	61	62	63
		64	65	66	67	68	69	70	71
		72	73	74	75	76	77	78	79
		80	81	82	83	84	85	86	87
		88	89	90	91	92	93	94	95
		96	97	98	99	100	101	102	103
		104	105	106	107	108	109	110	111
		112	113	114	115	116	117	118	119
		120	121	122	123	124	125	126	127
		128	129	130	131	132	133	134	135
		136	137	138	139	140	141	142	143
		144	145	146	147	148	149	150	151
		152	153	154	155	156	157	158	159
		160	161	162	163	164	165	166	167
		168	169	170	171	172	173	174	175
		176	177	178	179	180	181	182	183
		184	185	186	187	188	189	190	191
		192	193	194	195	196	197	198	199
		200	201	202	203	204	205	206	207
		208	209	210	211	212	213	214	215
		216	217	218	219	220	221	222	223
		224	225	226	227	228	229	230	231
		232	233	234	235	236	237	238	239
		240	241	242	243	244	245	246	247
		248	249	250	251	252	253	254	255
		256	257	258	259	260	261	262	263
		264	265	266	267	268	269	270	271
		272	273	274	275	276	277	278	279
		280	281	281	283	285	285	286	287
		288	289	290	291	292	293	294	295

STD GROUPS: HIGHEST MBR NUMBER < 32; REQUIRES 1/4 K DATA PAGE FOR 8 GROUPS LGE
 GROUPS: HIGHEST MBR NUMBER > 31; REQUIRES 2 K DATA PAGE FOR 2 GROUPS

[illegible]

STD GROUPS: HIGHEST MBR NUMBER < 32; REQUIRES 1/4 K DATA PAGE FOR 8 GROUPS
LGE GROUPS: HIGHEST MBR NUMBER > 31; REQUIRES 2 K DATA PAGE FOR 2 GROUPS

Figure 8.3-4 MLHG Assignment Sheet

GROUP SIZE	LGE							
	STD							
G R O U P A S S I G N M E N T S		0	32	64	96	128	160	192
		1	33	65	97	129	161	193
		2	34	66	98	130	162	194
		3	35	67	99	131	163	195
		4	36	68	100	132	164	196
		5	37	69	101	133	165	197
		6	38	70	102	134	166	198
		7	39	71	103	135	167	199
		8	40	72	104	136	168	200
		9	41	73	105	137	169	201
		10	42	74	106	138	170	202
		11	43	75	107	139	171	203
		12	44	76	108	140	172	204
		13	45	77	109	141	173	205
		14	46	78	110	142	174	206
		15	47	79	111	143	175	207
		16	48	80	112	144	176	208
		17	49	81	113	145	177	209
		18	50	82	114	146	178	210
		19	51	83	115	147	179	211
		20	52	84	116	148	180	212
		21	53	85	117	149	181	213
		22	54	86	118	150	182	214
		23	55	87	119	151	183	215
		24	56	88	120	152	184	216
		25	57	89	121	153	185	217
		26	58	90	122	154	186	218
		27	59	91	123	155	187	219
		28	60	92	124	156	188	220
		29	61	93	125	157	189	221
		30	62	94	126	158	190	222
		31	63	95	127	159	191	223

STD GROUPS: HIGHEST MBR NUMBER < 96 REQUIRES 256 BYTE DATA PAGE FOR 8 GROUPS.

LGE GROUPS: HIGHEST MBR NUMBER > 95 REQUIRES 2K BYTES DATA PAGE FOR 2 GROUPS.

GROUP	LGE												
	STD												
ASSIGNMENT	2 GRPS												
	2 GRPS												
	2 GRPS												
	2 GRPS												
	2 GRPS												
	2 GRPS												
	2 GRPS												
	2 GRPS												
	2 GRPS												
	2 GRPS												
	2 GRPS												
	2 GRPS												
	2 GRPS												
	2 GRPS												
	2 GRPS												
	2 GRPS												

STD GROUPS; HIGHEST MBR NUMBER < 96; REQUIRES 256 BYTE DATA
PAGE FOR 8 GROUPS.

LGE GROUPS; HIGHEST MBR NUMBER > 95 REQUIRES 2K BYTES DATA
PAGE FOR 2 GROUPS.

Figure 8.3-5 SFG Assignment Sheet

GROUP LGE	SIZE STD	GROUP ASSIGNMENTS: TWO-WAY TRUNK GROUPS							
		0	1	2	3	4	5	6	7
		8	9	10	11	12	13	14	15
		16	17	18	19	20	21	22	23
		24	25	26	27	28	29	30	31
		32	33	34	35	36	37	38	39
		40	41	42	43	44	45	46	47
		48	49	50	51	52	53	54	55
		56	57	58	59	60	61	62	63
		64	65	66	67	68	69	70	71
		72	73	74	75	76	77	78	79
		80	81	82	83	84	85	86	87
		88	89	90	91	92	93	94	95
		96	97	98	99	100	101	102	103
		104	105	106	107	108	109	110	111
		112	113	114	115	116	117	118	119
		120	121	122	123	124	125	126	127
		128	129	130	131	132	133	134	135
		136	137	138	139	140	141	142	143
		144	145	146	147	148	149	150	151
		152	153	154	155	156	157	158	159
		160	161	162	163	164	165	166	167
		168	169	170	171	172	173	174	175
		176	177	178	179	180	181	182	183
		184	185	186	187	188	189	190	191
		192	193	194	195	196	197	198	199
		200	201	202	203	204	205	206	207
		208	209	210	211	212	213	214	215
		216	217	218	219	220	221	222	223
		224	225	226	227	228	229	230	231
		232	233	234	235	236	237	238	239
		240	241	242	243	244	245	246	247
		248	249	250	251	252	253	254	255
		256	257	258	259	260	261	262	263
		264	265	266	267	268	269	270	271
		272	273	274	275	276	277	278	279
		280	281	281	283	285	285	286	287
		288	289	290	291	292	293	294	295

STD GROUPS: HIGHEST MBR NUMBER < 96; REQUIRES 1/4 K DATA PAGE FOR 8 GROUPS LGE
 GROUPS: HIGHEST MBR NUMBER > 95; REQUIRES 2 K DATA PAGE FOR 4 GROUPS

Figure 8.3-6 Two-Way Trunk Group Assignment Sheet

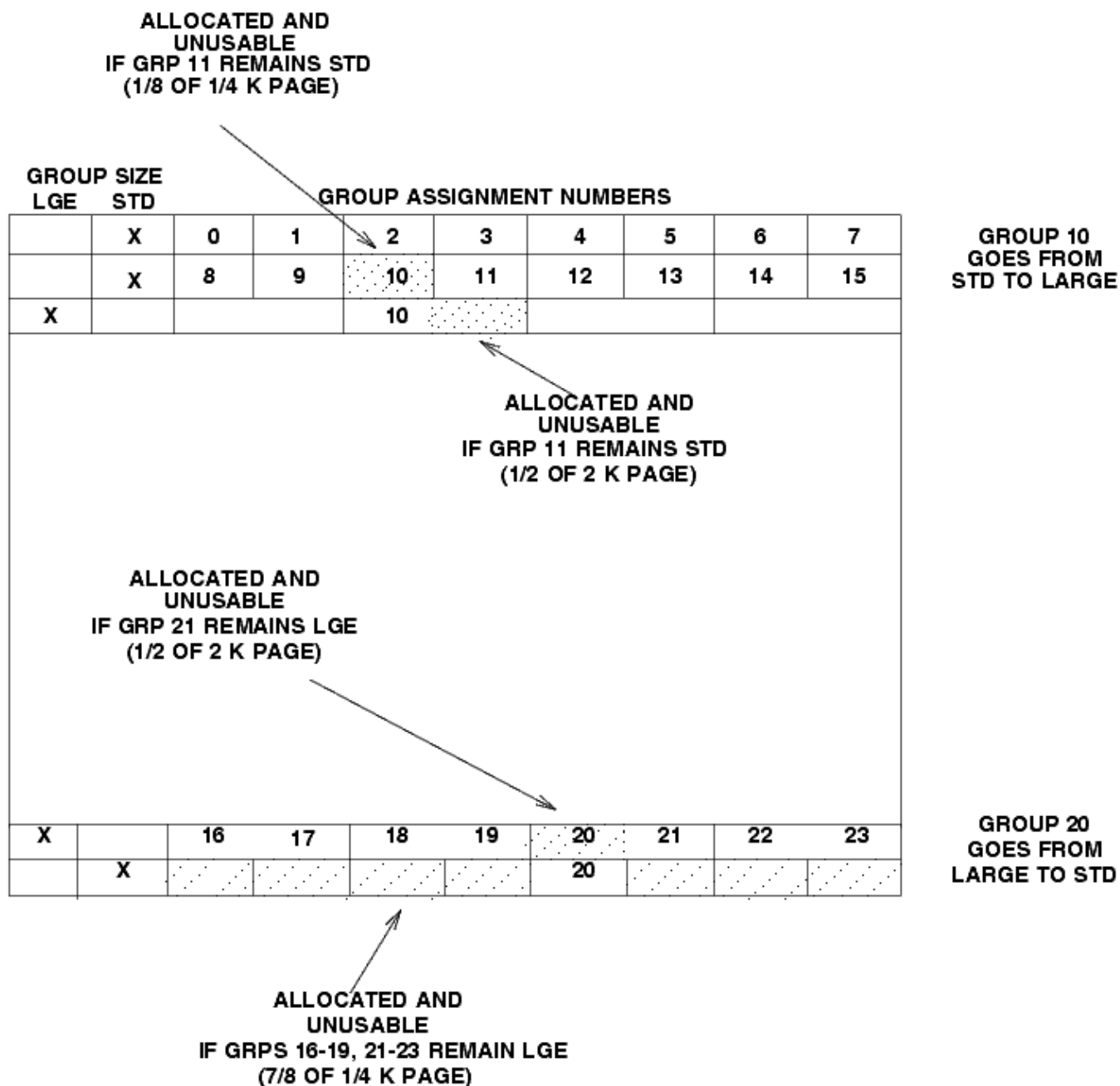


Figure 8.3-7 MLHG Group Number Rearrangement Example

8.3.6.3 CMP Memory

8.3.6.3.1 Description

The Communications Module (CMP) performs the switching of data time slot messages between SMs, and switching of control time slot messages between the AM, CM, and SP processors. It also provides system synchronization and "quick pump" of SM memory capabilities. The CMP has been a non-engineerable component that was introduced in the 5E6 software release. All switches through the 5E8 software release were equipped with

a duplicated CMP requiring 20.7 MB of memory, 4.7 MB in a TN1368 core board and 16 MB in an additional memory board (TN1369).

8.3.6.3.2 5E10 Software Release

New hardware was available for the CMP beginning with the 5E9(1) software release. This hardware increased the total RAM memory of the CM core board to 19 MB. The addition of this memory to the CMP core board resulted in a change to the circuit pack designation. The TN1368 circuit pack became, with this memory addition, a TN1800 circuit pack. The additional memory spectrum was needed to support the bigger text sizes, and ODD sizes of future offices and software releases. 5E10 did not require the TN1800. Existing offices with 20.7 MB was adequate for this release.

8.3.6.3.3 5E11 Software Release

No change from 5E10 software release. Existing offices with 20.7 MB of memory in the CMP were adequate. New offices were shipped with 35 MB of memory.

8.3.6.3.4 5E12 Software Release

As of 5E12 software release, the CMP must be equipped with 35 MB of memory. The TN1368 board was replaced with a TN1800 (CM2) or TN1871 (CM1). This new hardware increased the total RAM memory of the CMP core board to 19 MB. The additional 16 MB memory board (TN1369) remained the same. The additional memory spectrum is/was needed to support bigger text and ODD sizes for new offices and future software releases.

8.3.6.3.4.1 CM1

Offices with CM1 will upgrade their existing TN1368 core board with a TN1871 core board. There is a Change Notification (CN). CN b1423 includes the memory upgrade and Class A Modifications.

8.3.6.3.4.2 CM2

Offices with CM2 must choose how they expand to 35MB of memory. These choices are:

- Order ED5D740-30 (G-1 for upgrade of pair in service, G-2 upgrade spare) to convert TN1368 to TN1800. This option applies to MOST OFFICES that have already performed the Class A Modifications.
- Apply CN B1424 to acquire Class A modifications and upgrade memory with the TN1800.

8.3.6.3.5 5E13 Software Release

No changes from software release 5E12. The CMP requires 35 MB of memory.

NOTE: Due to the 3B21D 5E14 software release requirement, all CM1 offices will be required to convert to CM2 for the 5E14 software release. The 3B21 is only supported on the CM2.

8.4 AM/CMP OVERLOAD CONTROLS

8.4.1 DEFINITION

Overload is the 5ESS[®]-2000 switch condition that occurs when both the call processing and noncall processing loads offered to the system exceed its capacity. The overload condition must be detected and controlled before performance degrades.

There are two types of overload: real-time overload and shared-resource overload. Real-time overload occurs when there is insufficient time for the processor to perform all the work offered to the system. This is the primary overload critical to the system performance, which, if not corrected, leads to delays. Shared resource overload occurs when there is a shortage of shared software resources requested by processes in the system. The tone decoder (in the SM) is the only monitored hardware resource contributing to the resource overload. This type of overload hampers further processing.

In general, a real-time overload is usually caused by a surge of call traffic. A shared resource overload, on the other hand, is usually caused by inadequate resource allocation.

8.4.2 OBJECTIVES AND STRATEGIES OF OVERLOAD CONTROL

The general objective of overload control is to maximize system performance during periods of overload. More specifically, the purposes of overload control can be stated as follows:

- Ensuring system sanity and responsiveness
- Maintaining a high level of call processing
- Providing a graceful degradation of service, if degradation is inevitable.

To achieve these objectives, the overload control program constantly monitors the usage of the processor real time and the shared software resources. Overload control averages the usage over an appropriate time interval and compares the result with thresholds to determine the presence and the severity level of an overload. Overload control initiates appropriate actions to eliminate or minimize the effect of the detected overload conditions. These actions are a series of incremental controls ensuring a stable level of system performance with graceful degradation, if performance degradation is inevitable.

When real-time overload is detected, the general strategy is to:

- Limit the input of call processing work and, if necessary, the noncall processing work
- Defer the nonessential noncall processing work
- Ensure that a minimum of essential system checks are run to maintain the system sanity.

When resource overload is detected, the general recovery strategy is to:

- Identify and eliminate any resource hog to recover the overloaded resource
- Run sanity checks on the usage of this resource and correct the causing errors
- Reduce call processing and noncall processing activities which require this resource.

All of these control actions are fully automatic and require no immediate intervention by the central office

craftsperson or surveillance center. However, the operating personnel are informed by overload control about the overload type, overload level, and the control actions. Upon each occurrence or escalation of the overload, a message is printed at the receive-only printer (ROP). With the exception of exiting the state of overload, overload de-escalation of messages is usually not printed on the ROP to reduce ROP clutter. However, the master control center (MCC) display pages are updated on every state change. A 15-minute periodic overload message is also printed at this time.

8.4.3 AM/CMP OVERLOAD CONTROL

The CMP call capacity typically sets the overall switch capacity with 65 percent of the CMP real time allocated to call processing. Refer to the section on AM/CMP Processor for more information. To maintain the system capacity, the AM/CMP overload control checks for the following types of overload:

- **AM/CMP Real-Time Overload:** When the call processing occupancy exceeds its allocation and there is insufficient time to process a minimal amount of essential low-priority tasks, the AM/CMP enters real-time overload. For the AM, this allocation amount is different from the ROP printed AM occupancy. For a 40 percent allocation, its corresponding ROP printed occupancy equals 40 percent plus a printed no-load occupancy which depends on the number of switching modules (SMs). AM call processing occupancy needs to be monitored only in offices without DLN. The CMP no-load occupancy for call processing is less than 1 percent.
- **AM/CMP Resource Overload:** The AM/CMP resource overload occurs when the software resources in the AM/CMP required for call and noncall processing are not available. The AM/CMP software resources monitored for overload consists of maintenance control block (MCBs), process control block (PCBs), stack control block (SCBs), and timer control block (TCBs). In 5E8 and later the base priority output queue (BPOQ) is added to the AM and the IP-to-AP queue (IAQ) and MSG resources are added to the CMP to monitor message queues.

8.4.3.1 AM/CMP Real-Time Overload Control

8.4.3.1.1 Approach

Every 6-seconds, AM/CMP real-time overload control monitors the amount of AM/CMP real time spent in call processing and interrupts. To avoid a rapid oscillation of overload states, AM/CMP overload control compares a moving average real-time usage over four 6-second periods with overload thresholds. In addition, once overload exists, a change of state is allowed only at 12-second intervals in the AM. In the CMP, overload escalation is allowed only at 12-second intervals, but de-escalation is allowed only at 18 second intervals.

All control actions are fully automatic and require no manual intervention. Even under the most severe overload level, the AM/CMP maintains a call rate no less than the rated capacity.

8.4.3.1.2 Overload Levels

There are three types of overload states for AM/CMP real time:

- (1) **NONE:** There is no AM/CMP real-time overload, and the route request throttle (the control mechanism by which AM/CMP limits call requests from the SMs) is not in effect.
- (2) **MINOR:** This is the beginning state of the AM/CMP real-time overload. Several control strategies are activated. They are as follows:
 - Throttling route requests from SMs
 - Deferring nonessential tasks (AM only)

- Inhibiting avoidance routing (AVRT) for all SMs.
- Network Management is informed

(3) MAJOR: This is the most severe state of the AM/CMP real-time overload. All the control actions of MINOR are still in effect, but the throttling levels are increased.

AM real-time overload control must go through two stages before applying controls. It must be enabled before it is activated. AM overload control is enabled when the 24-second moving average of the real time spent on call processing and higher priority tasks (this is defined as the internal "extended occupancy") exceeds 55 percent. This 55 percent internal extended occupancy is different from the external printed AM occupancy. For a particular 5ESS®-2000 switch, the extended occupancy is from 2 to 9 percent higher than its corresponding printed occupancy. Therefore, the enable point corresponds to a printed occupancy value of 46 to 53 percent, depending on the actual amount of the high priority work (higher than call processing). This real-time overload control enable point of 46 to 53 percent printed AM occupancy (or 55 percent of the extended occupancy) contains 40 percent for call processing and 6 to 13 percent for both call processing overhead and a minimum level of operations, administration, and maintenance (OA&M) overhead.

Once overload control is enabled, it checks whether there is sufficient real time for a minimal amount of essential low priority (lower than call processing) tasks. These tasks mainly consist of audits and most of the craftsperson-initiated OA&M activities. This check is based on the rate at which the low priority tasks are executed. If the call processing work exceeds its allocation, the rate of execution for low priority tasks may start to diminish.

If the rate of execution for these essential low priority tasks is satisfactory, overload control is not instituted. Under certain conditions, such as very low OA&M activity and little ROP printing being performed, the printed occupancy can climb to 60 percent and beyond without call processing controls being invoked.

If the rate of execution for these essentially low priority tasks is unsatisfactory, then AM overload exists. Only then is AM real-time overload control finally activated and the AM institutes controls on SMs to throttle route requests. The actual activation point usually corresponds to a printed AM occupancy of about 55 to 65 percent. The exact value depends on the individual office configuration, activity, and application.

The CMP overload control is triggered when the rate of execution of low priority tasks in the CMP falls below 9 percent (CMP total occupancy is greater than or equal to 91 percent) **and** CMP call processing occupancy is greater than 65%.

When an overload condition is detected and throttling is activated, AM/CMP requests each SM to start throttling the rate of route requests (RRs) being sent to AM/CMP. There are 8 levels of this throttle. Call throttling applies to the CMP. The transition of the level depends on the incremental change in the overload condition. When the level stays below 7, the overload state is classified as MINOR. When the level escalates to 7 or 8, the overload state is classified as MAJOR.

8.4.3.1.3 Details of Control

Upon request from an overloaded SM, the AM/CMP attempts to route the (1-way) outgoing trunk calls around the overloaded SM. This control, AVRT, requires AM real time. Therefore, when the AM/CMP itself becomes overloaded, the AVRT service provided for the overloaded SM is inhibited.

Upon entering AM/CMP real-time overload, the AM/CMP requests all SMs to start throttling the RRs (sent from SM to AM/CMP to determine the call path information for each call) according to a predetermined set of 8 levels of SM call rate. The same rate applies to every SM simultaneously. For a given SM, if the actual RR rate is higher than the current throttle level, the excessive RRs are blocked and the calls sent to reorder immediately without being queued for retry. The call rate of each level of RR throttle is specified as shown in Table 8.4-1.

Calls blocked due to route requests being rejected by the AM/CMP are measured by the BLKOVD counter, which prints on the TRFC15 and TRFC30 reports.

Table 8.4-1 CMP Route Request Throttle Levels

CMP ROUTE REQUESTS THROTTLE LEVEL	SM ROUTE REQUESTS PER HOUR	SM-2000 ROUTE REQUESTS PER HOUR	CMP REAL-TIME OVERLOAD STATE
1	7,800	39,000	MINOR
2	6,900	34,500	MINOR
3	6,000	30,000	MINOR
4	5,100	25,500	MINOR
5	4,200	23,000	MINOR
6	3,300	16,500	MINOR
7	2,400	12,000	MAJOR
8	1,500	7,500	MAJOR

Level 1 provides the least control, and level 8 provides the maximum control. When the throttle stays below level 7, the severity of overload is classified as MINOR. When control escalates to level 7 or 8, the overload is defined as MAJOR. When an overload is recognized, the AM/CMP overload control initiates the RR throttle at level 3 which is MINOR. However, to come out of overload, levels 3, 2, and 1 must be traversed.

While overload persists, the CMP checks the call processing occupancy every 12 seconds. If it is higher than the 68 percent enable threshold, and CMP total occupancy is greater than 91%, the throttling level is escalated to the next higher level. Otherwise, the control is de-escalated one level. In this way, as the overload subsides, the CMP overload control descends through the throttling levels, allowing more and more calls to be passed from the SMs to the AM. The CMP checks the rate of execution of low priority tasks and call processing occupancy to determine if escalation or de-escalation is required.

Certain types of calls receive preference in getting through the throttle, such as 911- and 0- calls. In addition, terminating calls are given 2 to 1 priority over new line originations.

8.4.3.1.4 Most Severe State

One of the objectives of overload control is to maintain a high level of call processing even under the most severe overload situation. At the most severe state of AM/CMP real-time overload, the tightest level of the RR throttle continues to allow each SM to send 1,500 calls per hour to the AM/CMP (7,500 calls per hour for the SM-2000).

8.4.3.1.5 General Comments on AM/CMP Real-Time Overload

When the AM/CMP enters an overload condition, it tells the SMs to reduce the number of route requests that are sent to the AM/CMP. Since no real time is expended by the AM to control calls, the AM/CMP carried load attains some steady state. At no time does the carried load decrease below the rated capacity of the switch.

The AM/CMP overload control mechanism is designed to protect the switch from excessive load conditions yet maintain an essential amount of OA&M processing capability. Real time not used for OA&M work is available for call processing. Under extreme overload conditions such as sustained MAJOR overload, nonessential OA&M work should be deferred until the overload condition subsides.

Some customers may be affected more than others when overload controls are in effect. Since each SM is allowed to pass the same number of calls to the AM/CMP, different rejection rates are experienced in various SMs. That is, a customer served in an SM that is below the call rate limit set by a given level of control does not experience any different service than if no overload controls were in effect. A customer in an SM generating a larger call volume than the threshold could experience some calls being blocked.

8.4.3.2 AM/CMP Resource Overload Control

Overload control monitors the MCB, PCB, SCB, and TCB software resources in the AM/CMP. The base priority

output queue (BPOQ) is added to the AM. The CMP also monitors the MSG and IAQ resources. Every 6 seconds, overload control monitors the count of free (unused) blocks for each resource. If the free count runs short (for example, less than 10 percent of the total amount), the AM/CMP enters resource overload for that type.

Upon entering MCB, PCB, SCB, or TCB resource overload, the AM/CMP notifies the system integrity monitor. The system integrity monitor is a software process that begins to identify and eliminate potential resource hogs to recover the nearly exhausted resource. During MSG or IAQ overload, the CMP applies the same controls as though a real-time overload occurred. During an AM BPOQ overload, nonessential tasks are deferred as they are during an AM real-time overload.

If any resource is exhausted before being detected by overload control, the system integrity monitor is informed immediately by the encountering process which detected the exhaust and takes immediate recovery action.

The AM/CMP resource overloads occur infrequently, and they are most often due to a combination of peripheral problems that occur simultaneously in several SMs. A common example is repeated carrier group alarm (CGA) failures that can occur if a major link encounters trouble. In this case a momentary AM/CMP message control block overload may be noted during the time the AM/CMP is processing the CGA failures. However, resource overloads that persist over long periods of time or occur quite frequently should be investigated.

8.4.4 NETWORK MANAGEMENT

When call attempts in a telephone network rise beyond the capacity of that network, the overall performance of the network degrades. The network management (NM) programs of the 5ESS®-2000 switch provide real-time surveillance and control techniques to minimize this degradation, optimize call-carrying capacity, and maintain network integrity during periods of stress caused by either traffic overload or failure conditions. Whereas the 5ESS®-2000 switch internal overload controls maximize the efficiency of the switch under overload, the 5ESS®-2000 switch NM controls maximize the performance of the network by contributing to the optimization of traffic flow.

The NM includes automatic and manual controls. Automatic controls are activated when the switch enters AM/CMP real-time overload. Manual controls are activated by the manual input commands (on-site or remote from network management center). Although the automatic NM controls focus on helping the overloaded switch, the manual NM controls emphasize maximizing the network resource utilization. The NM controls are as follows:

(A) Automatic controls

- Selective incoming load controls (SILC) - for non-CCS network.

(B) Manual controls

- Code controls
- Trunk Group controls
 - cancel to (CANT)
 - skip (SKIP)
 - cancel from (CANF)
 - Reroute.

The DOC is an automatic CCS NM control. In a CCS network, when a 5ESS®-2000 switch enters AM/CMP real-time overload, all the connecting switches are informed immediately and start to throttle the calls destined for that overloaded switch. The controls available to the connecting switches are CANT and SKIP.

The SILC is an unilateral, autonomous NM control for non-CCS network. In a non-CCS network, when a 5ESS®-2000 switch is in AM/CMP MAJOR real-time overload, a certain percent of the incoming trunk calls on manually specified trunk groups are blocked by SILC. The control action is confined within the overloaded switch.

The trunk groups for both DOC and SILC must be manually designated by the craftsperson. Once the trunk groups are assigned, the activation or deactivation of the control is automatic.

Code control blocks traffic to destination codes that are hard or impossible to reach. This conserves network resources for other traffic. Code control is most effective for controlling focused overload, a condition characterized by a surge of traffic from many parts of the network to a single office or destination code. Call gapping is used to regulate the maximum rate at which calls are released toward a destination code.

Manual trunk group controls can be divided into two classes: prehunt and posthunt. Prehunt controls are applied after a trunk group is chosen but before the hunt for an idle member starts. Posthunt controls are applied after the trunk group hunt fails to locate an idle member but before alternate route treatment is applied.

The trunk group control takes effect when either the percentage of direct route traffic offered to the trunk group exceeds a threshold, or the percentage of alternate route traffic offered to the trunk group exceeds a threshold. The threshold for prehunt controls is the percentage of all calls attempting to select a member in a trunk group; and for posthunt controls, it is the percentage of calls failing to select a member in a trunk group. Direct route refers to the first choice trunk group in the normal routing chain, and alternate route refers to the subsequent choice trunk group(s) in the normal routing chain.

The CANT is a prehunt control which cancels traffic destined for a specified trunk group. The SKIP is a prehunt control causing a given trunk group to be skipped and alternate routing to another trunk group in the routing chain occurs. The CANF is a posthunt control which cancels traffic overflowing a given trunk group. The reroute is a posthunt control. When reroute takes effect, a substitute reroute routing chain is traversed. If the substitute reroute routing chain is exhausted, routing continues in the normal routing chain unless specified otherwise.

8.4.5 USER ADMINISTRATION

During periods of overload, the subscriber may experience delays in dial tone or the call may be blocked. The overload control feature minimizes the effect of overload so that the telephone service is affected as little as possible. For exchanges with ESP enabled, subscribers designated as "essential" receive priority originating service during periods of extreme overloads. No line or trunk is permanently blocked or delayed during overloads.

The operating telephone company personnel can make requests by way of the MCC video display terminal for overload status information. The overload status information consists of a list of overload monitors and controls in effect. Whenever the overload status of a processor changes, a message is printed at the ROP and the MCC pages are updated. The MCC Page 109 indicates the status of overload conditions, if they exist, in the AM, CMP, DLN and SM. Page 109 provides the capability to request specific SM or CMP overload status and either to allow or inhibit ESP. The capability to request specific SM or CMP information is provided from MCC Page 170. Page 109 provides only a summary status of what processor, if any, is in overload. Page 170 describes the type of overload that exists. In addition, manual input messages may also be used to request overload status information and to allow or inhibit ESP for the 5ESS®-2000 switch.

8.4.5.1 Load-Service Measurements

In cases where a 5ESS®-2000 switch is operated beyond its rated capacity, load-service performance may be measured using switch data. The summation of the BLKOVD counts from all SMs (TRFC15 Part 2 or TRFC30

Section 4) divided by the corresponding sum of ORIGPC + INCPC (TRFC15 Part 1 or TRFC30 Section 5) provides the calculated percent blocking due to the AM/CMP throttle request during overload.

8.4.5.1.1 AM Route Request Throttle

AM occupancy for calls need be considered only if no DLN is equipped. As the call load placed on the switch increases, the AM occupancy percentage rises. At some level of call volume and OA&M activity, the AM occupancy triggers AM overload controls. One control is the route request throttle, which limits service requests from the SMs in order to allow the maximum possible number of calls to be successfully processed by the AM.

8.4.5.2 CMP Load-Service Relationships - Software Releases 5E10 And Later

The CMP handles the call processing that in prior releases was done by the AM. With very high call loads and high recent change activity, the CMP can enter real-time overload. To maintain peak performance under overload, the 5ESS®-2000 switch has a real-time overload control for the CMP that throttles an appropriate fraction of call originations; see AM/CMP Real-Time Overload Approach for details.

Although the overhead for the AM depends on the number of SMs, the overhead for the CMP does not. In contrast, the monitor in the CMP for the real-time overload control depends on the level of recent-change work, whereas the monitor for the AM does not have this dependence. The traffic report, TRFC30 Section 126, provides data for obtaining the CMP occupancy from recent-change work. The occupancy from recent-change work is:

PERCENT OCCUP - CALL OCCUP - (PERCENT OCCUP at no-load)

NOTE: PERCENT OCCUP at no-load is equal to PERCENT OCCUP when no calls or recent change work is being done.

As stated in AM/CMP Real-Time Overload, the CMP call capacity will normally set the overall switch capacity with 65 percent of the CMP real time allocated to call processing. When the switch is engineered for 65 percent occupancy of the CMP for call processing, the switch still exceeds the committed capacity for the full range of office applications even under conditions of simplex failures in critical resources. In particular, the capacity still exceeds 1,500,000 calls/hour for an EQPOTS office, 650,000 calls/hour for a Metro office, and 850,000 calls/hour for a tandem office with 100 percent CCS7 traffic. Given the nominal, non-failure, state of critical components, the CMP is the most limiting resource for call processing for Metro offices.

8.5 AM DISK DRIVE FACILITIES

8.5.1 DESCRIPTION

The disk drive facility for the 5ESS®-2000 switch stores large amounts (hundreds of megabytes) of data. This is more than can be stored in the main memory areas of the switch. The disk drives are much slower than random access memory (RAM) but less volatile. Additionally, this facility is less expensive than main memory. The two following descriptions apply to the disk drive facilities of the two processors associated with the 5ESS®-2000 switch. The 3B20D processor was associated with all switches prior to 5E9(1). New office starts beginning with software release 5E9(1) were equipped with the 3B21D processor.

8.5.1.1 3B20D

The 5ESS®-2000 switch may be equipped with one or more pairs of Small Computer System Interface (SCSI) disk drives. The number of disk-drive pairs depends on the number of switching modules (SMs) and remote switching modules (RSMs) and the amount of automatic message accounting (AMA) data to be stored on disk. The types of information stored on the disk include:

- Backup copies of AM/CMP and SM(s) software release program.
- Backup copies of the *UNIX*® operating system.
- Backup copies of AM/CMP and SM(s) static office dependent data (ODD).
- Disk-resident ODD. These relations, called disk ODD (DODD), are stored only on disk and are accessed directly from the disk. This is done to better utilize the AM/CMP memory. Two backup copies of disk-resident ODD are retained on disk.
- AMA records.
- Logging data [history of craftsperson input/output, customer-originated recent change (CORC), recent change (RC) activity, etc.].

For more details concerning the specific information contained on the disk, and the associated disk partitions, refer to - 235-105-210 *Routine Operations and Maintenance Procedures* and - 235-600-30X *Equipment Configuration Data/System Generation (ECD/SG) Data Base Manual*.

Each disk drive can be divided into a maximum of 64 partitions. Each of these partitions has a preset name and size which are permanent. There are two types of partitions: file partitions and file systems. The file partitions are basically large files containing raw data records. The file systems contain data records grouped into files which have individual names, sizes, creation dates, etc. The files are contained in directories and may be modified or removed as necessary. Each file requires one or more blocks of disk memory each containing 512 bytes of data.

8.5.1.2 3B21D

The 3B21D can support up to three SCSI Moving Head Disk (MHD) pairs in the basic units and up to two additional SCSI MHD pairs if one growth unit is used. Up to five additional SCSI MHD pairs in the growth units can be supported. Although a SCSI MHD physically contains a 1 GB capability, initially only 600 MB was allocated to maintain compatibility with 3B20D processors. The 3B21D processor used the "66" base configuration (described in section 8.5.2.6). This consisted of one pair of primary 600 MB usage coupled with one pair of secondary 600 MB usage. The software backup disks (MHD #14 and or MHD #15) and other optional disks also used 600 MB. The "66" base configuration supports 155 MB of AMA and 213 MB of SMODD. The 3B21D Direct Memory Access (DMA)/Dual Serial CHannel (DSCH) interface only supports the 1 GB SCSI disk drives. Starting with software release 5E10, the "1010" configuration is supplied for all new offices.

Each Disk File Controller (DFC) can support up to two SCSI buses (SBUS A & SBUS B). If one growth unit is equipped, then the SCSI MHDs terminate on SBUS A. If both growth units are equipped, then the SCSI MHDs can terminate on SBUS A & SBUS B.

8.5.2 ENGINEERING CONSIDERATIONS

8.5.2.1 General

Disk ODD is not engineerable.

Each software release program for the 5ESS®-2000 switch supports a number of disk configurations. Various configurations are defined to allocate disk memory in differing ways. The critical disk allocations are those for AMA information. The correct disk configuration must be used to provide the proper AMA capacity for each office. It is recommended that there be sufficient disk memory for storing five days of AMA data to ensure the accuracy of billing records.

It is possible to compute a weighted average based on the specific needs of the office. This can be done by referring to the Local Switching System Specification for the various fields and lengths for the various call types and computing the weighted average record length for the particular office. Multiply the number of calls of each call type times the associated record length and divide by the total number of calls. Add the results for all of the call types together, and this will represent the weighted average record length.

The fields for AMA records such as sensor type, sensor identification, recording office type, and recording office identification are common to every AMA record. Therefore, they are not stored on the disk regardless of the type of AMA option used (teleprocessing or tape). After being engineered, a switching office has the flexibility to change the option without reengineering the AMA disk space. This means that the AMA disk memory engineering is independent of the AMA option used by the switching office. AMA can be calculated with Table 8.5-1. Both SM ODD and AMA space can be increased by adding optional disk pairs.

The AMA disk storage worksheet shown in Table 8.5-1 is used to determine AMA requirements.

Table 8.5-1 AMA Disk Storage Worksheet

1.	Enter number of local circuit-switched AMA records per day	_____ × 48 = _____
2.	Enter number of toll circuit-switched AMA records per day	_____ × 64 = _____
3.	Enter number of packet-switched AMA records per day	_____ × 74 = _____
4.	Enter number of LASS SCA/CAR AMA records per day	_____ × 106 = _____
5.	Enter number of other LASS type AMA records per day	_____ × 80 = _____
6.	Sum of items 1 through 5	
7.	Enter number of days of AMA disk storage required	_____
8.	Product of items 6 and 7	
9.	Enter the results of item 8	÷ 1,048,576 = _____
The results of item 9		
represents the total disk storage requirements in MB.		

Storage capacity on the optional disks is independent of disk type. For installing and retrofitting offices, optional disk pairs are laid out in a number of fixed combinations, as shown in Tables 8.5-7, 8.5-10 and 8.5-12. However, live offices may use the disk growth procedures to grow optional disk pairs using any of the optional layouts provided.

8.5.2.2 Disk Engineering Triggers

Optional disk pairs can be provided only for systems employing the 340-MB disk configurations. For new or retrofit offices, optional disk pairs are laid out in a number of fixed combinations. However, live offices may use disk growth procedures to grow optional disk pairs using any of the optional layouts available.

Four types of transitions may involve disk drives. They are as follows:

- **Disk Growth** - Disk growth is the addition of new disk drives. This growth is done in pairs of drives except in the case of software backup disks, which are grown singly. A single pair of 300-MB drives may be grown to 2 pairs of 300-MB drives, and a single pair of 340-MB drives may be grown to 2 pairs of 340-MB drives. The layout on the existing disk pairs does not change, and no system boot is required. The additional pair of disk drives is then used to provide additional AMA storage unless a disk reconfiguration is subsequently performed.
- **Disk Conversion** - Disk conversion is the process of replacing one type of disk drive with another. This may be desired to gain the improvements previously described or it may be required to provide additional disk space. Disk conversion does not provide for increased disk allocations, but only changes the physical hardware. A system boot is not required for disk conversion.
- **Disk Reconfiguration** - Disk reconfiguration is the procedure used to change the allocation of disk memory. This procedure allows an office to be changed from one disk configuration to another. This could be a configuration change to increase ODD space (such as a change from a 340 SML to a 340 MED). Reconfigurations can only be performed to larger capacity configurations; that is in the order given in the capacity tables. Reconfigurations from or to optional layouts are permitted; The SM ODD space may be reduced as long as sufficient space remains for the backup ODD files. Disk reconfiguration requires a system boot; however, the SMs are not pumped, and call processing is not affected.
- **Retrofit** - During any retrofit future growth should be considered and coordinated with the capacity requirements provided in this section to ensure that the office is engineered with the appropriate disk configuration and the appropriate number of disk pairs. The expected end-of-engineering period (EOP) system configuration (number of SMs, RSMs, etc.) should be considered when engineering the disk drive facilities.

Two separate growth procedures are supported for low level Equipment Configuration Data (ECD), access for ECD manipulations for 3B20D processors and high level forms used for 3B21D processors.

The following is a summary of the 3B21D procedures:

- Growth of simplex SCSI peripheral units. These peripherals include 1 GB SCSI software backup disk drives and SCSI 9-track tape drives.
- Growth of duplex pair 1 GB SCSI disk drives.

NOTE: Only 1 GB SCSI disk drives are supported on the 3B21D processor. In addition, a mixture of SMD and SCSI are not supported on the 3B21D processor.

For more details concerning the disk growth and conversion procedures, refer to - 235-105-23X Hardware Change Procedures. For more information on disk reconfiguration procedures, refer to - 235-105-210 *Routine Operations And Maintenance*. Details concerning retrofit may be found in - 235-105-XXX or 235-106-XXX *Software Release Retrofit Procedures 5EXX*.

8.5.2.3 AM Disk Drives

In software release 5E12, and later, only one base disk configuration is supported for the 3B20D: "1010" 3.5" 1 GB or 2 GB SCSIs. In the 66 configuration the "6" denotes the format used for the 600 MB size drive. The "3" denotes

the format used for the 322 MB SCSI. These disk drives (600 & 322) are only supported for optional drives. The 3B21D only supports the "1010" format (1 GB or 2 GB SCSIs). As in the past, optional disk engineering is based on two parameters: NRODD (Non-Redundant SM ODD) and AMA (Automatic Message Accounting). Disk ODD is not engineerable.

8.5.2.4 Engineering for Dual AMA Stream

The engineering rules for using dual AMA streams depends upon the daily amount of AMA data generated in a switching office. It also depends upon the throughput of the AMA output option used (for example, either tape or teleprocessing). The following are assumptions used to derive the rules:

- (1) The AMA data stored on the disk for one day are written to tapes or teleprocessed during the next day.
- (2) A minimum of 8 nonbusy hours a day are available to write tapes or to teleprocess AMA data.
- (3) For the tape option, one tape can be written per hour with 12,400 AMA data blocks on each tape (2,048 bytes per block).
- (4) For the teleprocessing option, the efficiency of the 4,800, 9,600, and 56 Kbps data links are 90, 90, and 80 percent, respectively.

For the tape option, Table 8.5-2 illustrates the rule for single and dual stream configuration. For the teleprocessing option, Tables 8.5-3 and 8.5-4 illustrate the rules for single and dual stream configurations.

Table 8.5-2 Tape Option Rules

CONFIGURATION	DAILY VOLUME (MB)
Single stream	< 203
Dual stream	> 203

Table 8.5-3 Teleprocessing Option (Single)

DATA LINK	DAILY VOLUME (MB)
One 4,800 bps	< 15.5
one 9,600 bps	< 31.1
one 56 KBs	< 161

Table 8.5-4 Teleprocessing Option (Dual)

DATA LINK	DAILY VOLUME (MB)
two 4,800 bps	< 31.1
two 9,600 bps	< 62.2

8.5.2.5 SCSI Feature Engineering

The SCSI feature impacts disk engineering as follows:

- The SCSI drives are mounted in 21-inch cabinets, rather than in the 30-inch cabinets occupied by the 340-MB drives. Because of this reason, SCSI drives cannot be mixed with the current 340-MB drives in the same cabinet.
- The AM supports SCSI drives.
- The AM must be equipped with either one or two pair of SCSI disk file controllers (DFC) or host adapters. Each DFC hosts two SCSI buses, attaching up to four SCSI disk drivers per bus. The DFC for the SCSI disks is

different hardware than that used by the 340-MB drives.

- All drives in a DFC are in the same frame. Each SCSI frame can contain two DFCs.

The following circuit packs are required for each SCSI DFC:

- Two host adapter circuit packs: UN294 and TN2116
- One duplex dual serial bus selector pack: TN69B
- One power converter: 410AB
- One power control circuit pack: TN6B.

The reduction in cost per MB as well as a savings in floor space, makes new applications and growth instances reason to consider SCSI disk drives. There may be cases where growth of SMD disks for an existing office may be desirable inasmuch as SCSI and SMD disks cannot be mixed in the same cabinet. In such cases, there may be a savings in the cost of a new cabinet that may mandate growing SMD disks in the existing cabinet.

8.5.2.6 5E10 and Later Software Releases

As in earlier software releases, optional disks may be added to supplement the base configuration capacities for AMA and SM ODD. Tables 8.5-5 and 8.5-6 show the disk layouts available for the optional disk pairs. Optional disk layouts are supported for both the 340 MB SMD, 322 MB SCSI, and the 600 MB SCSI disk drives. The choice of option 2 disks has been expanded from one to three layouts for each disk type. The two additional layouts allow for a finer granularity of the AMA/SM ODD mix (25-75 percent or 75-25 percent split). However, existing offices may use the disk growth procedures to grow optional disk pairs using any of the optional layouts provided.

Table 8.5-5 5E10 and Later Optional Disk Capacities

OPTION		SMODD (MB)	AMA (MB)	PERCENT SMODD	PERCENT AMA
1	0300	0	264	0	100
2	0325	62	192	25	75
	0350	126	128	50	50
	0375	190	64	75	25
3	03100	254	0	100	0
1	0600	0	576	0	100
2	0625	134	432	25	75
	0650	278	288	50	50
	0675	422	144	75	25
3	06100	502	0	100	0

Table 8.5-6 5E10 and Later 1GB Disk Capacities

OPTION		SMODD (MB)	AMA (MB)	PERCENT SMODD	PERCENT AMA
-	0100	0	1001	0	100
-	01025	62	192	25	75
-	01050	490	500	50	50

The AM supports up to 32 SCSI drives. Each pair of SCSI DFCs support a maximum of 16 SCSI disks. The AM does not support a mixed SMD/SCSI configuration, but the maximum number of drives supported with a mixed configuration is 8 pairs, or 16 disks. The AM no longer supports a pure SMD configuration inasmuch as the 600 MB SCSI system disks are required for 5E8. Optional backup disks (drives 14 and 15) are reserved as software backup disks and must be 600 MB SCSI drives. Growth jobs for other than disk pairs 0/1 and 14/15 have the option of using existing 322 MB SCSI or 340 MB SMD drives or of ordering 600 MB SCSI drives. However, when reconfiguring the office, the 600 MB SCSI drives must come first, followed by 322 MB SCSI drives, and finally 340

MB SMD drives.

8.5.2.6.1 5E10 Disk Configurations

The 5E10 software release only supports one type of disk interface: SCSI (Small Computer System Interface) disk drives. 340 MB Storage Module Device (SMD) drives are no longer supported in 5E10. There will be no SCSI/340MB SMD mixed offices.

If you are unsure as to the number and type of disks that are equipped in a switch, the input message OP:DFC can be used to list all active disk drives.

All disks shipped as of 7/93 are 3.5" 1GB SCSI drives (formatted as 600 MB). Therefore, there are three types of SCSI drives: the 322 MB SCSI, the 600 MB SCSI, and the 3.5" 1GB SCSI with two software formats: the small "3" and the large "6". The 3.5" 1 GB SCSI (formatted as 600 current orderable drive. Tables 8.5-7 and 8.5-9 show disk configurations for software release 5E10.

Rules on the 3.5" 1 GB SCSI drive.

- It is same physical size as the 600 MB and 322 MB SCSI drives.
- It is referred to as the 3.5" 1 GB SCSI drive to avoid confusion with the 1 GB SCSI drive that is provided in the 3B21D.
- The 3.5" 1GB and 1GB drives are not interchangeable.
- The 3.5 1GB drive is a stand-alone unit.

A minimum of one pair of 1GB or 600MB SCSI drives for pair 0/1 will continue to be a requirement for software release 5E10. Optional backup disks (drives 14 and 15) are reserved as a software backup disks and can be 3.5" 1GB or 600 MB SCSI drives.

Growth jobs for disk pairs other than 0/1 and 14/15 have the option of ordering the 3.5" 1 GB SCSI or using existing 600MB SCSI, or 322MB SCSI drives. However, the 3.5" 1GB and 600 MB SCSI disks must come first, then the 322MB SCSI disks. (Exception is backup disks 14/15 which must be 1GB or 600MB SCSI, if used.) There is no change from 5E9(2) in the software requirements for disk drives. The large "6" configuration and the small "3" configuration are still supported. The "6" configuration is stored on the 3.5" 1GB and 600MB SCSI drives. The "3" configuration is stored on the 322 MB SCSI drives.

There are two 3B20 base configurations: a "66" (3.5" 1GB SCSI and/or 600MB SCSI pair) configuration and a "63" (600MB SCSI, 322MB SCSI) configuration intended for offices that choose to minimize disk replacement.

The AM (Administrative Module) supports up to 32 SCSI drives. Each pair of SCSI Disk File Controllers (DFCs) support a maximum of 16 SCSI disks. The AM supports a SCSI only configuration.

For offices that have a mixed SCSI/SMD configuration prior to 5E10 software release, the following information is in regards to the software format. In some cases it is assumed that a 633 office will only need one SCSI pair to convert to a 66 for 5E10. This assumption is not true in all cases because a 633 configuration provides an optimal split between SM ODD AMA required on a per SM basis. The "66" does not; it is "heavy" on SM ODD and "light" on AMA. See number of SMs supported below. Some offices with more than 30 SMs may need a third disk pair depending on AMA usage.

Data in MBs:

66	63	25/75 split	50/50 split

SM ODD	245	58	120
			184
AMA*	149	35	227
			163

Note that the "66" has more SM ODD, but less AMA. The AMA is the limiting item because an SM requires more AMA storage than SM ODD due to the Bellcore standard of 5 days storage. Refer to the estimating equations that follow. There will be no problem with "63" going to "66".

Number of SMs supported:

		63	63 w/
	66	25/75 split	50/50 split

SM ODD	80-120	40-60	60-90
AMA	30	45	33

The following equations can be used to estimate SM

ODD and AMA:

SM ODD required =

of non-ISDN SMs and PSMs x 2 MB +

of ISDN SMs x 3 MB +

of SM-2000 SMs x 18 MB

AMA required =

of SMs x 1 MB per day x # of days +

of SM-2000 SMs x 6 MB per day x # of days

8.5.2.6.2 Disk Configurations for 3B21D

The 3B21D supports one type of disk interface: the SCSI (Small Computer System Interface) disk drives. There is one type of SCSI drive. The 1GB SCSI drives (formatted as 1GB "1000").

- The base is a "1010" for two 1 GB disk pairs.
- Optional pairs of "10" have a choice in how they are partitioned between SM ODD and AMA. There are five choices for the 3B20D. There are three choices for the 3B21D.
- The 3B21D can support up to seven pairs of disk drives plus two software backup disks.
- The SCSI drive is a circuit pack that must be mounted in the circuit pack rack. It is not a stand-alone unit.

8.5.2.7 5E11 Disk Configurations For The 3B20

As of software release 5E11, only one type of disk interface is supported: Small Computer System Interface (SCSI) disk drives. The 340MB Storage Module Device (SMD) drives were not supported as of software release 5E10. There are no SCSI/340 MB SMD mixed offices. In software release 5E11, the 322MB SCSI, which uses the small "3" software format, are no longer supported as the second pair in a base configuration. For software release 5E11, all SCSI drives on the 3B20D must be 1GB SCSI or 600MB SCSI for the base. Optional pairs can be any type of SCSI drive including 322MB SCSI. If you are unsure as to the number and type of disks that are equipped in a switch, the input message OP:DFC can be used to list all active disk drives. Therefore, there are three types of SCSI drives: the 322 MB SCSI, the 600MB SCSI, and the 3.5" 1GB SCSI with two software formats: the small "3" and the large "6". See Table 8.5-10.

- The 3.5" 1GB SCSI (formatted as 600MB) is the current orderable drive.

Rules on the 3.5" 1GB SCSI drive.

- It is the same physical size as the 600MB and 322MB SCSI drives.
- It is referred to as the 3.5" 1GB SCSI drive to avoid confusion with the 1GB SCSI drive that is provided in the 3B21D.
- The 3.5" 1GB and 1GB drives are not interchangeable.
- The 3.5" 1GB drive is a stand-alone unit.

A minimum of two pairs of 1GB or 600MB SCSI drives for pair 0/1 and pair 2/3 is a requirement for software release 5E11. Optional backup disks (drives 14 and 15) are reserved as software backup disks and can be 3.5" 1 GB or 600 MB SCSI drives.

Growth jobs for disk pairs other than 0/1, 2/3, and 14/15 have the option of ordering the 3.5" 1GB SCSI, using existing 600 MB SCSI, or 322 MB SCSI drives. However, the 3.5" 1GB and 600 MB SCSI disks must come first, then the 322 MB SCSI disks. (Exception is backup disks 14/15 which must be 1 GB or 600 MB SCSI, if used.)

The large "6" configuration and the small "3" configuration are still supported. The "6" configuration is stored on the 3.5" 1 GB and 600 MB SCSI drives. The "3" configuration is stored on the 322 MB SCSI drives.

There is one base configuration; a 66 (3.5" 1GB SCSI and/or 600 MB SCSI pair) configuration.

The AM (Administrative Module) supports up to 32 SCSI drives. Each pair of SCSI Disk File Controllers (DFCs)

support a maximum of 16 SCSI disks. The AM supports a SCSI only configuration.

8.5.2.8 5E11 Disk Configurations For The 3B21D

There is no change from software release 5E10. The 3B21D supports one type of disk interface: the SCSI disk drives. There is one type of SCSI drive, the 1GB SCSI drives (formatted as 1GB "1000").

- The base is a "1010" for two 1 GB disk pairs.
- Optional pairs of "10" have a choice in how they are partitioned between SM ODD and AMA. There are three choices for the 3B21D.
- The 3B21D can support up to seven pairs of disk drives plus two software backup disks.
- The SCSI drive is a circuit pack that must be mounted in the circuit pack rack. It is not a stand-alone unit like the 1GB SCSI in the 3B20D. See Table 8.5-10.

Table 8.5-7 5E10 Disk Configurations for 3B20D 63 Configuration

DISK PAIR											SM ODD MBs	AMA MBs
0	1	2	3	4	5	6	7	8	...	15		
R	R	-	-	-	-	-	*	-	-	-	58	35
R	R	0300	-	-	-	-	*	-	-	-		299
R	R	0300	0300	-	-	-	*	-	-	-		563
R	R	0300	0300	0300	-	-	*	-	-	-		827
R	R	0300	0300	0300	0300	-	*	-	-	-		1091
R	R	0325	-	-	-	-	*	-	-	-	120	227
R	R	0325	0300	-	-	-	*	-	-	-		491
R	R	0325	0300	0300	-	-	*	-	-	-		755
R	R	0325	0300	0300	0300	-	*	-	-	-		1019
R	R	0350	-	-	-	-	*	-	-	-	184	163
R	R	0350	0300	-	-	-	*	-	-	-		427
R	R	0350	0300	0300	-	-	*	-	-	-		691
R	R	0350	0300	0300	0300	-	*	-	-	-		955
R	R	0375	-	-	-	-	*	-	-	-	248	99
R	R	0375	0300	-	-	-	*	-	-	-		363
R	R	0375	0300	0300	-	-	*	-	-	-		627
R	R	0375	0300	0300	0300	-	*	-	-	-		891
R	R	03100	-	-	-	-	*	-	-	-	312	35
R	R	03100	0300	-	-	-	*	-	-	-		299
R	R	03100	0300	0300	-	-	*	-	-	-		563
R	R	03100	0300	0300	0300	-	*	-	-	-		827

Notes:

- a. "*" indicates the disk pair optional for software backup capability.
- b. "R" indicates that the disk pair is required in the base configuration.
- c. "-" indicates an unequipped disk pair.
- d. The AMA can grow up to 13 full MHDs for "63" and "66" combinations.
- e. Optional disk pair layout for "63" and "66" combinations is 06100, 0600, 0625, 0650, 0675, 03100, 0300, 0325, 0350, and 0375.
- f. Disk placement order for "63" and "66" combinations is (06100, 03100) (0625, 0650, 0675, 0325, 0350, 0375) and (0600, 0300).

Maximum limitations:

- (06100) = 5

- (0625, 0650, and 0675) = 1
- Optional disks with any SM ODD (either full or partial) = 5
- (0600) = 5 (mix of SCSI/SMD) or 13 (SCSI only).

Table 8.5-8 5E10 Disk Configurations for 3B20D 66 Configuration

DISK PAIR											SM ODD MBs	AMA MBs
0	1	2	3	4	5	6	7	8	...	15		
R	R	-	-	-	-	-	*	-	-	-	245	149
R	R	0600	-	-	-	-	*	-	-	-		725
R	R	0600	0600	-	-	-	*	-	-	-		1301
R	R	0600	0600	0600	-	-	*	-	-	-		1877
R	R	0625	-	-	-	-	*	-	-	-	379	581
R	R	0625	0600	-	-	-	*	-	-	-		1157
R	R	0625	0600	0600	-	-	*	-	-	-		1733
R	R	0625	0600	0600	0600	-	*	-	-	-		2309
R	R	0650	-	-	-	-	*	-	-	-	523	437
R	R	0650	0600	-	-	-	*	-	-	-		1013
R	R	0650	0600	0600	-	-	*	-	-	-		1589
R	R	0650	0600	0600	0600	-	*	-	-	-		2165
R	R	0675	-	-	-	-	*	-	-	-	667	293
R	R	0675	0600	-	-	-	*	-	-	-		869
R	R	0675	0600	0600	-	-	*	-	-	-		1445
R	R	0675	0600	0600	0600	-	*	-	-	-		2021
R	R	06100	-	-	-	-	*	-	-	-	747	149
R	R	06100	0600	-	-	-	*	-	-	-		725
R	R	06100	0600	0600	-	-	*	-	-	-		1301
R	R	06100	0600	0600	0600	-	*	-	-	-		1877

Table 8.5-9 5E10 Disk Configurations for 3B21D 1010 Configuration

DISK PAIR											SM ODD MBs	AMA MBs
0	1	2	3	4	5	6	7	8	-	15		
R	R	-	-	-	-	-	-	-	-	-	344	626
R	R	1000	-	-	-	-	-	-	-	-		1627
R	R	1000	1000	-	-	-	-	-	-	-		2628
R	R	1000	1000	1000	-	-	-	-	-	-		3629
R	R	1000	1000	1000	1000	-	-	-	-	-		4630
R	R	1025	-	-	-	-	-	-	-	-	584	1377
R	R	1025	1000	-	-	-	-	-	-	-		2378
R	R	1025	1000	1000	-	-	-	-	-	-		3379
R	R	1025	1000	1000	1000	-	-	-	-	-		4380
R	R	1050	-	-	-	-	-	-	-	-	834	1126
R	R	1050	1000	-	-	-	-	-	-	-		2127
R	R	1050	1000	1000	-	-	-	-	-	-		3128
R	R	1050	1000	1000	1000	-	-	-	-	-		4129

Table 8.5-10 5E11 Disk Configurations for 3B20D 66 Configuration

DISK PAIR											SM ODD MBs	AMA MBs
0	1	2	3	4	5	6	7	8	...	15		
R	R	-	-	-	-	-	*	-	-	-	245	70
R	R	0600	-	-	-	-	*	-	-	-		646
R	R	0600	0600	-	-	-	*	-	-	-		1222
R	R	0600	0600	0600	-	-	*	-	-	-		1798
R	R	0625	-	-	-	-	*	-	-	-	379	502
R	R	0625	0600	-	-	-	*	-	-	-		1078
R	R	0625	0600	0600	-	-	*	-	-	-		1654
R	R	0625	0600	0600	0600	-	*	-	-	-		2230

R	R	0650	-	-	-	-	*	-	-	-	523	358
R	R	0650	0600	-	-	-	*	-	-	-		934
R	R	0650	0600	0600	-	-	*	-	-	-		1510
R	R	0650	0600	0600	0600	-	*	-	-	-		2086
R	R	0675	-	-	-	-	*	-	-	-	667	214
R	R	0675	0600	-	-	-	*	-	-	-		790
R	R	0675	0600	0600	-	-	*	-	-	-		1366
R	R	0675	0600	0600	0600	-	*	-	-	-		1942
R	R	06100	-	-	-	-	*	-	-	-	747	70
R	R	06100	0600	-	-	-	*	-	-	-		646
R	R	06100	0600	0600	-	-	*	-	-	-		1222
R	R	06100	0600	0600	0600	-	*	-	-	-		1798

Notes:

- ``*'' indicates the disk pair optional for software backup capability.
- ``R'' indicates that the disk pair is required in the base configuration.
- ``-'' indicates an unequipped disk pair.
- The AMA can grow up to 13 full MHDs for "63" and "66" combinations.
- Optional disk pair layout for "63" and "66" combinations is 06100, 0600, 0625, 0650, 0675,
- Disk placement order for "63" and "66" combinations is (06100,03100) (0625, 0650, 0675, and (0600,0300).

1000 = 100% AMA

1025 = 25% SMODD and 75% AMA

1050 = 50% SMODD and 50% AMA Maximum limitations:

- (06100) = 5
- (0625, 0650, and 0675) = 1
- Optional disks with any SM ODD (either full or partial) = 5
- (0600) = 5 (mix of SCSI/SMD) or 13 (SCSI only).

Table 8.5-11 5E11 Disk Configurations for 3B21D 1010 Configuration

DISK PAIR											SM ODD MBs	AMA MBs
0	1	2	3	4	5	6	7	8	...	15		
R	R	-	-	-	-	-	-	-	-	-	378	581
R	R	1000	-	-	-	-	-	-	-	-		1582
R	R	1000	1000	-	-	-	-	-	-	-		2583
R	R	1000	1000	1000	-	-	-	-	-	-		3584
R	R	1000	1000	1000	1000	-	-	-	-	-		4585
R	R	1025	-	-	-	-	-	-	-	-	618	1332
R	R	1025	1000	-	-	-	-	-	-	-		2333
R	R	1025	1000	1000	-	-	-	-	-	-		3334
R	R	1025	1000	1000	1000	-	-	-	-	-		4335
R	R	1050	-	-	-	-	-	-	-	-	868	1081
R	R	1050	1000	-	-	-	-	-	-	-		2082
R	R	1050	1000	1000	-	-	-	-	-	-		3083
R	R	1050	1000	1000	1000	-	-	-	-	-		4084

Table 8.5-12 5E12 Disk Configurations for 3B20D and 3B21 1010 Configuration

DISK PAIR											SM ODD	AMA MBs
0	1	2	3	4	5	6			...			

												MBs	
R	R	-	-	-	-	-	-	-	-	-	-	378	472
R	R	1000	-	-	-	-	-	-	-	-	-		1473
R	R	1000	1000	-	-	-	-	-	-	-	-		2474
R	R	1000	1000	1000	-	-	-	-	-	-	-		3475
R	R	1000	1000	1000	1000	-	-	-	-	-	-		4476
R	R	1025	-	-	-	-	-	-	-	-	-	618	1223
R	R	1025	1000	-	-	-	-	-	-	-	-		2224
R	R	1025	1000	1000	-	-	-	-	-	-	-		3225
R	R	1025	1000	1000	1000	-	-	-	-	-	-		4226
R	R	1050	-	-	-	-	-	-	-	-	-	868	972
R	R	1050	1000	-	-	-	-	-	-	-	-		1973
R	R	1050	1000	1000	-	-	-	-	-	-	-		2974
R	R	1050	1000	1000	1000	-	-	-	-	-	-		3975

Disk engineering is based on two parameters: non-redundant SM ODD and Automatic Message Accounting (AMA).

- SM ODD partitions must be engineered based upon anticipated changes in the static, non-redundant ODD sizes. As a default, the following average values can be used for disk storage of static, non-redundant SM ODDs.

NOTE: These are nominal values which have changed since software release 5E6. Individual offices can make adjustments appropriate to their current situation and projected growth.

The AMA disk storage worksheet is shown in Table 8.5-1 .

NOTE: Traffic count AMAMEM collects the total number of AMA bytes per SM per 1/2 hour. Refer to TRFC30 Section 122 for additional information.

8.5.2.9

8.5.2.9.1 5E12 Disk Configurations

8.5.2.9.1.1 AM Disk Drives

In software release 5E12, only one base disk configuration is supported for the 3B20D: "1010" 3.5" 1 GB or 2 GB SCSI. In the 66 configuration the "6" denotes the format used for the 600 MB size drive. The "3" denotes the format used for the 322 MB SCSI. These disk drives (600 & 322) are only supported for optional drives. The 3B21D only supports the "1010" format (1 GB or 2 GB SCSI). As in the past, optional disk engineering for software release 5E12 is based on two parameters: NRODD (Non-Redundant SM ODD) and AMA (Automatic Message Accounting). Disk ODD is not engineerable.

To estimate the SM ODD, you may use the following information:

No. of non-ISDN SMS and PSMS x 3.0 MB +

No. of ISDN SMS x 4.0 MB +

No. of SM-2000 SMS x 26 MB.

Note in Table 8.5-13 that the AMA has been reduced to 542 MB (581 MB in 5E11) .

The AMA column indicates how many, if any, AMA-only disk pairs are required. The AMA disk storage algorithm can be used to determine AMA requirements. Beginning with 5E8, Section 122 of the TRFC30 report can be used to collect AMA bytes per SM. Tables 8.5-14 , 8.5-15 and 8.5-16 show the optional disk layouts. The rules for ordering disk configurations are shown for new and retrofitting offices.

Table 8.5-13 5E12 DISK CAPACITIES

BASE CONFIG	MINIMUM DISK PAIRS	SM-ODD MB	AMA MB
1010	2	377	542
VCDX	1	55	83

For 3B20D: "1010" is 3.5" 1 GB or 2 GB SCSIs (formatted to 1,000 MB) For 3B21D: "1010" is 1 GB or 2 GB SCSIs (formatted to 1,000 MB) For VCDX: Two mirrored 4 GB SCSI disks (one pair) are supported on the AM workstation. The data stored on 3B disks 0 and 2 is stored on the first disk. The data stored on 3B disks 1 and 3 is stored on the second disk.

SM ODD requirements are based on the sum of the non-redundant static ODD sizes for all SMs.

AMA requirements are determined using the AMA Disk Storage Algorithm.

Table 8.5-14 5E12 63 OPTIONAL LAYOUTS

63 Layout	SM ODD (MB)	AMA (MB)	% SM ODD to % AMA
0300	0	264	0/100
0325	62	192	25/75
0350	126	128	50/50
0375	190	64	75/25
03100	254	0	100/0

Table 8.5-15 5E12 66 OPTIONAL LAYOUTS

66 Layout	SM ODD (MB)	AMA (MB)	% SM ODD to % AMA
0600	0	576	0/100
0625	134	432	25/75
0650	278	288	50/50
0675	422	144	75/75
06100	502	0	100/0

Table 8.5-16 5E12 1010 OPTIONAL LAYOUTS

1010 Layout	SM ODD (MB)	AMA (MB)	% SM ODD to % AMA
1000	0	1000	0/100
1025	250	750	25/75
1050	500	500	50/50

8.5.2.9.1.2 Orderable Disk Configurations for New and Retrofitting Offices

The following formulas are used to engineer SM ODD and AMA capacities. In these formulas, the number of optional disks is increased until the capacity needs of the office are met. Note that 3.5" 1 GB and 2 GB disks for the 3B20D and the 3B21D 1 GB and 2 GB disks are formatted to 1 GB. Prior to software release 5E12, the 3.5" disks for the 3B20D were formatted to 600 MB.

The total capacity is based on the sum of: base pair capacities + optional pair capacities. The positional restriction of the optional pairs, if needed, is:

- All SM ODD packed toward base pair.
- Maximum of one mixed optional pair (SM ODD/AMA).
- All AMA is last.

The overall limitations on the number of disks:

- The maximum number of disk pairs for the 3B21D is 7 with 2 backup disks; the maximum number of disk pairs

for the 3B20D is 15 with 2 backup disks.

— The maximum number of mixed pairs is one.

8.5.2.9.2 5E12 AMA Disk Storage Algorithm

(No change since 5E7.)

How many:

- A. local circuit-switched AMA records are generated /day?
- B. toll circuit-switched AMA records are generated /day?
- C. packet-switched AMA records are generated per day?
- D. LASS SCA/CAR AMA records are generated per day?
- E. other LASS type AMA records are generated per day?
- F. days of AMA disk storage are required?

Total MB of disk storage =

$$F * (48*A + 64*B + 74*C + 106*D + 80*E) / 1048576$$

NOTE: LASS = Local Area Signaling Services

SCA = Selective Call Acceptance

CAR = Computer Access Restriction

8.5.2.9.3 Disk Engineering Rules for 5E12

General Disk Information:

- (A) All SM ODD packs toward the base pairs.
- (B) For 3B21D offices: all disks are formatted to 1 GB.
- (C) For 3B21D offices: the maximum number of disk pairs is seven and optional backup disks 14 and 15.
- (D) For 3B20D offices: an office with all SCSI drives may engineer up to a maximum of 15 disk pairs and

optional backup disks 14 and 15.

- (E) For 3B20D offices: SCSI disks pairs must match logically, but can be physically different in formatted size. For example, a 3.5" 1 GB or 2 GB SCSI disk may replace a 322 MB SCSI disk, but the 3.5" 1 GB SCSI disk has a 322 MB logical layout.
- (F) Generally, 3.5" format 1 GB, 2 GB and 600 MB SCSI disks are engineered with a large logical layout. 3.5" 1GB, 2 GB and 600 MB SCSI disks may also be engineered with a small logical layout. However, there is a loss of capacity when under engineering the 3.5" 1 GB, 2 GB and 600 MB SCSI disks.
- (G) 600 MB SCSI disks are engineered with a large logical layout (optional disks only)
- (H) 322 MB SCSI disks are engineered with a small logical layout and are only used as optional pairs.
- (I) All large logical layout disks precede all small logical layout disks in the disk chain.

For all offices Table 8.5-17 shows the rules that apply to disk replacements:

Table 8.5-17 Disk Replacement Rules for 5E12

CURRENT DISK	REPLACED BY	NEW LAYOUT
3.5" 1 GB SCSI	3.5" 2 GB	Same
3.5" 1 GB SCSI	3.5" 1 GB SCSI	Same
3.5" 1 GB SCSI	600 MB SCSI	Same
600 MB SCSI	3.5" 1 GB SCSI	Same
600 MB SCSI	600 MB SCSI	Same
322 MB SCSI	3.5" 1 GB SCSI	Small
322 MB SCSI	600 MB SCSI	Small
322 MB SCSI	322 MB SCSI	Same

8.5.2.9.3.1 Base Configuration

- For 3B21D all disks, including the base pairs, must be 1 GB or 2GB SCSI disks formatted to 1 GB.
- For 3B20D the 1010 base configuration consists of two pairs of 3.5" 1 GB or 2 GB SCSI disks formatted to 1 GB.

8.5.2.9.3.2 Optional Disks

- 3B21D optional disks must be 1 GB or 2 GB SCSI.
- 3B20D optional disks can be 3.5" 1 GB SCSI, 2 GB SCSI, 600 MB SCSI, or 322 MB SCSI. (The 322 MB SCSI drives must be last in the lineup.)
- 3B20D optional disks MHDs 16 through 32 can only be engineered for 100% AMA.

8.5.2.9.3.3 For All Offices

- Optional disks are engineered for offices that require more AMA and/or SM ODD than a base configuration provides.
- The following disk placement rules, beginning with the first optional disk, apply:
 - Zero or more 100% SM ODD optional disks.
 - Followed by zero or ONE and only ONE 25%, 50%, or 75% SM ODD/AMA mixed option disk pair.

— Followed by zero or more 100% AMA disks.

8.5.2.9.3.4 Software Backup Disks

- The software backup disks must match the disks used for primary disks 0 and 1.
- MHDs 14 and 15 are reserved for software backup use only.

8.5.2.9.3.5 New Ship Information

- All 5E12 new ships will receive 3B21D AMs.
- All software release 5E12 new ships will receive 2 GB SCSI disks with 1 GB logical layouts.

8.5.2.9.3.6 Retrofitting Information

- Existing 3B20D offices can only retrofit to the "1010" base configuration.
- Retrofitting 3B20D offices may use 3.5" 2 GB SCSI, 1GB SCSI, 600 MB SCSI, or 322 MB SCSI as optional disks.
- The 3B20D offices requesting additional disk drives will receive 3.5" 2 GB SCSI drives.
- Existing 3B21D offices must retrofit to the 1010 base configuration. Only 1 GB or 2 GB SCSI drives are supported.

8.5.2.9.3.7 Disk Conversion Reconfiguration And Growth

All procedures to support 340 MB disk drives have been removed.

8.5.2.9.3.8 ODA Information

ODA currently engineers SM ODD with 10% free space.

8.5.2.10 5E12 Disk Configurations For The 3B20

For software release 5E12, only one type of disk interface is supported: SCSI (Small Computer System Interface) disk drives. 340 MB Storage Module Device (SMD) drives are no longer supported as of software release 5E10. There will be no SCSI/340 MB SMD mixed offices. As of software release 5E11, the 322 MB SCSI, which uses the small "3" software format, is no longer supported as the second pair in a base configuration. For software release 5E12, only one 3B20D base configuration is supported, a "1010" 3.5" 1GB or 2 GB (as of 2nd quarter 1996) SCSI primary and secondary drive disk pair. Optional pairs can be any type of SCSI drive including 322 MB and 600 MB SCSI. If you are unsure as to the number and type of disks that are equipped in a switch, the input message OP:DFC can be used to list all active disk drives. All disks shipped as of 7/93 were 3.5" 1 GB SCSI drives (formatted as 600 MB). For software release 5E12, all disks shipped are 2GB and formatted as 1000 MB. Therefore, there are four types of SCSI drives: the 322 MB SCSI, the 600 MB SCSI, and the 3.5" 1 GB and 2 GB SCSI with three software formats: the small "3", and large "6" and "1010".

Rules For The 3.5" 1 GB And 2 GB SCSI drives:

- They are referred to as the 3.5" 1 GB and 2 GB SCSI drives to avoid confusion with the 1 GB and 2 GB SCSI drives that are provided in the 3B21D.
- The (3.5" 1 GB/2 GB) 3B20D and (1 GB/2 GB) 3B21D drives are not interchangeable.
- The 3.5" 1 GB and 2 GB drives (3B20D) are stand-alone units (not circuit packs).

A minimum of two pairs of 1 GB or 2 GB SCSI drives for pair 0/1 and pair 2/3 are a requirement for software release 5E12. Optional backup disks (drives 14 and 15) are reserved as software backup disks and can be 3.5" 1 GB, 2GB or 600 MB SCSI drives. Please refer to SEI Index 20, 3B21 for more information on SCSI drives.

Growth jobs for disk pairs other than 0/1, 2/3, and 14/15 have the option of ordering the 3.5" 2 GB SCSI or using existing 1 GB, 600 MB SCSI, or 322 MB SCSI drives. (600 and 322 optional only) However, the 3.5" 1 GB and 2GB and 600 MB SCSI disks must come first, then the 322 MB SCSI disks. (Exception is backup disks 14/15 which must be 1 GB or 600 MB SCSI, if used.)

The large "6" layout and the small "3" layout are still supported. (again, only for optional disks) The "6" format is stored on the 600 MB SCSI drives and the "3" format is stored on the 322 MB SCSI drives.

There is ONLY ONE BASE CONFIGURATION SUPPORTED a 1010 (3.5" 1 GB or 2 GB SCSI SCSI pair) configuration.

The AM (Administrative Module) supports up to 32 SCSI drives. Each pair of SCSI Disk File Controllers (DFCs) support a maximum of 16 SCSI disks. The AM supports a SCSI only configuration.

8.5.2.11 5E12 Disk Configurations For The 3B21D

There is no change from 5E11. The 3B21D supports one type of disk interface: the SCSI disk drives. There is one type of SCSI drive. The 1 GB or 2 GB SCSI drives (formatted as 1 GB "1000 MB"). The 2 GB SCSI drives were shipped as of 2nd quarter 1996.

- The base is a "1010" for two 1 GB or 2 GB disk pairs.
- Optional pairs of "10" have a choice in how they are partitioned between SM ODD and AMA. There are five choices for the 3B20D. There are three choices for the 3B21D. See section 4 for SM ODD & AMA tables.
- The 3B21D can support up to seven pairs of disk drives plus two software backup disks.
- The SCSI drive is a circuit pack that must be mounted in the circuit pack rack. It is not a stand-alone unit like the 3.5" 1 GB or 2 GB SCSIs in the 3B20D.

Please refer to SEI Index 20, 3B21D, for more information.

8.5.3 5E13 AM DISK DRIVES

In software release 5E13, only one base disk configuration is supported for the 3B20D: "1010" 3.5" 1 GB, 2 GB or 4 GB SCSIs. In the 66 configuration the "6" denotes the format used for the 600 MB size drive. The "3" denotes the format used for the 322 MB SCSI. These disk drives (600 & 322) are only supported for optional drives. The 3B21D only supports the "1010" format (1 GB, 2 GB or 4 GB SCSIs). In the past, optional disk engineering for 5E13 will be based on two parameters: NRODD (Non-Redundant SM ODD) and AMA (Automatic Message Accounting). Disk ODD is not engineerable. See Tables 8.5-18 8.5-19 8.5-20 and 8.5-21 for base configurations.

To estimate the SM ODD, you may use the following information:

- No. of non-ISDN SMs and PSMs x 3.0 MB +
- No. of ISDN SMs x 4.0 MB +
- No. of SM-2000 SMs x 26 MB

For the 3B20D:

- SM ODD requirements are based on the sum of the non- redundant static ODD sizes for all SMs.
- 1010 is 1 GB, 2 GB or 4 GB SCSIs (formatted to 1,000 MB) For VCDX:

Table 8.5-18 5E13 Base Configurations

BASE CONFIG	MINIMUM DISC PAIRSSM ODD (MB)	SM ODD (MB)	AMA (MB)
1010	2	390.6	388.3
VCDX	1	55.0	252.7

Table 8.5-19 5E13 63 OPTIONAL LAYOUTS

63 Layout	SM ODD (MB)	AMA (MB)	% SM ODD to % AMA
0300	0	264	0/100
0325	62	192	25/75
0350	126	128	50/50
0375	190	64	75/25
03100	254	0	100/0

Table 8.5-20 5E13 66 OPTIONAL LAYOUTS

66 Layout	SM ODD (MB)	AMA (MB)	% SM ODD to % AMA
0600	0	576	0/100
0625	134	432	25/75
0650	278	288	50/50
0675	422	144	75/75
06100	502	0	100/0

Table 8.5-21 5E13 1010 OPTIONAL LAYOUTS

1010 Layout	SM ODD (MB)	AMA (MB)	% SM ODD to % AMA
1000	0	1000	0/100
1025	250	750	25/75
1050	500	500	50/50

8.5.3.1 Orderable Disk Configurations for New and Retrofitting Offices

The following formulas are used to engineer SM ODD and AMA capacities. In these formulas, the number of optional disks are increased until the capacity needs of the office are met. Note that 3.5" 1 GB, 2 GB, and 4 GB disks for the 3B20D and the 3B21D 1 GB, 2 GB, and 4 GB disks are formatted to 1 GB. Prior to 5E12, the 3.5" disks for the 3B20D were formatted to 600 M

The total capacity is based on the sum of

- Base pair capacities + optional pair capacities.
- The positional restriction of the optional pairs, if needed, is:
 - All SM ODD packed toward base pair

— All AMA is last.

- The overall limitations on the number of disks:

— The maximum number of disk pairs for the 3B21D is 7 with 2 backup disks; the maximum number of disk pairs for the 3B20D is 15 with 2 backup disks.

— How many:

- local circuit-switched AMA records are generated /day?
- toll circuit-switched AMA records are generated /day?
- packet-switched AMA records are generated per day?
- LASS SCA/CAR AMA records are generated per day?
- other LASS type AMA records are generated per day?
- days of AMA disk storage are required?

Total MB of disk storage =

- $F * (48*A + 64*B + 74*C + 106*D + 80*E) / 1048576$

8.5.3.2 Disk Engineering Rules for 5E13

For 3B21D offices:

- All disks will be formatted to 1 GB.
- The maximum number of disk pairs is seven and optional backup disks 14 and 15.

For 3B20D offices:

- An office with all SCSI drives may engineer up to a maximum of 15 disk pairs and optional backup disk.
- SCSI disks pairs must match logically, but can be physically different in formatted size. For example, a 3.5" 1 GB, 2 GB or 4 GB SCSI disk may replace a 322 MB SCSI disk, but the 3.5" 1 GB, 2 GB or 4 GB SCSI disk will have a 322 MB logical layout.
- 3.5" 1 GB, 2 GB, 4 GB, and 600 MB SCSI disks may also be engineered with a small logical layout. However, there is a loss of capacity when under engineering the SCSI disks.
- All large logical layout disks precede all small logical layout disks in the disk chain.
- 600 MB SCSI disks are engineered with a large logical layout (optional disks only)
- 322 MB SCSI disks are engineered with a small logical layout and are only used as optional pairs.

For all offices:

- All SM ODD will pack toward the base pairs
- Table 8.5-22 shows the rules applying to disk replacements.

Table 8.5-22 Disk Replacement Rules for 5E13

CURRENT DISK	REPLACED BY	NEW LAYOUT
3.5" 2 GB SCSI	3.5" 4 GB SCSI	Same
3.5" 1 GB SCSI	3.5" 2 GB SCSI	Same
3.5" 1 GB SCSI	3.5" 1 GB SCSI	Same
3.5" 1 GB SCSI	600 MB SCSI	Same
600 MB SCSI	3.5" 1 GB SCSI	Same
600 MB SCSI	600 MB SCSI	Same
322 MB SCSI	3.5" 1 GB SCSI	Same
322 MB SCSI	600 MB SCSI	Same
322 MB SCSI	322 MB SCSI	Same

8.5.3.3 Base Disk Configuration

For all 3B21D offices:

- All disks, including the base pairs, must be 1 GB, 2 GB or 4 GB SCSI disks formatted to 1 GB

For 3B20D offices:

- The 1010 base configuration consists of two pairs of 3.5" 1 GB, 2 GB or 4 GB SCSI disks formatted to 1 GB.

8.5.3.3.1 Optional Disks

- B20D optional disks can be 3.5" 1 GB SCSI, 2 GB SCSI, 4 GB SCSI, 600 MB SCSI, or 322 MB SCSI. (The 322 MB SCSI drives must be last in the lineup.)
- B21D optional disks must be 1 GB, 2 GB or 4 GB SCSI.
- 3B20D optional disks MHDs 16 through 32 can only be engineered for 100% AMA.

For all offices:

- Optional disks are engineered for offices that require more AMA and/or SM ODD than a base configuration provides
- The following disk placement rules, beginning with the first optional disk, apply:
 - Zero or more 100% SM ODD optional disks.
 - Followed by zero or ONE and only ONE 25%, 50%, or 75% SM ODD/AMA mixed option disk pair.
 - Followed by zero or more 100% AMA disks.

8.5.3.3.2 Software Backup Disks

- The software backup disks must match the disks used for primary disks 0 and 1.

- MHDs 14 and 15 are reserved for software backup use only.

8.5.3.3.3 New Ship Information

- All 5E13 new ships receive 3B21D AMs.
- All 5E13 new ships will receive 2 GB or 4 GB SCSI disks with 1 GB logical layouts. New 4 GB disks will be shipped during the 1st quarter of 1998.

8.5.3.3.4 Retrofitting Information

- Existing 3B20D offices can only retrofit to the "1010" base configuration.
- Retrofitting 3B20D offices may use 3.5" 2 GB SCSI, 1 GB SCSI, 600 MB SCSI, or 322 MB SCSI as optional disks.
- The 3B20D offices requesting additional disk drives will receive 3.5" 4 GB SCSI drives (1st quarter 1998).
- Existing 3B21D offices (on 5E9.1) must retrofit to the 1010 base configuration. Only 1 GB, 2 GB or 4 GB SCSI drives are supported.

8.5.3.3.5 Disk Conversion, Reconfiguration and Growth

All procedures to support 340 MB disk drives have been removed.

8.5.3.3.6 ODA Information

ODA currently engineers SM ODD with 10% free space

8.5.4 ASSIGNMENT GUIDELINES

Assignment practices that tend to minimize AM/CMP ODD do not necessarily result in a savings of disk space because a fixed amount of space is provided. However, SM assignments that minimize SM ODD do result in more efficient use of disk facilities. The SM ODD disk partition contains the total of all SM and RSM ODDs in the office.

In both SMD and SCSI configurations, drives 14 and 15 are reserved for the simplex software backup disks, which are optional. Backup disk drives 14/15 must be the same hardware as disk drives 0/1. SCSI disk drives 0/1 cannot be mixed with SMD disk drives 14/15. SMD disk drives 0/1 cannot be mixed with SCSI disk drives 14/15. SCSI/SMD indicates that the SCSI disk drives are disk pairs 0/1 and SMD disk drives are configured in the other disk pairs.

Dual stream AMA is supported on all MHD pair, 0/1 through 30/31, except drives 14 and 15.

Backup of nonredundant, static SM ODD is restricted to drive pairs 2/3 through 12/13 as in earlier software releases.

The SCSI drives are duplexed across DFCs 0 and 1 or across DFCs 2 and 3. For example, device 0 on bus 0 of DFC matches device 0 of bus 0 on DFC 1, to comprise drive pair 0/1.

8.5.4.1 Feature Impact

The implementation of features or the assignment of features to individuals or groups has an impact on disk facilities. This requires additional ODD space for those lines or groups. For further details, refer to the Feature

Impact and Memory Management sections associated with SM and AM memory. Sections 10.3 and 8.3 .

8.5.5 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

There are no dedicated measurements for monitoring disk memory usage. The OP:ODD provides the necessary usage determination method as previously described.

8.5.6 MEMORY MANAGEMENT

NOTE: Traffic count AMAMEM collects the total number of AMA bytes per SM per 1/2 hour. Refer to TRFC30 Section 122 for additional information.

The AMA space on the disk may be monitored to assist in the management of the available disk space. A command (OP:AMA:DISK) may be entered from the MCC to initiate a report showing the percentage of AMA space used. In addition, automatic alarms are activated when the AMA disk area is 70 percent full, 90 percent full, and 100 percent full. When the AMA space is 100 percent full, a critical alarm is activated. If the critical alarm occurs, the AMA buffer in the switch can contain an additional 2,000 to 3,000 AMA records. It is recommended that the HOC be contacted after the first alarm (70 percent full) and requested to poll the switch for the data. Otherwise, an AMA tape must be mounted to store the data so that it is not lost.

All SM and RSM static ODD memory must be backed up on the disk. To determine the current SM ODD size on disk backup (actual pages), use the command OP:STATUS:FREEDISK. You must know the current software configuration (base + optional pairs). To obtain the current configuration, dump a VTOC using the command DUMP:MHD=n:VTOC.

Look at the output from the command. Find all lines that start with:

```
/no5odd/imdata[n]/dev/no5sodd[n]: = xxxxx blocks.
```

The base configuration has the lowest number [n]. Additional disks are the lines with [n + 1]. Convert the blocks to MB by dividing blocks by 2,048. Do the conversion for each line. Add the MB. This results in the total MB of free space that can be used. Next figure the current capacity of the disk drives

Lucent Technologies recommends that 10 percent remain unused for growth purposes; disk growth and reconfiguration should be considered when less than 10 percent is available. Each of the base configurations contains one SM ODD backup partition. All optional disk layouts except those consisting of 100 percent AMA, also contain SM ODD backup.

8.6 COMMON NETWORK INTERFACE RING

8.6.1 DESCRIPTION

The Common Network Interface (CNI) ring hardware is implemented in a single equipment bay in the 5ESS®—2000 switch. This single CNI cabinet is referred to as a small ring configuration, in contrast to the multiple bay, large ring configurations used by the *A-I-Net*® management system. The cabinet contains a power panel, control panel, and shelving for ring nodes. The CNI ring size varies depending upon the software release installed, the feature mix, and traffic load.

The CNI ring nodes are interconnected by a high-speed, parallel data bus. This bus daisy chains from node to node, lowest position to highest position of one group, then lowest position to highest position of the next group, etc., until it returns to its starting point.

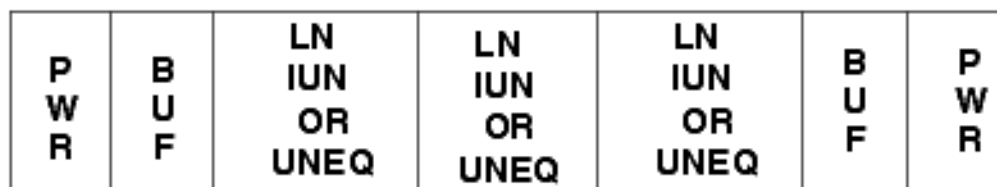
Two of the available versions of CNI node shelves are used in the CNI frame. They are codes J3F011AA and J3F011AC. These shelves are diagramed in Figures 8.6-1 and 8.6-2. In these figures, PWR indicates an equipment slot for a 495FA power converter and BUF indicates an equipment slot for a TN915 or TN918 buffer pack. Not all nodes or buffer packs in these figures need be equipped.

The J3F011AA shelf is designed to house two nodes, an ring peripheral controller node (RPCN) or direct link node (DLN) in the left, double width node position, and a link node (LN) or ISM user node (IUN). For this reason, the J3F011AA shelf must be used where an RPCN or DLN is to be installed.



DATA FLOW →

Figure 8.6-1 J3F011AA Shelf



DATA FLOW

Figure 8.6-2 J3F011AC Shelf

Three LN or IUN nodes can be equipped in a J3F011AC shelf. This shelf is for use in shelf positions 2 and 5 only. Figure 8.6-2 illustrates the J3F011AC shelf. Figures 8.6-1 and 8.6-2 indicate the direction for data flow in these shelves. The data flow is the direction of high-speed, parallel data bus interconnecting the nodes.

Four types of ring nodes are supported beginning with software release 5E4:

- RPCN

- DLN
- LN
- IUN.

All nodes contain ring interface and node processor circuitry. The RPCNs and DLNs provide communication between the ring and the administrative module (AM). The LNs provide communications between the ring and the CCS network. The LN data speed is 56 Kbps. Signaling links can be encrypted or not.

NOTE: Support of the 4.8 Kbps links is discontinued.

An IUN is an active node on a ring, but it can do no signaling or processing. One use of an IUN in the switch application is to electrically hold a place for a future LN. This avoids ring cabling at the time of growth. In some cases, it is required to control an adjacent interframe buffer. However, the node is generally a temporary filler while a node is being grown or degrown.

8.6.2 ENGINEERING CONSIDERATIONS

8.6.2.1 CNI Frame Layout Rules

The following are the basic rules for equipping a Small Scale Integrated (SSI) CNI ring in a 5ESS[®]—2000 switch:

- (1) Only one CNI cabinet is used.
- (2) Only two service groups are in a cabinet, and they are designated groups 00 and 32. Hardware duplication for reliability is maintained across these service groups, therefore both groups must have the same equipage.
- (3) The number of shelves in a group is limited to three.
- (4) Only J3F011AA and J3F011AC shelves may be used. The arrangement of these shelves is shown in Figure 8.6-3. Shelves 0 and 3 are required for the RPCN nodes. Shelves 1 and 2 in group 00 and shelves 4 and 5 in group 32 are optional, depending on node equipage.
- (5) Legal node types in software releases 5E4, and later, are RPCN, LN, IUN, and DLN.
- (6) Only one RPCN can be equipped per service group, and it must be in position 0 of each service group.
- (7) The LN and IUN nodes can be only in positions 1, 3, 4, 5, or 6 of both groups.
- (8) The IUN nodes can be in position 3 only.
- (9) A DLN is optional in 5E4 and later software releases. The DLN has a capacity of 30,000 SS7 trunks.
- (10) TN918 intraframe buffer cards must be used between Link Node 1 and the DLN in each service group. If either node is not equipped, then no TN918 is needed.
- (11) Four TN915/TN1803 interframe buffer cards must be used. They provide both cable-driving circuitry and data buffering between groups.
- (12) The TN915/TN1803 buffer cards must be positioned in each RPCN and the highest equipped node position of each group.
- (13) A node next to a buffer card must be equipped. This can be done by an IUN if the node is not needed for signaling.

- (14) Data flow must be observed in ring wiring.
- (15) DLNs must be added before the total link throughput exceeds the AM processing capacity.
- (16) DLNs, if equipped, must be in node position 2 of each service group.
- (17) A DLN30 is required if the occupancy of the DLN is 80% or greater and/or the maximum number of SS7 trunks assigned to the SSI DLN exceeds 30,000.

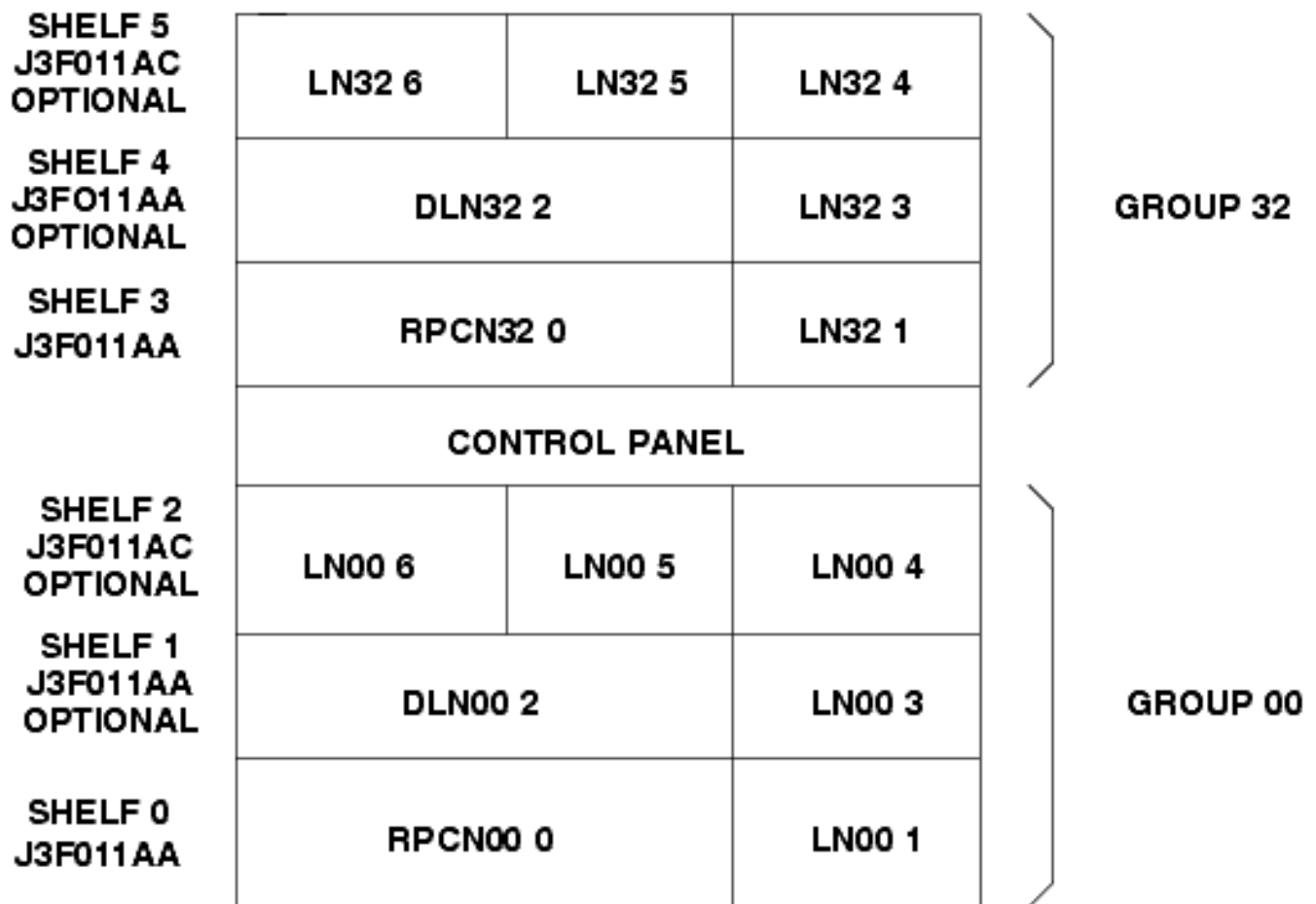


Figure 8.6-3 Shelf Positions Within the Cabinet

8.6.2.2 Recommended Start-Up Configuration

The acceptable configurations for the CNI cabinet are designed to:

- Permit graceful growth of DLN nodes (one pair) and LN nodes
- Minimize costs
- Limit the variations allowing optimum field support.

Figure 8.6-4 illustrates a CNI ring with one link pair. This is the minimum configuration. No spare nodes are provided. This configuration is used when one pair of links is engineered for an office. Growth of a second link pair

or DLN pair requires the addition of shelves to the frame.

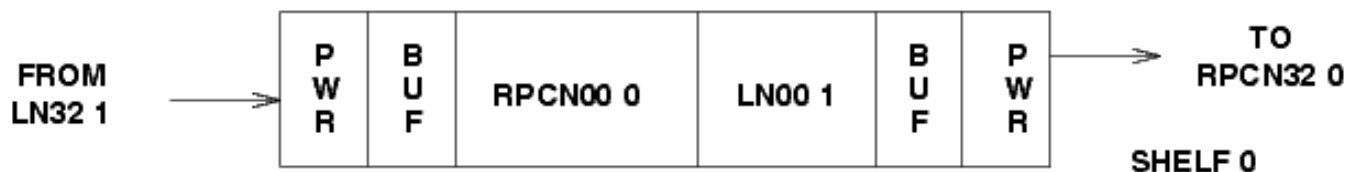


Figure 8.6-4 Ring with One Link Pair

(ONE SERVICE GROUP)

Figure 8.6-5 illustrates a CNI ring with two link pairs but no DLNs. This configuration requires one more shelf per group than the minimum ring configuration. Note that no buffer packs are needed between LN00 1 and LN00 3 because of the short cable length. The J3F011AA shelf is used for the extra link. This shelf also provides the space for future DLN growth.

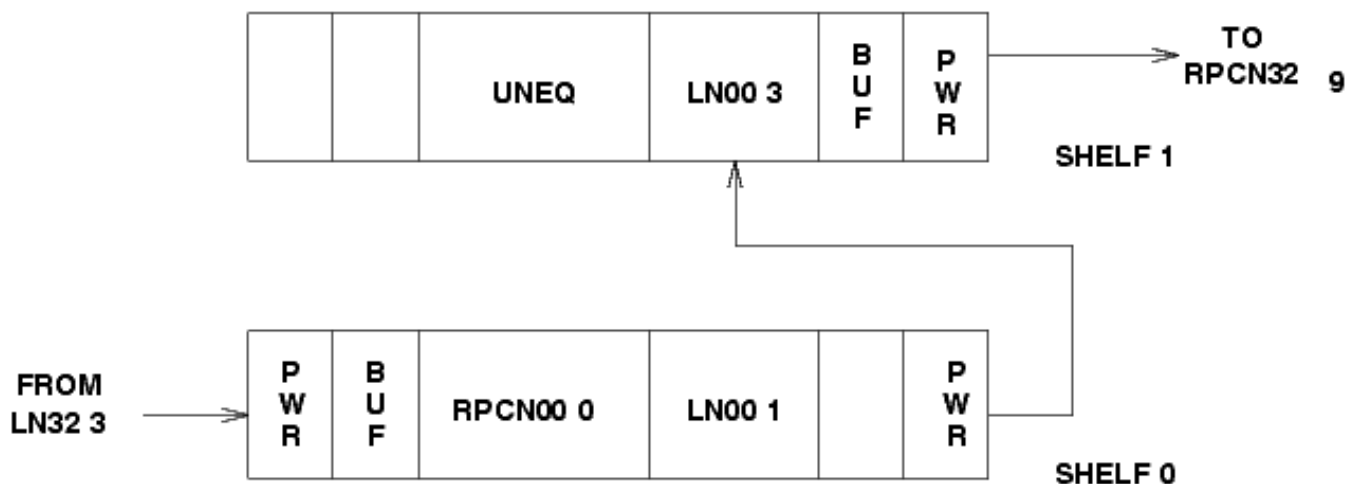


Figure 8.6-5 Ring with Two Link Pair Without DLN

(ONE SERVICE GROUP)

Figure 8.6-6 illustrates a CNI ring with two link pairs and DLN hardware. In this configuration a high-speed parallel data bus length between nodes 1 and 2 requires the use of TN918 intraframe buffer circuit cards.

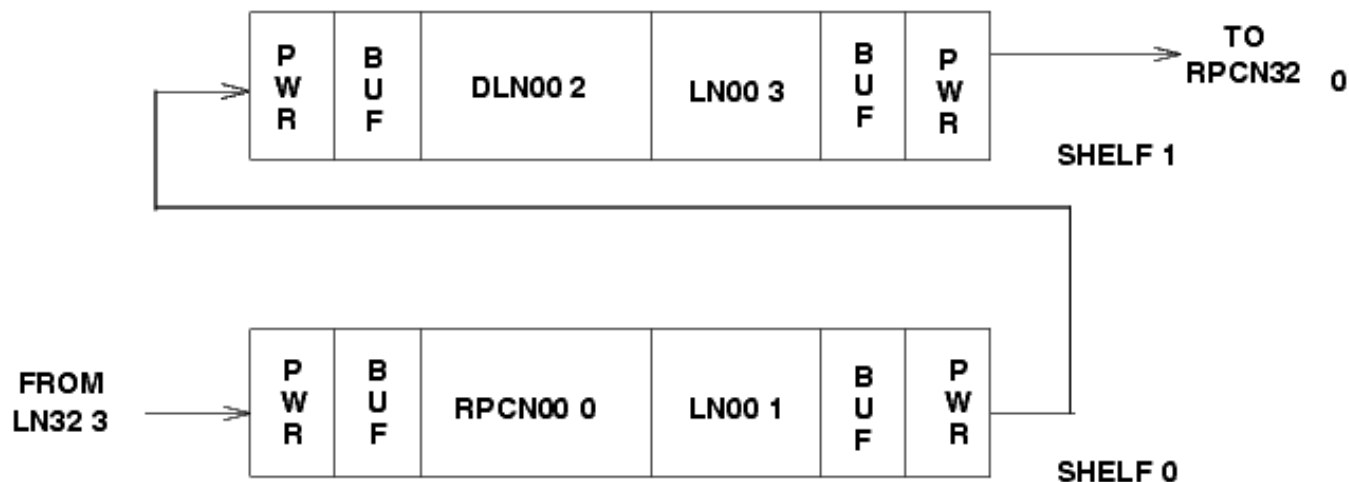


Figure 8.6-6 Ring With Two Link Pair and DLN

(ONE SERVICE GROUP)

Figure 8.6-7 illustrates a CNI ring with more than two link pair and a DLN. This is the maximum configuration and requires that all shelves be equipped. The J3F011AA and J3F011AC shelves are used. Link nodes 4, 5, and 6 need not be equipped. Note that the node equipage order for growth must be 6, 5, and 4, respectively, because the interframe buffer at the left end of the shelf needs an adjacent equipped node. With any of these cases, buffer packs are not needed between node 3 and shelf 2.

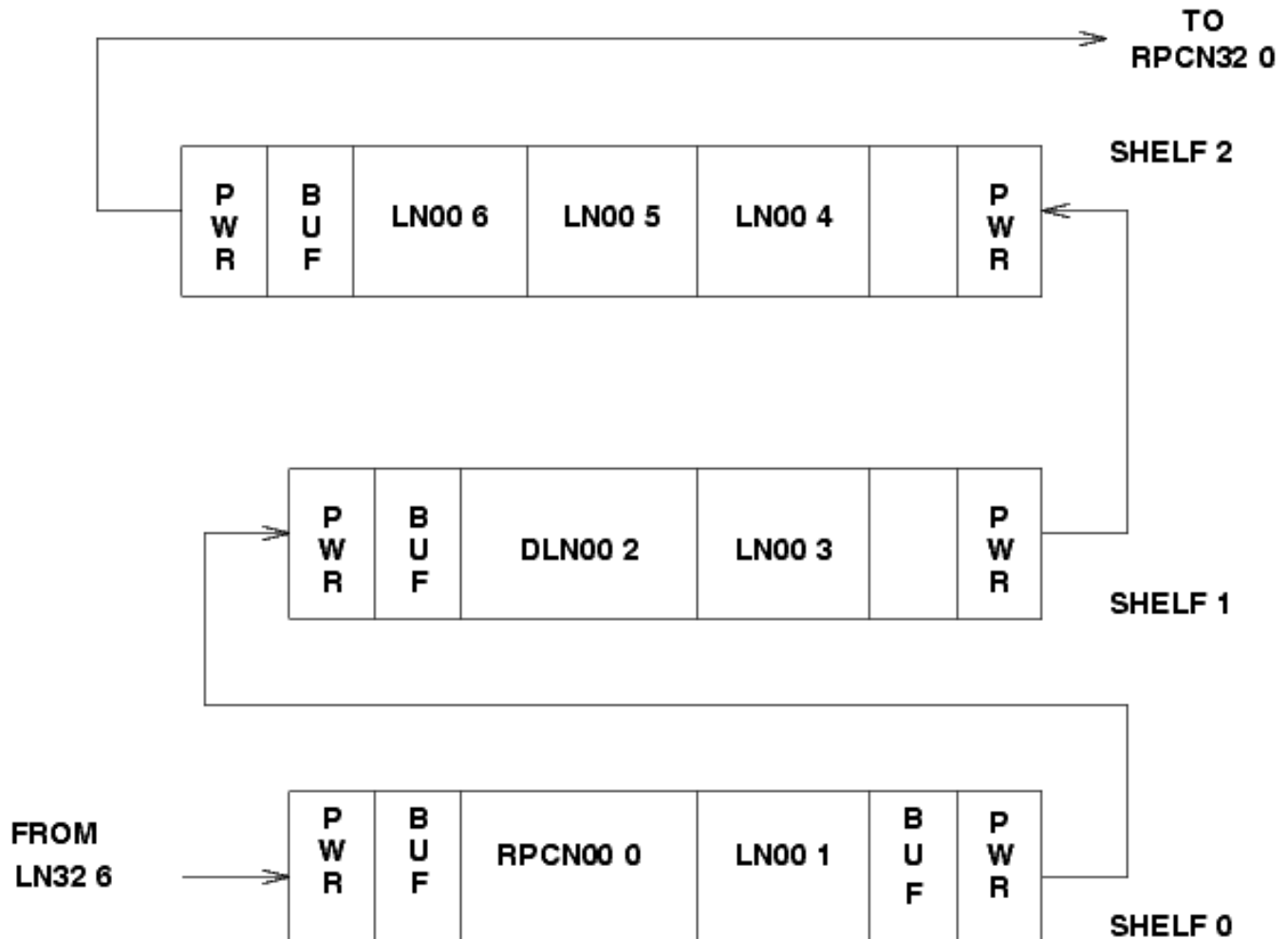


Figure 8.6-7 Fully Equipped Ring

(ONE SERVICE GROUP)

Figure 8.6-8 is a special case illustrating a CNI ring with one link pair and a DLN pair. This can be implemented in either of two ways:

- (1) If link growth is anticipated, the ring should be configured as shown in Figure 8.6-6. Node position 1 is equipped with the 56 Kbps link nodes. Node position 3 must be equipped with an IUN because of the adjacent interframe buffer card. The IUN can be converted to a signaling link at the time of growth.
- (2) If no link growth is anticipated, Figure 8.6-8 is a more economical choice. Node position 1 is unequipped, but node position 3 is equipped with a 56 Kbps link node. This configuration saves the cost of the IUN and intraframe buffer packs, but makes later link growth more complicated. Subsequent growth in node position 1 requires cabling and intraframe buffer packs.

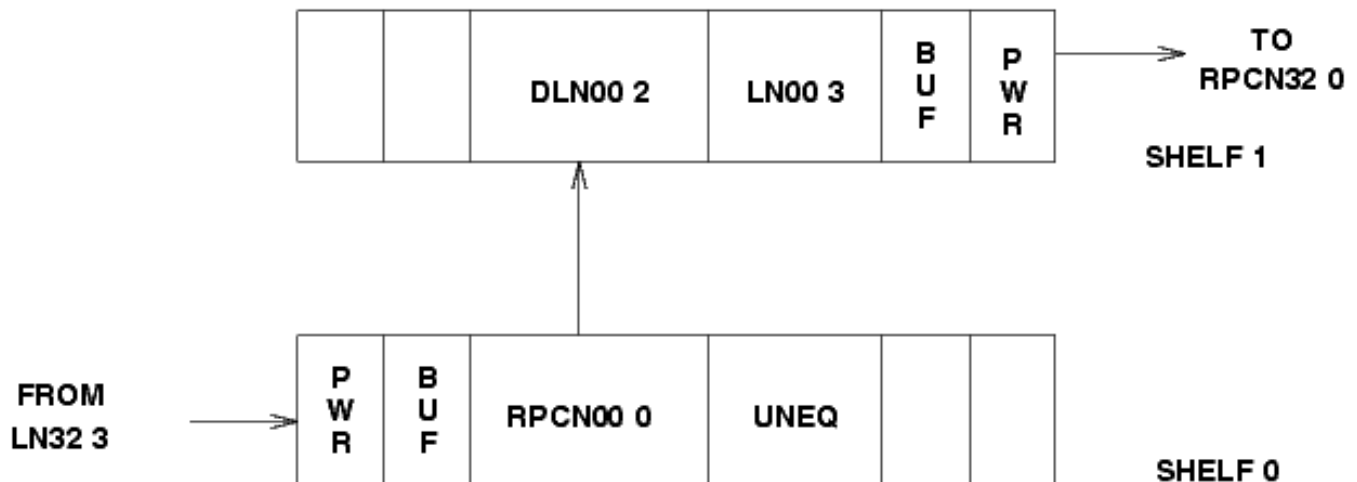


Figure 8.6-8 Ring with One Link Pair and DLN
(ONE SERVICE GROUP)

8.6.2.3 Sizing the Ring for Traffic Office Load

Choosing the correct number of link nodes to be equipped on a CNI ring depends on the office traffic load. The office traffic load will consist of call connections as well as connectionless feature traffic.

A 56 Kbps signaling link pair should be engineered so that each link in the pair is normally loaded to 40 percent capacity. These practices ensure that a single link can carry all normal traffic and have reserve capacity for peaking should the mate link fail. Use of IRN2 nodes, increases the link pair capacity to 19 pair. Table 8.6-1 shows the maximum engineered capacities for different link equipages.

Table 8.6-1 Maximum Engineered Link Pair Capacity

LINK PAIR EQUIPPED	CAPACITY MB/hr.
1	20.16
2	40.32
3	60.48
4	80.64
5	100.80
6	120.96
7	141.12
8	161.28
9	181.44
10	201.60
11	221.76
12	241.92
13	262.08
14	282.24
15	302.40
16	322.56
17	342.72
18	362.88
19	383.04

Many methods exist for converting call or feature traffic to actual number of bytes transferred over the SS7 links. The SS7 LINK ENGINEERING AND PLANNING SYSTEM (7LEAPS) is a software tool available to perform this function. It may be ordered through Customer Information Center as 256-071-105 .

Link provisioning should be done using projected end-of-period peak hour loads. Provisioning in this way assumes that the call traffic or feature traffic has a steady arrival rate throughout the hour. If the service provider engineer is aware of sudden bursts (load spikes) of heavy signaling traffic, link provisioning should be adjusted accordingly.

8.6.2.4 Monitoring Link Traffic Load

8.6.2.4.1 Overview of Monitoring Link Traffic Load

Once the ring is sized, the capacity of the links and the link nodes must be monitored. This can be accomplished by calculating the link node capacity. The following equation provides a means of achieving this:

$$LN\_CAP = \frac{\frac{\text{percent real time}}{100} \times 1,000}{\sum(T_i \times M_i)}$$

Figure 8.6-9 Link Node Capacity Worksheet

This equation determines the maximum number of messages per second that can be handled by a small scale integration (SSI) link node. The following steps solve the equation. Figure 8.6-9 is the worksheet for recording the result of the following steps.

- (1) **Calculating Real Time** - The value to use in the equation for *percent real time* is 78. The percentage of link node real time is always 78 for link node type of SSI used in the CNI ring of an SSP (SS7 office).

This makes the numerator of the equation equal to 780 ms. This is derived from $(78 \div 100) \times 1000$ (converting to ms).

- (2) **Determining the Message Type(s) and Traffic Mix(es)** - The message type(s) is denoted by the letter "i" in the equation. It is possible to have one or more message types arriving in the SSI link node. This means that there can be more than one "i" in the equation. Contact your traffic engineer or planning/marketing staff member to identify the message type information for your office. The following data are required:

- The types of messages that may arrive at the link node for routing and screening
- Whether the message type has screening flag ON or OFF
- Whether the message is linkbound, ringbound or bidirectional
- The fraction of the traffic mix each message is to provide
- The average message size.

This information can be entered on the *Link Node Capacity Worksheet* in Figure 8.6-9. The traffic or planning engineer can fill in columns A, B, C, and D. Potential types of messages and directions are shown on the worksheet in Table 8.6-2 *Processing Times Per Message in the SSI Link Node*. For every message type, "i", there is a percentage of the traffic, "M", that it will provide.

NOTE: The sum of all "M"s must equal 1.

- (3) **Determine the Processing Time(s)** - From Table 8.6-2, find the processing time for each type of message and its direction. The time value for each message equates to a "T" in the equation. Place this information on the worksheet in column E.

A MESSAGE TYPE	B SCREENING FLAG	C LINKBOUND RINGBOUND BI-DIRECTIONAL	D TRAFFIC MIX PERCENTAGE (MIX VALUES - Mi)	E PROCESSING TIME (ms)	F D × E (ms)
see Table [ptime] column B	see Table [ptime] column C			see Table [ptime] cols. D, E, or F	
TOTALS	XXXXXXX	XXXXXXX	TOTAL Mi = 1.00	XXXXXXX	

Figure 8.6-10 Link Node Capacity Worksheet

Table 8.6-2 Processing Time Per Message in the SSI Link Node

A NO.	B MESSAGE TYPE	C SCREENING FLAG	D LINKBOUND PROCESSING PER MESSAGE (ms)	E RINGBOUND PROCESSING PER MESSAGE (ms)	F BI-DIRECTIONAL LINK NODE PROCESSING (ms)
1	SCCP PC	OFF	1.07	2.06	3.13
2	ROUTED SCCP PC	ON	1.06	4.21	5.27
3	ROUTED MTP ISUP	OFF	1.01	2.20	3.21
4	MTP ISUP	ON	1.01	3.80	4.81

- (4) **Solving the Equation for Link Node Capacity** - At this point, the numerator of the equation equals 780 and the denominator,

$$\text{SUM } (T_i \times M_i)$$

can be rewritten as:

$$\text{SUM } (T_{\text{message type } i} \times M_{\text{message type } i})$$

which means:

(Processing time of message type 1 × Traffic mix of message type 1) +

(Processing time of message type 2 × Traffic mix of message type 2) +

(Processing time of message type 3 × Traffic
mix of message type 4) + ... +

(Processing time of message type n × Traffic
mix of message type n).

Based on the worksheet, every message type traffic mix in column D should be multiplied by the processing time in column E and the results should be entered in column F.

Total columns D and F. Column D must total 100 percent or 1.00. Column F total is the denominator of the equation. Divide the numerator by the denominator to determine the number of messages that the link node can handle per second or the link node throughput.

- (5) **Analyzing the Result** - Using the *CCS7 Link Throughput* graph (Figure 8.6-11) plot the average message size obtained from engineering on the horizontal axis and the link node throughput (number of messages the link node can handle per second from the previous step) on the vertical axis, and find the intersection of the two. This intersection is the estimated capacity of the link within 5 capacity curves, under linkset failure conditions.

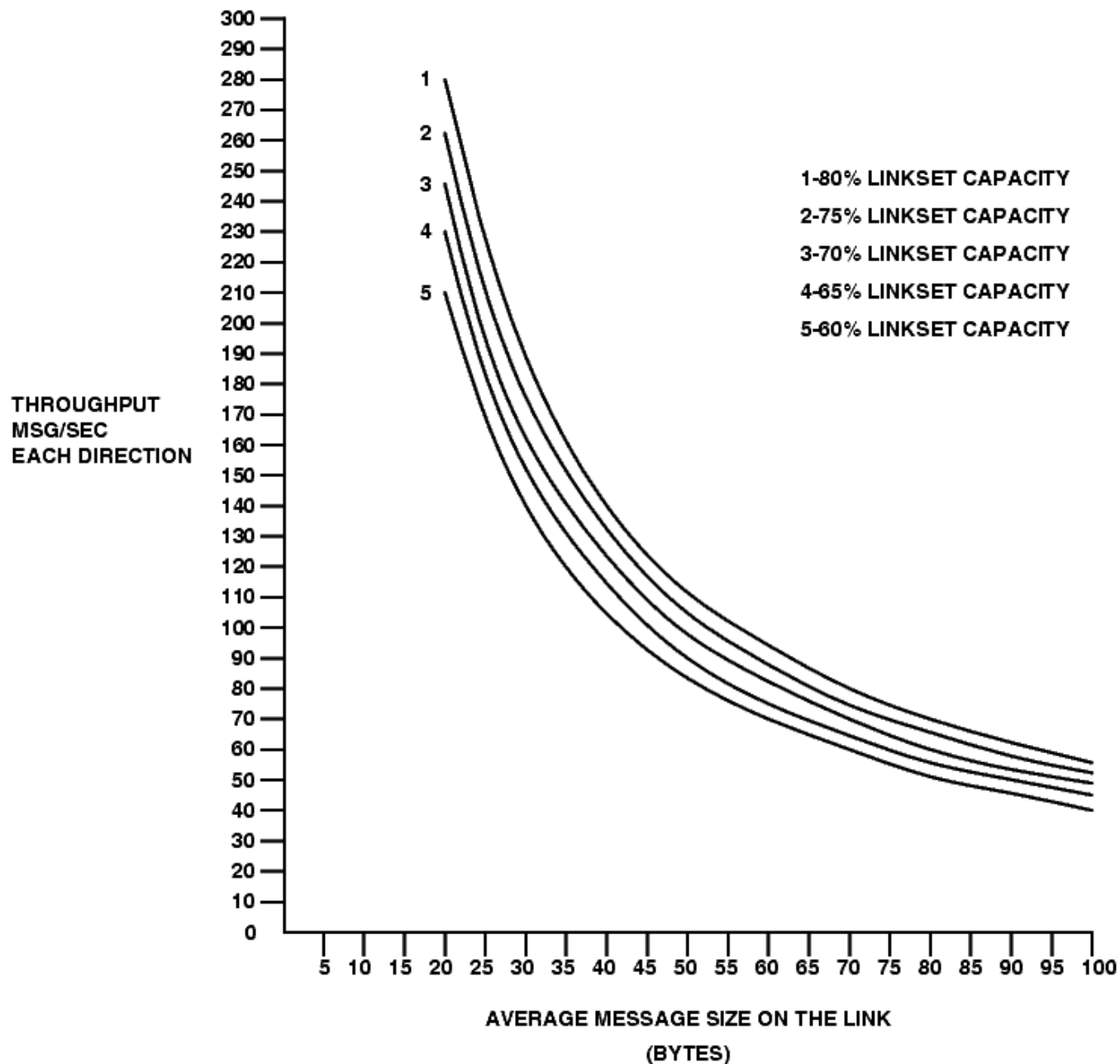


Figure 8.6-11 CCS7 Link Throughput

8.6.2.4.2 Example of Monitoring Link Traffic Load

As an example, a SSI link node expected to process a bidirectional traffic mix consisting of 20 percent MTP ISUP messages and 80 percent SCCP GTT messages, with all messages requiring screening (screening is ON), is estimated by the following:

NOTE: Figure 8.6-12 is the worksheet for this example.

- (1) **Calculating Real Time** - Because this is an SSI link node, the numerator equals 780. At this point, the equation looks like:

$$LN\_CAP = \frac{\frac{78}{100} \times 1,000}{SUM(T_i \times M_i)} = \frac{780}{SUM(T_i \times M_i)}$$

Figure 8.6-12 Example of Using the Link Node Capacity Worksheet

- (2) **Determining the ``i's (Message Types) and ``M's (Traffic Mixes)** - The traffic engineer or planning/marketing person should provide the following:
- There are two ``i's or message types in this equation: Message type 1 is bidirectional MTP ISUP with screening flag ON
Message type 1 is bidirectional SCCP GTT with screening flag ON
 - There are two ``M's or traffic mix percentages in this equation: For message type 1, the MTP ISUP message, the ``M" is .20
For message type 2, the SCCP GTT message, the ``M" is .80
- NOTE:** The addition of the ``M's in this equation equals 1.00.
- (3) **Determining the ``T's or Processing Times** - There are two ``T's or processing times in this equation. One is for each message type. To determine the value for these ``T's, consult Table 8.6-2. The processing time for message type 1, a bi-directions MTP ISUP, is 4.81. The processing time for message type 2, a bidirectional SCCP GTT, is 5.02.

A MESSAGE TYPE	B SCREENING FLAG	C LINKBOUND RINGBOUND BI-DIRECTIONAL	D TRAFFIC MLX PERCENTAGE (MLX VALUES - Mi)	E PROCESSING TIME (ms)	F D × E (ms)
see Table [prtime] column B	see Table [prtime] column C			see Table [prtime] cols. C, D, or E	
<i>MTP ISUP</i>	<i>ON</i>	<i>BI-DIRECTIONAL</i>	<i>.20</i>	<i>4.81</i>	<i>0.96</i>
<i>SCCP GTT</i>	<i>ON</i>	<i>BI-DIRECTIONAL</i>	<i>.80</i>	<i>5.02</i>	<i>4.01</i>
<i>TOTALS</i>	<i>XXXXXXXX</i>	<i>XXXXXXXX</i>	<i>TOTAL Mi = 1.00</i>	<i>XXXXXXXX</i>	<i>4.97</i>

Figure 8.6-13 Example of Using the Link Node Capacity Worksheet

- (4) **Complete the Denominator of the Equation** -

- For the message type 1, MTP ISUP, multiply column D by column E. In this instance: $.20 \times 4.81$. The result of this, .96, is entered in column F. This represents the processing time required for MTP ISUP message.
- For the message type 2, SCCP GTT, multiply column D by column E. Similarly, in this instance: $.80 \times 5.02$. The result, 4.01, is entered in column F. This represents the processing time required for SCCP GTT message.
- Add the processing times of the MTP ISUP and SCCP GTT messages. This is $.96 + 4.01$ or a total of 4.97. Enter this at the bottom of column F. The equation looks like:

$$LN\_CAP = \frac{780}{.96 + 4.01} = \frac{780}{4.97}$$

- (5) **Solving the Equation for Link Node Capacity** - The numerator divided by the denominator gives a result of 156.94

$$LN\_CAP = 156.94$$

With this combination of messages the link node can handle 156.94 messages per second or link node throughput.

- (6) **Analyzing the Result** - Using the *CCS7 Link Throughput* graph, plot the average message size obtained from engineering on the horizontal axis and the link node throughput, obtained from the above calculation, on the vertical axis. Find the intersection of these two. This intersection represents the estimated capacity of the link within the five capacity curves, under linkset failure conditions.
- If the average message size is greater than 30 bytes, the linkset is operating above capacity.
 - If the average message size is less than 30 bytes, the linkset is operating below capacity.

8.6.3 OVERLOAD CONTROL FOR CCS CALLS

In network traffic management (NTM), the functions are to monitor the traffic in the network in real time and to activate controls to correct network traffic flow problems. The objective is to complete as many calls as possible and to keep the network operating near maximum efficiency. Network traffic overload in a properly engineered network is caused by unusual customer demands or network equipment malfunction.

Real time NTM measurements, used by the network traffic manager, includes status and event discrete indicators and 5-minute NTM measurements. These measurements are collected from the switching systems by a NTM Operations System. However, another method of monitoring the level of congestion is to study the switch congestion failures (SWCONG), unsuccessful attempts (TOTAL UNSUCC ATTEMPTS), no circuit available (No Circuit Available) counts in TRFC30 Section 120.

8.6.4 OVERLOAD CONTROL FOR DLN

The call capacity of the 5ESS[®]—2000 switch has increased over time because of three main enhancements;

- (1) Addition of the communication module processor (CMP)
- (2) Deployment of common channel signaling (CCS) in the local exchange carrier (LEC) networks for the

support of the Custom Local Area Signaling Service (CLASS).

- (3) Introduction of CCS network interchange which changed the signaling from multifrequency to CCS in the IEC-LEC network.

The DLN Overload Control capability is introduced to better handle the sustained CCS overloads occurring in the LEC and IEC networks.

8.6.4.1 Description

The DLN overload control capability enables the 5ESS[®]—2000 switch to better handle sustained CCS overloads occurring in the LEC and IEC networks. Two principal areas of concern for the overload control involve the resource overload controls (congestion controls) and real-time overload controls. The DLN overload control capability:

- Adds a 3-level overload control for the DLN
- Keeps the current 3-level incoming congestion controls
- Adds 2-level outgoing congestion controls
- Adds call failure handling for PIC and SMP overloads
- Adds new counts to the TRFC30 report
- Connects DLN overloads to the central 5ESS[®]—2000 switch overload control.

The overload control mechanism checks for DLN overload every six seconds. When a real-time overload is detected in the DLN, the overload mechanism initiates controls to automatically return the system to a normal state and issues an overload report at the ROP or MCC. A real-time minor overload occurs because of message delays in the DLN. At this time, the automatic congestion control level 1 requests the sending switch to reduce the number of CCS call originations by implementing CCS avoidance routing. The overload control throttles low priority messages in an attempt to reduce the buffer occupancies. If the condition worsens to a major overload, the automatic congestion control level 2 is set and another message is sent to the sending switch to reduce call traffic. In addition, 100 percent CCS avoidance routing activates in the CMP to eliminate any new CCS originations until the overload condition subsides.

8.6.4.2 E-Link Access

The E-Link connects the SS7 signaling links between Signaling End Points (SEP) and non-Home Signaling Transfer Points (STP). From an end office perspective, a non-Home STP pair is any STP pair other than the pair on which the A-Link terminates for that end office. The destination of the A-Links identifies the home STP pair. A benefit of E-Link Access appears in networks requiring all global title translation to be performed in a specified non-Home STP pair.

The E-Link Access provides:

- **Improved survivability** - Provides additional routes to destinations to further minimize SEP isolation. E-Link sets serve as alternate routes in the event of failed A-Link sets.
- **Direct message routing** - May be used to allow traffic study to be directly routed to other STP pairs or quads from SEPs to use fewer intermediate STPs. This speeds up call processing and improves network performance.

8.6.4.2.1 Feature Loading

"E" and "A" links coexist in the same Common Network Interface (CNI) frame at the end office. The destination of the link and database translations determines whether a link is designated as "A" or "E". "A-Links" and "E-Links" use the same node hardware as other Lucent signaling products. "E-Links" use the same types and quantities of node hardware as do the "A-Links".

8.6.4.2.2 Feature Assignment

"E-Links" are paired; one link to the active (non-HOME) STP and the other link to the active (non-HOME) STP's mate. Load sharing occurs between the two links of the pair (exactly as with "A-Links").

This feature allows the assignment of both an alternate route and a secondary alternate route. If the primary route should become unavailable, its signaling load is acquired by the alternate route. If the primary and alternate route both become unavailable, then signaling load is directed to the secondary alternate route. The primary, alternate, and secondary alternate routes should be assigned to different STP pair.

NOTE: One combined "E-Link" set can serve as an alternate route for another combined "E-Link" set.

The "E/A-Link feature" package does not require unique hardware, as it is a software (logical) feature. Equipage of this feature requires more link node hardware.

Lucent Technologies recommends that "E-Links" be engineered to 40% of maximum loading, the same as "A-links" so that if one link of a pair becomes unavailable, the other link can manage the load. If all links from an end office to an STP pair become unavailable alternate routing is attempted. Alternate routing is not attempted until all links in the combined link set of the PRIMARY route have become unavailable.

The number of "A-Links" should be engineered to handle the entire office signaling load, independent of any direct routing loads on the "E-Links". This is because if all "A-Links" fail, the "E-Links" carry the entire office signaling load. When designing the SS7 network architecture, only one combined "A-Link" set is supported, while 15 combined "E-Link" sets can be supported per end office.

8.6.4.2.3 Measurements/Monitoring

The Signaling Network Performance Report collects and itemizes counts for "E-Link" sets, as it does for "A-Link" sets. All office total counts include the usage on "E-Links". A measurement of alternate routing occurrences and duration is reported per link set. All reports are transmitted to their current interfaces.

The 30 Minute Marginal Performance report is also modified to support the "E/A-Link feature".

8.6.4.3 CCS7 Capacity Improvement DLN30

The CCS7 Capacity Improvement DLN30 feature increases the 5ESS®-2000 switch CCS7 call processing capacity. This feature requires a DLN-AP30 replacement for a DLN-AP and a conversion from a Small Scale Integration (SSI) based technology to Integrated Ring Node Version 2 (IRN2) for all the CNI nodes, Link Nodes (LNs) and Ring Peripheral Controller Nodes (RPCNs). It also requires new IRN2 shelves.

This feature supports the following hardware upgrades to the CNI ring:

- The DLN application processor was replaced with the HC *MOTOROLA*® 68030. This change requires that the DLN's SSI based ring interface also be replaced with the IRN2 Technology. The IRN2 Technology is necessary for the DLN to deliver the required performance. The AP-30 is only available with the IRN2 technology.
- The new AP-30 hardware grows the DLN memory from the existing 2 MB to 16 MB. This memory is not

engineerable.

- The upgrade of the SSI-RPCN to IRN2 technology.
- The upgrade of the SSI-LN to IRN2 technology
- Two new shelves are required for this feature. They are J3F011GD-1 and J3F011GC-1. The J3F011GD-1 can be equipped with an RPCN, DLN30, and three LNs. The J3F011GC-1 can be equipped with up to eight LNs.
- A total of six groups are available with IRN2. They are 00/32, 01/33 and 02/34. Each group pair must be identically equipped.

These hardware upgrades:

- Increase the SS7 message handling capacity of the CNI ring.
- Increase the number of SS7 link terminations from 5 to 19 pairs by using the IRN2 technology and a new IRN2 shelf arrangement to link pairs.
- Increase the DLN memory, which results in an increase in trunk translation data allocation in the DLN.
- Grows the maximum DLN memory from the existing 2 MB for the SSI DLN to 16 MB for the DLN30. The additional memory supports 100,000 SS7 trunks and new features.
- Increases the DLN30 internal call capacity from 280,000 call/hr to 750,000 calls/hr.

TRFC30 Section 66 is used to determine when to replace a DLN with a DLN30. Replace the DLN with a DLN30 when occupancy reaches 80 percent or more.

It is necessary to replace a DLN with a DLN30 when more than 30,000 SS7 trunks are required per office. In an office, all ring hardware must be the same type. Mixing of SSI and IRN2 technologies is not allowed, except when converting from SSI to IRN2.

8.6.5 TRANSITION IMPACT

8.6.5.1 Analog to Digital Links

All 5E2(2) offices introduced the CNI ring with one 4.8 Kbps link pair configured as shown in Figure 8.6-4 . Upgrading these offices to 56 Kbps digital links requires software release 5E3 or later, the growth of one or more 56 Kbps LN pairs, and the addition of digital facilities for signaling links. After the 56 Kbps links are operational and the traffic moved to them, the 4.8 Kbps link nodes can be degrown.

Two J3F011AA shelves, one for shelf 1 in group 00 and the other for shelf 1 in group 32, are used to grow a link pair. The 56 Kbps node can be equipped in position 3. After growth, the ring configuration is shown in Figure 8.6-5 . Two options are available to remove the 4.8K node:

- (1) It can be changed to an IUN by ECD changes and reserved for later link growth.
- (2) It can be electrically removed from the ring to reduce costs and maintenance.

If the 4.8 Kbps node is removed from the ring, the final ring configuration is as shown in Figure 8.6-14 . Any time that the ring is reconfigured in an active office, special care must be exercised. An operational node should not be taken out of service for recabling unless its mate is in service. This permits call processing to continue uninterrupted. When moving CCIS6 trunk signaling traffic from an assigned link node, there are special network

considerations that involve coordination with far-end offices.

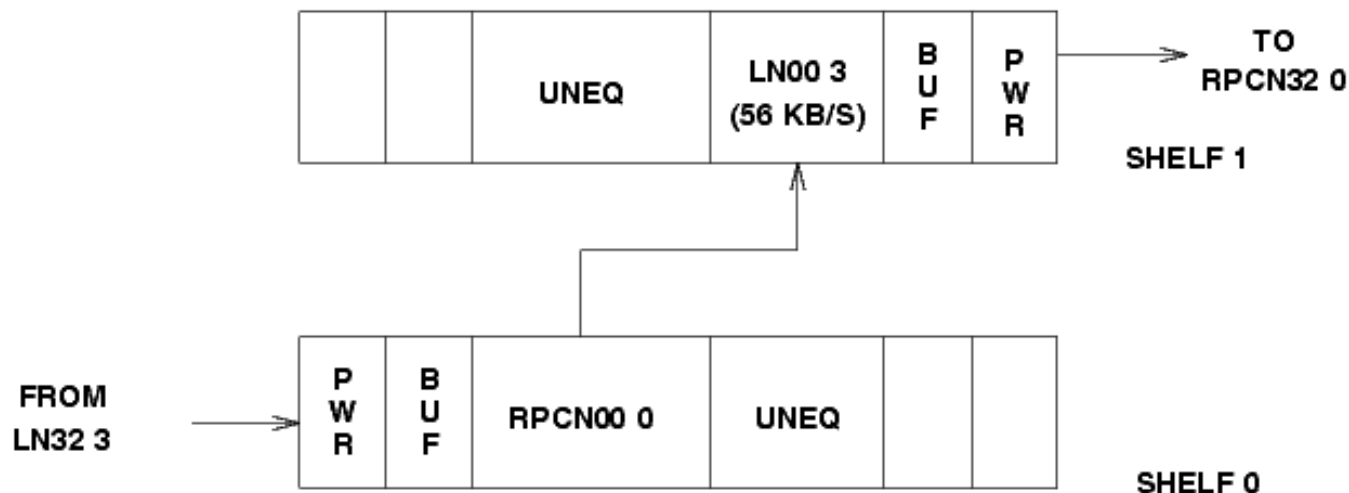


Figure 8.6-14 Ring After Analog-to-Digital Conversion

8.6.5.2 Adding DLN to Ring with One Link Pair

Because the DLN nodes are needed only for added capacity, the configuration consisting of two RPCNs, two DLNs, and two LNs is used only if the link nodes are 56 Kbps links. When adding a DLN to the minimum ring shown in Figure 8.6-4, the J3F011AA shelf is used. In this event, an IUN is also required to control the adjacent interframe buffer. This ring is shown in Figure 8.6-15.

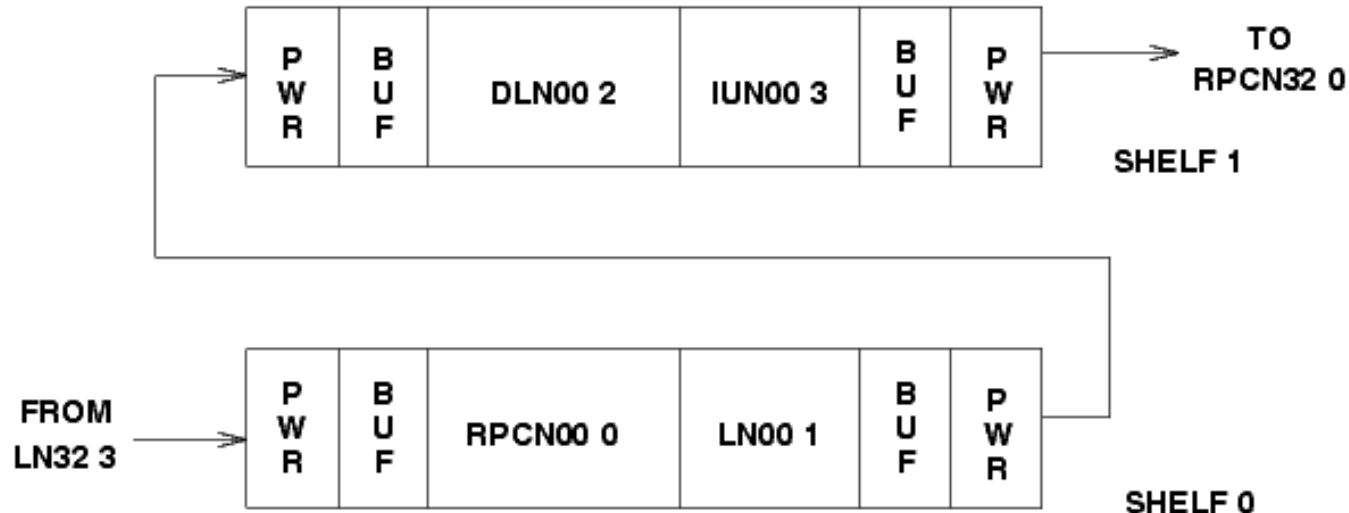


Figure 8.6-15 Ring with One Link Pair and DLN

8.6.5.3 Adding DLN to Ring with Two Link Pairs

The normal starting configuration for adding DLN nodes to a ring with two link pairs is shown in Figure 8.6-5. The DLN addition is performed by equipping node position 2. This also requires adding intraframe buffers between LN00 1 and DLN002. When DLN growth is performed, the resulting ring configuration is the same as the previously described ring illustrated in Figure 8.6-6.

8.7 LOCAL AREA SIGNALING SERVICES

8.7.1 DESCRIPTION

Local area signaling services (LASS) features are a group of central office features using existing customer lines to provide end-users with call management capabilities. The LASS features provide capabilities for both business and residence customers based on the delivery of the calling party number. The LASS features take advantage of emerging networks to offer interswitch services that would otherwise be difficult to provide.

For more information concerning available LASS features, their descriptions, and applicable traffic measurements, see 235-190-130, *Local Area Signaling Services Features*.

9. CM RESOURCE UTILIZATION

This section provides information for administering 5ESS®-2000 switch and the 5ESS®-2000 switch Compact Digital Exchange (CDX) communication module (CM). CM administration does not apply to the Very Compact Digital Exchange (VCDX) switching system. For more information, refer to 235-120-110 — *Very Compact Digital Exchange (VCDX) Reference Guide*. The assumption is that the reader has a basic knowledge of the 5ESS®-2000 switch architecture and operations. The following subsections provide resource utilization information on a physical group basis. Refer to the table of contents at the beginning of each subsection for a complete description of the information included. Each subsection provides information to administer the particular resource. The following subject areas are included:

- Module message processor (MMP)
- Message switch control unit (MSCU)
- Communication module processor (CMP).

The CM is the central hub of the switching system. All interprocessor voice, data, and system messages pass through the CM. The CM includes the time multiplex switch (TMS) and the message switch (MSGS). The CM is connected to the switching module (SMs) by way of the network control and timing (NCT) links.

The MSGS provides connections for messages between processors [SM-to-SM, SM-to-administrative module (AM), AM-to-SM, SM-to-foundation peripheral controller (FPC), etc.]. The MSGS consists of an MSCU and several MMPs. The MMP is an interface to the NCT link connecting the MSGS and the SM. The MSCU is used to route control time slot to the proper SM or the AM. The MSCU contains input/output microprocessing interface (IOMI) boards. The IOMI provides the interface between the peripheral interface controller (PIC) and peripheral controller subsystem (PC). There are:

- (1) A maximum of 4 IOMI circuit packs per MSCU2
- (2) Four IOMI communities per IOMI circuit pack
- (3) Four PCs per IOMI community
- (4) A maximum of 64 PCs per MSCU2.

The new start offices have the option of using the MSCU3 in the CM2. The CM2C requires the MSCU3. The MSCU3 has a new circuit pack, the Input-Output Processor Model 2/Message Switch Controller Model 3 (IOP2/MSC3). This pack combines the functionality of the Peripheral Interface Controller (PIC2), the Bus Interface Controller (BIC), the Duplex Dual Serial Bus Selector (DDSBS), the Pumpable Micro Control Store (PMCS), and the first IOMI pack (IOMI-A) onto one board. All 4 IOMI-A buses can terminate on IOP/MSC3. Besides the IOP/MSC3 circuit pack, a new backplane for MSCU3 is necessary. No other packs, units or cables are affected.

Two message switch peripheral units are in the CM1: the FPC providing control and diagnostic messages to the office network timing control (ONTC) units, and the pump peripheral controller (PPC) which enables the AM to fast pump the SMs during initialization. CM1 also has the message interface clock unit (MICU). The MICU converts the MSGS to the TMS.

Each MMP has ports for up to eight message links to SMs. In the CM1 version, each SM is connected through message links to four different MMPs, two on each MSGS side. Thus, each MSGS side requires a minimum of two MMPs for every eight SMs, or fractions thereof. If required, expansion to 12 MMPs per MSGS side is possible. Two MMPs per MSGS are possible for the CM2C.

The structures of the processors in the MSGS allow the processor occupancies to be inferred from the frequencies

at which the base level cycles (BLCs) are executed. (The occupancy of a 1 ESSTM switch processor is inferred similarly, from the frequency which E-E cycles are executed.) The numbers of executed BLCs as well as the number of messages handled, are counted for each MMP in the CM.

The loads on the MSGS components are expressed in terms of messages handled per unit of time. The occupancies and BLC frequencies of MSGS components are approximately linearly related to the load. As the load increases, the occupancy increases and the BLC frequency decreases. A regression of the observed message loads against the corresponding observed numbers of BLCs allow an estimate to be computed for the message load that theoretically results in 100 percent occupancy. The capacity estimate is then determined as a specified fraction of this 100 percent occupancy load. These capacity estimates are then provided on the central office equipment report (COER) reports and may be used to judge the adequacy of the MSGS components at current and projected loads.

The 5ESS[®]-2000 switch capacity is not limited by the MSGS, which has a capacity that greatly exceeds 300,000 calls per hour (5,500,000 messages). The MMP capacity is approximately 1,200,000 messages per hour, far above the expected peak load.

The CM2 is composed of a TMS2 and a MSGS2 providing a greater call capacity for the switch and permitting a more compact physical design.

The time multiplexed switch - model 2 (TMSU2) is a dual 256 by 256 switch (compared to a 32 by 32 switch in TMS1). An option allows the TMS2 to be equipped as a single-fabric 256 by 256 switch. The number of host and local SMs (requiring a control time slot) which can be supported is 94 for the single-fabric configuration and 190 for the dual-fabric configuration. If at least two RSMs are included, 96 and 192 modules, respectively, can be supported. The CM2C supports only two local or host SMs and six RSMs.

The TMS2 is used to switch like numbered NCTs between SMs to allow for inter-SM calls. Except for the CM2C, the TMS2 can support single and dual fabric switching:

- A single fabric CM2 can consist of from two to six cabinets on both sides combined and can support a maximum of 96 SMs. Not more than two of the SMs can be RSMs (except for the CM2C, as noted previously).
- A dual fabric CM2 can consist of from 2 to 12 cabinets on both sides combined and can support a maximum of 192 SMs. Not more than two of the SMs can be RSMs. The CM2C does not support dual switching fabric.

NOTE: The type of fabric is determined when the office is originally engineered. However, conversion from single fabric to dual fabric is also supported.

The message switch peripheral unit - model 3 (MSPU3) is an enhancement of the MSPU1 and MSPU2 designs. It includes the MMPs. In CM1 each MMP contains four boards: processor pack, control pack, and two high-level data link controllers (HDLC). The enhancement not only reduced the software required for message handling but also reduced the required real time per message.

The Time Multiplexed Switch Unit 3 (TMSU3), from 5E6 and later, supports the CM fabric reduction. This reduction replaces two fabric controller packs and up to three fabric packs with one fabric circuit pack. Configuration requirements for TMSU3s and TMSU2s in a CM2 cabinet are as follows:

- TMSU3 is used for all new office ships and for all existing office growth.
- The TMSU3 can be used for both single and dual fabric applications.
- TMSU Shelves 0 and 1 in both base bays (Bays 5 and 6) must be the same vintage. Either TMSU2 or TMSU3 will work as long as both shelves in both bays are identical. This rule applies to both single as well as dual fabric applications. After satisfying this requirement, growth can be completed with either TMSU2 or TMSU3 in any combination.

In addition to other enhancements, the message switch control unit - model 2 (MSCU2) can support up to 24 parent-frame MMPs and 24 growth-frame MMPs. The 48 MMPs can support up to 192 SMs.

COMPACT COMMUNICATION MODULE 2

The CM2C is a reduced cost CM2 introduced with the 5ESS[®]-2000 Switch Compact Digital Exchange (CDX) . The CM2C interfaces a maximum of two Local or Host SMs and up to six RSMs. One of the SMs may be an SM-2000]. A maximum of two MMPs per side and three Network Clock external references are supported. The time multiplex switch (TMS) supports up to four NCT links (TMSLNKs) in a single fabric environment. The CM2C is packaged on one shelf per side and is powered by a single power converter. The CMPs occupy a separate shelf.

9.1 MODULE MESSAGE PROCESSOR

9.1.1 DESCRIPTION

9.1.1.1 General

The module message processors (MMPs) provided in communications module model 2 (CM2) function in a manner similar to those provided in CM1.

Each MMP consists of a 2-circuit pack design (different from the ones used in CM1) equipped in the message switch peripheral unit 3 (MSPU3). The MMPs provide communication links between the switching modules (SMs) and administration module (AM). The MMPs control the sending and receiving of messages and also administer the link-level protocol for messages sent to and from the SM processors. Each MMP supports up to eight fixed time slot channels for messages from up to eight SMs; therefore, to determine the number of MMPs, divide the number of SMs in the office by 8 and round up. The CM2 can be equipped with up to 48 MMPs in 8 MSPU3s to support communications between the AM and up to 192 SMs.

With the CM2 offices, single MMPs are equipped per side. The single MMP provides two communication link terminations per SM [one per message switch (MSG) side]. The MSPU can be equipped with optional dual MMPs. The dual MMP provides four communication link terminations per SM as in CM1.

9.1.1.2 Optional Dual Message Module Processor

The dual MMPs consist of the two existing MMPs: one each in MSG0 and MSG1, plus two additional MMPs, one each in MSG0 and MSG1. Each of the additional MMPs are of the type to be grown on two new separate communities of MMPs, one on each MSCU side. The additional MMPs are equipped on the right half of the existing MMP shelf. Besides the two additional communities and the additional two MMPs, a new control and display (C&D) pack, a new power pack, and additional cabling are needed to grow dual MMPs.

If one SM in a single MMP configuration is grown to dual MMP, it is recommended that the rest of the SMs on the same single MMPs be grown to dual also.

9.1.1.2.1 Single to Dual MMP Growth

Dual MMPs are of the same type as the existing MMPs and the same growth procedures are used in growing dual MMPs as used for single MMPs. The existing recent change views are used for this growth.

The optional dual message module processor (DMMP) feature provides reliability of full message transfer capacity over both active communication links in CM2 equipped offices. The DMMP is not a new hardware unit. Rather, this optional feature allows equipage of more hardware to provide greater reliability.

When CM2 was introduced, MMPs were configured as either "alpha" or "beta." Alpha MMPs processed only alpha control time-slots and beta MMPs processed only beta control time-slots. Alpha control time-slots are even numbered below the 96th SM and odd numbered above the 96th SM. Beta control time-slots are odd numbered below the 96th SM and even numbered above the 96th SM. For the standard CM2 configuration 2 MMPs work as an alpha/beta pair. For example, of the alpha/beta MMP pair for SM 1 through SM 8, the alpha MMP processes even numbered control time-slots for SM 1 through SM 8, while the beta MMP processes the odd numbered control time-slots for SM 1 through SM 8.

In a CM2 office, if maintenance actions remove an MMP from service, some messaging capacity is lost. During such events, the remaining MMP of the alpha/beta associated pair is required to handle the full messaging load. For normal plain old telephone service (POTS) SMs, if one half of the alpha/beta pair is removed from service, message traffic usually is not great enough to cause service impact (delays). However, integrated services digital network (ISDN) SMs and other SMs that generate high messaging rates may become a concern during simplex operation.

With the introduction of message intensive features such as ISDN services, local area signaling service (LASS), Advance Services Platform/private virtual network (ASP/PVN), etc. along with the higher call capacity, the message load and the control time slot (CTS) links and the MMP become greater. As a result, the importance of having both an alpha and beta MMP in-service in a CM2 equipped office may be more critical. Therefore, dual MMPs are an optional feature to provide the capability of CTS link sharing which balances the message load between the CTS links of an SM.

The DMMP is an optional feature to prevent an MMP hardware failure from causing messaging delays (service impact) from high message traffic SMs in a CM2 office. In other words, a DMMP configuration associates 2 alpha and 2 beta MMPs. This mode of operation provides a standby MMP for both the active alpha and beta MMP. Therefore, with dual MMPs, a single MMP fault does not impact call processing because there is still two CTS links per SM to load balance the message traffic.

9.1.1.3 Communications Module Processor

The communications module processor (CMP) is a nonengineerable processor. All 5E6 and later offices are equipped with duplicated CMPs requiring 20 MB of memory. The TN1368 core board consists of two 68030 microprocessors and 4 MB of memory. Another memory board (TN1369) provides an additional 16 MB of memory. Approximately 18 MB is required to support text and ODD in 5E8. Of this, 8 MB is a fixed allocation for the ODD.

9.1.2 CAPACITY CONSIDERATIONS

9.1.2.1 CTS MESSAGE OVERLOAD

In normal switch operation, each SM uses two CTSs, with each CTS having a bandwidth of 48 Kbps. This bandwidth is sufficient for most conditions. Some situations exist, however, for which the message load is too large for the CTSs to carry. For these cases, administrators must take steps to reduce the message load on affected SMs. Two ways exist to discover if an SM's CTSs are at or near overload.

- When the SM has too many message to transmit over the CTS the following message prints on the ROP:

```
OP OVERLD SM = xx (Where xx is the SM number)
REAL TIME NONE
RESOURCE MSGS
CONTROLS NONE
```

- TRFC 30 Section 125 (CTS) shows CTS occupancies for SMs selected by an "ALW" input message at the MCC. This section reports the average occupancy and the maximum occupancy in a 6 second period for each CTS, both transmit and receive, over the previous 30 minute reporting period.

Link occupancies as reported on the TRFC30 Section 125 should not normally exceed the following values:

- Receive (RCV)]-average occupancy of 55 percent with a 6-second peak of 75 percent.
- Transmit (XMT)]-average occupancy of 45 percent with a 6-second occupancy of 65 percent.

Occasionally exceeding these values is acceptable but if the values are frequently exceeded or if the "OP OVRLD RESOURCE MSGS" occurs, steps should be taken to reduce the message flow to and from the SM having high link occupancy.

If the SM serves as a routing SM, move one or more of the hundreds groups to a less loaded SM. If it is equipped with lines and trunks, moving them off the SM to a different SM may reduce the message load if the call rate for these lines or trunks is large. Both real time (processor occupancy) and CTS occupancy of the destination SM must

be investigated to avoid overloading a different SM.

If the SM serves as a hunting SM, the hunting can be moved to a less loaded SM. In the most severe case of extremely high call rates, the hunting may have to be done on an SM dedicated to hunting.

If the SM serves as the host to an AP and also has lines and trunks equipped, move lines and trunks having high call rates to a different SM. Refer to ASSIGNMENT GUIDELINES for more information.

In some cases, redefining the end customer's feature may provide controls on the call rate to the SM with high CTS occupancy or may redistribute the messages. For instance, decreasing the size of an SFG for a terminal group reduces the number of calls and, therefore, the number of messages to the SM doing the hunting for the group.

Some customers may have features that generate intense bursts of call originations or terminations, such as a focused load on an SM. Call-in talk shows and some forms of marketing are examples. For these cases short term load on the CTSs can lead to overload conditions causing lost messages. To avoid this, it may be necessary to impose restrictions on calls to the associated lines or trunks during the times of high call volumes. Network management controls on originating switches such as call gapping or choking can achieve this. Providing the customer with a choice of alternate features may also ease the load on the CTSs during these periods.

9.1.2.2 DETERMINING REQUIREMENTS FOR DUAL MMP

Offices should monitor their message traffic to determine if dual MMPs are needed for any SMs. The specific measurement to monitor is TRFC30 Section 125. This section reports the occupancies of the CTS for each SM during the previous 30-minute reporting period. Figure 9.1-1 shows a TRFC30 Section 125 report. The transmit (XMT) quantities are occupancies for the link directions away from the SM, and the receive (RCV) are the quantities for link directions toward the SM.

The quantities reported are:

- Average percentage occupancies for both CTS links for the XMT and RCV directions (4 quantities).
- The maximum percentage occupancy for each link and each direction during a 6-second period (4 quantities).

The following procedure determines if dual MMPs are recommended for a particular SM.

- (1) Calculate the sum of the average percent occupancy for the XMT and for the RCV directions.

Summed average XMT occupancy = [0XMT(AV) + 1XMT(AV)]

Summed average RCV occupancy = [0RCV(AV) + 1RCV(AV)]

Calculate the *overall summed average* XMT and RCV occupancies by averaging the above quantities over several (typically 100) busy half-hours.

- (2) Determine the 99th percentile value for each of the maximum percent occupancy quantities using only reports from busy half-hours. To obtain an accurate estimate of the 99th percentile value. At least 100 data points for each quantity should be collected. Assuming 10 busy half-hours per day and 5 days per week suggests that 2 weeks of data are needed for this analysis. This analysis assumes that both links are being used during the measurement period.

For each link and each direction, calculate the following:

Average peak = Sum (peak value)/ N

Peak variance = Sum ((peak value - average peak)²)/(N-1)

where: N is the number of observations and

Sum is a sum over these N observations.

The 99th percentile, P99, is:

$$P99 = \text{Average peak} + 3.13667 \times \sqrt{\text{peak variance}}$$

- Determine the 99th percentile value for the summed maximum percent occupancy using only reports from busy half-hours. As in the previous example, at least 100 data points (about 2 weeks of data) are needed for the analysis. The analysis assumes that both links are being used during the measurement period.

— Calculate the following summed quantities:

Summed peak value (XMT) = [0XMT(PEAK) + 1XMT(PEAK)]

Summed peak value (RCV) = [ORCV(PEAK) + 1RCV(PEAK)]

— Calculate the 99th percentiles of the summed peak values in both the XMT and the RCV directions as follows:

Average summed peak = Sum (summed peak value) / N

Summed peak variance = Sum ((summed peak value - average summed peak)²) / (N-1)

where: N is the number of observations and

Sum is a sum over these N observations.

The 99th percentile, PSUM99, is:

$$PSUM99 = \text{Averagesummedpeak} + 3.13667 \times \sqrt{\text{Summedpeakvariance}}$$

- Dual MMPs are recommended for those SMs for which any of the following occur:
 - The summed average XMT occupancy exceeds 58 percent.
 - The summed average RCV occupancy exceeds 45 percent.
 - P99 for either XMT exceeds 46 percent and PSUM for XMT exceeds 81 percent.
 - P99 for either RCV exceeds 32 percent and PSUM for RCV exceeds 58 percent.

Each MMP manages the even or odd control time-slots for 8 SMs. Offices can provision both single MMP and DMMP configurations in the same CM2 or CM2C equipped office.

9.1.3 ENGINEERING CONSIDERATIONS

The capacity of the MMP limits the total of the call processing and maintenance messages processed. The capacity of an MMP with CM2 is 120,000 EQPOTS calls per hour. An MMP may have as many as eight SMs (two SMs for CM2C offices) assigned to it.

The occupancy of the MMP is based on BLCs. As the number of messages processed by an MMP increases, the BLC decreases. (As the messages increase in number, more work is required during a BLC to process the messages. This results in more time being required to complete the BLC). The MMP has a message capacity of more than 1,200,000 messages per hour. The exact number of BLCs at this rate cannot be determined. However, a threshold [for Engineering and Administrative Data Acquisition System (EADAS) or some other type of traffic surveillance system] of 1,200,000 MMP BLCs per half-hour should provide enough time to perform a more thorough analysis of the MMP usage prior to reaching the capacity of the MMP.

As shown in Figure 9.1-2, the threshold for an MMP can be estimated by graphing the number of messages per half-hour against the number of BLCs per half-hour (from section 18 of the 30-minute traffic report). A straight line can be projected through the y axis to approximate the number of BLCs per half-hour at the 0-message point. The threshold could be set at 900,000. Figure 9.1-2 is an example, and data for any particular MMP could cause the graph and associated scales to vary.

NOTE: ENGINEERING CONSIDERATIONS for CM2C equipped offices is the same as that for CM1 and CM2 offices.

9.1.4 ASSIGNMENT GUIDELINES

The CM2 offices prior to software release 5E6 and CM2C offices [5E9(1) and later] are equipped with single MMPs. After any retrofit to software release 5E6 or later, these offices should be monitored for SMs with high message traffic. Such SMs may need to grow dual MMPs in offices since SMs equipped with the MC68020 processor have the potential to overload the control time slots (CTS) under "normal" call processing. For example, NCT links on SMs having a high penetration and usage of the shared DN features can experience large momentary CTS message traffic leading to excessive occupancies and subsequent message delays. In this feature, the size of the shared DN group contributes to the number of messages per call and, therefore, also to the CTS occupancy.

The dual MMP configuration in CM2 works the same as CM1. The J-Drawing J5D020 A-1 for bays and J5D020 B-1 for growth bays include lists and notes for dual MMP installation. Dual MMPs are optional in the CM2 beginning with software release 5E6 and may be grown after retrofit.

NOTE: ASSIGNMENT GUIDELINES for CM2C equipped offices is the same as that for CM1 and CM2 offices.

9.1.4.1 Existing Offices

In the case of growth of existing offices, if ISDN SMs are to be added, they should be added to dual MMPs. Existing offices should be constantly monitored for SMs with high message traffic using the CTS occupancy counts on Section 125 of TRFC30 as described previously to determine whether or not an SM needs to be on dual MMPs. The reassigning of live SMs from one MMP to another on an in-service basis is not supported.

The procedure performed in a working CM2 office needing to grow and degrow dual MMPs is described in the *Hardware Change Procedure Growth* 235-105-231 and *Hardware Change Procedure Degrowth* 235-105-331.

9.1.4.2 New Start Offices

For new starts, it is recommended that all ISDN SMs should be on dual MMPs. It is advantageous to put ISDN SMs on the same MMP because of the intra-MMP messaging capability, and because ISDN SMs involve high message traffic. If there are multiple MMPs with ISDN SMs, it is advantageous to put those MMPs on the same community of MMPs to share the same dual MMP community since it is recommended that ISDN SMs go on dual MMPs. Two alternatives for the physical arrangement exist for SM assignment and SM numbering. First, the ISDN SMs can be assigned at the beginning of the configuration, and analog SMs can follow the ISDN SMs. Second, the analog SMs can be assigned at the beginning of the configuration and ISDN SMs can be assigned at the end of the configuration. Of course, an office can go to 100 percent dual MMPs without any restrictions.

9.1.5 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

See Section 18 of the TRFC30 report in 235-070-100 *Traffic and Plant Measurement-Appendix 1* for information associated with MMPs. The TRFC30 Section 125 contains CTS occupancy information useful for determining whether an SM needs to go to dual MMPs.

9.1.5.1 Message Switch Receiver Not Ready

The MMP receiver-not-ready (MGRNR) count, taken on a per-MMP basis, represents the number of times the MMP could not accept messages from an SM due to blockage or full message buffers. This count should not normally exceed zero.

9.1.5.1.1 Base-Level Cycles

The base-level cycles (BLCYC) measurement is provided on a per-MMP basis. The count must be multiplied by 1000 to obtain the true number of cycles.

9.1.6 FEATURE IMPACT

The use of some features requires additional messages to be processed by the MMPs. However, the MMPs have a great deal of reserve capacity so that the extra messages generated by features should never cause an overload situation.

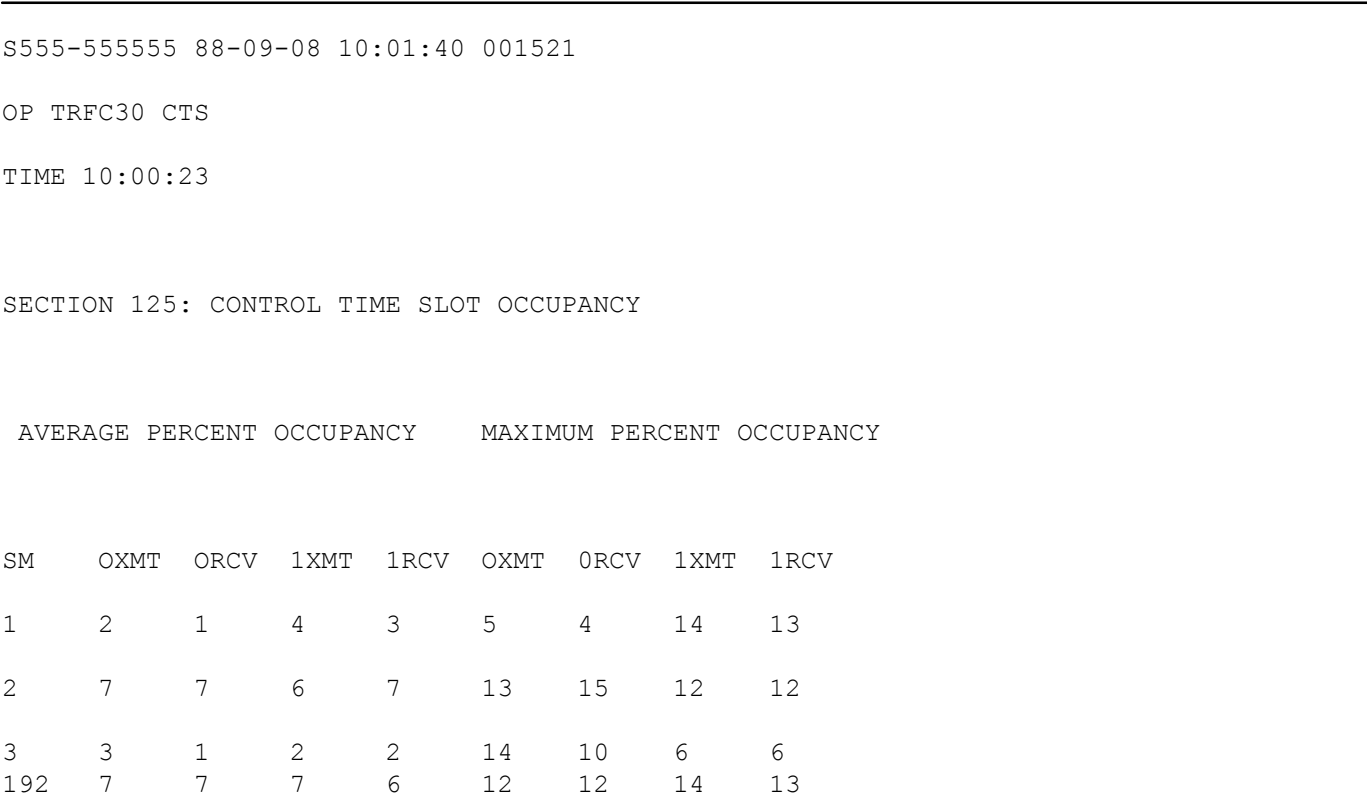


Figure 9.1-1 Example of TRFC30 Section 125 Output

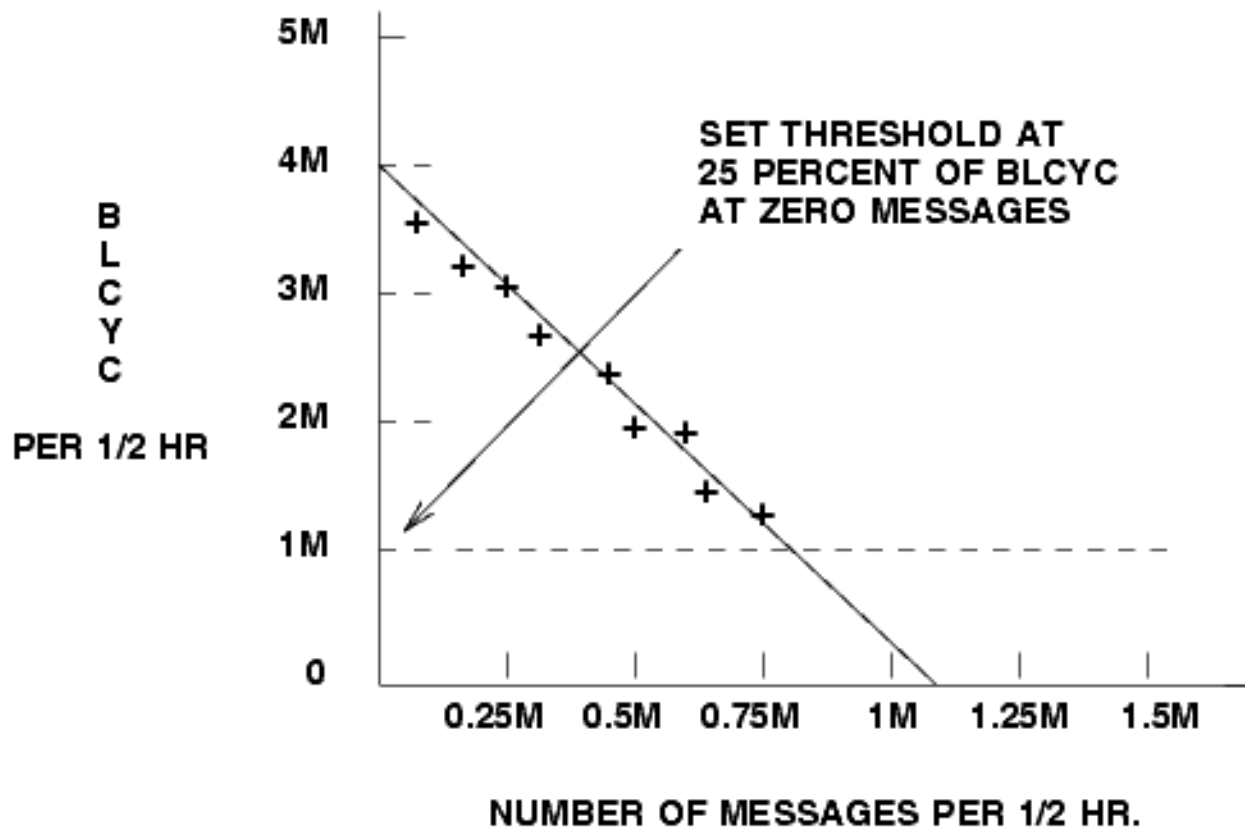


Figure 9.1-2 MMP Threshold Determination Example

9.2 MESSAGE SWITCH CONTROL UNIT

9.2.1 DESCRIPTION

The message switch control unit (MSCU) is responsible for handling interprocessor communication. The MSCU includes the duplex dual serial bus selector (DDSBS); the bus interface controller (BIC); the peripheral interface controller (PIC); and either one or two input-output microprocessor interface (IOMI) circuits, depending on office size.

The DDSBS provides access to the AM. The DDSBS receives serial messages from the AM central control through the dual serial channel (DSCH), performs a serial-to-parallel conversion for transmission to the BIC, and transmits the serial reply message back to the AM.

The BIC acts as a buffer between the 32-bit DDSBS and the 16-bit PIC. The BIC buffers data and command information flowing to the PIC, data and status information from the PIC, and performs the necessary handshaking interface tasks.

The PIC is the main processing element of the MSCU. It services each of the peripheral controllers (PCs) and the AM to facilitate the movement of commands and data between the AM, the PCs [module message processors (MMPs), foundation peripheral controllers (FPCs), and pump peripheral controllers (PPCs)], and the CMP.

The IOMI provides the interface between the 16-bit PIC and one or more 8-bit PCs (a maximum of 16 PCs per IOMI). A PC is an MMP, an FPC, a PPC, or a CMP.

9.2.2 ENGINEERING CONSIDERATIONS

9.2.2.1 Feature Impact

The use of some features requires that additional messages be processed by the MSCU.

9.2.2.2 Capacity Calculation Procedure Based on 30-Minute Traffic Reports

During the measurement periods both the MSC0 and MSC1 are assumed to be available. The MSCU capacity is determined assuming just one MSC is available. The capacity is expressed in units of messages per hour (C_{msgs}) and calls per hour (C_{calls}).

- Step 1: For each MSC, plot the BLL cycles per half-hour (30-minute traffic report, Section 19) against S , the number of messages processed by the MSC per half-hour at low message rates (typically below 20 percent of the expected MSCU capacity) as shown in Figure 9.2-1. S is obtained by the following equation:

$$S = \frac{CMPBPOT + CMPBPIN + DLNINPUT + DLNOUTPUT + \sum_{i=1}^X MMPMSG_i + Y}{2}$$

X represents the number of MMPs. The quantities $CMPBPIN$ and $CMPBPOT$ are obtained from Section 126, $CPMSG$ is obtained from Section 19, $DLNINPUT$ and $DLNOUTPUT$ are obtained from Section 66, and $MMPMSG_i$ for each of the MMPs is obtained from Section 18 of the 30-minute traffic report. The quantity Y in equation (A) accounts for the messages sent to the FPC. They are not included in any traffic report. The value of Y is approximated by adding $ORIG$ and INC from TRFC30 Section 5. Y is to be included in S for the MSC with the less active CMP only. As an alternative to using TRFC30 Section 5, the $ORIGPC$ and $INCPC$ from the two TRFC15 reports immediately preceding the TRFC30 report may be used.

Draw a regression straight line (excluding the obvious outliers) through the measurement points, as shown in

Figure 9.2-1 , and get M , the intercept of the straight line with the message rate axis. M represents the number of messages processed in a half-hour if the MSC is always busy with message processing.

- Step 2 : For each MSC get T_1 , the average time (in ms) to process a message according to the following equation:

$$T_1 = \frac{1,800,000}{M}$$

T_1 includes a $0.19\ ms$ overhead for each message originated at the MMP or CMP.

For each MSC determine T_2 , the average time (in ms) to process a message without the $0.19\ ms$ overhead using the following equation:

$$T_2 = T_1 - 0.19p$$

p represents the probability that an arbitrary message originates at an MMP and is given by the following equation :

$$p = \frac{S - \frac{CPMSG}{2} - DLNOUTPUT}{S}$$

The quantities $Sf1$, $CPMSG$ and $DLNOUTPUT$, needed for calculating p , may be obtained at any of the measurement points shown in Figure 9.2-1 . Calculate p at a few of those measurement points, take an average, and then use that average in equation (C).

- Step 3 : Take an average,

$$\bar{T}_2,$$

of the

$$T_{2s}$$

at the two MSCs as follows :

$$\bar{T}_2 = \frac{T_2(MSC0) + T_2(MSC1)}{2}$$

- Step 4 : The MSCU capacity in messages per hour, (C_{msgs}), is obtained as follows :

$$C_{msgs} = \frac{0.84 \times 3,600,000}{\bar{T}_2}$$

The factor 0.84 in equation (F) is used because up to an occupancy of 84 percent of the customer perceived message delay through the PIC for all message types meets objectives.

- Step 5 : As shown in Figure 9.2-2 , plot the total number of messages per half-hour (obtained by adding the quantity S , given by equation (A), for the two MSCs) against the total number of calls per half-hour (obtained by

adding the peg counts for the ORIGINAT and INCOMING call types from Section 5 of the 30-minute traffic report). Draw a regression straight line (excluding the obvious outliers) through the measurement points. As shown in Figure 9.2-2, determine, m_0 , the intercept of the straight line on the message axis, and, $SLOPE$, the slope of the straight line.

- Step 6 : The MSCU capacity in calls per hour, (C_{calls}), is obtained as follows :

$$C_{calls} = \frac{C_{msgs} - m_0}{SLOPE}$$

Equations (F) and (G) above determine the MSCU capacity (when only one MSC is available) in messages per hour and calls per hour, respectively.

9.2.2.3 Comments on Call/Feature Mix

The MSCU capacity depends on the call/feature mix. The measurement points should be taken on an office configuration that has approximately the same call/feature mix as in the larger office for which the MSCU capacity is being determined.

9.2.2.4 Example Capacity and Load-Service Curves

Capacity and load service curves are provided for certain office types based on measurements, expected call/feature mixes for those office types, and a performance analysis model that characterizes the message processing performance of the MSCU. At capacity, 5 percent of processing overhead results from noncall processing messages and 5 percent of overhead is caused by DSCH contention. These are conservative assumptions.

9.2.2.4.1 Example 1: Metropolitan Office

Based on lab measurements,

$$\bar{T}_2 = 0.4867 \text{ ms per message, } SLOPE = 12.6 \text{ messages per call, and } m_0 = 311 \text{ K messages per hour.}$$

Using equations (F) and (G), the MSCU capacity is given as :

- $C_{msgs} = 6.214$ million messages per hour
- $C_{calls} = 468$ K calls per hour

Figure 9.2-3 plots the mean and the 95th percentiles of the queuing delay for messages going from the AM/direct link node (DLN) queues to the MMP. Among all the message types these messages experience the maximum queuing delay. It is observed that the capacity is around the knee of the load-service curves.

9.2.2.4.2 Example 2: Toll/Tandem Office

With a mix of 50 percent CCS calls and 50 percent 2-way trunk calls:

$$\bar{T}_2 = 0.5586 \text{ ms per message, } SLOPE = 17.97 \text{ messages per call, and } m_0 = 271 \text{ K messages per hour.}$$

Using equations (F) and (G), the MSCU capacity is given as :

- $C_{msgs} = 5.414$ million messages per hour
- $C_{calls} = 286$ K calls per hour

Figure 9.2-4 plots the mean and the 95th percentiles of the queuing delay for messages going from the AM/DLN queues to the the maximum delay messages (MMP). The capacity for this example is also around the knee of the load-service curves.

Figure 9.2-5 plots the capacity of the toll/tandem office (in calls per hour) as a function of the percent of CCS calls and 2-way trunk calls.

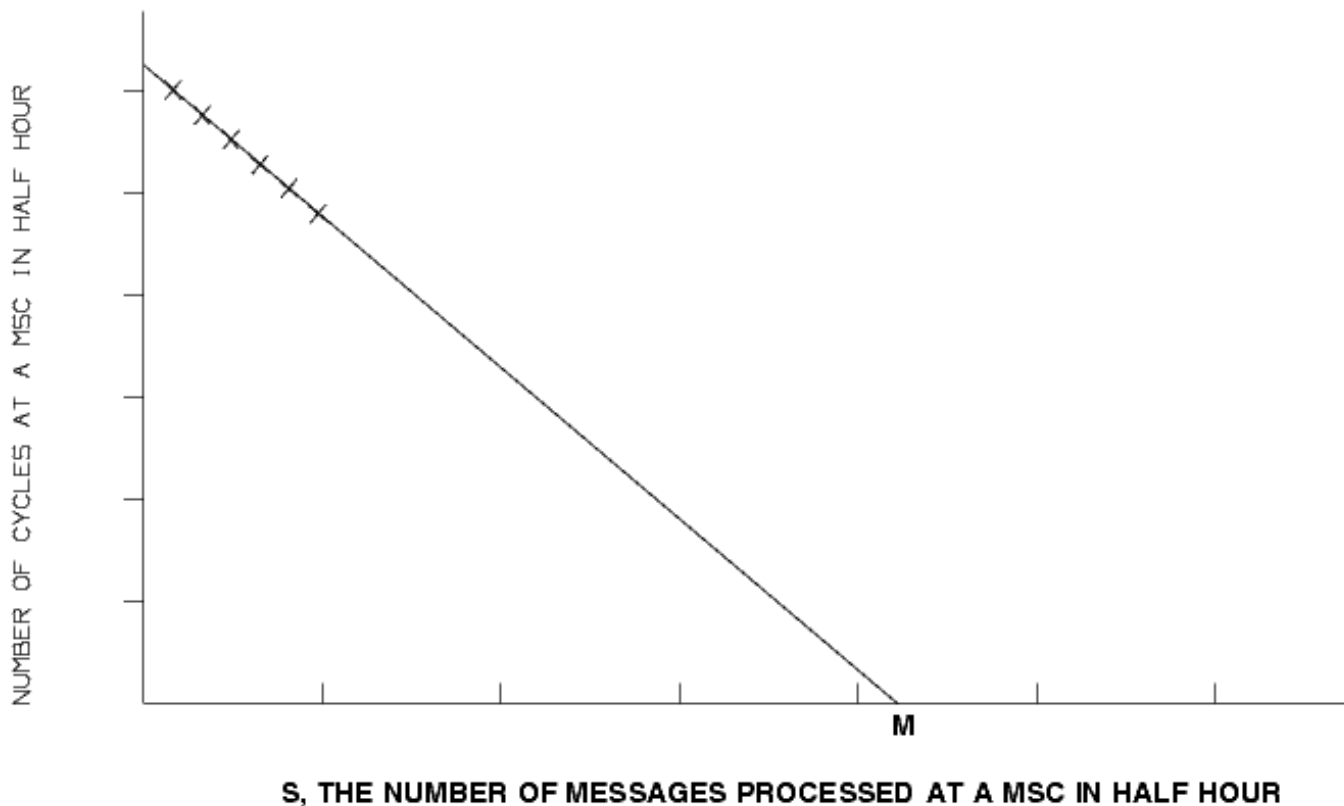


Figure 9.2-1 MSCU Capacity Calculation Step 1

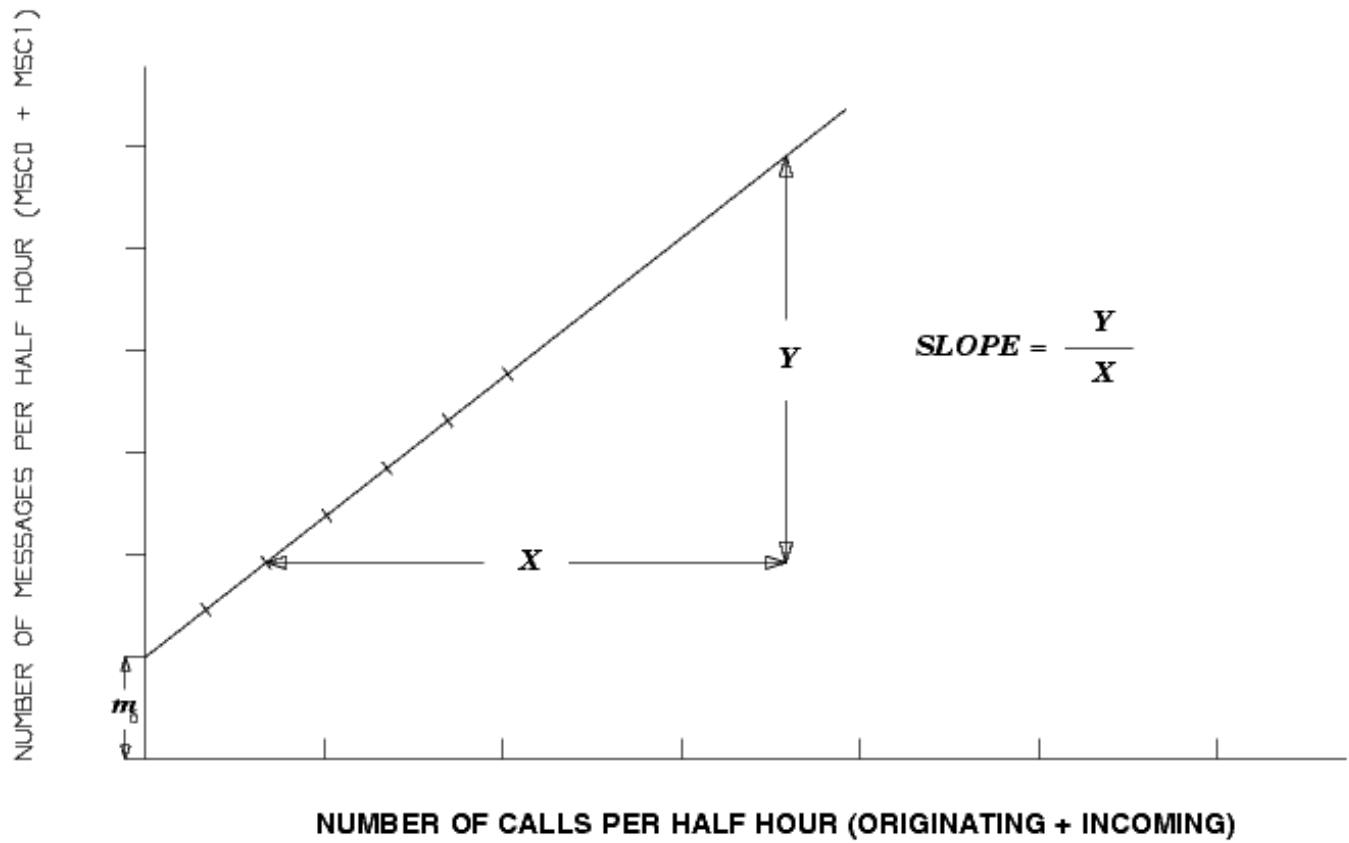


Figure 9.2-2 MSCU Capacity Calculation Step 5

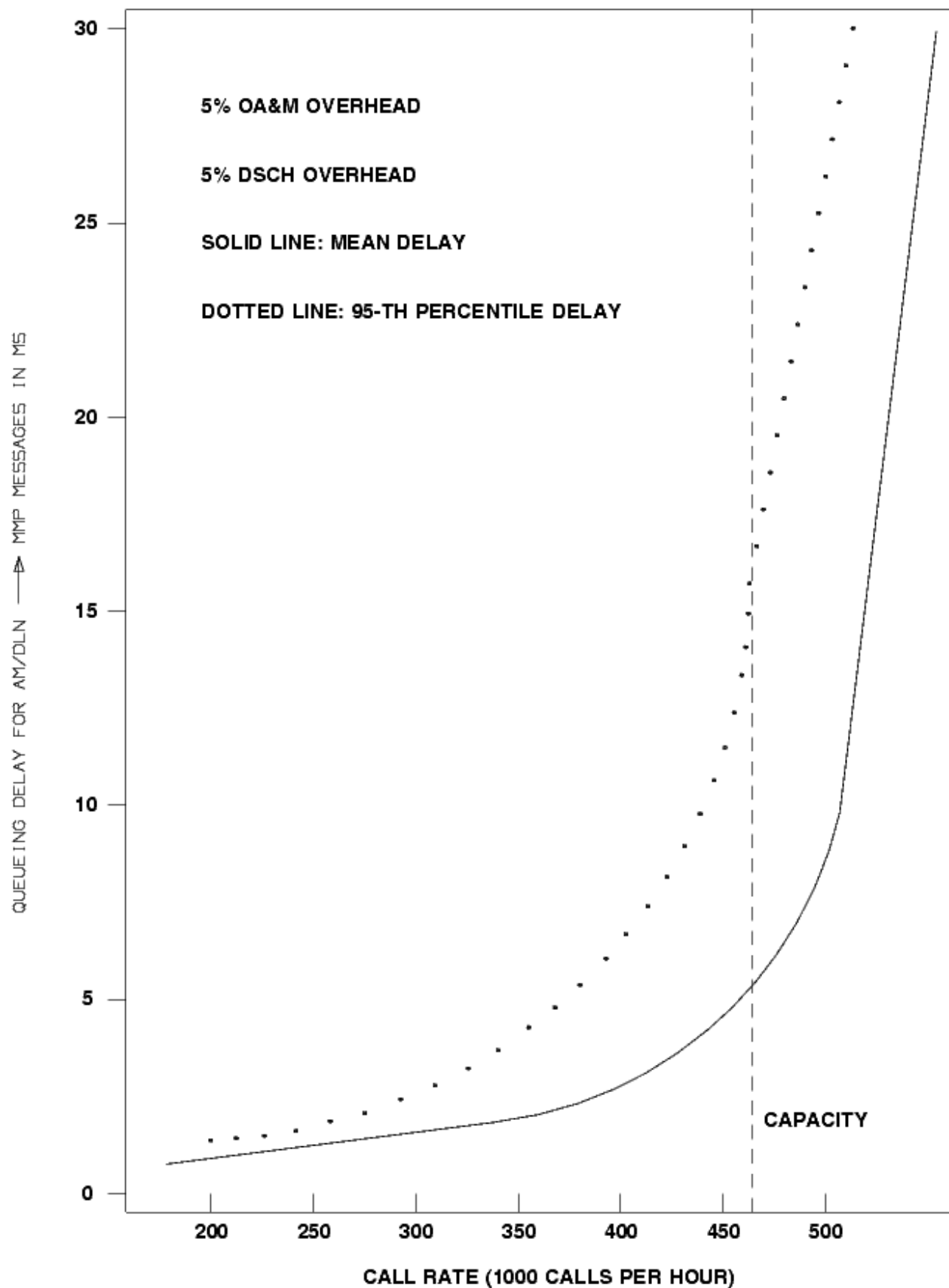


Figure 9.2-3 MSCU Load Service Curves for Metropolitan Offices

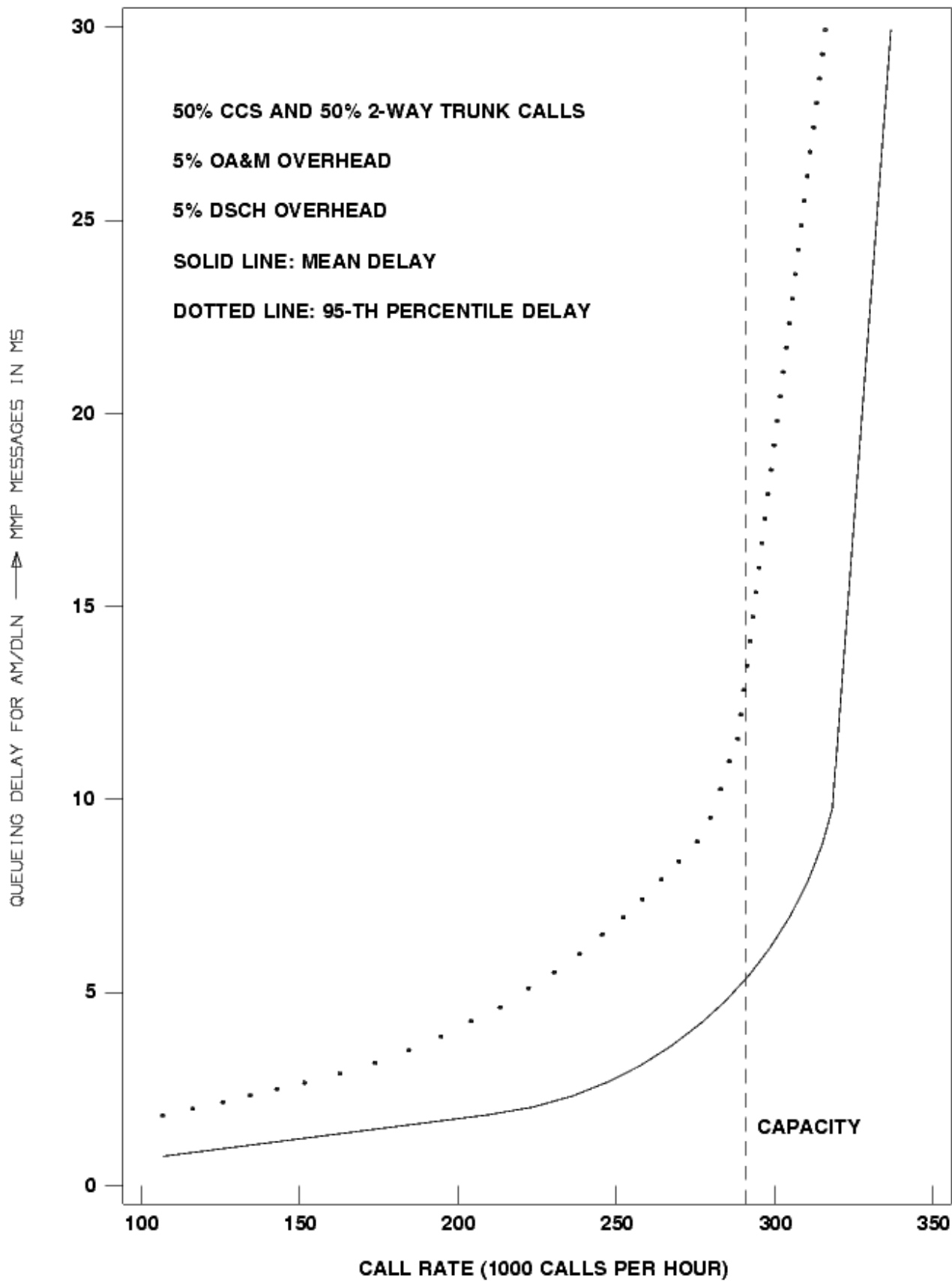


Figure 9.2-4 MSCU Load Service Curves for Toll/Tandem Offices

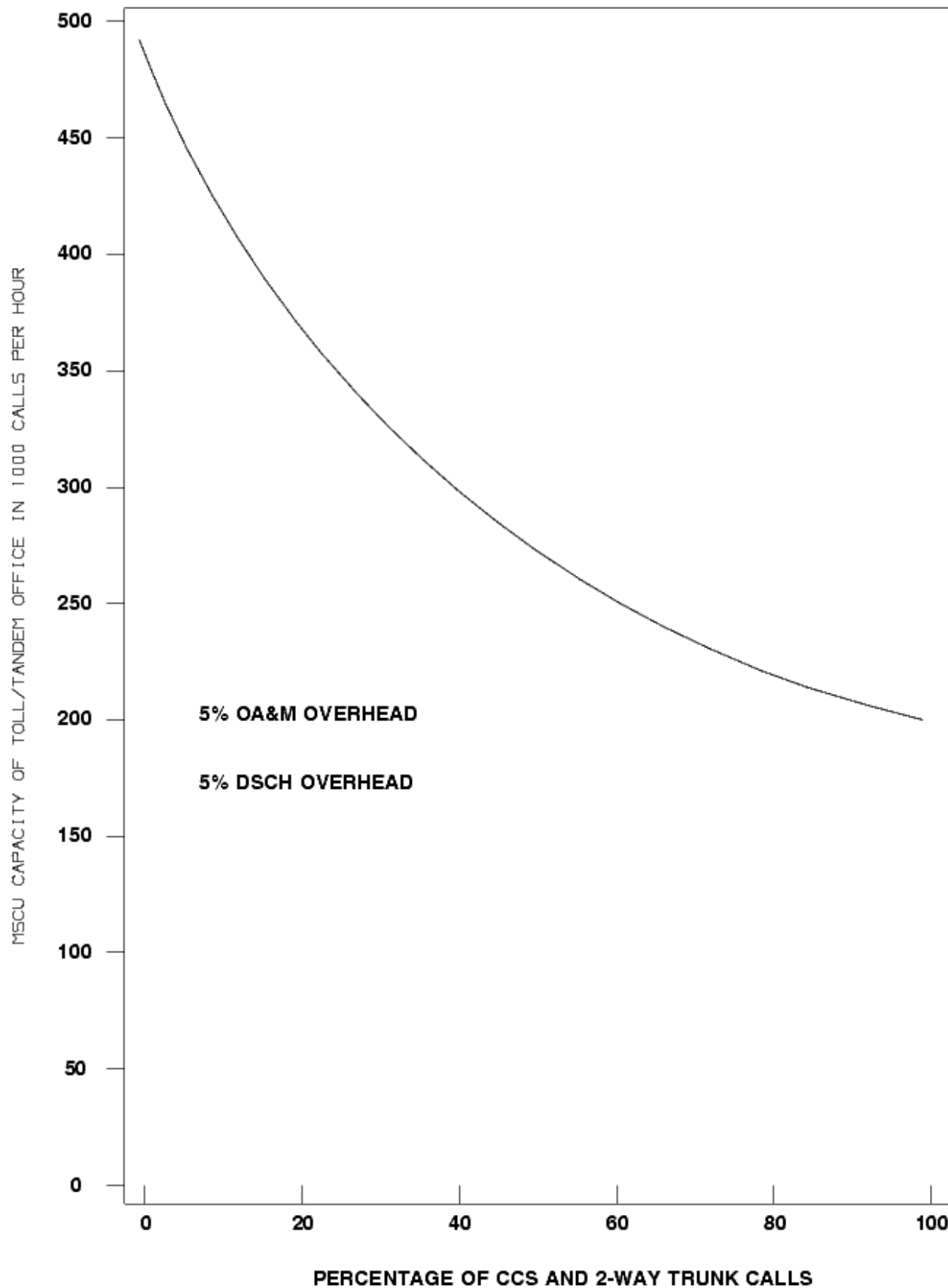


Figure 9.2-5 MSCU Capacity Example

9.3 MSGS COMMUNICATION MODULE PROCESSOR (CMP)

9.3.1 DESCRIPTION

The CMP was introduced to increase the call processing and operation, administration and maintenance (OA&M) capacity of the 5ESS[®]—2000 switch/5ESS[®]-2000 switch. The CMP also provides real-time relief for the AM. The two-board design consists of a 4-MB core board and a 16-MB memory board, equipped with input/output microprocessor interface (IOMI) interfaces to MSCU/PIC and TMS.

The optional CMP Upgrade feature introduces a CMP core board (TN1800). It increases core board memory from 4-MB (with the TN1368) to 16-MB (with the TN1800). The 16-MB auxiliary board is unchanged.

The optional CMP Upgrade may be ordered to upgrade the TN1368 to TN1800 and add the additional memory. The Upgrade consists of plug compatible replacements for TN1368s.

9.3.2 CAPACITY CONSIDERATIONS

Offices equipped with the CMP Upgrade result in a reduction of CMP occupancy from 5 to 10 percent.

9.3.3 ENGINEERING CONSIDERATIONS

For switches configured with the CM1, the CMP plugs into spare MMP slots. For switches configured with the CM2, one shelf is needed on each side of the CM. However, for CM2C offices, only one shelf is needed for both CMPs.

The current CMP design allows multiple CMPs.

The CMP with call processing application has the following functionalities, among others, in the CMP:

- Packet routing
- Trunk routing
- Trunk translation
- Global service allocation
- Automatic route selection
- Conferencing.

9.3.4 ASSIGNMENT GUIDELINES

There are no assignment considerations required for this feature.

9.3.5 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

Measurements for the CMP can be found in the following sections of TRFC30 and TRFC15:

- TRFC30 Section 126 - CMP
- TRFC15 Section 2B - CMP Processor Performance.

9.4 QUAD-LINK PACKET SWITCH NETWORK

9.4.1 DESCRIPTION

The Quad-Link Packet Switch (QLPS) Network is an overlay network providing high bandwidth/low latency message transport between an SM-2000 and other SM-2000s and between an SM-2000 and the following processors:

- SM
- AM
- FPC
- Direct Link Node (DLN)
- CMP.

For this explanation, the QLPS may be considered to connect "endpoints."

The two QLPS Networks are composed of the following major hardware elements:

- **QLPS** - fits into the same slot as the Quad-Link Interface board in a CM2 single/dual fabric TMS and has access to four TMS fabric ports. The QLPS, QLI1 and QLI2 can be equipped in the same TMSU. The QLPS provides the switching function for High Level Data Link Control (HDLC) data frames. It is based upon a number of closely coupled state machines rather than a central processor. The QLPS assembles frames received from the network endpoints, verifies frame integrity, determines the destination, and stores the frames until they are delivered to their destinations. The QLPS provides four 256 time slot links to the TMS fabric and four 32 time slot links out of 1024 time slots are used for QGPs. Time slots are switched based upon the destination field of the HDLC frame. Frames are received on multiple time slot channels. The QLPS supports 127 channels. Each QLPS TN1682 board will occupy one QLI slot in the TMSU. Offices needing a QLPS network will have two QLPS boards per side. QLPS can be used in either single or dual fabric TMSs.
- **QLPS Gate Way Processor (QGP)** - provides QLPS access to and from the MSCU/PIC. Configured in a dual MC68030 processor architecture, the MSGS processor performs I/O functions with the MSCU while the other processor, the AP, accesses the Packet Bus Media Access Controller (PBMAC). Both QLPS networks may contain 0, 1, or 2 QGPs per MSGS side. Depending on the QGP configuration there may be 0, 4, or 2 QGLs per QGP. If there are 4 QLPSs and 4 QGPs, then each QGP has 2 equipped QGLs. That is, one to each QLPS in the network. Each QGP on a MSGS side serves 1 QLPS network. For example:

QGP 0-0, 1-0 and QLPS 0-0, 1-0 serve network 0

QGP 0-1, 1-1 and QLPS 0-1, 1-1 serve network 1.

If there are 4 QLPSs and 2 QGPs, then each QGP has 4 equipped QGLs. That is, one to each QLPS in both networks. Each QGP on a MSGS side serves both QLPS networks. For example:

QGP 0-0/1-0 and QLPS 0-0, 1-0 serve network 0

QGP 0-0/1-0 and QLPS 0-1, 1-1 serve network 1.

The PBMACs terminate the QGL links between the QLPS and QGPs and provide the necessary HDLC functions required by the QLPS Network. Each MC68030 processor has exclusive use of one MB of static RAM and both processors share another one MB. The QGP's function is to transmit and receive SM-2000 messages over the QGLs, administer and translate appropriate protocol functions, and transmit and receive messages for the AM, the CMP, and SMs by way of the IOMI interface to the MSCU.

QGP consists of two circuit packs: the QGP (Gateway Processor), TN1683, and the GWL (Gateway Link), TN1684. An office may be equipped with zero, two, or four QGPs based on call capacity needs. The QGP resides in the left half of the CMP Unit.

- **Message Handler (MH)** — provides access from the SM-2000 processor to the QLPS Network. The MH uses a Synchronous/Asynchronous Protocol Data Formatter (SPYDER-T) device interface with the QLPS data stream. Based upon MC68040 processor, the MH is allotted 32 time slots by the TSIU-4. These 32 time slots are transmitted and received in the MH by a SPYDER-T device. A subset of these 32 time slots is used to connect into the QLPS Network. The SPYDER-T provides all necessary HDLC functions required by the QLPS Network. One MB of static RAM resides on the MH for the sole use of the MC68040 processor. Another 1 MB resides on the MH and is shared by the SPYDER-T, the MC68040, and the SMP. The MH's function is to transmit and receive messages, performing all level 2 protocol functions, over the QLPS Network for the SMP.
- **QLPS Protocol Handler (QPH)** - provides access between the PSU and QLPS Network. It is based on the international PH3 hardware.
- **QLPS-QGP Link (QGL)** - interconnection between the QLPS and QGP. Each QGL has a 2 Mb/s bidirectional bandwidth. Each QGP has four QGL connections, one to each QLPS in the OSDS messaging network.

9.4.2 CAPACITY CONSIDERATIONS

WARNING: WARNING: QLPS functionality requires Message Handler (MH) pipes between the QLPS and SM-2000. Without MH QPIPEs, the SM-2000 may go into CTS overload and may initialize because of the overload.

If SM-2000 is functional in the office prior to the start of QLPS growth, Message Handler pipes must be grown after completion of QLPS growth in order to make the QLPS functional for the SM-2000

If SM-2000 is to be grown in the office after the QLPS is functional, the Message Handler pipes must be grown as apart of the SM-2000 growth procedure. Growth of MH pipes is described in 235-105-210 *Operations and Routine Maintenance*

The 5ESS[®]-2000 switch operating with software release 5E12 supports both SMs and SM-2000s. Both types support analog lines, digital trunks, ISDN lines, SLC[®] lines, analog trunks and service circuits. Both also act as host SMs to support RSMs. The SMs also support analog lines. The stressed Metro office model (Table 9.4-1) assumes 20 percent of the lines are ISDN.

Table 9.4-1 Required Call Capacity for 5E12 and Later

OFFICE MODEL	REQUIRED CAPACITY (CALLS/ HOUR)	AVERAGE NUMBER OF MESSAGES PER CALL						
		SM TO SM	SM TO CMP	SM TO FPC	SM TO AM	CMP TO SM	SM TO DLN	DLN TO SM
EQPOTS	1500 K	4.7	1.7	1.0	0.1	1.0	0	0
Metro	850	10.5	2.5	1.1	0.1	1.9	5.0	5.0
Stressed								
Tandem w/	750 K	4.5	4.2	1.0	0.3	1.0	6.6	6.6
100% CCS								
Toll	750 K	4.5	4.2	1.0	0.5	1.0	7.3	7.3

Table 9.4-2 assumes all analog lines and digital trunks are on the SM-2000 even though these can also terminate on SMs. During busy hours, OAM&P activities normally add another 10 percent of the messages and are included in Table 9.4-2.

Table 9.4-2 Required Message Capacity for 5E12 and Later

OFFICE MODEL	REQUIRED MESSAGE CAPACITY (MESSAGES/HOUR)	
	QGP COMPLEX	QLPS COMPLEX
EQPOTS	6.3 M	14.9 M
Metro Stressed	10.0 M	20.0 M
Tandem w/ 100% CCS	10.8 M	14.5 M
Toll	12.1 M	15.8 M
Signaling messages between the SM and DLN are bundled together up to three or more messages at a time so the actual messages processed by the QGP and QLPS are less than the total number of call processing messages		

A 5ESS[®]-2000 office with a mix of SM-2000s and SMs may also put a stressed load on the QGP because the QGP then needs to handle messages for calls between SM-2000s and SMs. However, each of the office models, even under worst case assumptions, is less than the maximum of 8.3 million messages/hour.

Under single fault configuration, the QGP complex (2QGP per side, 4QGP configuration) has a throughput of 12.2 million messages/hour (3400 messages/sec) at a processor occupancy of 75 percent or less. Under single fault configuration, QGP complex (1QGP per side, 2QGP configuration) has a throughput of 6.1 million messages/hour (1,700 messages/sec) at a processor occupancy of 75 percent or less. The QLPS complex (always 4 QLPS boards running active/standby) is based on a state machine, and has a throughput many times the largest possible offered load. The offered throughputs are specified with respect to an average message length of 100 bytes, including the message header.

Under single fault configuration, the message links between the QLPS complex and QGP complex have sufficient bandwidth to transmit or receive 10 million messages/hour (2,780 messages/sec) while maintaining an average link occupancy of 60 percent or less. The bandwidth is specified with respect to an average message length of 100 bytes, including the message header. The message distribution is dependent on the call mix and feature usage, and will generally be different for each 5ESS[®]-2000 office

Table 9.4-3 shows the SM-2000 required call capacity and the percentage of inter-SM calls for different 5ESS[®]-2000 offices based on typical offered loads. These offices will be more message intensive than either the POTS or metro offices. The processor real-time call processing capacity is greater than 120,000 calls per hour for an SM-2000 with an SMP60 processor.

Table 9.4-3 SM-2000 Required Call Capacity for 5E12/5E13

OFFICE MODEL	SM-2000 REQUIRED CALL CAPACITY (CALLS/HOUR)	PERCENTAGE INTER- SM-2000 CALLS
Tandem with 100% CCS	92,000 (Out+In)/2	90
Toll	108,000 (Out+In)	90

These figures reflect the average number of messages per call shown in Table 9.4-1, adding 10 percent for OAM&P activities and another 30 percent for capacity contingency, the number of messages than an SM-2000 needs to process is given in Table 9.4-4. These messages go through the message link between the SM-2000 and QLPS.

Table 9.4-4 SM-2000 Required Message Capacity for 5E12/5E13

OFFICE MODEL	REQUIRED MESSAGE CAPACITY (MESSAGE/HOUR)
Tandem w/ 100% CCS	2.85 M
Toll	3.66 M

9.4.3 ENGINEERING CONSIDERATIONS

This section enables an engineer or administrator to determine when an SM-2000 must have connections to a QLPS Network. SM-2000s with offered loads or equivalent number of lines, less than certain values do not require QLPS connectivity. As the offered load increases beyond this first set of limits, QLPS should be grown. This is preferred over growing another SM-2000. The information in this section also covers the growth situation of a single SM-2000 grown into an existing office equipped with SMs.

The QLPS/QGP is optional, so engineering rules are required when the various combinations of QLPS and QGPs are needed in an office.

Four combinations are possible as follows:

- No QLPS and no QGPs
- Four QLPS and no QGPs
- Four QLPS and two QGPs
- Four QLPS and four QGPs.

The factors that determine which combination to be engineered in the module in a given office are as follows:

- Type of call mix
- Number of SMs
- Number of SM-2000s
- Call rate on the SM-2000s.

9.4.3.1 QLPS/QGP

The following steps determine how many lines or trunks can be equipped on an SM-2000 without QLPS (CTS used for all messaging between processors) and also on an SM-2000 with QLPS but not having QGPs equipped. These assume all SM-2000s and average busy season calling rates.

(1) Determine the office call characteristics:

- Stressed Metro offices are characterized by heavy feature usage per call and feature penetration per line. These offices are usually in business areas with high calling rates per line.
- Typical Metro offices are characterized by less feature usage and penetration. These offices are in urban areas with both residential and business customers.
- Suburban offices are mainly residential with fewer features per call. Some small businesses may be present.

(2) Determine the type of SM-2000 equipage of interest.

(3) Choose the non-QLPS or the QLPS option.

(4) Use the expression following the appropriate table to see if a particular line/trunk mixture can be supported.

(5) All trunks are assumed to be trunks with CCS signaling, using the DLN for signaling.

Table 9.4-5 SM-2000 With Lines Only

OFFICE TYPE	CAPACITY NO QLPS	CAPACITY QLPS NO QGP
Stressed Metro	15,000	50,000
Typical Metro	18,000	50,000
Suburban	23,000	50,000

Calculate:

$$\frac{(O + T) \text{ per line} \times \text{Number of Lines}}{2} < C$$

or

$$\frac{\text{Number of Lines} < 2 \times C}{(O + T) \text{ per line}}$$

Where:

C is a quantity from Table 9.4-5 , Number of Lines is the number of lines on the SM-2000, and O + T is the number of originating and terminating calls.

Table 9.4-6 SM-2000 With Trunks Only

OFFICE TYPE	CAPACITY NO QLPS	CAPACITY QLPS NO QGP
Stressed Metro	11,000	21,000
Typical Metro	12,000	21,000
Suburban	14,000	21,000
Tandem	14,000	21,000

Calculate:

$$\frac{(Out + In) \text{ per trunk} \times \text{Number of Trunks}}{2} < C$$

or

$$\text{Number of Trunks} < \frac{2 \times C}{(Out + In) \text{ per trunk}}$$

Where:

C is a quantity from Table 9.4-6 , Number of Trunks is the number of trunks on the SM-2000, and Out + In is the number of originating and incoming calls.

Table 9.4-7 SM-2000 With Lines And Trunks

OFFICE TYPE	CAPACITY NO QLPS	CAPACITY QLPS NO QGP
Stressed Metro	14,000	33,000
Typical Metro	16,000	34,000
Suburban	18,000	35,500

Calculate:

$$\frac{(O + T)}{2 \times \text{Number of Lines}} + \frac{(Out + In)}{2 \times \text{Number of Trunks}} < C$$

Where:

C is a quantity from Table 9.4-7, Number of Trunks is the number of trunks on the SM-2000, and Out + In is the number of originating and incoming calls.

If the line/trunk ratio is given, the number of lines supported is:

$$\text{Number of Lines} = \frac{2 \times C}{\frac{(O + T) \text{ per line} + (Out + In) \text{ per trunk}}{(\text{Number of Lines} \quad \text{Number of Trunks})}}$$

and then

$$\text{Number of Trunks} = \frac{\text{Number of Lines}}{(\text{Number of Lines} \quad \text{Number of Trunks})}$$

NOTE: The above calculations assume Average Busy Season rates for the tables. To get High Day tables, multiply table entries by 1.2.

9.4.3.2 QGP

A 5ESS®-2000 switch can be equipped with QLPS and a single QGP pair. For most switch applications and configurations this combination is sufficient to handle the interprocessor message traffic. Some switch applications, however, may require two pairs of QGPs to handle the larger message load in some situations. The capacity of a QGP is stated in messages per hour so the number of interprocessor messages per call (handled by the QGP) must be known. The number of messages per call handled by the QGP is the parameter that determines the QGP call capacity for a given switch. A QGP can process about 1,700 messages per second or about 6.1 million messages an hour. Use Table 9.4-8 to determine when two pairs of QGPs should be equipped but keep in mind that this table is for offices with lines and trunks predominantly on SM-2000s (for large, new ship offices only). Offices with SMs growing SM-2000s are not expected to have call distribution spread between SMs and SM-2000s leading to QGP capacity exhaustion. Switches with offered loads greater than these shown should grow the second pair of QGPs.

Table 9.4-8 Single QGP Pair Call Capacity

OFFICE TYPE	CAPACITY PER HOUR
Stressed Metro	480,000
Typical Metro	510,000
Suburban	530,000
Toll/Tandem	500,000

9.4.3.3 Link Engineering for SM-2000

The NCT2 link engineering is available for SM-2000s. For the SM an equal number of time slots is available on the peripheral and network sides. For the SM-2000 engineering, the peripheral-to-peripheral feature permits intra-SM calls without NCT2 involvement.

Two types of optical link interfaces are required: Network Control and Timing and Peripheral Control and Timing.

9.4.3.3.1 Network Control and Timing Link

The Network Control and Timing Link between the SM-2000 and its associated CM is referred to as an NCT2 link. The NLI transmits and receives 512 time slots on an NCT2 link, mapping these slots into 768 time slots of the TSI link. This means that 256 time slots are inaccessible on the TSI.

The format on the NCT2 links is equivalent to two interleaved 32 MB NCT links of the SM. This relates to 512 time slots of 16 bits each. NCT2 links are always provided in even and odd pairs. A link carries only odd or only even time slots regardless of the CM2 single or dual fabric configuration.

The following are NCT2 restrictions:

- The NCT2 links of 512 time slots each must be provided in pairs, that is one odd and one even, and must be nested at the same TSI slice (TSIS).
- The NCT2 links must terminate to couplet positions (0 and 1 or 2 and 3). This is expected by peripheral control.
- Two or 4 links may be NCT2 in any slice numbered 1 or higher.
- Only two NCT2 links are permitted on TSIS(0) as described.
- The SM-2000 is limited to 28 cross coupled Line or Trunk Peripheral (LTP) cabinets and 1 SM cabinet (SMC).

9.4.4 OVERLOAD CONTROL

9.4.4.1 QLPS Overload Control

The QLPS overload control is triggered by critical QLPS failures. They are applied if all QLPS connectivity is lost to an SM-2000. This can occur when all QLNKs are lost when the CM2 is equipped with QGPs (SM-2000) or if all ISMQLNKs are lost when not equipped with QGPs. When this occurs all messages queued for QLNKs or ISMQLNKs are discarded and all new messages are directed to CLNKs and transmitted or received via the Control Time Slots. Severe throttles are initially applied, but they are gradually relaxed, allowing CLNK occupancy monitors to control the overload condition. Overload controls are immediately retired when QLNKs are again available.

9.4.4.2 QGP Overload Control

The QGP overload control is triggered by resource exhaustion. These overload controls are provided to allow for misengineered offices or multiple fault events. Overload throttles are applied to all SM-2000, throttling originations, terminations, routing requests, or CNI. The degree of throttling depends upon QGP processor occupancies and QGPQPIPE occupancies.

9.5 COMMUNICATIONS MODULE 2 WITH SM-2000

9.5.1 ENGINEERING CONSIDERATIONS

At present the quantity of equipment for a Communication Module (CM) is determined by the number of Switching Modules (SMs) in time slots per SM-2000 and is a variable quantity rather than fixed for CM engineering.

The Network Link Interface (NLI) is the interface between the SM-2000 and the CM2. It transfers time slots back and forth from the Time Slot Interchanger (TSI) links on one side and the Network Control and Timing 2 (NCT2) links on the other side. The NCT2 links are always equipped in pairs. A new set of engineering and ordering rules exist for CM2 offices with SMs (using NCT links), SM-2000s (using NCT2 links), and EXM-2000s (using NCT links).

A CM1 (Communication Module Model 1) office must be converted to a CM2 (Communication Module Model 2) office before installing SM-2000s. It is strongly recommended that existing CM2 single fabric offices with 60 or more SMs convert to CM2 dual fabric before installing SM-2000s in the office, since the current conversion procedure is simple.

The major engineerable items in the CM2 for SM-2000 and SMs follow.

For SMs, the Foundation Link Interface (FLI), TN883, is designed to provide a control interface to the Dual Message Interface portion of the CM Control Unit (CMCU), and it also terminates the NCT links for the first SM on the Time Multiplex Switch (TMS). The NCT2 links used for SM-2000 do not terminate on a FLI pack. The FLI is only provided on base cabinets 5 and 6 (one pack per shelf) of the Time Multiplexed Switch Unit Model 2 (TMSU2) or TMSU3.

The Quad Link Interface (QLI), TN888, is designed to provide the link interface between the CM2 and the SMs. CM2s equipped with QLIs support both single and dual fabric and are equipped on the TMSU2 or TMSU3. Each QLI terminates four NCT links, the equivalent of two SMs.

The CM2 Optical Transceiver (COT), BKF1, terminates the NCT2 links from an SM-2000 (via a NLI) and provides the electrical/optical conversion for the QLI2 circuit pack. Each COT supports two NCT2 links (one pair). COT and QLI2 must be equipped in conjunction with each other (for example, if a QLI2 is equipped in EQL 032, a COT is equipped in EQL 032R).

The COT, 982TT, is used as an optical connector to the SMs. Every two NCT links require a 982TT for the SMs.

The Quad Link Interface 2 (QLI2), TN1681, is designed to provide 64 Mbps NCT2 links between the SM-2000 and CM2, while maintaining the existing interface to the TMS fabric. CM2s equipped with QLI2s support both single and dual fabric configurations. QLI2s can be equipped on both a TMSU2 or TMSU3. Each QLI2 terminates two NCT2 links.

The following are the Office Data Administration (ODA) restrictions for offices equipped with SM-2000 for single fabric link assignments:

- Boards 0 and 1 on TMSU shelf 0 and 1 on base cabinets 5 and 6 cannot be used for SM-2000s (FLIs).
- QLI2 or QLI boards must occupy consecutive board positions within a shelf (at least two at a time).
- Either QLI or QLI2s may occupy multiple sets of consecutive boards, but they can not be mixed.

The Input Output Microprocessor Interface (IOMI), UN25B, provides the interface between the Peripheral Interface Control (PIC) and the Peripheral Controller (PC). There is a maximum of four IOMI circuit packs (IOMI-A, IOMI-B, IOMI-C, IOMI-D) per Message Switch Control Unit Model 2 (MSCU2) side. Each UN25B pack can access four IOMI buses. The IOMI-A is always provided (for CMP, FPC, PPC). The other packs are added depending on the number of Message Switch Peripheral Unit Model 3 (MSPU3) communities equipped. The IOMI connection to the QGP will

be via a reserved IOMI cable at the third circuit pack (IOMI-C). Some offices require IOMI-C to be equipped before IOMI-B.

New start offices in 5E9(1) and later software releases have the option of using the new version of MSCU called MSCU3 in the CM2. The MSCU3 has a new circuit pack, kBN10 containing the function of four other circuit packs and the first IOMI pack (IOMI-A) UN25B on one board. All four IOMI-A terminate on the kBN10. The IOMI connection to the QGP is through a reserved IOMI cable at the IOMI circuit pack (IOMI-C) or second UN25B.

10. SM RESOURCE UTILIZATION

This section provides information for administering 5ESS®-2000 switch switching module (SM). The assumption is that the reader has a basic knowledge of the 5ESS®-2000 switch architecture and operations. These details are provided in 235-900-1XX - *Product Specification*. The following subsections provide resource utilization information on a physical group basis. Refer to the table of contents at the beginning of each subsection for a complete description of the information included. Each subsection provides information to administer the particular resource.

Worksheets are provided, where applicable, to assist long-term capacity monitoring. These worksheets enable the administrator to determine if the capacity of the SM will exhaust before the end of the engineering period.

The Extended Switch Module 2000 (EXM-2000) is an evolution of the SM providing a significant per time slot cost reduction, enhanced architecture, and platforms for new features and services.

10.1 SWITCHING MODULE PROCESSOR

10.1.1 DESCRIPTION

The hardware in the switching module (SM/SM-2000) includes line and trunk interfaces and networks, service circuits, and processor control functions. The major parts of the call processing functions are performed in the SM/SM-2000 (such as line and trunk scanning, digit collection, outpulsing, and supervision). Since many calls processed by an SM/SM-2000 involve customers outside that particular SM/SM-2000, many functions and measurements in the SM/SM-2000 are related to half-calls (originating, terminating, outgoing, or incoming calls). The switching module processor (SMP) handles each half-call independently. A terminal process is created in software to perform the necessary tasks associated with the line or trunk for that particular call.

The SMP hardware has undergone continuous development to improve SM/SM-2000 performance. Some of these SMP enhancements provide additional memory addressability, some provide improvements in real-time (faster processor and higher clock rates), and some provide both. The most current information relative to SM and SM-2000 processors in current software releases can be found in Section 10.04.

The SMP itself is the shelf or unit that functions as central processor unit for the SM, or SM-2000 itself. This is often confused with the designation for the pack within the unit that contains the actual processing components. The available or existent SM MCTU or SM-2000 SMPU shelf types are:

MCTU	The Module Controller and Time Slot Interchange Unit (MCTU) is an SM data processing unit that incorporates one of a group of SM processors that consists of the: SMP12, SMP23, SMP23CDM, or the SMP23CDMX. They are based on either the 68012 or 68020 processor using the TSIU3, and support a variety of memory configurations. The SMP12 and SMP23 module processors support up to 12 memory boards with the Memory Expansion Unit (MEU). The SMP23CDM utilizes no external memory board slots and contains all of its memory on the core board. The SMP23CDMX adds to the core board memory of the SMP23CDM by utilizing 5 memory board expansion slots.
MCTU2	The MCTU2 is a complete redesign of the MCTU. This SM data processing unit incorporates either the SMP20 processor or SMP20DC using the 68020 processor chip. The 68020 processor is capable of 32-bit addressability, which means that the processor has the potential for 4-GB processor addressability. 96 MB is the maximum memory equipage for the MCTU2.
MCTU3	The MCTU3 combines several circuit packs into one reducing the MCTU2 from two shelves to one. The MCTU3 consists of a new Single Board 20 Core pack (SB20CORE), combining two core support packs, the application pack, memory boards and Ethernet interface pack on a single board. The MCTU3 also provides a new power pack, and DLI pack. The SB20CORE circuit pack contains a maximum of three 32 MB memory SIMMs. The MCTU3 is equipped with the TSIU3, PI, DSU2, and CI/CI2 circuit packs. There are two CI slots available permitting a maximum of 46 PICBs. The DI packs support a maximum of 32 PIDBs.
SM2000	THE SM2000 is the initial processor unit which contained the CORE 40 processor, and is equipped with with four memory slots. This unit is capable of increased processing capacity, and accomodates a larger number of peripheral units than the previous processor types
SM2005	In the future a new backplane and compressed shelving will be shipped with all new offices. The SM2005 is a redesign of the SM2000 to rearrange and consolidate the hardware components into a more compressed form. This compressed unit is known as the SM2005. and contains the CORE60 processor. The SM2005 is equipped with two memory board slots. These units are equipped with the CORE60MM (UN588)

The SM processor pack of MCTU, MCTU2, or MCTU3 has its own distinct designation and should not be confused

with the designation of the processor shelf that contains it. The two designations are not interchangeable. The same is true of the for the SM-2000, SM2005 and their processor boards the CORE40, the CORE60 and CORE60MM. Available or existing SM/SM-2000 and SM2005 processors are:

- SMP23** The Switching Module Processor 23 (SMP23) is available to upgrade the current SMPU or SMPU2 with the 68000 processor or SMPU2 with the 68012 processors with respect to memory capacity and real-time performance. The SMP23 is equipped with a MC68020 microprocessor. This microprocessor extends the addressing capacity to 32 MB with MEU equipped, and the real-time capacity is improved at least 30 percent over the SMPU or SMPU2 with the 68000 processor with speedup and the SMPU2 with the 68012 processor. Although the SMP23 can operate with TN56 or TN2012 memory boards, mixing of different memory packs is not allowed. See Section 10.04 for maximum configurations.
- SMP23CDM** The SMP23 Core/Memory board (SMP23CDM) is a core board (TN1423) with dynamic memory utilizing a MC68020 microprocessor. This feature provides the SMP23 processor, and 32 MB of memory on a single board. This board replaces the existing SMP23 core board (TN1407/TN1407B). The TN1423 board is also available as a memory upgrade in SMP12, and SMP23 applications that need memory extension, but don't have sufficient physical space for extra memory boards. The new board requires no backplane changes with respect to the SMP12, or SMP23. The new board contains the same functionality as the TN1397, TN1407, and TN1407B. In addition, it includes on-board dynamic memory. When the TN1423 is used to replace the TN1397, TN1407, or the TN1407B, all existing memory boards must be removed. All offices that upgrade to the 5E10 software release must have the SMP23CDM feature in all SMs where no physical space exists for further memory expansion beyond 20 MB.
- SMP23CDMX** The SMP23CDMX is an extension of the SMP23CDM processor. The conversion of a SMP23CDM to a SMP23CDMX involves adding an Update Bus Cable, a new bootstrapper board, the code to support it, and possibly changing the Memory Controller boards. The SMP23CDMX is introduced as part of the 5E12 software release and as a software update in software releases 5E10 and 5E11. The SMP23CDMX supports 32MB of DRAM on the processor core board and up to 5 4MB (TN2012) on the MCTU shelf. This means that the maximum memory equipage of a SMP23CDMX is 52MB (32MB DRAM + (5 x 4MB)).
- CORE40** The CORE40 was the initial processor equipped in the SM2000. It has been superseded by later models.
- CORE60** The Switching Module Processor 60 (CORE60) replaced the CORE40 in all new SM-2000 switching modules. CORE60 provides an enhanced processor platform with higher capacity that supports processor speed up from 1.5 times over the CORE40. The enhanced CORE60 processor supports the current CORE40 board functionality with the enhancements of the MC68060 microprocessor operating at 50MHz. Also added are a SCRAM Cache subsystem with 512 Kb, optimized CORE I/O, and an additional 64 MB Dynamic RAM.
- CORE60MM** The CORE60MM is designed to improve the processor performance and provide two CORE RAM memory configurations of either 64MB (UN594) or 128 MB (UN588).e CORE40. The 64MB CORE60MM (UN594) is supported on SM2000 for software release 5E12. The 128 MB CORE60MM (UN588) will be used for all newly shipped SM2005 SMs.

An SMP capacity graph shown in Figure 10.1-1. The graph indicates that the SM should reach call carrying capacity at approximately 90 percent occupancy. The amount of overhead varies due to differences in the configuration of the SM [number of line units, concentration ratios used, number of SMs in a multimodule remote switching module (MMRSM), etc.]. Typically, about 55 to 70 percent of the SMP real-time is allocated to call processing functions.

It is very likely that the line units in an SM will reach usage (CCS) capacity before the SMP reaches call capacity. In the event that the SMP reaches or exceeds capacity, service deterioration may occur in the form of longer dial tone delay.

10.1.2 ENGINEERING CONSIDERATIONS

The engineering of the switching module processor (SMP) uses 5ESS®—2000 Digital Ordering and Planning System (DOPS). Decisions must be made on the SMP configuration, the maximum number of peripheral units assigned in the SM because of the real-time call capacity of the SMP, and the type and amount of memory required.

The SMP configuration decision is based on whether the SM will have integrated systems digital network (ISDN) or Operator Services Position System (OSPS) equipment. If it will house either, the SMP must be an MCTU2 or better. If the SM will not house either, but will require certain ISDN capabilities (such as shared analog DN), the SMP must be at least equipped with an SMPU2 or MCTU with the 68012 processor. If the SM will not contain ISDN hardware and will not require ISDN capabilities, the SMP configuration may be any of the configurations supported by the software release. The decision of which SMP to use in any given SM is based on real-time capacity and availability of SMP types.

- **OSPS:** The possible OSPS position switching module (PSM) applications include directory assistance (DA), toll and assistance (T&A), and commercial automatic call distribution (ACD). The OSPSs are provided in terms of operator positions supported as well as busy-hour call capacities.
- **ISDN:** The capacity of an ISDN SM equipped with an SMP20 in terms of PODS (plain old digital service), the equivalent of an analog line-to-line call is 7,500 calls per hour, assuming 78 percent of SMP real-time is allocated to call processing. (In general, an ISDN SM has more real time available for call processing since there is no analog line scanning.) The actual SMP call capacity depends on the mix of the voice and data features; typical ISDN SMs have capacities in the range of 5,000 to 7,500 feature-rich calls per hour. The 5,000 calls per hour value is based on a stressed SM with more than 50 percent of the directory numbers (DNs) being shared and 1 or 2 business and residential custom services (BRCS) features used per call. The 7,500 value corresponds to little shared DN and less than 20 percent of the calls using BRCS features.

As with the AM/CMP, the capacity of the SM has been determined through laboratory measurements and is given for specific call types and features. The same call-mix model given in the section on *AM/CMP Processor Capacity* is assumed to establish the real-time requirement.

The real-time call capacity of the SMP must be considered when engineering the SM. If five ISLUs are put on an SM and are loaded to capacity with centrex users who use their features often, there may be a real-time call capacity problem. Refer to the Real-Time Call Capacity Worksheets for more information.

Since a call may originate in one SM and terminate in another, it is reasonable to measure the load on the SM in terms of the number of full-calls per hour.

The real-time call capacity of an SMP varies based on the software release and SMP configuration employed. These capacities are shown in Section 10.04. The capacities are given in EQPOTS (nonfeature) calls per hour at a processor occupancy rate of 90 percent. The 30-minute traffic report provides call measurements in terms of half-calls, which equal approximately twice the number of full EQPOTS calls represented in the table. The number of full-calls in an SM can be determined as follows:

$$\text{Total SM Calls} = \frac{\text{Originating} + \text{Outgoing} + \text{Incoming} + \text{Terminating}}{2}$$

The number of half-calls handled and the processor occupancy in each 30-minute period in Section 15 of the

TRAFFIC 30 reports are measured and transmitted to engineering and administrative data acquisition system (EADAS), the switching control center system (SCCS), the local maintenance channel, and the network administration center (NAC) channel.

The various tasks that the SMP executes are processed in accordance with a predetermined list of priorities. The lowest priority or nonessential work may be deferred to off-peak hours. The SMP performs this work when it has no higher priority work to perform. The SMP occupancy is defined as the percentage of time that the processor performs work other than the deferrable tasks and low priority audits. The amount of time the processor spends doing higher priority work is measured. This measurement is sent to EADAS, the local traffic channel, the local maintenance channel, and the NAC channel as a part of the 30-minute report.

The measurements provided may be used to determine SMP capacity, that is the number of half-calls which would result in maximum allowable occupancy. The COER receives data from EADAS for the peak half-hour of each day for each SM. From this data, COER provides a monthly report that enables the administrator to determine whether each SM is overloaded and; if not, how much capacity is available for additional calls. Similarly, the MLSS report provides a main station capacity estimate.

The measurements displayed on the reports include the measured values of occupancy and the corresponding numbers of circuit-switched half-calls, the percent of dial-tone delay greater than 3 seconds for the combination of dial-pulse and touch-tone dialed calls, and the tone decoder attachment delay. In addition to providing the daily peak data on the monthly report, COER summarizes the daily data using high day (HD) calculations.

The dial-tone delay (for lines) and tone-decoder delay (for trunks) data provide the main indication of an overload condition in an SM. The remaining data allows the administrator to confirm the existence of an overload, and to determine how close the SM is to the rated capacity if an overload does not exist. An indication of how fully an SM is used can be obtained from a comparison of the HD calls with the estimated capacity which COER calculates and provides. This value is based on the following:

- (1) A value of overhead, which is the processor occupancy at zero calls (no-load occupancy)
- (2) A value of the maximum allowable occupancy
- (3) The daily peak values of calls measured during the month.

This calculation assumes a linear relationship between calls and occupancy and takes into account the variation in the monthly data so that the result is more accurate.

In general, the SMPs do not limit the traffic capacity of the SM. In most cases, the SMPs have more than sufficient capacity to process all traffic offered to the associated peripheral units while reserving sufficient real-time for the addition of new features.

The rated call capacities provided in Section 10.04 assume a processor occupancy rate of 90 percent. A certain percentage of the processor real-time is allocated to fixed work. This work includes system operating overhead, origination scanning, and other nondeferrable tasks and is required even when there is no call-processing load. The associated processor occupancy measurement is called the no-load occupancy. The no-load occupancy depends on the equipage of the peripheral units in the SM as previously described. For example, an SMPU2 (68000 processor with speedup) using the 5E2(2) software release and equipped with 2 or 3 line units has a no-load occupancy of about 21 to 24 percent. The worst case is an SMPU (68000 processor) with 4 multimodule RSMs and 8 line units with the 10:1 concentration ratio. In this case, the no-load occupancy is approximately 42.3 percent (See Figure 10.1-1). The difference between the no-load occupancy and the maximum occupancy available in the SM processor (90 percent) represents the amount of time available for call processing.

The inverse relationship between calls and holding times is displayed in Figure 10.1-2 for the 5E2(2) software release, where the curves have been drawn for CCS holding times corresponding to 100 percent occupancy, 81 percent occupancy, and 50 percent occupancy. Also displayed in the figure is the distribution of holding times

observed in the 1/1A ESSTM switch. The cross-hatched area is the typical region of operation with a mixture of lines and trunks on an SM. The middle horizontal line on the figure corresponds to the maximum number of calls likely to be carried by the SM network and the upper horizontal line shows the current real-time capacity of the SMP for POTS calls. The lower horizontal line shows the typical SM load of about 4,000 calls and indicates that SM capacity is limited by the network. The SMP has ample real-time available for a feature-rich call load.

10.1.3 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

Section 15 for circuit-switched calls and Section 69 for packet-switched calls of the 30-minute traffic report and Part 2 of the 15-minute traffic report provide measurements related to processors. For the SM, the key measurements are percent occupancy and blockage due to overload.

10.1.3.1 Percent Occupancy

The percent occupancy measurement in TRFC30 Section 15 represents the percentage of time the processor spends doing call processing and other nondeferrable work. As the SMP percent occupancy approaches 90 percent, dial tone delays may be noticeable. As long as the percent occupancy is less than 70 percent for the SMP, the processor should not be the cause of any degraded service.

10.1.3.2 Blockage Due to Overload

The calls blocked during AM/CMP overload (BLKOVD) count in TRFC30 Section 4 is incremented when it is determined in the SM that a route request message cannot be sent to the AM/CMP because it is in an overload condition. In this case, the call is routed to reorder tone. This count should normally not exceed zero.

10.1.4 FEATURE IMPACT

The SMP performs more than 95 percent of the work required to support features. Therefore, a heavy penetration of features or the implementation of new features can have a significant impact on the SMP. Specifically, BRCS features provide additional loads on the SMP. Other features such as Carrier Interconnect may have additional impact on the SMP. **For details concerning feature descriptions and impacts, refer to the 235-190-XXX document series.**

10.1.5 TRANSITION IMPACT

It may be necessary to convert from one of the SMP configurations to another. This conversion may be necessary due to a software release update or retrofit, or the implementation of new features. These conversions may be required to provide access to more memory or to provide additional real-time (a faster processor), or both.

Unit and subunit growth may have an impact on the SMP. Hardware changes as well as memory changes (recent changes) may be required. These growth procedures are performed on a "live" system and therefore require great care to prevent service interruptions.

Unit growth is the addition of peripheral units. This includes the growth of an entire peripheral unit, as well as the growth of a service group (SG) in an existing unit. Examples include the growth of a trunk unit, local digital service unit, digital line trunk unit (DTLU), line unit (LU), digital carrier line unit (DCLU), global digital service unit (GDSU), or metallic service unit (MSU). Although peripheral unit and SG growth necessitate wiring and cabling, much of this is connectorized. The MSU and directly connected test unit (DCTU) are for testing purposes and do not provide call processing functions.

The growth of a peripheral unit in the 5ESS[®]-2000 switch differs significantly from the corresponding growth for an analog office. The biggest difference is the use of serial data and control buses for interconnection to the network. Note that in the case of analog lines and trunks, this alleviates the need for junctor rearrangement (since there are no junctors), and significantly reduces the wiring and cabling involved in the addition process. Necessary

assignments and connections include: the addition of peripheral interface data buses (PIDBs) and peripheral interface control buses (PICBs) to an appropriate data interface (DI) and control interface on the SM; wiring the metallic test buses (MTBs) for metallic access to the unit; cabling and wiring for the backplane connectors; physically mounting the shelves on a frame; assigning time slots if necessary; and the recent change for the common and control circuits. Power sources and fuses must be checked, and the unit's integrity must be verified before it is brought up in the live office. The growth of new peripheral units on an existing SM requires additional office wiring, and is primarily a Lucent Technologies installation activity (unless local practices dictate otherwise).

Subunit growth includes the growth of assignable packs within peripheral units, the translations associated with each pack, diagnostic and operational tests, and the equipage state for each pack. This stage of growth includes the addition of the logical name for the termination (for example, trunk equipment number) and the pack type and vintage. Examples include the growth of trunk circuit packs in a TU, the growth of a carrier system on a DFI in a DLTU, the growth of MSU or GDSU packs, and the growth of an entire integrated *SLC*[®] 96 carrier remote terminal (RT) or an individual channel unit on the RT which would affect the DCLU. The growth procedures for the DFI do involve PIDB and PICB cabling, but no frame, shelf, or power work is necessary. This level of growth can occur any time during an engineering interval, as dictated by the needs of subscribers or the telephone company.

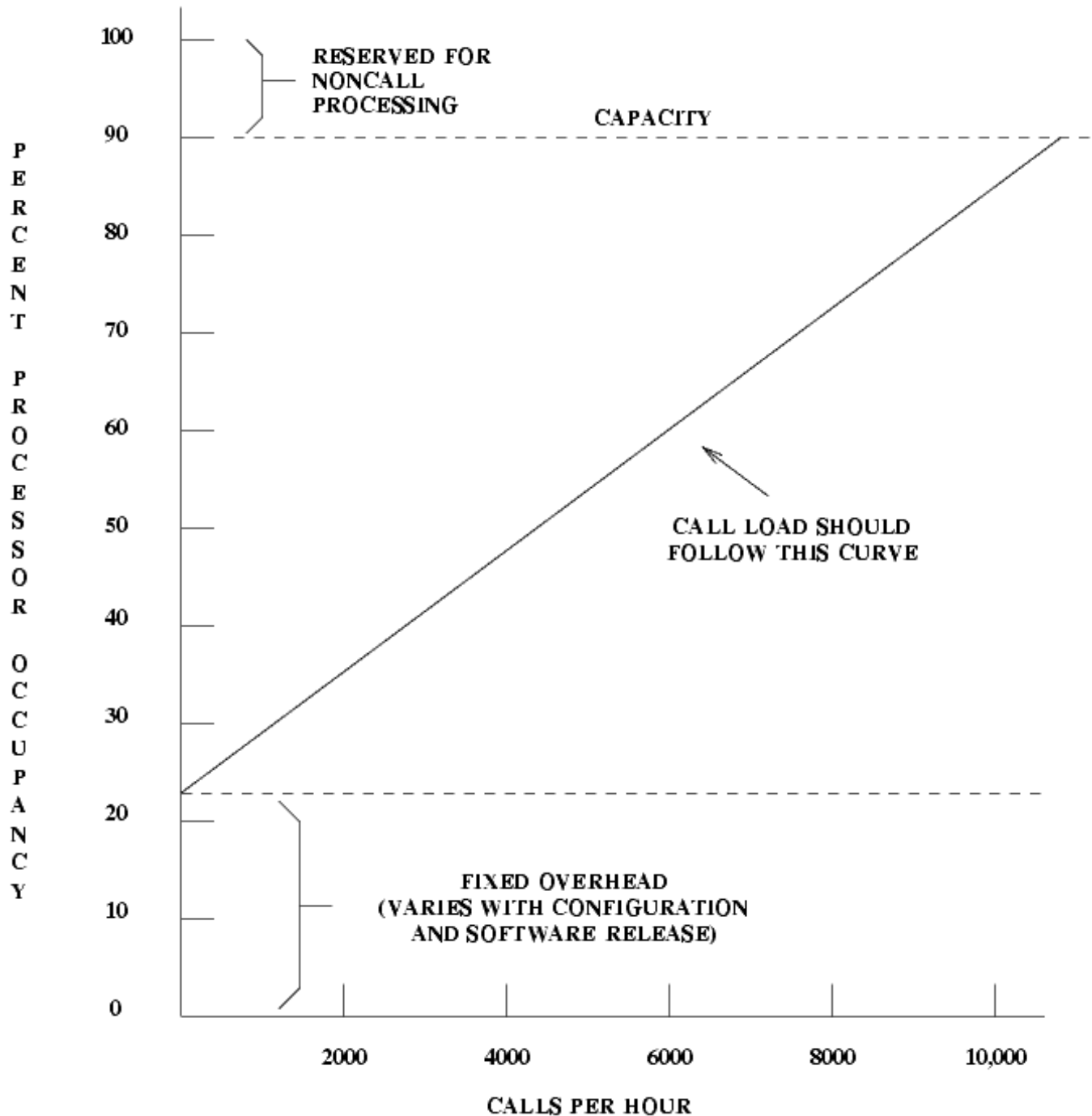


Figure 10.1-1 Switching Module Processor Capacity Example [5E2(2) and Later Software Releases]

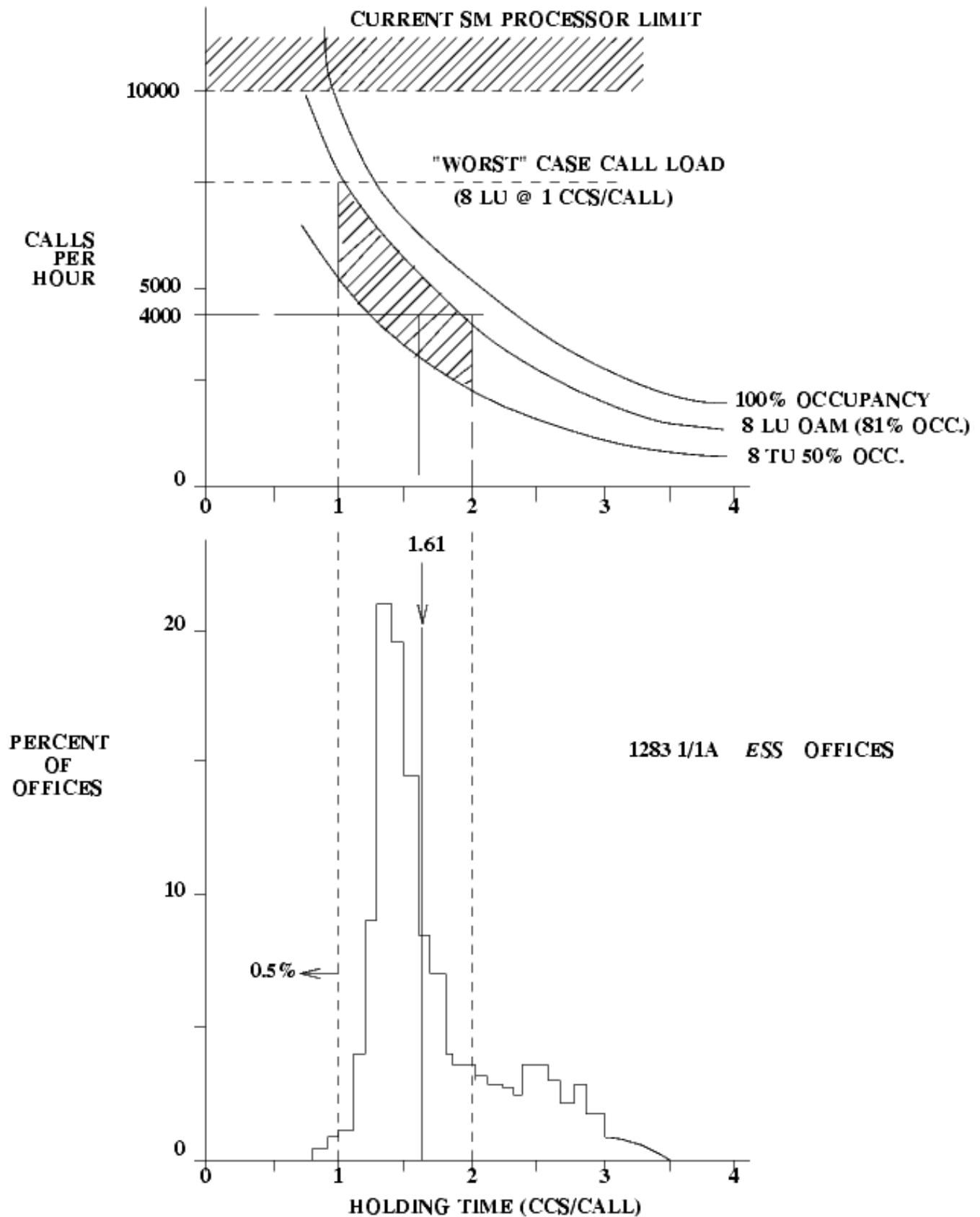


Figure 10.1-2 5ESS 2000 Switch Load Curve

10.2 SWITCHING MODULE REAL-TIME WORKSHEETS

The SM Real-Time Worksheet estimates the switching module (SM) real-time call capacity either in half calls per busy hour or in full calls per busy hour at 90 percent occupancy, and the SM processor (SMP) occupancy at the offered load in the 5ESS®—2000 switch. The worksheet enables switch customer to make an appropriate assignment of lines, trunks, attendants, and features to SMs, considering the associated real-time use of the SMP. The worksheet calculates real time consumption for the SMP12, but it can be applied to SMs equipped with SMP1, SMP20, SMP20 data cache, and SMP23 using the conversion factors inside the worksheet. The term "SM" used in this worksheet refers to an SM, remote switching module (RSM), or optically remote module (ORM). As a general guideline, this worksheet is needed only when one of the following is true:

- (1) (Average high day (Originating + Terminating) calls/line) multiplied by
SUM of {

(Number of analog nonshared DN centrex lines),

2 × (Number of analog shared DN centrex lines),

80 × (Number of analog attendant consoles),

1.5 × (Number of BRIs which have no shared DN),

2 × (Number of BRIs which have at least one shared DN),

120 × (Number of digital attendant consoles)}

1 × (Number of ACD/BRCS agents)}

plus

(Average high day (Incoming + Outgoing) calls/trunk)
multiplied by 0.7 × (Number of trunks) is greater
than 8,000.

NOTE: The current Basic Rate Interfaces (BRIs) and packet trunks are only equipped on SMs with the SMP20, SMP20 data cache, and SMP23 processor.

- (2) There is an applications processor (AP) attached to the SM and one of the following is true:
- a. Number of lines is more than 200
 - b. Number of attendant consoles is more than 3

10.2.1 SOURCES OF DATA

10.2.1.1 5E10 and Later Software Releases

In the 5E10 and later software releases, there are many different call types. Instead of providing the SM real-time

usage for each call type and requesting input such as "number of calls per busy hour" for each call type, the following approach simplifies the call capacity estimation process.

Analog lines are classified into different categories or types, such as POTS lines, rural/suburban lines, nonattendant electronic tandem network (ETN) lines, etc. These classification criteria are based on the features assigned to the lines. For example, a rural/suburban analog line is any analog line assigned with at least one of the following features: speed calling, call forwarding, call waiting, 3-way calling. If a line has other features in addition to any of these, then it is classified as a metro analog line. Detailed definitions of each analog line type is found in the worksheet (items 6 through 12). An analog line should be classified into only one type. For each type of analog line, the expected SM real-time usage is provided for an average call made from this type of line. The expected SM real-time cost for an average call made from this type of line is based on an assumption that a certain call mix is generated from this type of analog line. Instead of input such as "number of certain feature calls per busy hour," inputs such as "number of calls made from/to rural/suburban analog lines per busy hour" are requested. This approach simplifies the SM call capacity calculation.

Similarly, ISDN BRIs are classified into different types based on the features assigned to the BRI and its DN, that is, featureless BRI, nonattendant, non-ETN, nonshared DN, digital centrex, etc. Detailed information is found in the worksheet. In the SM Real-Time Worksheet, a multipoint BRI supporting three users is considered as having three ISDN BRI users. An ISDN BRI can simultaneously be used for different features at different times or even at the same time. For example, a BRI can support both voice and data. Also, since a BRI may have multiple DNs associated with it, a BRI voice traffic can be a mix of nonshared DN and shared DN. One BRI can belong to more than one type.

Trunks are also classified into five types, and each trunk belongs to only one type.

For each type of analog line, the number of calls made from this type of line can be estimated indirectly as follows:

$$(\text{average high day calling rate per line}) \times (\text{number of this type of line})$$

or

$$(\text{average CCS per line}) \div (\text{average holding time in seconds per call}) \times (\text{number of this type of line}), \text{ if the average high day calling rate per line is not directly available.}$$

The output of this worksheet is the percent of the SMP12 (or SMP with speedup) call capacity used by the offered load and the call capacity at 90 percent occupancy. By using the worksheet, the administrator also accesses the relative real-time call capacity impact of each kind of analog line, BRI, trunk, AP, and miscellaneous circuits.

10.2.2 USING THE WORKSHEET

The SM real-time worksheet provides spaces to enter the input data and the results of the arithmetic calculations. In many cases, a "skeleton equation" is provided below the basic line in the worksheets for your convenience in making intermediate calculations to determine "**YOUR INPUT**."

The means for determining the data inputs may vary. As an example, input data for **CALL WAITING** can be determined as follows:

- Data can be collected for all terminal groups in the SM.
- Data can be collected on a selected subset of terminal groups and the results extrapolated to represent the office totals.

Nominal or "common-sense" values may be used to supplant the need for a detailed analysis in many instances,

particularly where low feature-penetration exists in the office.

Also, note that the **MSEC PER CALL** coefficient is a measure of the relative importance of the various inputs. For example, **SPEED CALLING, 1 Digit** is much less significant than **CALL TRANSFER**. **OVERHEAD OCCUPANCY CALCULATION** The minimum overhead occupancy of the SMP12 is 20 percent of the switching module processor (SMP) processor's time. Additional no-load occupancy requirements occur (items 1 through 5 below) is incurred from analog line units in the SM/RSM and depends on the number of line units in the SM/RSM, and the line unit concentration ratio. There is additional overhead occupancy in an MMRS, depending on the number of RSMs in the MMRS cluster. No additional overhead is incurred by ISLUs in the SM or RSM.

Please input the expected traffic partition & feature

penetration during a 1 hour interval.

The general format of this worksheet is:

SM TRAFFIC PARTITION (NUMBER OF CALLS/HOUR)	NUMBER OF UNITS	SMP12 OCCUPANCY PER UNIT PERCENT	SMP12 OVERHEAD OCCUPANCY (PERCENT)
_____	_____	x _____	= _____

1. NUMBER OF 4:1 LINE UNITS _____ x 0.75 = _____

ON THIS SM OR RSM. _____

2. NUMBER OF 6:1 LINE UNITS. _____ x 0.95 = _____

ON THIS SM OR RSM. _____

3. NUMBER OF 8:1 LINE UNITS _____ x 1.20 = _____

ON THIS SM OR RSM. _____

4. NUMBER OF 10:1 LINE UNITS _____ x 1.45 = _____

ON THIS SM OR RSM. _____

5. IS THIS AN SM IN AN MMRS _____ x 0.87 = _____

CLUSTER? _____

If yes, enter one less than the number of SMS in the cluster,
else enter "0" for example, for a 4-module MMRSMS enter "3".

Note: Maximum number of RSMS in an MMRSMS
cluster is 4.

Sum of the above 5 calculations (items 1 through 5) ==> |A: _____|

Expected no-load occupancy (A + 20) ==> |B: _____|

TRAFFIC PARTITION

(ORIGINATING AND TERMINATING CALL MIX)

Please input traffic partition during your high day busy hour
(number of (O+T) calls per hour). The number of originating and
terminating calls per partition can be estimated as follows:

average high-day busy hour calling rate of O+T calls per
end-user number of end-users

or

average high day busy CCS per end user
 _____ x number of end-users

average holding time in seconds per call

Where the "end-user" is defined as:

1. Customer premises equipment (CPE) such as an analog phone, shared or nonshared directory number (DN) of a digital phone, terminal, attendant console, printer, computer, FAX machine, applications processor (AP), etc.
2. Another switch (local, tandem, toll, PBX, etc.)
3. Conference circuit
4. Announcement circuit.

ANALOG LINES

TRAFFIC PARTITION

If your SM has analog traffic, at least some of items 6 through 15 should be used. Each analog line should be classified in only one category.

6. NUMBER OF CALLS WHICH USE x 161 =

POTS LINES _____

(181, if RSM)

Number of calls per hour which originate from or terminate on POTS lines in this SM or RSM. No features are assigned to these lines.

7. NUMBER OF CALLS WHICH USE _____ x 193 =

RURAL OR SUBURBAN ANALOG LINES _____

(213, if RSM)

Number of calls per hour which originate from or terminate on rural or suburban analog lines, that is, analog lines with at least one of the following features assigned: speed calling, call forwarding, call waiting, or 3-way calling. If lines have features in addition to any of the ones mentioned here, it should not be included in this classification.

8. NUMBER OF CALLS WHICH USE _____ x 247 =

NONATTENDANT NON-ETN _____

(NONELECTRONIC TANDEM NETWORK) (267, if RSM)

ANALOG CENTREX LINES

Number of calls per hour which originate from or terminate on nonattendant, non-ETN, analog centrex lines, that is, analog lines with at least one of the following features assigned: call pickup, individualized dialing plan (IDP), call transfer,

automatic route selection (ARS), private facility access (PFA), terminal groups, modular queuing for lines, intercom call restriction (ICR), carrier interconnect (CI), or multiline hunt group (MLHG). These lines may also have been assigned features as listed in item 7, but they cannot have other types of features assigned. In particular, this item does not include shared DN lines included in item 10.

9. NUMBER OF CALLS WHICH USE x 271 =

NONATTENDANT ETN ANALOG _____

CENTREX LINES (291, if RSM)

Number of calls per hour which originate from or terminate on nonattendant ETN analog centrex lines; that is, analog lines with at least one of the following features assigned: ETN trunk queuing, deluxe ARS, authorization and account code, message detailed recording (MDR), or simulated facilities group (SFG) calls. These lines may also have been assigned features as listed in items 7 and 8. This item does not include shared DN lines included in item 11.

10a. NUMBER OF NON-ATTENDANT, NON ETN x 480 =

SHARED DN ANALOG CENTREX _____

(500, if RSM)

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 2 to 4

members.)

10b. NUMBER OF NON-ATTENDANT, NON ETN x 720 =

SHARED DN ANALOG CENTREX _____
(750, if RSM)

Number of calls originated from, or terminated to, a shared DN
of non-attendant non-ETN analog centrex lines. (From 5 to 8
members.)

10c. NUMBER OF NON-ATTENDANT, NON ETN x 950 =

SHARED DN ANALOG CENTREX _____
(990, if RSM)

Number of calls originated from, or terminated to, a shared DN
of non-attendant non-ETN analog centrex lines.
(From 9 to 32 members.)

11a. NUMBER OF NON-ATTENDANT, ETN x 510 =

SHARED DN ANALOG CENTREX _____
(530, if RSM)

Number of calls originated from, or terminated to, a shared DN
of non-attendant non-ETN analog centrex lines. (From 2 to 4
members.)

11b. NUMBER OF NON-ATTENDANT, ETN x 750 =

SHARED DN ANALOG CENTREX _____

(780, if RSM)

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines.

(From 5 to 8 members.)

11c. NUMBER OF NON-ATTENDANT, ETN x 980 =

SHARED DN ANALOG CENTREX _____

(1020, if RSM)

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 9 to 32 members.)

12. NUMBER OF CALLS WHICH USE x 632 =

ANALOG ATTENDANT _____

(652, if RSM)

Number of attendant or centralized attendant calls per hour.

This item is for SMs or RSMs with any analog attendant console.

NON-ISDN TRUNKS

Note: Each trunk should be classified in only one of the categories (items 13 through 18).

13. NUMBER OF CALLS WHICH USE x 146 =

POTS TRUNKS _____

(166, if RSM)

Number of incoming and outgoing calls per hour on POTS trunks
that originate from or terminate on this SM or RSM.

14. NUMBER OF CALLS WHICH USE x 210 =

TRUNK CENTREX _____

(230, if RSM)

Number of incoming and outgoing calls per hour on trunks which
have at least one of the following features assigned: Uniform
Numbering Plan, Overlap Outpulsing, or Cut-Through calls.

15. NUMBER OF CALLS USE x (240+27xNDSO) =

FRACTIONAL DS1 TRUNKS _____

(260+30xNDSO), if RSM)

Number of incoming and outgoing calls per hour on DS1 trunks on this
SM/RSM, multiplied by the average of DSO channels involved in the
fractional DS1 trunk calls.

ISDN TRUNKS AND PRI

16. NUMBER OF CALLS WHICH USE x 45 =

TRUNK PACKET SWITCH DATA _____

Number of calls per hour over the incoming internal protocol (IP) trunk. This item is applicable if this SM or RSM is equipped with incoming IP trunks.

This item is applicable if this SM/RSM is equipped with incoming internal protocol (IP) trunks.

17. NUMBER OF CALLS WHICH USE x 180 =

PRIMARY RATE INTERFACES _____

PLAIN OLD DIGITAL SERVICE

(PODS (205, if RSM)

Number of voice-only calls per hour originating from or terminating on featureless primary rate interfaces (PRI) which go to PBXs. This item is applicable if this SM or RSM is connected to PBXs by PRIs.

18. NUMBER OF CALLS WHICH USEx 230 =

PRI CENTREX _____

(255, if RSM)

Number of voice-only calls per hour originating from or terminating on PRIs having INWATS or OUTWATS features going to a PBX. This item is applicable if this SM or RSM is connected to

PBXs by PRI.

19. NUMBER OF CALLS WHICH USE $\times (420+27 \times \text{NDS0}) =$

FRACTIONAL DS1 PRI _____
 $((460+30 \times \text{NDS0}), \text{ if RSM})$

Number of incoming and outgoing calls per hour on DS1 PRIs on this SM/RSM, multiplied by the average number of DS0 channels involved in the fractional DS1 trunk calls.

APPLICATION PROCESSOR

Items 20 through 24 are applicable only if an AP is attached via BRIs to the SM/RSM. The real time for these items as indicated in the "SM REAL-TIME CONTRIBUTION" column is the SMP real time spent in processing messages between the AP and the SMP. The SMP real time spent on processing messages between the user's ISDN CPE and the SMP can be found in items 36 and 37.

20. NUMBER OF CALLS WHICH USE $\times 25 =$

AP MESSAGE DETAILED _____
 RECORDING (MDR)

Number of MDRs per hour that are generated by the switch and sent to the SM AP.

21. NUMBER OF CALLS WHICH USE x 50 =
AP MESSAGE SERVICE _____
SYSTEM (MSS) OR
ELECTRONIC DIRECTORY SERVICE (EDS)

Number of times per hour that an MSS or EDS system on the SM AP
is initiated by the switch analog user.

22. NUMBER OF CALLS WHICH USE x 120 =
AP MSS OR EDS _____

Number of times per hour that an MSS or an EDS session on the SM
AP is initiated by the switch ISDN users. This item is
applicable if up to 40 percent of the AP MSS or EDS ISDN users
have the 40-character display feature.

23. NUMBER OF CALLS WHICH USE x 135 =
AP MSS OR EDS _____

Number of times per hour that an MSS or an EDS session on the SM
AP is initiated by the switch ISDN users. This item is
applicable if 41 to 60 percent of the AP MSS/EDS ISDN users have
the 40-character display feature.

24. NUMBER OF CALLS WHICH USE x 160 =
AP MSS OR EDS _____

Number of times per hour that an MSS or an EDS session on the SM
AP is initiated by the switch ISDN users. This item is
applicable if more than 60 percent of the AP MSS or EDS ISDN
users have the 40-character display feature.

INTELLIGENT PROCESSOR

One example of an intelligent processor is a service circuit node linked to the SM via a BRI.

25. NUMBER OF CALLS WHICH USE x 580 =

INTELLIGENT PROCESSOR _____

INITIATED TRANSFER (610, IF RSM)

Number of calls terminating to a peripheral intelligent processor, with the intelligent processor then causing a call transfer to occur. The real times include only the intelligent processor termination and call transfer components and not any consumption by other features which may be involved in the call. The total effect on the SM real time consumption depends on how each vendor implements the feature on the intelligent processor.

CONFERENCE AND ANNOUNCEMENT CIRCUITS

26. NUMBER OF CALLS WHICH USE x 100 =

CONFERENCE CIRCUITS

Number of times per hour that conference circuits are used.

This item applicable if conference circuits are on the SM or RSM.

27. NUMBER OF CALLS WHICH USE x 125 =

ANNOUNCEMENT CIRCUITS _____

Number of times per hour that announcement circuits are used.

ISDN LINES

If the SM has ISDN traffic, at least some of items 28 through 42 should be used. One BRI can belong to more than one category.

28. NUMBER OF CALLS WHICH USE x 240 =

PLAIN OLD DIGITAL _____

SERVICE (PODS) (265, if RSM)

Number of calls per hour which originate from or terminate on featureless BRIs on the SM or RSM.

29. NUMBER OF CALLS WHICH USE x 330 =

NONATTENDANT NON-ETN _____

NONSHARED DN DIGITAL CENTREX (355, if RSM)

Number of calls per hour which originate from or terminate on a nonattendant, non-ETN, centrex, nonshared DN of a BRI. A

nonattendant, non-ETN, centrex, nonshared DN is a nonshared DN with at least one of the following features assigned on the DN or BRI (and no other features assigned) speed calling, call forwarding, 3-way calling, call waiting, call pickup, call transfer, IDP, ARS, PFA, terminal group, modular queuing for lines, ICR, CI, MLHG, LASS, and ASP.

30. NUMBER OF CALLS WHICH USE x 357 =

NONATTENDANT ETN _____

NONSHARED DN DIGITAL CENTREX (382, if RSM)

Number of calls per hour which originate from or terminate on a nonattendant, ETN, centrex, nonshared DN of a BRI. A nonattendant, ETN, centrex, nonshared DN has at least one of the following features assigned to the DN or the BRI: queuing for trunks, deluxe ARS, authorization codes, account codes, and SFG. Features listed in item 29 may also be assigned to the DN or the BRI.

31a. NUMBER OF NON-ATTENDANT, NON ETN x 480 =

SHARED DN DIGITAL CENTREX _____

(SMALL GROUP) (500, if RSM)

Number of calls originated from, or terminated to, a shared DN of a BRI or a multipoint BRI. (From 2 to 4 members.)

31b. NUMBER OF NON-ATTENDANT, NON ETN x 720 =

SHARED DN DIGITAL CENTREX _____

(MEDIUM GROUP) (750, if RSM)

Number of calls originated from, or terminated to, a shared DN of a BRI or a multipoint BRI. (From 5 to 8 members.)

31c. NUMBER OF NON-ATTENDANT, NON ETN x 950 =

SHARED DN DIGITAL CENTREX _____

(LARGE GROUP) 990, if RSM)

Number of calls originated from, or terminated to, a shared DN of a BRI or a multipoint BRI. (From 9 to 32 members.)

Note: With respect to items 32a, 32b, and 32c, a non-

attendant, ETN centrex shared DN is a shared DN with at least one of the features listed in item 30 assigned on the DN or the BRI or the multipoint BRI. Features listed in item 29 may also be assigned on the DN or the BRI.

32a. NUMBER OF NON-ATTENDANT, ETN x 510 =

SHARED DN DIGITAL CENTREX _____

(SMALL GROUP) (530, if RSM)

Number of calls originated from, or terminated to, a shared DN of a BRI or a multipoint BRI. (From 2 to 4 members.)

32b.NUMBER OF NON-ATTENDANT, ETN x 750 =

SHARED DN DIGITAL CENTREX _____

(MEDIUM GROUP) (780, if RSM)

Number of calls originated from, or terminated to, a shared DN
of a BRI or a multipoint BRI. (From 5 to 8 members.)

32c. NUMBER OF NON-ATTENDANT, ETN x 980 =
SHARED DN DIGITAL CENTREX _____
(LARGE GROUP) (1020, if RSM)

Number of calls originated from, or terminated to, a shared DN
of a BRI or a multipoint BRI. (From 9 to 32 members.)

33. NUMBER OF CALLS FROM _____ x 45 = _____
 PACKET SWITCH DATA _____
 ORIGINATIONS _____

Number of packet switch data calls per hour (including on-demand B-channel packet switch data calls) originating from, but not terminated to, the SM or RSM.

34. NUMBER OF CALLS WHICH USE 265 =
CIRCUIT SWITCH DATA _____
(290, if RSM)

Number of featureless circuit-switched data calls per hour
originating from or terminating at the SM or RSM.

35. NUMBER OF CIRCUIT-SWITCHED DATA x 310 =

CENTREX CALLS _____

(335, if RSM)

Number of times per hour that circuit switched data calls
originated from or terminated to this SM with at least one of
the following features assigned: hunt group/transfer, MLHG
queuing, ARS, PFA, authorization code, account code, ICLID, or MDR.

APPLICATION PROCESSOR

Items 36 and 37 are applicable only if the AP is attached to the
switch by BRIs. (The AP may be attached to any SM on the
switch.) The real-time consumption for these items is the SMP
real time spent on processing messages between the user's ISDN
CPE and the SMP. If the AP is connected to the SM, the SMP real
time spent on processing messages between the AP and the AP
associated system process can be found in items 20 through 24.

36. NUMBER OF CALLS FROM _____ x 280 =

AP USERS (WITHOUT _____

40-CHARACTER DISPLAY TERMINALS)

Number of times per hour that ISDN users without 40-character display terminals initiate an EDS or MSS session at the SM or RSM.

37. NUMBER OF CALLS FROM _____ x 360 =
 AP USERS (WITH _____
 40-CHARACTER DISPLAY TERMINALS)

Number of times per hour that ISDN users with 40-character display terminals initiate an EDS or MSS session at the SM or RSM.

DIGITAL ATTENDANTS

38. NUMBER OF CALLS WHICH USE _____ x 895 =
 DIGITAL ATTENDANT _____
 (920, if RSM)

Number of times per hour that attendant 1- and 2-way calls split with bridge are made. This item is applicable if attendants using ISDN consoles are located on the SM or RSM.

39. NUMBER OF CALLS WHICH USE _____ x 195 =
 DIGITAL MESSAGE SERVICE _____
 SYSTEM (MSS) ATTENDANT _____ (220, if RSM)

Number of times per hour that attendant MSS call coverage calls are made on this SM or RSM. The assumption is that the digital MSS attendant is always logged onto the AP by way of a packet or

circuit switch data call to monitor or insert messages. This item is applicable if attendants using ISDN consoles are located on the SM or RSM.

40. NUMBER OF CALLS WHICH USE x 310 =
 ACD/BRCS AGENT _____

Number of calls per hour terminating to, or originating from, ACD/BRCS agents on this SM or RSM.

Note: If the SM has OSPS/CACD traffic as well as ACD/BRCS traffic, the call counts for both types of ACD traffic can be combined in this item. However, this worksheet does not account for any other OSPS traffic, and therefore, if other OSPS traffic exists on this SM, the worksheet will not provide an accurate result for the call capacity of this SM.

Sum of YOUR INPUT (items 6 through 40) ==> |C: _____
 | _____|

Sum of SM REAL-TIME CONTRIBUTION (_____
 items 6 through 40) ==> |D: _____
 | _____|

YOUR SM OR RSM CALL CAPACITY AT 90 PERCENT OCCUPANCY

Enter A and B as decimal fractions in these formulas.

SMP1

In the SM equipped with SMP1, within 1 hour the SM call capacity at 90 percent occupancy is:

$$3,6000,000 \times (0.90 - (1.18 \times \mathbf{B} \underline{\hspace{2cm}}))$$

$$\underline{\hspace{2cm}} = \underline{\hspace{2cm}} \text{ calls per hour}$$

$$\mathbf{D} \underline{\hspace{2cm}}$$

$$1.28 \times 2 \times \underline{\hspace{2cm}}$$

$$\mathbf{C} \underline{\hspace{2cm}}$$

SMP12 (or SMP1 with SPEEDUP)

In the SM equipped with SMP12 (or SMP1 with SPEEDUP), within 1 hour the SM call capacity at 90 percent occupancy is:

$$3,600,000 \times (0.90 - \mathbf{B} \underline{\hspace{2cm}})$$

$$\underline{\hspace{2cm}} = \underline{\hspace{2cm}} \text{ calls per hour}$$

$$\mathbf{D} \underline{\hspace{2cm}}$$

$$2 \times \underline{\hspace{2cm}}$$

C _____

SMP12 (or SMP1 with Speedup) provides the following performance improvements over SMP1: reduction of no-load occupancy by 15 percent, approximately 22 percent reduction in real time per call, and approximately 37 percent increase in overall call capacity.

SMP20

In the SM equipped with SMP20, within 1 hour the SM call capacity at 90 percent occupancy is:

$$\begin{aligned}
 &3,6000,000 \times (0.90 - (0.63 \times \mathbf{B} \text{ } \underline{\hspace{1cm}})) \\
 &\underline{\hspace{2cm}} = \underline{\hspace{2cm}} \text{ calls per hour} \\
 &\quad \mathbf{D} \text{ } \underline{\hspace{2cm}} \\
 &0.59 \times 2 \times \underline{\hspace{2cm}} \\
 &\quad \mathbf{C} \text{ } \underline{\hspace{2cm}}
 \end{aligned}$$

SMP20 provides the following performance improvements over SMP12 (or SMP1 with SPEEDUP): reduced no-load occupancy by 37 percent, approximately 41 percent reduction in real time per call, and approximately 95 percent increase in overall call capacity.

SMP20 WITH DATA CACHE

In the SM equipped with SMP20 with data cache, within 1 hour the SM call capacity at 90 percent occupancy is:

$$\begin{aligned}
 & 3,6000,000 \times (0.90 - (0.48 \times \mathbf{B} \text{ } \underline{\hspace{1cm}})) \\
 & \underline{\hspace{1cm}} = \underline{\hspace{1cm}} \text{ calls per hour} \\
 & \qquad \qquad \mathbf{D} \text{ } \underline{\hspace{1cm}} \\
 & \qquad 0.59 \times 2 \times \underline{\hspace{1cm}} \\
 & \qquad \qquad \mathbf{C} \text{ } \underline{\hspace{1cm}}
 \end{aligned}$$

SMP20 with data cache provides the following performance improvements over SMP20: reduced no-load occupancy by 23 percent, approximately 33 percent reduction in real time per call, and approximately 57 percent increase in overall call capacity.

SMP23

In the SM equipped with SMP23, within 1 hour the SM call capacity at 90 percent occupancy is:

$$\begin{aligned}
 & 3,6000,000 \times (0.90 - (0.58 \times \mathbf{B} \text{ } \underline{\hspace{1cm}})) \\
 & \underline{\hspace{1cm}} = \underline{\hspace{1cm}} \text{ calls per hour} \\
 & \qquad \qquad \mathbf{D} \text{ } \underline{\hspace{1cm}} \\
 & \qquad 0.47 \times 2 \times \underline{\hspace{1cm}} \\
 & \qquad \qquad \mathbf{C} \text{ } \underline{\hspace{1cm}}
 \end{aligned}$$

SMP23 provides the following performance improvements over

SMP20:reduced no-load occupancy by 7 percent, approximately 20 percent reduction in real time, and approximately 27 percent increase in overall call capacity.

Note:If these calculations indicate a call capacity occupancy greater than 90 percent, consider deloading the SM/RSM.

PERCENT OF CALL CAPACITY USED BY THE OFFERED LOAD

SMP1

If your SM is equipped with SMP1, the percent of the SMP1 call capacity used by the offered load is:

$$\frac{1.28 \times D}{3,600,000 \times (0.90 - (1.18 \times B))} = \text{calls per hour}$$

SMP12 (or SMP1 with Speedup)

If your SM is equipped with SMP12 (or SMP1 with SPEEDUP), the percent of the SMP12 call capacity used by the offered load is:

$$\frac{D}{3,600,000 \times (0.90 - (B))} \times 100 = \text{percent}$$

SMP20

If your SM is equipped with SMP20, the percent of the SMP20 call capacity used by the offered load is:

$$\begin{aligned}
 & 0.59 \times \mathbf{D} \text{ _____} \\
 & \text{_____} \times 100 = \text{_____} \text{ percent} \\
 & 3,600,000 \times (0.90 - (0.63 \times \mathbf{B} \text{ _____}))
 \end{aligned}$$

SMP20 with Data Cache

If your SM is equipped with SMP20 with data cache, the percent of the SMP20 call capacity used by the offered load is:

$$\begin{aligned}
 & 0.39 \times \mathbf{D} \text{ _____} \\
 & \text{_____} \times 100 = \text{_____} \text{ percent} \\
 & 3,600,000 \times (0.90 - (0.48 \times \mathbf{B} \text{ _____}))
 \end{aligned}$$

SMP23

If your SM is equipped with SMP23, the percent of the SMP23 call capacity used by the offered load is:

$$\begin{aligned}
 & 0.47 \times \mathbf{D} \text{ _____} \\
 & \text{_____} \times 100 = \text{_____} \text{ percent}
 \end{aligned}$$

$$3,600,000 \times (0.90 - (0.58 \times \mathbf{B} \text{_____}))$$

Where:

B = No-load capacity

C = Total number of (O+T) calls per busy hour

D = Total real time used by the offered load.

10.3 SWITCHING MODULE MEMORY

10.3.1 DESCRIPTION

The switching module (SM/SM-2000) and remote switching module (RSM) memory contains software releases and data [static and dynamic office dependent data (ODD)] necessary to perform most of the call processing functions.

The SM/SM-2000 processor (SMP) is fully duplicated and is operated in an active/standby configuration. In the normal configuration, the active SMP controls the entire SM/SM-2000, and keeps the data areas in the standby processor updated.

Memory for each SMP is supplied in the following two forms:

- (1) Read-Only Memory (ROM) - The ROM contains data that is preset at manufacture. The ROM data is not lost if power is temporarily removed.
- (2) Random-Access Memory (RAM) - The RAM contains data that can be changed under program control. The RAM data is lost if power is temporarily removed.

Most SM/SM-2000 programs are kept in RAM with backup provided on disk at the administration module (AM). The backup programs are transmitted over the network control time slot (NCT) links from the AM processor when the system is initialized, when a new software release is loaded, or when program integrity is suspect. An RSM engineered to provide stand-alone billing has an additional amount of memory to temporarily store automatic message accounting (AMA) records.

NOTE: The information in this section applies to the SM only.

10.3.2 ENGINEERING CONSIDERATIONS

Components of SM/SM-2000 memory size are as follows:

- Software Release (also known as text)
- Unprotected ODD (also known as dynamic ODD)
- Nonredundant ODD (part of static ODD)
- Redundant ODD (part of static ODD)
- Stand-Alone Billing
- Unallocated memory.
- Real Time Billing
- Peripheral Options

10.3.2.1 Software Release

The software release (or text) is the code that runs the SM/SM-2000. The size is different for different SM or SM-2000 configurations. Note that the text size grows from software release to software release because the amount of code to support new features increases from release to release.

10.3.2.2 Unprotected ODD

The Unprotected ODD (UODD) is the dynamic data for storing transient call information, such as equipment status, or call status at any given time during the process of a call. Unprotected ODD is a variable value (not assigned a specific size) UODD is not backed up on disk.

10.3.2.3 Nonredundant ODD

Nonredundant ODD (NRODD) and redundant ODD (RODD) are known as static ODD. These data are considered static because they can only be changed by human intervention such as through recent change. As the name implies, NRODD is different in every SM/SM-2000. The information stored in NRODD is the feature information on individual phones such as:

- What features each subscriber purchased
- Speed call lists
- Call forwarding information
- Screen lists for Local Area Signaling Services
- Individual dialing plans.

The NRODD grows from release to release with the addition of new features. The NRODD also grows if new lines are added to the SM/SM-2000 because feature information on those lines are to be stored here. SM/SM-2000 ODD engineering is based upon anticipated changes in the static, nonredundant SM/SM-2000 ODD sizes. NRODD is backed up on disk.

10.3.2.4 Redundant ODD

Redundant ODD (RODD), part of static ODD, consists of information needed to route calls between SM/SM-2000s. It is redundant in every SM/SM-2000. Examples of redundant ODD are as follows:

- Office dialing plans
- Rate and route table
- Division of revenue data.

The RODD increases if new rate or route information is added. One copy of RODD is backed up on disk.

10.3.2.5 Stand Alone Billing

Stand-Alone Billing (SAB) is the area used to store billing information if the SM/SM-2000 is in stand-alone mode. Fifty kB is automatically added for SAB in every SM/SM-2000, but additional SAB memory can be added. To use the 50 kB or to add additional SAB, the SAB Right-to-Use fee must be purchased.

10.3.2.6 Unallocated Memory

Total SM/SM-2000 memory is the sum of text, UODD, NRODD, RODD, SAB, and Peripheral Options. The remaining memory between the total memory required and the end of the memory board, is the unallocated memory available for future growth of NRODD and RODD. If additional SAB is used, all unallocated memory is assigned to SAB; however, UODD, NRODD and RODD can still be grown. The memory is taken from SAB as if it were unallocated memory. When unallocated memory is exhausted, additional memory boards need to be ordered.

10.3.2.7 Real Time Billing

SM memory is allocated for real-time billing function .

10.3.2.8 Peripheral Options

Peripheral image optioning reduces SM/SM-2000 memory size by eliminating text code for peripheral units not equipped in the SM/SM-2000 being pumped.

10.3.3 ASSIGNMENT GUIDELINES

The most efficient way to utilize SM/SM-2000 memory is to avoid replicating data in the SM/SM-2000 whenever possible. This is accomplished by limiting the distribution across SM/SM-2000s of IDP groups, shared speed-call groups, and other shared data. Refer to 235-190-XXX series documents for further details.

It is necessary to give more consideration to the sequential assignment of other parameters. This is because many translations have moved from the AM to the SM/SM-2000 and because other previously hashed relations are now accessed by the compacted-index method. Table 10.3-1 identifies these parameters and provides the guidelines for group sizes. If group number assignments are skipped, the omitted numbers should be in multiples of the group size indicated. For example, charge index assignments could be in ranges of 0 through 15, 32 through 47, and 128 through 144. The numbers in the ranges of 16 through 31 and 48 through 127 are not assigned. Also refer to the assignment guidelines previously provided for the AM.

Table 10.3-1 SM Sequential Assignment Guidelines

PARAMETER	GROUP SIZE
Screening indexes	64
Code indexes	128
POTS route indexes	21
BRCS route indexes	9
Charge indexes	21
Call pickup groups	64

Multiline hunt groups affect real-time usage and memory within an SM/SM-2000. These groups must be spread in limiting SM/SM-2000s because of the redundancy of memory. Unless an MLHG has uniform call distribution (UCD), terminal 1 receives the heaviest usage, then terminal 2, etc. If the MLHG does not have UCD, the MLHG should be assigned with terminal 1 having the highest priority class of service. Terminal 2 should have the next lower priority, etc.

Because memory is also involved with the MLHGs, the same scheme as used in BRCS IDP group should be used.

Although normalized office codes (NOCs) and telephone numbers do not require assignment in groups, it is best to assign them sequentially whenever possible. In the case of telephone numbers, hundreds groups should be filled before opening new hundreds groups.

Additionally, SM/SM-2000 memory may be saved through the use of BRCS feature groups (BFGs) as shown in Table 10.3-2. For detailed information on modular feature types, refer to 235-190-101 *Business and Residence Modular Features*.

Table 10.3-2 Modular Feature Types and BFG SM Memory Savings

BEGINNING SOFTWARE RELEASE	MFT ABBREVIATION	FEATURE TYPE	POTENTIAL SM MEMORY SAVINGS PERCENTAGE
5E6	CPI	Calling Party Number/Billing Number	100
	HI	Home Intercom	100
	ID	Individualized Dialing (Replaces IDP) ^a	0

	SC	Speed Calling	b
	SCA	Local Area Signaling Services - Selective Call Acceptance/ Computer Access Restriction	100
	SCF	Local Area Signaling Services Selective Call Forwarding	100
	SCR	Local Area Signaling Services Selective Call Rejection	100
	SDA	Local Area Signaling Services Selective Distinctive Alerting	100
Notes:			
a. The IDP modular feature type was available prior to 5E6 software release.			
b. An indeterminate amount of speed calling memory savings results from BFG use. The actual memory savings depends upon how speed calling is implemented. The use of shared and unshared speed calling lists changes memory savings potential. Shared speed calling lists use 30-50% less memory than unshared speed calling lists.			

10.3.4 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

There are no dedicated measurements for monitoring SM/RSM memory usage. The OP:ODD command provides the necessary usage determination method as previously described. Additionally, the major and minor alarms provide the only types of service indicators.

10.3.5 FEATURE IMPACT

Memory usage in an SM/SM-2000 or RSM may be impacted by feature penetration. For further details concerning these and other features and how they impact the current software release, refer to the memory worksheets in this manual.

10.3.6 MEMORY MANAGEMENT

Memory can be sized and administered by communities to achieve additional efficiency. The following communities may be considered:

- ORMs
- RSMs
- RSM clusters
- All other SM/SM-2000s
- SM/SM-2000s with heavy BRCS penetration.

10.3.6.1 Static ODD

The following is a list of general tips that may assist in the management of memory.

- Screening entries are not needed for unused prefixes.
- Packing can be optimized for indexed relations by sequentially numbering groups and members.
- PBX direct inward dialing (DID) telephone number assignments require careful consideration. Generally, there are three ways to assign PBX DID lines: by individual lines, by hundreds group, or by the local digit interpreter table (LDIT) or incoming digit interpreter table (INDIT). There are advantages and trade-offs associated with each of these methods as described as follows:

- PBX DID telephone numbers translated in the LDIT or office dialing plan (INDIT) require less memory than directory number tables. However, verification of these lines cannot be performed based on the telephone numbers (only by information on LDIT or INDIT forms).
 - Assignments made on individual lines use a large amount of memory, but verifications are easily performed.
 - Assignments made based on the hundreds group use memory efficiently and are relatively easy to verify.
- Limiting the distribution across SM/SM-2000s of IDP groups and shared speed call groups reduces data duplication and, therefore, saves memory.

During periods of high RC activity, tuples entered into hashed relations may be placed into secondary overflow which is linearly searched. This indicates the need for a reorganization (memory reorganization), as the relations are in overflow. Although a reorganization should be scheduled for automatic execution each day, heavy RC activity may require a manual reorganization. This is done through the use of the EXC:REORG input message from the MCC or SCCS. It may be necessary to first allow the reorganization by the ALW:REORG command, although reorganization should normally be in the allow state. For further details on the use of this message and the system response, refer to Input Message Manual 235-600-700, and 235-600-750, Output Message Manual. Further information concerning reorganization can also be found in 235-105-220, Corrective Maintenance Procedures.

Should the reorganization fail, it is probably due to insufficient room in the allocated area of memory in that SM/SM-2000 or RSM. The mechanism of reorganization moves one data base relation at a time from the used area to the available area in the SM/RSM, performs the reorganization, and frees the space previously used by the relation. This results in a reduction of the number of pages of secondary overflow of the relation, as well as reducing the size of used memory area. If the relation is too large for the allocated area, the reorganization will fail.

To obtain the status of memory allocation in the office, the following input requests can be made.

- To determine which relations may need reorganization:
 - INH:REORG
 - EXC:REORG.

The result of these commands is a printout of the relations needing reorganization. When this is completed, the automatic reorganization should be allowed with the ALW:REORG command.

- To determine the amount of static ODD space currently used, enter the OP:ODD message.

These messages are input from the MCC or SCCS and cause a report to be generated for each SM/SM-2000 or RSM and the AM. For further details concerning these messages, refer to 235-600-700 and 235-600-750. The report provides the following information:

- The number of 128-byte memory blocks used
- The number of 128-byte memory blocks available with the current allocation. (There may be additional memory present which can be allocated.)
- Percent of the currently allocated memory used.

The percent of memory used is calculated by dividing the number of blocks used by the total of the blocks used and

the blocks available. This sum of used and available blocks is the value of a parameter called DBPHYSBLKS.

The 5ESS®-2000 switch data base management (DBM) subsystem automatically stores the ODD on pages (areas of storage 128 to 8,192 bytes long) within memory of the AM and the SM/SM-2000s. As lines and trunks and other services are added to the 5ESS®-2000 switch, ODD memory requirements may increase. Because ODD data items are stored in pages, the memory requirement is a function of the number of pages used and their sizes rather than a direct relationship to the number of lines, trunks, or services supported. For example, because of line assignment guidelines, adding POTS lines typically does not increase SM/SM-2000 ODD.

Since changes in the ODD impact its size, ODD memory should be monitored. This is particularly true of the SM/SM-2000 ODD which may exceed the engineered size and require the allocation of more space or even the installation of more memory boards. The size of ODD memory should be checked periodically, such as before and after any memory impacting growth procedure is performed. These growth procedures include:

- Heavy feature growth.
- Any addition of digit analysis, such as changes which require more digits to be translated.
- Additions to the screening table.
- The addition of new IDP groups to the SM/SM-2000. This is particularly true if there is a large amount of private digit analysis required for the IDP group. The addition of a new IDP group is defined as the addition of the first member line or trunk to the SM/SM-2000. Further information concerning the implementation of new IDP groups may be found in 235-190-XXX series documents.

For further details concerning the impact on memory by feature and hardware growth procedures, refer to the memory worksheets.

Generally, the SM/SM-2000 static memory should be monitored. There must be enough memory provided to allow reorganization. The memory monitoring tool (OP:ODD) may be used to monitor static ODD memory in the SM/SM-2000s and RSMs.

Unallocated memory or available memory should be about 500 kB for best switch operation. If engineering this space requires another SM memory board, ensure that at least 200 kB of available memory is provided at the end of the engineering period. This may save the expense of the additional memory board. If disk space is available for backup copies of SM/SM-2000 ODDs, and extra space is not required for stand-alone billing, ODD memory may be allocated to the maximum amount possible given the memory board equipage. Consideration should be given to SM/SM-2000 additions when determining needed backup disk space.

10.3.6.2 Dynamic ODD

Dynamic ODD, also known as UODD, is sized based on the type of SM/SM-2000 memory image. For example, a Loaded SM/SM-2000 serving ISDN or OSPS has more UODD allocated than a Standard or Basic SM. An SM/SM-2000 serving hundreds of ISDN BRIs uses more UODD than an SM/SM-2000 serving a small number of BRIs. The purpose of having two UODD sizes is to conserve SM memory for the vast majority of SM/SM-2000s which have fewer than 1,024 ISDN lines assigned. The allocation of the SM/SM-2000 UODD is performed by the ODA process. The OP ODD report provides information on AM, SM/SM-2000, and CMP.

10.3.6.3 Stand-Alone Billing

In the 5E5 and later software releases, all SM/SM-2000s; including RSMs, ORMs, host SMs (HSMs), and 2-mile ORMs (TRMs) can have the stand-alone billing option.

A minimum of 50 kB of memory is dedicated to stand-alone billing memory on an SM, and 740 kB on an SM2000.

Allocated memory for ODD is located immediately before the stand-alone memory. Any unallocated memory is located immediately after stand-alone memory.

The SM/SM-2000 unprotected ODD (UODD) memory growth is performed by moving the starting address of the SM/SM-2000 nonredundant ODD (NRODD) into higher memory by the ST:UODDGRW input message. However, the ending address of the NRODD remains unchanged. Therefore, the UODD growth is limited in size by the amount of available memory available within the NRODD. The SM/SM-2000 UODD growth should be executed only in rare circumstances because the SM/SM-2000 UODD is already engineered to be sufficient for most offices.

The NRODD growth increases the amount of memory allocated to the NRODD by shifting the entire redundant ODD (RODD) and stand-alone billing areas into higher memory. This is accomplished through the use of the ST:NRODDGRW input message.

The RODD growth shifts all stand-alone billing area into higher memory through the use of the ST:RODDGRW input message. The RODD growth occurs simultaneously on every SM/SM-2000.

The "unallocated" memory space is free for UODD, NRODD, RODD, or stand-alone billing growths to acquire. However, when the unallocated space has been used completely, no further UODD, RODD, NRODD, or stand-alone billing growths can occur without memory board growth or reduction of stand-alone billing memory. Specifying a growth size larger than the unallocated size in an SM/SM-2000 results in a corresponding reduction in the allocated stand-alone billing space (up to the last 50 kB on an SM, and 740 kB on an SM-2000) since NRODD and RODD have priority over stand-alone billing. Note that the growth will fail if an attempt is made to grow ODD into the 50 kB dedicated to stand-alone billing.

Reducing the stand-alone billing space results in the SM/SM-2000 being able to store billing information for a smaller period of time if the SM/SM-2000 should be forced into the stand-alone mode. If there is not enough memory in the unallocated space to grow SM/SM-2000 NRODD or RODD, then the traffic or equipment engineer should be consulted to order additional memory. Detailed ODD growth procedures can be found in 235-105-210.

By using the CFR:SAMEM input message, stand-alone billing growth increases the amount of memory allocated to stand-alone billing by allocating all unallocated memory. Note that stand-alone billing memory is not in use when this allocation occurs. Thus, the OP:ODD output message shows unallocated (UNALLOC) memory as 0 bytes and adds the formerly unallocated memory to stand-alone billing memory (SABM). The VFY:SAMEM input message may be used to verify the amount of allocated stand-alone billing memory. Refer to Input Message Manual, 235-600-700 and Output Message Manual 235-600-750 for details on the CFR:SAMEM, OP:ODD, ST:NRODDGRW, ST:RODDGRW, ST:UODDGRW, and VFY:SAMEM messages.

The amount of memory dedicated for stand-alone billing data is dependent on the expected number and type of billed calls and the expected duration of stand-alone operation.

10.4 SM MEMORY WORKSHEET HARDWARE AND FEATURE GROWTH

10.4.1

When transitioning to a new software release, it is advisable to review all subsequent software release information in order to determine future growth considerations.

10.4.2 5E10 SOFTWARE RELEASE

With software release 5E10, there are four software configurations: basic, standard, loaded, and SM-2000.

10.4.2.1 HARDWARE

Table 10.4-1 5E10 SMPU Configurations

PROCESSOR ^a		MEMORY BOARDS ^b	MAX. SLOTS	MAX. EQUIPAGE (MB) ^c
SMP12	68012	TN56	5 + 7	24
		TN2012	5 + 3	32
SMP23	68020	TN56	5 + 7	24
		TN2012		
SMP23CDM		TN1423	0	32
SMP20	68020	TN1374	6	24
SMP20DC		TN1376	6	48
		TN1661	6	96
CORE 40	68940	TN 1685	4	128
		TN 1806	2	256
CORE60	68060	TN1685	4	192
		TN1806	4	256

Notes:

- Processor addressability limits: 68012 & 68023 - 32 MB, 68020 - 4 GB, SB20CORE/ CORE40 /CORE60 - 748 MB.
- TN56 = 2MB, TN2012 = 4 MB, TN1374 = 4 MB, TN1376 = 8 MB, TN1661 = 16 MB, TN1685 = 32 MB, TN1423 = 32 MB, TN1806 = 64 MB. The TN1374, TN1376, TN1661 boards may be mixed in the same MCTU2 (68020). The TN1685 and TN1806 boards may be mixed in the same CORE40/60. The other boards are not mixable. The TN1423 is a new microprocessor board with dynamic memory.
- In the 5E10 and later software releases, the 64 MB Memory Board feature provides additional Dynamic Random Memory (DRAM) for SM-2000. With this feature, the SM-2000 dynamic memory spectrum is expanded from the existing 128 MB to 265 MB. In addition, this feature provides memory mixing allowing an SM-2000 to be simultaneously equipped with 32MB and 64MB memory boards, TN1685 and TN1806.

10.4.2.1.1 TN1423 Microprocessor Board (Feature SMP23CDM)

The SMP23/SMP12 required an MEU to expand beyond 20 MB (5 slots x 4 MB). Some SMs were equipped without an MEU and subsequently, other hardware was added on the shelf reserved for the MEU. Therefore, the SM was capped at 20 MB. More than 20 MB were required for all SMs in software release 5E10. To alleviate the need for an MEU, a new feature was provided in software release 5E10 to replace the microprocessor board with a TN1423 dynamic memory board that contains 32 MB of memory. The existing five TN2012 boards could then be removed for use elsewhere (see below).

- This feature is also known as SMP23CDM for SMP23 Core Dynamic Memory.
- This feature supports conversion from the SMP12 to TN1423. However, the firmware on the TN874B needs to be updated (re-burned).
- SMs with TN56s that wish to expand from 24 MB (hardware limit - 12 slots x 2 MB) to 32 MB could use this option instead of replacing all 12 TN56s with eight TN2012s (8 x 4 MB). Or the "surplus" TN2012s from SMs

with TN2012s that installed this board can be used to replace the TN56s.

When the TN1423 is installed in SMs equipped with TN2012s, the five TN2012s can be used to grow memory in other SMs with MEUs. TN2012 boards can also be used to grow 3B21 AM memory.

10.4.2.1.2 Module Control Time Slot Interchange Unit Version 3 (MCTU3)

Non-SM-2000 SMs shipped when this equipment is available are equipped with the MCTU3 that has a 68LC040 processor. The MCTU3 has all the existing functionality of the SMP20 plus additional capabilities. It is a one shelf unit, instead of a two shelf unit (MCTU2) needed for the SMP20.

10.4.2.1.3 SM-2000 Memory

The CORE40 was shipped with the SM-2000 in software release 5E9(2). There are four memory slots. Only the TN1685 (32 MB) board was supported in 5E9(2). In 5E10, the CORE40 supported either TN1685s or TN1806s or a mix of both.

The CORE60 was shipped with the SM-2000 in software release 5E10. There are still four memory slots. However, the CORE60 comes with the first 64 MB of memory attached to the processor core board. If 96 MB is required, only one TN1685 is needed. If 96 MB is required, only one TN1685 will be needed. Two TN1685s or one TN1806 56 MB will provide a total of 128 MB. Mixing of TN1685s and TN1806s is permitted.

Note that if an upgrade from a CORE40 to a CORE60 is ordered for improved real time, some of the memory packs are no longer needed as the CORE60 comes with 64 MB on the processor board.

10.4.2.2 SOFTWARE

The 5E10 software release supports four SM software configurations: Basic, Standard, Loaded and SM-2000.

10.4.2.2.1 Peripheral Image Optioning (PO)

Table 10.4-2 shows the PO image sizes for the 5E10 software release.

Table 10.4-2 5E10 Image Sizes and Configuration Support

IMAGE	KB	BASIC	STANDARD	LOADED	SM2000
-					
LDSU ^a , ^b	92 + 42	√	√	√	
LDSF ^a , ^c	202+202				√
ISTF ^a	60 + 42	√	√	√	
IDCU	742		√	√	√
SAS	426	√	√	√	√
ISLU2	842			√	√
PI2	450			√	√
PH3	1156			√	
DNUS	1054				√

Notes:

- a. If the SM has LDSU, RAF, or ISTF, the 42 KBs is counted only once. For example, if the SM has LDSU and RAF, the total is 92 + 80 + 42.
- b. Not applicable to LDSU1.
- c. LDSF Functionality is provided with all SM-2000 SMs. Therefore, if you have SM2000, you will need LDSF with 202 KB and the additional 202 KB if you have GDSF, or LDSF.

10.4.2.2.2 Variable UODD

The sizing of Unprotected Office Dependant Data (UODD) is possible., UODD is a variable number. The size varies based upon the specific features and number of lines supported in static ODD (non-redundant and redundant). For example, in software release 5E8 the UODD for all Basic SMs was one fixed size of 1304 KB. Now each SM has a unique size. The Office Data Assembler (ODA) checks all static relations and totals the UODD required to support those static relations. There is a fixed association between the static data and the related relations stored in UODD. For planning purposes, there is a default number (maximum size). That default number can be used when projecting memory sizes if the actual value is not known.

10.4.2.2.3 Software Resource Engineering (SRE)

Another way of keeping memory sizes under control is SRE. A subset of the relations are sized according to an algorithm, but is growable through recent change input. The algorithms are designed to accommodate five standard deviations or 99.97% of the SMs. A small group of relations require input from traffic engineer to calculate the data. Currently, the two relations that require user input are the OSPS relations COINOT and SRVOT. They request the percent of office traffic for coin, MECH, Listing Services, and QUANTUM calls. Refer to recent change view 8.9 for more information.

Some registers may be grown by input to recent change view 8.40. The need to grow registers is rare, but may be warranted for the following situations:

- If a service requires an unusual number of registers for call processing such as call transfer registers for some *A-I-NET*® services or Automatic Call Distribution (ACD). To prevent SM breakage on a register, the register may be grown.
- If an office is an extreme outlayer in feature usage such as very large ISDN SMs with greater than five calls per hour per ISDN line and greater than 210 second holding times per line.
- If a register needs to be grown, contact Lucent Technologies for assistance. Please keep in mind that the number of affected offices is very small.

10.4.2.2.4 Memory Engineering Guidelines

The following are the memory engineering guidelines for each of the SM configurations. For each configuration, the software release text (non-ODD) requirement without any optional peripherals and with all optional peripherals are accommodated by the default ODD sizes.

Total memory required = text + NRODD + RODD + UODD + SAB + PO. In order to determine the total amount of memory required, the OP ODD report lists the existing NRODD, RODD, UODD, and SAB. The missing part has always been the text size. Base text size is determined by the software configuration. The software configuration prior to software release 5E9(2) could be determined by the total size of the UODD (used + available). A table lookup of the size to software configuration could be used. Now that the UODD is no longer a fixed size, the software configuration information must come from elsewhere. The OP MEMSIZE report lists the software configuration for all SMs in the office. The last missing part is the POs equipped and the associated memory.

10.4.2.2.4.1 Basic SMs

The 5E10 software release text base size for the Basic SM is 17.1 MB. The peripherals range from .131 (LDSU + HDSU) to 1.039 MB. The ODD size for 90% of the Basic SMs in software release 5E10 is 4.8 MB or less. The total value of text, PO, ODD, and SAB for 90% of SMs is projected to range between 22.08 and 22.99 MB. Therefore, all Basic SMs fit in 24 MB or less.

10.4.2.2.4.2 Standard SM

The 5E10 software release text base size for the Standard SM is 19.17 MB. The peripherals range from .131 to 1.764 MB. The ODD size for 90% of the Standard SMs in software release 5E10 is 5.02 MB or less. The total value of text, PO, ODD, and SAB for 90% of SMs is projected to range between 24.37 and 26.01 MB. Therefore, all Standard SMs fit in 28 MB or less.

10.4.2.2.4.3 Loaded SM

The 5E10 software release text base size for the Loaded SM is 26.75 MB. The peripherals range from .131 to 4.424 MB. The ODD size for 90% of the Standard SMs in software release 5E10 is 6.6 MB or less. The total value of text, PO, ODD, and SAB for 90% of SMs range between 33.53 and 37.83 MB. Since Loaded SMs do not equip all the POs, all SMs are projected to fit within 40 MB or less.

10.4.2.2.4.4 SM-2000

The 5E10 software release text base size for SM-2000 is 33 MB. With all peripherals added, the size is 37.93 MB. The ODD size for 90% of the SM-2000s is 55 MB or less. The total value of text, PO, ODD, and SAB for the SM-2000s is 94.09 MB or less. Therefore, SM-2000 fits in less than 96 MB. Note that the reserved Stand Alone Billing (SAB) in SM-2000 is 582 KB. In SMs, SAB is 54 KB.

10.4.2.3 ADMINISTRATION

10.4.2.3.1 SMMAP Command

The SMMAP command, available in software release 5E9(2) and later, is `dump:smmap, sm=x`. When reading this command, the start and end address of each image and its associated hashsum (parity check for errors) is listed. Many of the peripheral images are the sum of several individual images that come as a "family". Each member of the family and associated hash sum check are listed in the dump of the SMMAP command.

10.4.2.3.2 Memory Worksheets

The following worksheet can be used to project software release 5E10 SM memory sizes from software release 5E9 or software release 5E9(2) SM memory sizes using output from the OP ODD report. For software release 5E9(2) to software release 5E10, input software release 5E9(2) numbers in line 1a of the worksheet instead of software release 5E9 numbers. For line 1b, feel free to use any growth factor that you deem appropriate. The worksheet defaults to 10%.

Currently, the worksheet does not support SM-2000. 96 MB of memory is sufficient through software release 5E10.

Note that OSPS offices may wish to add memory to RODD if they are installing some of the OSPS special features that reside in RODD.

Worksheet SM Identifier _____

NRODD

1. 5E9 or 5E9(2) NRODD

a. OP:ODD, NRODD used value = _____ KB

b. Multiply line 1a by 1.1 for 5E10 EOP growth = _____ KB

c. Calculate projected 30% free space = _____ KB

$(3 * \text{line } 1b) / 7$

If line 1c < 256 KB, change to 256 KB.

d. Total NRODD (line 1b + line 1c) = _____ KB

UODD

2. 5E9 or 5E9(2) UODD

a. If 5E9, use following default total _____ KB

basic = 2150, std = 2550, loaded = 3604.

b. If 5E9(2), OP:ODD UODD used value = _____ KB

c. If 5E9(2), calculate projected 30% free space = _____ KB

$(3 * \text{line } 2a) / 7$

If line 2c < 100 KB, change to 100 KB.

d. Total UODD (line 2a or (line 2b + line 2c)) = _____ KB

RODD

3. 5E9 or 5E9(2) RODD

a. From OP:ODD, RODD used value = _____ KB

b. Calculate projected 30% free space = _____ KB

$(3 * \text{line } 3a) / 7$

(If line 3a < 256 KB, change to 256 KB.)

c. Total RODD (line 3a + line 3b) = _____ KB

4. Total ODD in MB _____ MB

If on 5E9, use $(1d + 2d + \text{line } 3c + 1400) / 1024$

If on 5E9(2), use $(1d + 2d + \text{line } 3c + 600) / 1024$

5. Total 5E10 Text _____ MB

Complete Appendix A and place total here.

6. Subtotal for SM memory (ODD + text + SAB) required = _____ MB

(line 4 + line 5 + .05)

7. Total SM memory required (with SAB) = _____ MB

(line 6 + line 7)

NOTE: / = divide, * = multiply, - = subtract. Roundup to nearest 100th. If line 6 is slightly over a board boundary, recalculate NRODD and UODD using 29% free $(2.9 * \text{line}) / 7.1$. If the total still does not fit, recalculate using 1% decrements until there is a fit. If you are not satisfied with the final percent free space, order additional memory. Be aware that NRODD free space < 20% triggers a minor alarm.

Appendix A

1. Base 5E10 Text

a. Input one of the following: _____ MB

(basic is 17.1, std is 19.71,
loaded is 26.75)

b. Add if Basic, Std, or Loaded SM,

If LDSU present, enter 92. _____ KB

If RAF present, enter 80. _____ KB

If ISTF present, enter 60. _____ KB

If LDSU or RAF or ISTF present, enter 42. _____ KB

If SAS present, enter 426. _____ KB

If GDSF present, enter 504. _____ KB

c. Add if Standard or Loaded SM,

If IDCU present, enter 742. _____ KB

d. Add if Loaded SM,

If ISLU present, enter 474. _____ KB

If PI present, enter 218. _____ KB

If PH2 present, enter 1472. _____ KB

If PH3 present, enter 1156. _____ KB

If ISLU2 present, enter 804. _____ KB

If PI2 present, enter 450. _____ KB

If PHA present, enter 450. (Wireless only) _____ KB

e. Calculate total peripheral images in KB. _____ KB

(Add all values for b + c + d)

f. Divide line e by 1024 to get total in MB = _____ MB

g. Total text (line a + line f) = _____ MB

ENTER THIS TOTAL ON LINE 4 OF MAIN WORKSHEET.

The worksheet projects the amount of memory needed for software release 5E10. It is necessary to determine the difference between how much memory you currently have available, based on number and type of memory boards, and how much must be provided per the worksheet total. The OP: MEMSIZE command may be used to obtain the types and quantity of memory boards for all SMs in the office.

If the difference between the amount required and the amount available is less than .3 MB, it may be necessary to order more memory, or NRODD and UODD free space may be adjusted. The .3 MB is a guideline. It may be desirable to increase that number since this is an estimator. For example, if 22 MB is available and the worksheet estimates 21.75 MB is needed, it is recommended that another memory board be acquired. Remember, this worksheet is an estimator. Projecting end-of-period growth is not exact.

Note that the OP:MEMSIZE tool is run before the retrofit. If 30% free space for NRODD or UODD require an additional memory board, the tool decreases the percent free space for both NRODD and UODD in one percent increments until the memory fits without growing a memory board. If you are not comfortable with the percent free

space that OP MEMSIZE calculates, it is necessary to add more memory and override the free space calculation by requesting the desired amount on the EQIM form (record 5700-1/2).

10.4.2.3.3 Non-Redundant Office Dependent Data (NRODD) Growth-Line 1b

The 10% growth is for lines and features. If you expect a lot of growth or negligible growth, the percent can be adjusted accordingly.

10.4.2.3.3.1 NRODD Free Space-Line 1c

For retrofits, the free space is automatically adjusted below the 30% default if 30% would require another memory board. The minimum required for a retrofit is 256 KB (.25 MB). 512 KB (.5 MB) free space (line 1c) should be more than sufficient for a maximum. The total NRODD, line 1d, represents the total of NRODD in KB of used + available (free).

If you wish to change the percent free space in this worksheet, you need to recalculate line 1c. For 25%, change line 1c to: $(2.5 * \text{line 1b}) / 7.5$. For 40%, change line 1c to: $(4 * \text{line 1b}) / 6$.

If you wish to override the percent free space that is calculated by the OP MEMSIZE calculation for retrofit, notify your Lucent Technologies Regional Engineer to input the value in the EQIM (Switching Module Equipage Form) form 5700-1/2 Remember that all NRODD free space is backup on disk. If you assign 40% versus 30% free space, you are backing up a lot more data on disk.

10.4.2.3.4 Unprotected Office Dependent Data (UODD) Growth:

UODD is no longer a fixed size per the software configuration ordered. It is variable based upon the specific relations in non-redundant and redundant ODD. Use the default value until there is some actual 5E9(2) UODD data. The minimum value for retrofits is 100 KB.

10.4.2.3.4.1 UODD Free Space Line 2c

For retrofits, the free space automatically is adjusted below the 30% default if 30% would require another memory board. Refer to NRODD free space for information on recalculating the free space and overriding the OP MEMSIZE calculation. Remember that OP MEMSIZE uses the same free space value for NRODD and UODD. The minimum value for retrofits is 100 KB. UODD free space is not backed up in disk because the data is transient.

10.4.2.3.5 Redundant Office Dependent Data (RODD) Growth

RODD consists of routing information, for example, office screening and routing tables. Unless there is growth such as an NPA (Numbering Plan Area) split, RODD remains relatively constant. Therefore, a line for growth was not added. OSPS offices, however, may wish to add memory to RODD if they are installing some of the OSPS special features that reside in RODD.

10.4.2.3.5.1 RODD Free Space-Line 3b

A minimum of 256 KB (.25 MB) of free space is required. In most cases, the minimum is the number used because the calculated value is usually less than 256 KB.

10.4.2.3.6 Total ODD-Line 4

Additional memory of 800 KB is added when going from software release 5E9 to software release 5E9(2) or software release 5E10 because some of the text has been moved to UODD. The additional 600 KB is for relation growth from software release 5E9(2) to software release 5E10.

10.4.2.3.7 Total Text Line 5

Total text consists of base text plus peripheral options. Text for equipped peripheral options are downloaded at the time of retrofit. Appendix A must be completed to calculate total text size. For software release 5E10, to determine which peripherals are in the SM, you can use the command SMMAP. Before software release 5E9(2), office records can be used to determine which peripherals are equipped. You may also run the OP MEMSIZE trace command. If you are unsure as to which peripherals are equipped, you may elect to assume that all are equipped when calculating memory required. This assumption always provides enough memory, but also over-engineers in most cases. It over-engineers loaded SMs because of the number of possible choices.

10.4.2.3.8

Example SM Memory Calculation for Basic SM

SM Identifier: SAMPLE BASIC SM 5E9 to 5E10

NRODD

1. 5E9 or 5E9(2) NRODD

a. OP:ODD, NRODD used value = 980 KB

b. Multiply line 1a by 1.1 for 5E10 EOP growth = 1078 KB

c. Calculate projected 30% free space = 462 KB

(3 * line 1b) / 7

If line 1c < 256 KB, change to 256 KB.

d. Total NRODD (line 1b + line 1c) = 1540 KB

UODD

2. 5E9 or 5E9(2) UODD

a. If 5E9, use following default total 2150 KB

basic = 2150, std = 2550, loaded = 3604.

b. If 5E9(2), OP:ODD UODD used value = _____ KB

c. If 5E9(2), calculate projected 30% free space = _____ KB

(3 * line 2b) / 7

If line 2c < 100 KB, change to 100 KB.

d. Total UODD (line 2a or
(line 2b + line 2c)) = 2150 KB

RODD

3. 5E9 or 5E9(2) RODD

a. From OP:ODD, RODD used value = 280 KB

b. Calculate projected 30% free space = 256 KB

(3 * line 3a) / 7

(If line 3a < 256 KB, change to 256 KB.)

c. Total RODD (line 3a + line 3b) = 546 KB

4. Total ODD in MB 5.5 MB

If on 5E9, use (1d + 2d + line 3c + 1400) / 1024

If on 5E9(2), use (1d + 2d + line 3c + 600) / 1024

5. Total 5E10 Text 17.73 MB

Complete Appendix A and place total here.

6. Subtotal for SM memory (ODD + text + SAB)
required = 23.23 MB

(line 4 + line 5 + .05)

Line 7 to be added only if additional SAB is required:

7. Additional SAB required = 0 MB

8. Total SM memory required (with SAB) = 23.23 MB

(line 6 + line 7)

NOTE: / = divide, * = multiply, - = subtract. Roundup to nearest 100th.

Appendix A

1. Base 5E10 Text

a. Input one of the following: 17.1 MB

(basic is 17.1, std is 19.71,
loaded is 26.75)

b. Add if Basic, Std, or Loaded SM,

If LDSU present, enter 92. 92 KB

If RAF present, enter 80. 80 KB

If ISTF present, enter 60. _____ KB

If LDSU or RAF or ISTF present, enter 42. 42 KB

If SAS present, enter 426. 426 KB

If GDSF present, enter 504. _____ KB

c. Add if Standard or Loaded SM,

If IDCU present, enter 742. _____ KB

d. Add if Loaded SM,

If ISLU present, enter 474. _____ KB

If PI present, enter 218. _____ KB

If PH2 present, enter 1472. _____ KB

If PH3 present, enter 1156. _____ KB

If ISLU2 present, enter 804. _____ KB

If PI2 present, enter 450. _____ KB

If PHA present, enter 450. (Wireless only) _____ KB

e. Calculate total peripheral images in KB. 640 KB

(Add all values for b + c + d)

f. Divide line e by 1024 to get total in MB = .63 MB

g. Total text (line a + line f) = 17.73 MB

ENTER THIS TOTAL ON LINE 4 OF MAIN WORKSHEET.

In this example, worksheet line 8 indicates more than 22 MB is required. The minimum would be 24 MB for the closest memory board boundary. 24 MB minus 23.24 MB leaves approximately .66 MB for SAB, if additional SAB is desired and another memory board is not desired. If more than .76 MB of additional SAB is desired, another memory board is needed.

10.4.3 5E11 SOFTWARE RELEASE

10.4.3.1 HARDWARE

10.4.3.1.1 Switching Module (SM)

Table 10.4-3 5E11 SMPU Configurations

PROCESSOR ^a		MEMORY BOARDS ^b	MAX. SLOTS ^c	MAX. EQUIPAGE (MB) ^d
SMP12	68012	TN56	5 + 7	24**
SMP12		TN2012	5 + 3	32**
SMP23	68020	TN56	5 + 7	24**
		TN2012	5 + 3	32**
SMP23CDM		TN1423	0	32
SMP23CDMX	68020	TN1423	-	52
		TN2012		5
SMP20	68020	TN1374	6	24
SMP20DC		TN1376	6	48
		TN1661	6	96
CORE40	68040	TN1685	4	128
		TN1806	2	256
CORE60	68060	TN1685	4	192
		TN1806	2	256

Notes:

a. Processor addressability limits: 68012 & 68023 - 32 MB, 68020 - 4 GB, SB20CORE/ CORE40 /CORE60 - 748 MB.

b. TN56 = 2MB, TN2012 = 4 MB, TN1374 = 4 MB, TN1376 = 8 MB, TN1661 = 16 MB, TN1685 = 32 MB, TN1423 = 32 MB, TN1806 = 64 MB. The TN1374, TN1376, TN1661 boards may be mixed in the same MCTU2 (68020). The other boards are not mixable. The TN1423 is a microprocessor board with dynamic memory. The TN1685 and TN1806 can be mixed in the same CORE40/60. The KBN20 is a processor board in the MCTU3 with one memory module of 32 MB.

The KBN21 has two modules with 64 MB.

- c. Maximum equipage (**) requires the use of the MEU (Memory Expansion Unit). Memory equipage is a total of on board DRAM plus external memory packs.
- d. The TN1423 is a processor board which supports 32 megabytes of on-board memory; the SMP23CDM does not support external memory boards, the SMP23CDMX supports zero to five TN2012 external memory boards.

The OP MEMSIZE command can be used to print a complete list of the memory boards (type and quantity) for an entire office.

10.4.3.1.1 Module Control Time Slot Interchange Unit Version 3 (MCTU3)

The MCTU3 has all the existing functionality of the SMP20 plus additional capabilities. It is a one shelf unit, instead of a two shelf unit (MCTU2) needed for the SMP20.

10.4.3.1.2 SM-2000 Memory

The CORE60 was shipped with the SM-2000 in software release 5E11. There are four memory slots in the SM-2000. However, the CORE60 comes with the first 64 MB of memory attached to the processor core board. When 128 MB is required, two TN1685s can be used or one TN1806.

NOTE: Be aware that if an upgrade from a CORE40 to a CORE60 is ordered for improved real time, some of the 32 MB memory packs will no longer be needed as the CORE60 comes with 64 MB on the processor board.

10.4.3.1.3 SMPU5/SM2005

Beginning with the 5E11 software release, a new backplane and compressed shelving was shipped with all new offices the compressed unit was known as the SMPU5, or currently as the SM2005.

10.4.3.2 SOFTWARE

10.4.3.2.1 General

With software release 5E11, there are five software configurations: basic, standard, loaded, signaling, and SM-2000. Signaling is a software configuration for VCDX offices with an SM that wish to support SS7 signaling on a Packet Switch Unit (PSU).

10.4.3.2.2 Switching Module (SM)

10.4.3.2.2.1 Peripheral Image Optioning (PO)

Peripheral image Optioning (PO) is available with all five configurations. The PO that is available for 5E10 software release is the same for software release 5E11. There are three additional images used as a group for the new signaling configuration. The signaling configuration will be used for Very Compact Digital eXchange (VCDX) offices that wish to support SS7 signaling. The new hardware item, Access Interface Unit (AIU), is not an image; it is part of the text (base software) code.

As in the past, if the SM does not have the specific peripheral, the code for text will not be loaded, therefore, keeping the memory growth to a minimum. For example, if a loaded SM has PH3s, not PH2s, then the code to operate the PH2s will not be loaded as part of the text size.

PO can be degrown between releases. NRODD, RODD, and UODD can not be degrown between releases! For example, if an SM has PH2 and PH3 protocol handlers, it has the PH2 peripheral code and the PH3 peripheral

code. If the PH2s are removed, the PH2 code can be removed via a maintenance degrow command. The memory is then placed back in unallocated available for growth somewhere else.

Table 10.4-4 lists the peripheral images that are optional, their respective sizes, and configuration support. The peripheral images come in packages. To determine which peripherals are in which SMs, there is a machine command which will dump the list. The command is SMMAP command and is used as dump:smmap, sm=x.

Table 10.4-4 5E11 Image Sizes and Configuration Support

IMAGE	KB	BASIC	STANDARD	LOADED	SIGNAL	SM 2000
LDSU	92 + 42	√	√	√	√	
LDSF	202+202					√
RAF	80 + 42	√	√	√	√	
ISTF	60 + 42	√	√	√	√	
LDSU, RAF, ISTF ^a	42	√	√	√	√	
IDCU	742		√	√	√	√
GDSF	366	√	√	√	√	√
SAS	426	√	√	√	√	√
ISLU	474			√		
ISLU2	842			√	√	√
PI	218			√		
PI2	450			√	√	√
PH2	1472			√		
PH3	1156			√		
PH4	1442			√	√	√
PHV ^a	450			√	√	√
PHA ^a	450			√	√	√
LDSF ^b	202					√
SS7 on PSU (VCDX ONLY)	3992				√	√
GDSF or LDSF ^c	202	√	√	√	√	√
(Adds DSC3 code)						
DNUS	1054					√

Notes:

- a. If the SM has LDSU, RAF, or ISTF, the 42 KBs is counted only once. Although LDSU was originally segregated as an option, most SMs will require this option. The few SMs that will NOT require this option are SMs that are only equipped with the older LDSU1. The LDSU1 does not support SS7 functionality. For CDMA in wireless offices only
- b. LDSF Functionality is provided with all SM-2000 SMs. Therefore, if you have SM-2000, you will need LDSF with 202 KB and the additional 202 KB if you have GDSF, or LDSF.
- c. If the SM has GDSF or LDSF, the 202 KB is counted only once. This code supports the DSC3 functionality.

10.4.3.2.2 Variable UODD

UODD is a variable number. The size varies based upon the specific features and number of lines supported in static ODD (non-redundant and redundant). For example, in 5E8 the UODD for all Basic SMs was one fixed size of 1304 KB. Now each SM has a unique size. The Office Data Assembler (ODA) will check all static relations and total the UODD required to support those static relations. There will be a fixed association between the static data and the related relations stored in UODD.

10.4.3.2.3 Switch Resource Engineering (SRE)

Another way of keeping memory sizes under control is SRE. A subset of the relations will be sized according to individual algorithms, but can be grown by using recent change view 8.40. The algorithms are designed to accommodate five standard deviations or 99.97% of the SMs. A small group of relations will require usage data

from traffic engineers. Currently, the two relations that require user input are the OSPS relations COINOT and SRVOT. They request the percent of office traffic for coin, MECH, Listing Services, and QUANTUM calls. Refer to recent change view 8.9 for more information. The need to grow registers is rare, but may be warranted for the following situations:

- If a register needs to be grown, contact Lucent Technologies for assistance. Please keep in mind that the number of affected offices is very small.
- If a service requires an unusual number of registers for call processing such as call transfer registers for some *A-I-Net*® services or Automatic Call Distribution (ACD). To prevent SM breakage on a register, the register may be grown.
- An office is an extreme outlayer in feature usage such as very large ISDN SMs with greater than 210 second holding times per line.

10.4.3.2.4 Switch Resource Engineering (SRE) Growable Relations

Information on growable relations is found in Table 10.4-9

10.4.3.2.3 Memory Engineering Guidelines

The following are the memory engineering guidelines for each of the SM configurations. For each configuration, the software release text (non-ODD) requirement without any optional peripherals and with optional peripherals is given with the default ODD sizes.

Total memory required = text + NRODD + RODD + UODD + SAB + PO. In order to determine the total amount of memory required, the OP ODD report lists the existing NRODD, RODD, UODD, and SAB. The missing part has always been the text size and now the PO sizes. Base text size is determined by the software configuration. The OP MEMSIZE report will list the software configuration for all SMs in the office. The configuration to size is a look-up function in this document. The command DUMP:SMMAP can be used to determine the POs that are equipped. To calculate memory for specific SMs, refer to the worksheet.

10.4.3.2.3.1 Basic SMs

The 5E11 software release text base size for the Basic SM is projected to be 18.8 MB. The ODD size for 90% of the Basic SMs in software release 5E11 will be 6.42 MB or less. The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, and HDSU for a total of .27 MB. The POs for new ships are assumed to be equipped with LDSU, HDSU, GDSF, and SAS for a total of 1.04 MB. Time Division Multiple Access (TDMA) retrofits are assumed to be equipped with LDSU, ISTF, and HDSU. Therefore, all Basic SMs will fit in 26 MBs or less. Note that in SMs, reserved SAB is 54 KB.

10.4.3.2.3.2 Standard SM

The 5E11 software release text base size for the Standard SM is projected to be 20.69 MB. The ODD size for 90% of the Standard SMs in software release 5E11 will be 6.42 MB or less. The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, HDSU, and IDCU for a total of 1 MB. The POs for new ships are assumed to be equipped with LDSU, HDSU, GDSF, SAS, and IDCU for a total of 1.77 MB. Therefore, all Standard SMs will fit in 30 MBs or less. Note that in SMs, reserved SAB is 54 KB.

10.4.3.2.3.3 Loaded SM

The 5E11 software release text base size for the Loaded SM is projected to be 28.61 MB. The ODD size for 90% of the Standard SMs in software release 5E11 will be 8.72 MB or less. The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, HDSU, IDCU, ISLU, PI, PH2 and PH3 for a total of 4.24 MB. The POs for new

ships are assumed to be equipped with LDSU, HDSU, GDSF, SAS, IDCU, ISLU2, PI2, and PH4 for a total of 4.43 MB. The POs for CDMA retrofits are assumed to be equipped with LDSU, ISTF, HDSU, PI2, PH4, PHV, and PHA for a total of 2.92 MB. The POs for CDMA new ships are assumed to be equipped with LDSU, HDSU, PI2, PH4, PHV, PHA, LDSF, GDSF for a total of 3.35 MB. Since Loaded SMs will not equip all the POs, all SMs are projected to fit within 44 MBs or less. Note that in SMs, reserved SAB is 54 KB.

10.4.3.2.3.4 Signaling SM:

This new software configuration has been added for VDCX offices that wish to support SS7 signaling on a Packet Switch Unit (PSU). VCDX offices that do not wish to support SS7 signaling can use the loaded software configuration above. SS7 signaling on PSU requires PH3 protocol handlers.

The 5E11 software release text base size for the Signaling SM is projected to be 30.39 MB. The ODD size for 90% of the Signaling SM in 5E11 will be 9.38 MB or less. The POs are assumed to be equipped with LDSU, HDSU, GDSF, SAS, IDCU, ISLU2, PI2, PH3, PH4, and SS7 on PSU for a total of 8.53

Stand Alone Billing (SAB) memory has been added to the VCDX offices because they must provide the ability to hold at least 72 hours of billing data in stand alone mode. Since Signaling SMs will not equip all the POs, all SMs are projected to fit within 52 MBs or less.

10.4.3.2.3.5 SM 2000

10.4.3.2.3.5.1 SM2005

Beginning with the 5E11 software release, a new backplane and compressed shelving was shipped with all new offices. The compressed unit is known as the SM2005. In the 5E11 software release text base size for SM-2000 is 28.14 MB. The ODD size for 90% of the SM-2000s is 31.52 MB or less. The POs for service provider retrofits and TDMA retrofits are assumed to be equipped with LDSF, DSC3, and DNUS for 1.43 MB. The POs for new starts are assumed to be equipped with LDSF, GDSF, DSC3, DNUS, SAS, IDCU, ISLU2, PI2, PHA, PVA, and PH4 for a total of 4.45 MB. Therefore SM-2000 requires more than 96 MB. The memory will fit in 100 MB or less. It is recommended that 128 MB of memory be equipped in preparation for future growth/impacts. Reserved Stand Alone Billing in SM-2000 is 582 KB.

10.4.3.3 ADMINISTRATION

10.4.3.3.1 SMMAP Command

The SMMAP command available in software release 5E9.2 and later, is `dump:smmap, sm=x`. When reading this command, the start and end address of each image and its associated hashsum (parity check for errors) is listed. Many of the peripheral images listed in table 10.4-4 are the sum of several individual images that come as a "family". Each member of the family and associated hash sum check are listed in the dump of the SMMAP command.

10.4.3.3.2 OP MEMSIZE Command

Refer to the following section on software release 5E12 for a discussion of this command.

10.4.3.3.3 Memory Worksheets, 5E11

The following worksheet can be used to project software release 5E11 SM memory sizes from software release 5E10 SM memory sizes using output from the OP ODD report. For line 1b, feel free to use any growth factor that you deem appropriate. The worksheet defaults to 10%.

Note that OSPS offices may wish to add memory to RODD if they will be installing some of the OSPS special

features that reside in RODD.

Worksheet SM Identifier _____

NRODD

. 5E10 NRODD

a. OP:ODD, NRODD used value = _____ KB

b. Multiply line 1a by 1.1 for 5E10 EOP growth= _____ KB

c. Calculate projected 30% free space = _____ KB

(3 * line 1b) / 7

If line 1c < 256 KB, change to 256 KB.

d. Total NRODD (line 1b + line 1c) = _____ KB

UODD

2. 5E10 UODD

a. OP:ODD UODD used value = _____ KB

b. Calculate projected 30% free space = _____ KB

(3 * line 2a) / 7

If line 2a < 100 KB, change to 100 KB.

c. Total UODD (line 2a + line 2b) = _____ KB

RODD

3. 5E10 RODD

a. From OP:ODD, RODD used value = _____ KB

b. Calculate projected 30% free space = _____ KB

(3 * line 3a) / 7

If line 3a < 256 KB, change to 256 KB.

c. Total RODD (line 3a + line 3b) = _____ KB

4. Total ODD in MB _____ MB

Use $(1d + 2c + \text{line } 3c) / 1024$

5. Total 5E11 Text _____ MB

Complete Appendix A and place total here.

6. Subtotal for SM memory
(ODD + text + SAB) required = _____ MB

(Line 4 + Line 5 + .05 if SM or .57 if SM-2000)

Line 7 to be added only if additional SAB
is required:

7. Additional SAB required
(see SAB below) = _____ MB

8. Total SM memory required
(with SAB) = _____ MB

(line 6 + line 7)

Note: / = divide, * = multiply. Roundup to nearest 100th.

If line 6 is slightly over a board boundary, recalculate NRODD and UODD using 29% free $(2.9 * \text{line}) / 7.1$. If the total still does not fit, recalculate using 1% decrements until there is a fit. If you are not satisfied with the final percent free space, order additional memory. Be aware that NRODD free space < 20% will trigger a minor alarm.

Appendix A

1. Base 5E11 Text

a. Input one of the following: _____ MB

(basic is 18.6, std is 21.17, loaded is 29.75,
signaling is 34.55, SM-2000 is 41.4)

b. Add if Basic, Std, or Loaded SM,

If LDSU present, enter 92. _____ KB

If RAF present, enter 80. _____ KB

If ISTF present, enter 60. _____ KB

If LDSU or RAF or ISTF present,
enter 42. _____ KB

If SAS present, enter 426. _____ KB

If GDSF present, enter 568. _____ KB

c. Add if Standard or Loaded SM,

If IDCU present, enter 742. _____ KB

d. Add if Loaded SM,

If ISLU present, enter 474. _____ KB

If PI present, enter 218. _____ KB

If PH2 present, enter 1472. _____ KB

If PH3 present, enter 1156. _____ KB

If ISLU2 present, enter 842. _____ KB

If PI2 present, enter 450. _____ KB

If PH4 present, enter 1442. _____ KB

If PHA present, enter 450.
(Wireless only) _____ KB

If PHV present, enter 450.
(Wireless only) _____ KB

e. Add if signaling SM,

If SS7 on PSU present, enter 3992. _____ KB

If SM, complete steps f, g and h.

If SM-2000 skip to item i.

f. Calculate total peripheral
images in KB. _____ KB

(Add all values for b + c + d + e)

g. Divide line f by 1024 to get total
in MB = _____ MB

h. Total text (line a + line g) = _____ MB

ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

i. If SM-2000,

If LDSF, enter 202. _____ KB

If GDSF, enter 302. _____ KB

If LDSF or GDSF, enter 202. _____ KB

If DNUS, enter 1054. _____ KB

If SAS, enter 426. _____ KB

If IDCU, enter 742. _____ KB

If ISLU2, enter 834. _____ KB

If PI2, enter 450. _____ KB

If PH4, enter 1440. _____ KB

If PHA present, enter 450.
(Wireless only) _____ KB

If PHV present, enter 450.
(Wireless only) _____ KB

If SS7 on PSU, enter 3992. _____ KB

j. Calculate total peripheral images
in KB. _____ KB

(Add all values for i)

k. Divide line j by 1024 to get total
in MB = _____ MB

l. Total text (line a + line k) = _____ MB

ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

The worksheet will project the amount of memory that you will need for software release 5E11. It will be up to you to determine the difference between how much memory you currently have available, based on number and type of memory boards, and how much you will need to provide per the worksheet total. You may use the OP MEMSIZE command to obtain the types and quantity of memory boards for all SMs in the office.

If the difference between the amount required and the amount available is less than .3 MB for SMs, you may want to order more memory because you may be cutting your memory requirements too close or you may want to adjust your NRODD and UODD free space. The .3 MB is a guideline. You may want to increase the number since this is an estimator. For example, if 28 MB is available and the worksheet estimates 27.75 MB needed, it is recommended that you order another memory board. Remember, this worksheet is an estimator. Projecting end-of-period growth is not an exact science.

Note that the OP MEMSIZE tool will be run before the retrofit. If 30% free space for NRODD or UODD will require an additional memory board, the tool will decrease the percent free space for both NRODD and UODD in one percent increments until the memory fits without growing a memory board. If you are not comfortable with the percent free space that OP MEMSIZE calculates, you will need to add more memory and override the free space calculation by requesting the desired amount on the EQIM form (record 5700-1/2).

10.4.3.3.3.1 Non-Redundant Office Dependent Data (NRODD) Growth-Line1b

The 10% growth is for lines and features. If you expect a lot of growth or negligible growth, the percent can be adjusted accordingly.

10.4.3.3.3.2 NRODD Free Space-Line 1c

For retrofits, the free space will automatically be adjusted below the 30% default if 30% would require another memory board. The minimum required for a retrofit is 256 KB (.25 MB). 512 KB (.5 MB) free space (line 1c) should be more than sufficient for a maximum for SMs. SM-2000s would require a larger number. The total NRODD, line 1d, represents the total of NRODD in KB of used + available (free). If you wish to change the percent free space in this worksheet, you will need to recalculate line 1c. For 25%, change line 1c to: $(2.5 * \text{line } 1b) / 7.5$. For 40%, change line 1c to: $(4 * \text{line } 1b) / 6$.

If you wish to override the percent free space that is calculated by the OP MEMSIZE calculation for retrofit, notify your Lucent Technologies Regional Engineer to input the value in the EQIM (Switching Module Equipage Form) form 5700-1/2 that is described in the TG-5, Division 8, Section 2, Paragraph 2.18. He/she must make the physical change. Remember that all NRODD free space is backup on disk. If you assign 40% versus 30% free space, you will be backing up a lot more data on disk.

10.4.3.3.3.3 Unprotected Office Dependent Data (UODD) Growth-Line 2

UODD is no longer a fixed size per the software configuration ordered. It is variable based upon the specific relations in non-redundant and redundant ODD. The minimum value for retrofits is 100 KB.

10.4.3.3.3.4 UODD Free Space-Line 2b

For retrofits, the free space will automatically be adjusted below the 30% default if 30% would require another memory board. Refer to NRODD free space for information on recalculating the free space and overriding the OP MEMSIZE calculation. Remember that OP MEMSIZE will use the same free space value for NRODD and UODD. The minimum value for retrofits is 100 KB. UODD free space is not backed up in disk because the data is transient.

10.4.3.3.3.5 Redundant Office Dependent Data (RODD) Growth-Line 3

RODD consists of routing information, e.g. office screening and routing tables. Unless there is grow such as an NPA (Numbering Plan Area) split, RODD remains relatively constant. Therefore, a line for grow was not added. OSPS offices, however, may wish to add memory to RODD if they will be installing some of the OSPS special features that reside in RODD.

10.4.3.3.3.6 RODD Free Space-Line 3b

A minimum of 256 KB (.25 MB) of free space is required. In most cases, the minimum will be the number used because the calculated value is usually less than 256 KB.

10.4.3.3.3.7 Total ODD-Line 4

Total ODD is the sum of NRODD + UODD + RODD.

10.4.3.3.3.8 Total Text-Line 5

Total text consists of base text plus peripheral options. Text for equipped peripheral options will be downloaded at the time of retrofit. Appendix A must be completed to calculate total text size. For software release 5E10, to determine which peripherals are in the SM, you can use the command SMMAP. If you are unsure as to which peripherals are equipped, you may elect to assume that all are equipped when calculating memory required. This assumption will always provide enough memory, but will also over-engineer in most cases. It will way over-engineer loaded SMs because of the number of possible choices.

10.4.3.3.3.9 Additional Stand Alone Billing (SAB)-Line 7

Additional SAB is an option for all SMs (including remote SMs, host SMs, optically remote SMs and 2-mile remote SMs).

The amount of available memory for SAB is the difference between the total amount of available memory per number and type of memory boards and line 6. For example, if 32 MB is available (four 8 MB boards) and the total of line 6 is 30.5, there is 32 - 30.5 MB or 1.5 MB available for SAB. If 2 MB is required and only 1.5 MB is available, SAB will get 1.5 MB unless additional memory boards are provided.

The 54 KB of SAB that all SMs receive is the .05 added in Line 6. SM-2000 SMs receive is the .57 added in Line 6.

Example SM Memory Calculation for Basic SM

SM Identifier: SAMPLE BASIC SM 5E10 to 5E11

NRODD

1. 5E10 NRODD

a. OP:ODD, NRODD used value = 980 KB

b. Multiply line 1a by 1.1 for 5E10 EOP growth = 1078 KB

c. Calculate projected 30% free space = 462 KB

(3 * line 1b) / 7

If line 1c < 256 KB, change to 256 KB.

d. Total NRODD (line 1b + line 1c) = 1540 KB

UODD

2. 5E10 UODD

a. OP:ODD UODD used value = 1421 KB

b. Calculate projected 30% free space = 609 KB

(3 * line 2a) / 7

If line 2a < 100 KB, change to 100 KB.

c. Total UODD (line 2a + line 2b) = 2030 KB

RODD

3. 5E10 RODD

a. From OP:ODD, RODD used value = 378 KB

b. Calculate projected 30% free space = 256 KB

(3 * line 3a) / 7

(If line 3a < 256 KB, change to 256 KB.)

c. Total RODD (line 3a + line 3b) = 634 KB

4. Total ODD in MB 4.12 MB

Use (1d + 2c + line 3c) / 1024

5. Total 5E11 Text 19.29 MB

Complete Appendix A and place total here.

6. Subtotal for SM memory (ODD + text + SAB)
required = 23.41 MB (line 4 + line 5 + .05
if SM or .57 if SM-2000)

Line 7 to be added only if additional SAB
is required:

7. Additional SAB required
(see SAB below) = 0 MB

8. Total SM memory required (with SAB) = 41 MB
(line 6 + line 7)

Note: / = divide, * = multiply. Roundup to nearest 100th.
If line 6 is slightly over a board boundary, recalculate
NRODD and UODD using 29% free (2.9 * line) / 7.1. If the
total still does not fit, recalculate using 1% decrements
until there is a fit. If you are not satisfied with the
final percent free space, order additional memory. Be aware
that NRODD free space < 20% will trigger a minor alarm.

Appendix A

1. Base 5E11 Text

- a. Input one of the following: 18.6 MB
- (basic is 18.6, std is 21.17, loaded is 29.75, signaling is 34.55, SM-2000 is 41.4)
- b. Add if Basic, Std, or Loaded SM,
- If LDSU present, enter 92. 92 KB
- If RAF present, enter 80. 80 KB
- If ISTF present, enter 60. 60 KB
- If LDSU or RAF or ISTF present, enter 42. 42 KB
- If SAS present, enter 426. 426 KB
- If GDSF present, enter 568. _____ KB
- c. Add if Standard or Loaded SM,
- If IDCU present, enter 742. _____ KB
- d. Add if Loaded SM,
- If ISLU present, enter 474. _____ KB
- If PI present, enter 218. _____ KB
- If PH2 present, enter 1472. _____ KB
- If PH3 present, enter 1156. _____ KB
- If ISLU2 present, enter 842. _____ KB
- If PI2 present, enter 450. _____ KB
- If PH4 present, enter 1442. _____ KB
- If PHA present, enter 450. _____ KB
- (Wireless only)
- If PHV present, enter 450. _____ KB
- (Wireless only)
- e. Add if signaling SM,

If SS7 on PSU present, enter 3992. _____ KB

If SM, complete steps f, g and h.

If SM-2000 skip to item i.

f. Calculate total peripheral images in KB. 700 KB

(Add all values for b + c + d + e)

g. Divide line f by 1024 to get total in MB = .69 MB

h. Total text (line a + line g) = 19.29 MB

i. If SM-2000

If LDSF, enter 202. _____ KB

If GDSF, enter 302. _____ KB

If LDSF or GDSF, enter 202. _____ KB

If DNUS, enter 1054. _____ KB

If SAS, enter 426. _____ KB

If IDCU, enter 742. _____ KB

If ISLU2, enter 834. _____ KB

If PI2, enter 450. _____ KB

If PH4, enter 1440. _____ KB

If PHA present, enter 450.
(Wireless only) _____ KB

If PHV present, enter 450.
(Wireless only) _____ KB

If SS7 on PSU, enter 3992. _____ KB

j. Calculate total peripheral images

in KB. _____ KB

(Add all values for i)

k. Divide line j by 1024 to get total
in MB = _____ MB

l. Total text (line a + line k) = _____ MB

ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

In this example line 6, more than 23 MB is required.
The minimum
would be 24 MB for the closest memory board boundary. 24
MB - 23.41 MB leaves approximately .59 MB for SAB if
additional SAB is desired and another memory board is not
desired. If more than 1 MB of additional SAB is desired,
another memory board would be needed.

10.4.4 5E12 SOFTWARE RELEASE

10.4.4.1 HARDWARE

10.4.4.1.1 Switching Module (SM)

Table 10.4-5 5E12 SMPU Configurations

PROCESSOR ^a		MEMORY BOARDS ^b	MAX. SLOTS ^c	MAX. EQUIPAGE (MB) ^d
SMP12	68012	TN56	5 + 7	24**
		TN2012	5 + 3	32**
SMP23	68020	TN56	5 + 7	24**
		TN2012	5 + 3	32**
SMP23CDM	68020	TN1423	0	32
SMP23CDMX	68020	TN1423		52
		TN2012		5
SMP20	68020	TN1374	6	24
SMP20DC		TN1376	6	48
		TN1661	6	96
CORE40	68040	TN1685	4	128
		TN1806	2	256
CORE60	68060	TN1685	4	192
		TN1806	2	256
CORE60MM	68060	TN1686	4	192
UN 594				
		TN1806	4	320

CORE60MM	68060	TN1686	2	192
UN 588		TN1686	2	256
Notes: a. Processor addressability limits: 68012 & 68023 - 32 MB, 68020 - 4 GB, SB20CORE/ CORE40 /CORE60 - 748 MB. b. TN56 = 2MB, TN2012 = 4 MB, TN1374 = 4 MB, TN1376 = 8 MB, TN1661 = 16 MB, TN1685 =32 MB, TN1423=32 MB, TN1806 = 64 MB. The TN1374, TN1376, TN1661 boards may be mixed in the same MCTU2 (68020). The other boards are not mixable. The TN1423 is a new microprocessor board with dynamic memory. The TN1685 and TN1806 can be mixed in the same CORE40/60. or CORE60MM. The CORE40 has no memory on the processor board; the CORE60 has 64MB on the board, and the CORE60MM can be equipped with 64 MB or 128 MB of memory c. .Max slots for CORE60 assumes SM2000 processor. Max slots for CORE60MM assumes SM2005 processor. d. Maximum equipage (**) requires the use of the MEU (Memory Expansion Unit), which is no longer orderable..Memory totals denote DRAM on processor pack plus all external memory packs e. The TN1423 is a processor board which supports 32 megabytes of on-board memory; the SMP23CDM does not support external memory boards, the SMP23CDMX supports zero to five TN2012 external memory boards.				

10.4.4.1.1.1 TN1423 Microprocessor Board (Feature SMP23CDM)

This feature is also known as SMP23CDM (provided in 5E10) for SMP23 Dynamic Core Memory and provided 32 MB of memory. The feature was ported back to 5E9(1) software release so that offices skipping from 5E9(1) to the 5E10 software release could use it. It was also ported to the 5E9(2) software release because it needs to be added before any retrofit to 5E10. This feature supports the conversion from the SMP12 to TN1423. Prudent use of this board can save money when growing memory. The TN1423 is priced slightly higher than the cost of an MEU and one TN2012. When this board is installed in SMs equipped with TN2012s, the five TN2012s can be used to grow memory in other SMs with MEUs or a few MEUs may be ordered to grow memory in some SMs using the surplus TN2012s. The surplus TN2012 boards can also be used to grow AM memory.

10.4.4.1.1.2 Module Control Time Slot Interchange Unit Version 3 (MCTU3)

Non-SM-2000 SMs shipped equipped with the MCTU3 that has a 68LC040 processor (beginning with 5E10 software release update). The MCTU3 has all the existing functionality of the SMP20 plus additional capabilities. It is a one-shelf unit, instead of the two-shelf unit (MCTU2) needed for the SMP20.

10.4.4.1.2 SM-2000 Memory

As part of the 5E11 software release update, a new backplane and compressed shelving is shipped with all new offices. The compressed unit is known as the SMPU5. The CORE60 was shipped with the SM-2000 in all 5E11 orders, regardless of whether the SMPU4 or SMPU5 is equipped. The SMPU4 is equipped with four memory slots. The SMPU5 is equipped with two memory slots. The CORE60 is equipped with the first 64 MB of memory attached to the processor core board. With 128 MB required, two TN1685s can be used or one TN1806. **Note: If two TN1685s are used in the SMPU5, both memory slots are equipped.** Note that if an upgrade from a CORE40 to a CORE60 will be ordered for improved real time, some of the 32 MB memory packs will no longer be needed as the CORE60 comes with 64 MB on the processor board.

10.4.4.1.2.1 CORE60MM

The CORE60MM operating at 66 MHz is designed to improve the processor performance and provide two CORE RAM memory configurations of either 64MB (UN594) or 128 MB (UN588). The hardware and associated software for the CORE60MM are designed to improve the speed of the SM-2000 Switching Module by a factor of 1.8 over the CORE40. The 64MB CORE60MM (UN594) is supported on SMPU4 for software release 5E12. The 128

MB CORE60MM (UN588) is supported on SM2000 for release 5E12. The 128MB CORE60MM (UN588) will be used for all newly shipped SM2005 offices.

10.4.4.2 SOFTWARE

10.4.4.2.1 Switching Module (SM)

With Software Release 5E12, there are five software configurations: basic, standard, loaded, signaling, and SM-2000. Signaling is a software configuration for VCDX offices equipped with an SM that support SS7 signaling on a Packet Switch Unit (PSU). The signaling configuration (since AA5E11) has everything from the loaded configuration plus the ability to do SS7 signaling.

10.4.4.2.1.1 Peripheral Image Optioning (PO)

Peripheral Image Optioning (PO) is available with all five configurations. There are three additional images used as a group for the new Signaling configuration. 5E12 sees the introduction of two additional images: LDSF2 + DSC4 and PHV3C. The signaling configuration will be used for Very Compact Digital eXchange (VCDX) offices that wish to support SS7 signaling. The new hardware item, Access Interface Unit (AIU), is not an image; it is part of the text (base software) code.

As in the past, if the SM does not have the specific peripheral, the code for text will not be loaded, therefore, keeping the memory growth to a minimum. For example, if a loaded SM has PH3s, not PH2s, then the code to operate the PH2s will not be loaded as part of the text size. PO can be degrown between releases. (NRODD, RODD, and UODD can not be degrown between releases!) For example, if an SM has PH2 and PH3 protocol handlers, it has the PH2 peripheral code and the PH3 peripheral code. If the PH2s are removed, the PH2 code can be removed via a maintenance degrow command. The memory is then placed back in unallocated available for growth somewhere else. The following table lists the peripheral images that are optional, their respective sizes, and configuration support. The peripheral images come in packages. These are shown in table 10.4-6.

Table 10.4-6 5E12 Image Sizes and Configuration Support

IMAGE	KB	BASIC	STANDARD	LOADED	SIGNAL	SM2000
LDSU	92	√	√	√	√	
LDSF+DSC4	516					√
RAF	80	√	√	√	√	
ISTF	60 + 42	√	√	√	√	
LDSU, RAF, ISTF ^a	42	√	√	√	√	
IDCU	742		√	√	√	√
GDSF	366	√	√	√	√	√
SAS	426	√	√	√	√	√
ISLU	474			√		
ISLU2	834			√	√	√
PI	218			√		
PI2	450			√	√	√
PH2	1472			√		
PH3	1156			√		
PH4	1440			√	√	√
SS7 on PSU	3992				√	√
PHV ^d	450			√	√	√
PHA ^d	450			√	√	√
PHV3C ^d	3992			√	√	√
LDSF ^b	202					√
SS7 on PSU(VCDX)	3992				√	√
GDSF or LDSF ^c	202	√	√	√	√	√
DNUS	1054					√

Notes:

- a. If the SM has LDSU, RAF, or ISTF, the 42 KBs is counted only once. Although LDSU was originally segregated as an option, most SMs will require this option. The few SMs that will NOT require this option are SMs that are only equipped

with the older LDSU1. The LDSU1 does not support SS7 functionality.

- b. LDSF Functionality is provided with all SM2000 SMs. Therefore, if you have SM2000, you will need LDSF with 202 kB and the additional 202 kB if you have GDSF, or LDSF.
- c. If the SM has GDSF or LDSF, the 202 kB is counted only once. This code supports the DSC3 functionality.
- d. For CDMA in wireless offices only.

10.4.4.2.1.2 Variable UODD

Another change from previous releases is the sizing of Unprotected Office Dependant Data (UODD). UODD is a variable number. The size varies based upon the specific features and number of lines supported in static ODD (non-redundant and redundant). For example, in the 5E8 software release, the UODD for all Basic SMs was one fixed size of 1304 KB. Now each SM has a unique size. The Office Data Assembler (ODA) checks all static relations and totals the UODD required to support those static relations. There is a fixed association between the static data and the related relations stored in UODD.

10.4.4.2.1.3 Switch Resource Engineering (SRE) Growable Relations

Information on growable relations is found in Table 10.4-9

10.4.4.2.2 Memory Engineering Guidelines

NOTE: Some 5E12 offices may require more than 32 MB for Basic and 33 MB for Standard SM configurations. The variance in total Office Dependent Data (ODD) between offices is growing exponentially due to changes in the marketplace. As customers incorporate changes, such as turning offices into "virtual" switches by assigning specific hundreds groups of screening indexes to resellers, the amount of Redundant ODD (RODD) increases at a rate never seen before. In other words, translations for routing and screening are being used in new ways. As more and more routing and screening data is required with the new competitive environment, more RODD will be required. For these reasons, Lucent Technologies is looking for ways to better estimate memory requirements. The existing planning algorithms may require changes to account for the wider spread in ODD. Memory requirements for Basic and Standard SM configurations are being investigated. New memory requirements for these configurations will be provided as they become available.

The following are the memory engineering guidelines for each of the SM configurations. For each configuration, the software release text (non-ODD) requirement without any optional peripherals and with optional peripherals is given with the default ODD sizes. Total memory required = text+NRODD+RODD+UODD+SAB+PO. In order to determine the total amount of memory required, the OP ODD report lists the existing NRODD, RODD, UODD, and SAB. The missing part has always been the text size and now the PO sizes. Base text size is determined by the software configuration. The OP MEMSIZE report will list the software configuration for all SMs in the office. The command DUMP:SM MAP can be used to determine the POs that are equipped. When using the following tables, you may refer to Table 10.4-6 for PO sizes. The total memory includes the text, ODD, and SAB listed in the verbiage plus the PO value in the table to determine the total memory (in MBs) required.

10.4.4.2.2.1 Basic SM

The 5E12 software release text base and patch sizes for the Basic SM are projected to be 18.37 MB + 2.58 MB = 20.95 MB. The ODD size for 90% of the Basic SMs in 5E12 is 7.2 MB or less. The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, and HDSU for a total of .78 MB. The POs for new ships are assumed to be equipped with LDSU, HDSU, GDSF, and SAS for a total of 1.52 MB. Therefore, most Basic SMs will fit in 30 MBs (actual) or less (32 MBs physical). Note that in SMs, reserved SAB is 54KB.

10.4.4.2.2.2 Standard SM

The 5E12 software release text base and patch sizes for the Standard SM are projected to be 20.25 MB + 3.19 MB = 23.44 MB. The ODD size for 90% of the Standard SMs in 5E11 are 7.31 MB or less. The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, HDSU, and IDCU for a total of 1.50 MB. The POs for new ships are assumed to be equipped with LDSU, HDSU, GDSF, SAS, and IDCU for a total of 2.25 MB. Therefore, most Standard SMs will fit in 34 MB (actual) or less (36 MBs physical). Note that in SMs, reserved SAB is 54 KB.

10.4.4.2.3 Loaded SM

The 5E12 software release text base and patch sizes for the Loaded SM are projected to be 27.29 MB + 4.18 MB = 31.47 MB. The ODD size for 90% of the Loaded SMs in 5E12 will be 9.53 MB or less. The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, HDSU, IDCU, ISLU, PI, PH2 and PH3 for a total of 4.74 MB. The POs for new ships are assumed to be equipped with LDSU, HDSU, GDSF, SAS, IDCU, ISLU2, PI2, and PH4 for a total of 4.90 MB. The POs for CDMA retrofits are assumed to be equipped with LDSU, ISTF, HDSU, PI2, PH4, PHV, and PHA for a total of 4.01 MB. The POs for CDMA new ships are assumed to be equipped with LDSU, HDSU, PI2, PH4, PHV, PHA, LDSF, GDSF for a total of 4.52 MB. Since Loaded SMs will not equip all the POs, most SMs are projected to fit within 45 MBs (actual) or less (48 MBs physical). Note that in SMs, reserved SAB is 54 KB.

10.4.4.2.4 Signaling SM

This software configuration has been added for VCDX offices that wish to support SS7 signaling on a Packet Switch Unit (PSU). VCDX offices that do not wish to support SS7 signaling can use the loaded software configuration above. SS7 signaling on PSU requires PH3 protocol handlers. The 5E12 software release text base and patch sizes for the Signaling SM are projected to be 30.01 MB + 4.51 = 34.52 MB. The ODD size for 90% of the Signaling SM in 5E12 will be 10.32 MB or less. The POs are assumed to be equipped with LDSU, HDSU, GDSF, SAS, IDCU, ISLU2, PI2, PH3, PH4, and SS7 on PSU for a total of 9.36 MB. The POs for a new VCDX are assumed to be a total of 9.87 MB. Stand Alone Billing (SAB) memory has been added to the VCDX offices because they must provide the ability to hold at least 72 hours of billing data in stand alone mode. Since Signaling SMs will not equip all the POs, all SMs are projected to fit within 54 MBs (actual) or less (60 MB physical).

10.4.4.2.3 SM-2000

The 5E12 software release text base and patch sizes for SM-2000 are projected to be 38.72 MB. + 4.51 MB = 43.23. The ODD size for 90% of the SM-2000s is 55 MB or less. The POs for service provider retrofits and TDMA retrofits are assumed to be equipped with LDSF, DSC3, and DNUS for 5.73 MB. The POs for new starts are assumed to be equipped with LDSF, GDSF, DSC3, DNUS, SAS, IDCU, ISLU2, PI2, and PH4 for a total of 5.83 MB. The POs for a T/CDMA retrofit are assumed to be equipped with LDSU (DSU2), LDSF+DSC4, ISTF, GDSF+DSC3, PI2, PH4, PHV1, and PHA1 for a total of 4.95 MB. The POs for CDMA are assumed to be equipped with LDSF, GDSF, DSC3, DNUS, PI2, PHA, PHV, and PH4 for a total of 5.35 MB. The POs for VCDX retrofit are assumed to be LDSF, GDSF, DSC3, DNUS, ISLU2, PI2, PH4, SAS, IDCU, and SS7 on PSU for a total of 10.38 MB. The POs for a VCDX are assumed to be equipped with LDSF2+DSC4, ISTF, GDSF+DSC3, IDCU, ISLU2, PI2, PH4, PHV1, and PHA1PHV3C for a total of 10.79 MB. Therefore, SM-2000 will require more than 96 MBs (actual). The memory will fit in 128 MB (physical) or less if not VCDX. Note that the reserved Stand Alone Billing (SAB) in SM-2000 is 582 KB. Stand Alone Billing (SAB) memory has been added to the VCDX offices because they must provide the ability to hold at least 72 hours of billing data in stand alone mode.

10.4.4.3 ADMINISTRATION

10.4.4.3.1 Switching Module

10.4.4.3.1.1 SMMAP Command

The SMMAP command, is dump:smmmap, sm=x When reading this command, the start and end address of each image and its associated hashsum (parity check for errors) is listed. Many of the peripheral images listed in Table

10.4-6 , are the sum of several individual images that come as a "family". Each member of the family and associated hash sum check are listed in the dump of the SMMAP command.

10.4.4.3.1.2 OP MEMSIZE Command

10.4.4.3.1.2.1 Description

The OP:MEMSIZE command can be used to project memory requirements from release to release. For example, if an office is on software release 5E10 retrofitting to software release 5E11, a software update is loaded which contains the memory projections for 5E11. When the command is run (i.e. using TORELEASE "5E11"), the new memory requirements are calculated and the hardware is checked to determine if additional memory boards are required before the retrofit. The command may also be used to monitor memory growth within a release (i.e. using TO RELEASE "5E101"). The command also lists on a per SM basis, the type and quantity of all memory packs, the software configuration, and whether additional Stand Alone Billing is set to yes. This tool is currently supported for software release 5E11.

10.4.4.3.1.2.2 Input

The OP:MEMSIZE input command is used to list current ODD availability in the AM, SM(s), or CMP, and determine growth values. The format of the command is:

```
OP:MEMSIZE, TORELEASE="5E???"
```

NOTE: It is important that the most current issue of the tool be utilized. The tool continues to go through a refinement process to improve accuracy, reflect hardware/software changes or incorporate enhancements/improvements. Software Update 970002 contains the most current issue for retrofitting to 5E10 and 97003 for retrofitting to software release 5E11. To identify the latest software update (BWM) loaded use the OP:VERSION command. To see the current and previous two software updates refer to page 1950 on the MCC.

10.4.4.3.1.2.3 Process

Once the command is input, the program completes the following steps.

- (1) Figures the differences between the current dictionary (DICT) file and the target dictionary file. If the current and the target are the same then there will be no differences.
- (2) Calculates the size of its UODD, NRODD, and RODD relations. Counts the size of each relation that has a dict file difference and then modifies that total by the difference. For relations with no differences, it just uses the total of the current relation. A minimum of 256K or 30% free space is added to the NRODD and the RODD size and 256K or 35 % free space is added to the UODD size. Note: Free space for the NRODD can be below 30% but the minimum amount of free space for NRODD is 256K. The total of all UODD, NRODD, and RODD relations, including the projection of how they will change in the target generic is reported in KILO ODD NEEDED column.
- (3) Adds up the ODD (KILO ODD NEEDED), Text, and Peripherals Images sizes, as well as the minimum SABM. Consider this the Projected size.
- (4) Reads GLPMEMSIZE to determine how much memory is in each processor. This is reported as MEG MEM EQUIPPED.
- (5) Compares the amount of memory equipped (MEG MEM EQUIPPED) to the Projected (Projected) size the tool has calculated and the Engineering (Engineered) size that it gets from the spec5E file MIN MEMORY row. This is done to decide if the OP:MEMSIZE output should report a YES or a NO in the MEMORY

NEEDED column. If the MEG MEM EQUIPPED is: Greater than, or equal to both the Projected and Engineered size, then the column will report NO. If it is less than the Engineered size, then the MEMORY NEEDED column will report YES.

Less than Projected but greater than the Engineered, the tool will decrease the amount free space in the NRODD (% FREE column) to a 256 K minimum before it reports that there is a memory problem. This is an attempt to get the projected image to fit in the equipped memory. It will not, however, go below the Engineered size.

The greater of Projected and Engineered will be reported in the MEG TOTAL NEEDED (MIN) column.

The % FREE column will be blank if the MEMORY NEEDED column is YES. The % FREE column will be 30 or less depending on whether the Projected NRODD size was decreased as described above.

NOTE: When NRODD free space falls below 20% or 5%, minor or major alarms are activated. The free space calculated by OP:MEMSIZE will automatically set the value for free space for the retrofit. If you wish to override the percent free space that is calculated by the OP MEMSIZE calculation for retrofit, notify your Lucent Regional Engineer to input the value in the EQIM (Switching Module Equipage Form) form. The Lucent Regional Engineer must make the physical change. Remember that all NRODD free space is backup on disk. If you assign 40% versus 30% free space, you will be backing up a lot more data on disk.

When determining the amount of text memory (base text + Peripheral Options) for each SM, the list of specific peripherals equipped for each SM is required. The SMMAP command, can be used to list specific peripherals for each SM.

The STP:MEMSIZE command may be executed to stop the invocation of the tool.

10.4.4.3.1.2.4 Output

To report a forecast summary of the memory needed by the office's AM, CMP, and SMs to retrofit to the specified release. The report contains the current memory sizes of all the processors and sizes needed for the target release. Output is sent to the ROP and saved in the /rclog/sodd/memsize.rep file. The tool will verify if the current and target release data files are available. If not, it will output an error message. The tool will also verify if the hardware on the switch is ready for the retrofit. If not, it will output an error message. Any errors encountered during the execution of the tool on any processor will result in an error message reporting the processors that could not be sized.

The OP:MEMSIZE command will also output the equipment specifics (memory boards & number) for each processor in the office.

10.4.4.3.2 Switch Resource Engineering (SRE) Growable Relations

Information covering SRE growable relations is found in aTable 10.4-9

10.4.4.3.3 Memory Worksheets, 5E12

The following worksheet can be used to project 5E12 SM memory sizes from 5E11 SM memory sizes using output from the OP ODD report. For line 1b, feel free to use any growth factor that you deem appropriate. The worksheet defaults to 10%. Note that OSPS offices may wish to add memory to RODD if they will be installing some of the OSPS special features that reside in RODD.

Worksheet SM Identifier _____

RODD

. 5E11 NRODD

a. OP:ODD, NRODD used value = _____ KB

b. Multiply line 1a by 1.1 for 5E11
EOP growth = _____ KB

c. Calculate projected 30%
free space = _____ KB

(3 * line 1b) / 7

If line 1c < 256 KB, change to 256 KB.

d. Total NRODD (line 1b + line 1c) = _____ KB

UODD

2. 5E11 UODD

a. OP:ODD UODD used value = _____ KB

b. Calculate projected 30% free space = _____ KB

(3 * line 2a) / 7

If line 2b < 100 KB, change to 100 KB.

c. Total UODD (line 2a + line 2b) = _____ KB

RODD

3. 5E11 RODD

a. From OP:ODD, RODD used value = _____ KB

b. Calculate projected 30% free space = _____ KB

(3 * line 3a) / 7

If line 3b < 256 KB, change to 256 KB.

c. Total RODD (line 3a + line 3b) = _____ KB

4. Total ODD in MB _____ MB

Use $(1d + 2c + \text{line } 3c) / 1024$

5. Total 5E12 Text _____ MB

Complete Appendix A and place total here.

6. Subtotal for SM memory
(ODD + text + SAB) required = _____ MB

(Line 4 + Line 5 + .05 if SM or .57 if SM-2000)

Line 7 to be added only if additional SAB is required:

7. Additional SAB required
(see SAB below) = _____ MB

8. Total SM memory required (with SAB) = _____ MB

(line 6 + line 7)

Note: / = divide, * = multiply. Roundup to nearest 100th.
If line 6 is slightly over a board boundary, recalculate NRODD and UODD using 29% free $(2.9 * \text{line}) / 7.1$. If the total still does not fit, recalculate using 1% decrements until there is a fit. If you are not satisfied with the final percent free space, order additional memory. Be aware that NRODD free space < 20% will trigger a minor alarm.

Appendix A

1. Base 5E12 Text

a. Input one of the following: _____ MB

(basic is 20.95, std is 23.44, loaded is 31.47,

signaling is 34.52, SM-2000 is 43.23)

b. Add if Basic, Std, or Loaded SM,

If LDSU present, enter 92.	_____	KB
If LDSF2 present, enter 516.	_____	KB
If RAF present, enter 80.	_____	KB
If ISTF present, enter 60	_____	KB
If LDSU or RAF or ISTF present, enter 42.	_____	KB
If SAS present, enter 426.	_____	KB
If GDSF present, enter 366.	_____	KB

c. Add if Standard or Loaded SM,

If IDCU present, enter 742.	_____	KB

d. Add if Loaded SM,

If ISLU present, enter 474.	_____	KB
If PI present, enter 218.	_____	KB
If PH2 present, enter 1472.	_____	KB
If PH3 present, enter 1156.	_____	KB
If ISLU2 present, enter 834.	_____	KB
If PI2 present, enter 450.	_____	KB
If PH4 present, enter 1440.	_____	KB
If PHA present, enter 450. (Wireless only)	_____	KB
If PHV present, enter 450. (Wireless only)	_____	KB
If PHV3C present, enter 616. (Wireless only)	_____	KB

e. Add if signaling SM,

If SS7 on PSU present, enter 3992.	_____	KB

If SM, complete steps f, g and h.
If SM-2000 skip to item i.

f. Calculate total peripheral images
in KB. _____ KB

(Add all values for b + c + d + e)

g. Divide line f by 1024 to get total
in MB = _____ MB

h. Total text (line a + line g) = _____ MB

ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

i. If SM-2000,

If LDSF, enter 202. _____ KB

If GDSF, enter 366. _____ KB

If LDSF or GDSF, enter 202. _____ KB

If DNUS, enter 1054. _____ KB

If SAS, enter 426. _____ KB

If IDCU, enter 742. _____ KB

If ISLU2, enter 834. _____ KB

If PI2, enter 450. _____ KB

If PH4, enter 1440. _____ KB

If PHA present, enter 450.
(Wireless only) _____ KB

If PHV present, enter 450.
(Wireless only) _____ KB

If PHV3C present, enter 616.
(Wireless only) _____ KB

If SS7 on PSU, enter 3992. _____ KB

j. Calculate total peripheral images
in KB. _____ KB

(Add all values for i)

k. Divide line j by 1024 to get total
in MB = _____ MB

l. Total text (line a + line k) = _____ MB

ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

The worksheet will project the amount of memory that you will need for the 5E12 software release. It will be up to you to determine the difference between how much memory you currently have available, based on number and type of memory boards, and how much you will need to provide per the worksheet total. You may use the OP MEMSIZE command to obtain the types and quantity of memory boards for all SMs in the office.

If the difference between the amount required and the amount available is less than .3 MB for SMs, you may want to order more memory because you may be cutting your memory requirements too close or you may want to adjust your NRODD and UODD free space (See following paragraphs.). The .3 MB is a guideline. You may want to increase the number since this is an estimator. For example, if 28 MB is available and the worksheet estimates 27.75 MB needed, it is recommended that you order another memory board. Remember, this worksheet is an estimator. Projecting end-of-period growth is not an exact science.

Note that the OP MEMSIZE tool will be run before the retrofit. If 30% free space for NRODD or UODD will require an additional memory board, the tool will decrease the percent free space for both NRODD and UODD in one percent increments until the memory fits without growing a memory board. If you are not comfortable with the percent free space that OP MEMSIZE calculates, you will need to add more memory and override the free space calculation by requesting the desired amount on the EQIM form (record 5700-1/2).

10.4.4.3.4 Non-Redundant Office Dependent Data (NRODD) Growth-Line 1a

The 10% growth is for lines and features. If you expect a lot of growth or negligible growth, the percent can be adjusted accordingly.

10.4.4.3.5 NRODD Free Space-Line 1c

For retrofits, the free space will automatically be adjusted below the 30% default if 30% would require another memory board. The minimum required for a retrofit is 256 KB (.25 MB). 512 KB (.5 MB) free space (line 1c) should be more than sufficient for a maximum for SMs. SM-2000s would require a larger number. The total NRODD, line 1d, represents the total of NRODD in KB of used + available (free).

If you wish to change the percent free space in this worksheet, you will need to recalculate line 1c. For 25%, change line 1c to: $(2.5 * \text{line } 1b) / 7.5$. For 40%, change line 1c to: $(4 * \text{line } 1b) / 6$.

If you wish to override the percent free space that is calculated by the OP MEMSIZE calculation for retrofit, notify your Lucent Technologies Regional Engineer to input the value in the EQIM (Switching Module Equipage Form) form 5700-1/2 that is described in the TG-5, Division 8, Section 2, Paragraph 2.18. The engineer must make the physical change. Remember that all NRODD free space is backup on disk. If you assign 40% versus 30% free space, you will be backing up a lot more data on disk. Unprotected Office Dependent Data (UODD) growth: UODD is no longer a fixed size per the software configuration ordered. It is variable based upon the specific relations in non-redundant and redundant ODD. The minimum value for retrofits is 100 KB.

10.4.4.3.6 UODD Free Space-Line 2b

For retrofits, the free space will automatically be adjusted below the 30% default if 30% would require another memory board. Refer to NRODD free space for information on recalculating the free space and overriding the OP MEMSIZE calculation. Remember that OP MEMSIZE will use the same free space value for NRODD and UODD. The minimum value for retrofits is 100 KB. UODD free space is not backed up in disk because the data is transient.

10.4.4.3.7 Redundant Office Dependent Data (RODD) Growth

RODD consists of routing information, e.g. office screening and routing tables. Unless there is grow such as an NPA (Numbering Plan Area) split, RODD remains relatively constant. Therefore, a line for grow was not added. OSPS offices, however, may wish to add memory to RODD if they will be installing some of the OSPS special features that reside in RODD.

10.4.4.3.8 RODD Free Space-Line 3b

A minimum of 256 KB (.25 MB) of free space is required. In most cases, the minimum will be the number used because the calculated value is usually less than 256 KB.

10.4.4.3.9 Total ODD-Line 4

Total ODD is the sum of NRODD + UODD + RODD.

10.4.4.3.10 Total Text-Line 5

Total text consists of base text plus peripheral options. Text for equipped peripheral options will be downloaded at the time of retrofit. Appendix A must be completed to calculate total text size. For 5E11, to determine which peripherals are in the SM, you can use the command SMMAP. If you are unsure as to which peripherals are equipped, you may elect to assume that all are equipped when calculating memory required. This assumption will always provide enough memory, but will also over-engineer in most cases. It will way over-engineer loaded SMs because of the number of possible choices.

10.4.4.3.11 Additional Stand Alone Billing (SAB)-Line 7

Additional SAB is an option for all SMs (including remote SMs, host SMs, optically remote SMs and 2-mile remote SMs). The amount of available memory for SAB is the difference between the total amount of available memory per number and type of memory boards and line 6. For example, if 32 MB is available (four 8 MB boards) and the total of line is 30.5, there is 32 - 30.5 MB or 1.5 MB available for SAB. If 2 MB is required and only 1.5 MB is available, SAB will get 1.5 MB unless additional memory boards are provided. To determine the amount of SAB memory required for storage of AMA records. The 54 KB of SAB that all SMs receive is the .05 added in Line 6. SM-2000 SMs receive is the .57 added in Line 6.

EXAMPLE

SM Memory Calculation for Basic SM

SM Identifier: SAMPLE BASIC SM 5E11 to 5E12

NRODD

1. 5E11 NRODD

- a. OP:ODD, NRODD used value = 980 KB
- b. Multiply line 1a by 1.1 for 5E10 EOP growth = 1078 KB
- c. Calculate projected 30% free space = 462 KB
- (3 * line 1b) / 7
- If line 1c < 256 KB, change to 256 KB.
- d. Total NRODD (line 1b + line 1c) = 1540 KB

UODD

2. 5E11 UODD

- a. OP:ODD UODD used value = 1421 KB
- b. Calculate projected 30% free space = 609 KB
- (3 * line 2b) / 7
- If line 2b < 100 KB, change to 100 KB.
- c. Total UODD (line 2a + line 2b) = 2030 KB

RODD

3. 5E11 RODD

- a. From OP:ODD, RODD used value = 8 KB
- b. Calculate projected 30% free space = 256 KB
- (3 * line 3b) / 7
- (If line 3b < 256 KB, change to 256 KB.)
- c. Total RODD (line 3a + line 3b) = 634 KB

4. Total ODD in MB 4.12 MB

Use $(1d + 2c + \text{line } 3c) / 1024$

5. Total 5E12 Text 21.73 MB

Complete Appendix A and place total here.

6. Subtotal for SM memory
(ODD + text + SAB) required = 25.85 MB

(line 4 + line 5 + .05 if SM or .57 if SM-2000)

Line 7 to be added only if additional SAB is required:

7. Additional SAB required (see SAB below) = 0 MB

8. Total SM memory required (with SAB) = 25.85 MB

(line 6 + line 7)

Note: / = divide, * = multiply. Roundup to nearest 100th.
If line 6 is slightly over a board boundary, recalculate NRODD and UODD using 29% free $(2.9 * \text{line}) / 7.1$. If the total still does not fit, recalculate using 1% decrements until there is a fit. If you are not satisfied with the final percent free space, order additional memory. Be aware that NRODD free space < 20% will trigger a minor alarm.

Appendix A

1. Base 5E12 Text

a. Input one of the following: 20.95 MB

(basic is 20.95, std is 23.44, loaded is 31.47,

signaling is 34.52, SM-2000 is 43.23)

b. Add if Basic, Std, or Loaded SM,

If LDSU present, enter 92.	92 KB
If LDSF2 present, enter 516.	516 KB
If RAF present, enter 80.	80 KB
If ISTF present, enter 60.	60 KB
If LDSU or RAF or ISTF present, enter 42.	42 KB
If SAS present, enter 426.	426 KB
If GDSF present, enter 366.	_____ KB

c. Add if Standard or Loaded SM,

If IDCU present, enter 742.	_____ KB

d. Add if Loaded SM,

If ISLU present, enter 474.	_____ KB
If PI present, enter 218.	_____ KB
If PH2 present, enter 1472.	_____ KB
If PH3 present, enter 1156.	_____ KB
If ISLU2 present, enter 842.	_____ KB
If PI2 present, enter 450.	_____ KB
If PH4 present, enter 1442.	_____ KB
If PHA present, enter 450. (Wireless only)	_____ KB
If PHV present, enter 450. (Wireless only)	_____ KB
If PHV3C present, enter 616. (Wireless only)	_____ KB

e. Add if Signaling SM,

If SS7 on PSU present, enter 3992. _____ KB

If SM, complete steps f, g and h.

If SM-2000 skip to item i.

f. Calculate total peripheral images
in KB. 700 KB

(Add all values for b + c + d + e)

g. Divide line f by 1024 to get total
in MB = .78 MB

h. Total text (line a + line g) = 1.73 MB

i. If SM-2000

If LDSF, enter 202. _____ KB

If GDSF, enter 366. _____ KB

If LDSF or GDSF, enter 202. _____ KB

If DNUS, enter 1054. _____ KB

If SAS, enter 426. _____ KB

If IDCU, enter 742. _____ KB

If ISLU2, enter 842. _____ KB

If PI2, enter 450. _____ KB

If PH4, enter 1442. _____ KB

If PHA present, enter 450.
(Wireless only) _____ KB

If PHV present, enter 450.
(Wireless only) _____ KB

If PHV3C present, enter 616
(Wireless only) _____ KB

If SS7 on PSU, enter 3992. _____ KB

j. Calculate total peripheral images
in KB. _____ KB

(Add all values for i)

k. Divide line j by 1024 to get total
in MB = _____ MB

l. Total text (line a + line k) = _____ MB

ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

In this example, more than 25 MB is required. The minimum would be 28 MB for the closest memory board boundary. 28 MB - 25.85 MB leaves approximately 2.15 MB for SAB if additional SAB is desired and another memory board is not desired. If more than 2 MB of additional SAB is desired, another memory board would be needed.

10.4.5 5E13 SOFTWARE RELEASE

10.4.5.1 HARDWARE

10.4.5.1.1 AM

10.4.5.1.1.1 3B20D AM

Additional memory is required. The AM is currently equipped with 56 MB. This is significant as 64 MB is the addressable memory limit of a 3B20D.

CAUTION: The 5E14 software release will require in excess of 64 MB of memory. Retrofitting to 5E14 WILL REQUIRE CONVERSION TO A 3B21D prior to retrofit.

10.4.5.1.1.2 3B21D AM

No additional memory is required. The AM is currently equipped with 64MB of memory via a 32 MB core board and one 32 MB Single In-Line Memory Module (SIMM). Memory is added on-site with an upgrade package of Single In-line Memory Module(s) (SIMMs) if required. New 3B21D offices are shipped with 64MB of memory.

10.4.5.1.1.3 New Memory Issues

The reasons for the increase in 5E13 AM memory are primarily attributed to the following:

- Deregulation features and applications (such as Local Number Portability (NPA-NXX), Switch Unbundling, and Long Distance Platform) are requiring additional memory to support new and expanded Office Dependent Data (ODD) structures.
- To meet our customers time-to-market expectations, more features are being delivered as software updates (SUs). As we continually improve productivity in software development and deploy larger and more frequent features via the Software Update process, more memory will be required in the base hardware configuration.
- Introduction of Rapid Software Delivery features.

10.4.5.1.2 Switching Module (SM)

Table 10.4-7 5E13 SMPU Configurations

PROCESSOR ^a		MEMORY BOARDS ^b	MAX. SLOTS ^c	MAX. EQUIPAGE (MB) ^d
SMP12	68012	TN56 TN2012	5 + 7 5 + 3	24** 32**
SMP23	68020	TN56 TN2012	5 + 7 5 + 3	24** 32**
SMP23CDM	68020	TN1423 ^e	0	32
SMP23CDMX	68020	TN1423 TN2012		52 5
SMP20 SMP20DC	68020	TN1374 TN1376 TN1661	6 6 6	24 48 96
CORE40	68040	TN1685 TN1806	4 2	128 256
CORE60	68060	TN1685 TN1806	4 2	192 256
CORE60MM UN594	68060	TN1685 TN1806	4 4	192 320
CORE60MM	68060	TN1685	2	192
UN 588		TN1806	2	256

Notes:

a. Processor addressability limits: 68012 & 68023 - 32 MB, 68020 - 4 GB, SB20CORE/ CORE40 /CORE60 - 748 MB.

b. TN56 = 2MB, TN2012 = 4 MB, TN1374 = 4 MB, TN1376 = 8 MB, TN1661 = 16 MB, TN1685 = 32 MB, TN1423 = 32 MB, TN1806 = 64 MB. The TN1374, TN1376, TN1661 boards may be mixed in the same MCTU2 (68020). The other boards are not mixable. The TN1423 is a new microprocessor board with dynamic memory. The TN1685 and TN1806 can be mixed in the same CORE40/60. or CORE60MM. The CORE40 has no memory on the processor board; the CORE60 has 64MB on the board, and the CORE60MM can be equipped with 64 MB or 128 MB of memory

c. Max slots for CORE60 assumes SM2000 unit. Max slots for CORE60MM assumes SM2005 unit.

d. Maximum equipage (**) requires the use of the MEU (Memory Expansion Unit). Memory totals denote DRAM on processor pack plus all external memory packs

e. The TN1423 is a processor board which supports 32 megabytes of on-board memory; the SMP23CDM does not support external memory boards, the SMP23CDMX supports zero to five TN2012 external memory boards.

10.4.5.1.2.1 TN1423 Microprocessor Board (Feature SMP23CDM)

This feature is also known as SMP23CDM (provided in 5E10) for SMP23 Dynamic Core Memory and provided 32 MB of memory. The feature was ported back to 5E9(1) software release so that offices skipping from 5E9(1) to the

5E10 software release could use it. It was also ported to the 5E9(2) software release because it needs to be added before any retrofit to 5E10. This feature supports the conversion from the SMP12 to TN1423. Prudent use of this board can save money when growing memory. The TN1423 is priced slightly higher than the cost of an MEU and one TN2012. When this board is installed in SMs equipped with TN2012s, the five TN2012s can be used to grow memory in other SMs with MEUs or a few MEUs may be ordered to grow memory in some SMs using the surplus TN2012s. The surplus TN2012 boards can also be used to grow AM memory.

10.4.5.1.2.2 SMP23CDMX

The TN1423 in combination with the TN1408, the TN1418 and appropriate wiring upgrade comprise the SMP23CDMX. This combination permits the TN1423 to use external memory packs.

10.4.5.1.2.3 Module Control Time Slot Interchange Unit Version 3 (MCTU3)

Non-SM-2000 SMs shipped equipped with the MCTU3 that has a 68LC040 processor (beginning with 5E10 software release update). The MCTU3 has all the existing functionality of the SMP20 plus additional capabilities. It is a one-shelf unit, instead of the two-shelf unit (MCTU2) needed for the SMP20.

10.4.5.1.2.4 SMP 12 Discontinued

The SMP12 Microprocessor will NO LONGER BE SUPPORTED as of 5E13 Software release. Memory requirements for the 5E13 release have exceeded the spectrum that an SMP12 can support. An SMP12 (with and MEU) equipped on a SM has a limit of 32 MB. The Basic SM for 5E13 will be required to equip a minimum of 36 MB of memory. The other SM configurations require even greater memory equipage. You may wish to consider this information as you plan to meet the 32 MB requirement for 5E12.

10.4.5.1.3 SM-2000 Memory

As part of the 5E11 software release update, a new backplane and compressed shelving is shipped with all new offices. The compressed unit is known as the SMPU5. The CORE60 was shipped with the SM-2000 in all 5E11 orders, regardless of whether the SMPU4 or SMPU5 is equipped. The SMPU4 is equipped with four memory slots. The SMPU5 is equipped with two memory slots. The CORE60 is equipped with the first 64 MB of memory attached to the processor core board. With 128 MB required, two TN1685s can be used or one TN1806. **Note: If two TN1685s are used in the SMPU5, both memory slots are equipped.** Note that if an upgrade from a CORE40 to a CORE60 will be ordered for improved real time, some of the 32 MB memory packs will no longer be needed as the CORE60 comes with 64 MB on the processor board.

10.4.5.1.3.1 CORE60MM

The CORE60MM is designed to improve the processor performance and provide two CORE RAM memory configurations of either 64MB (UN594) or 128 MB (UN588). The hardware and associated software for the CORE60MM are designed to improve the speed of the SM-2000 Switching Module by a factor of 1.8 over the CORE40. The 64MB CORE60MM (UN594) is supported on SM2000 for software release 5E12. The 128 MB CORE60MM (UN588) is supported on SM2005 for release 5E12. The 128MB CORE60MM (UN588) will be used for all newly shipped SMPU5 offices.

10.4.5.2 SOFTWARE

10.4.5.2.1

10.4.5.2.2 Switching Module (SM)

With Software Release 5E13, there are five software configurations: basic, standard, loaded, signaling, and SM-2000. Signaling is a software configuration for VCDX offices equipped with an SM that support SS7 signaling.

on a Packet Switch Unit (PSU). The signaling configuration (since AA5E11) has everything from the loaded configuration plus the ability to do SS7 signaling.

10.4.5.2.1 Peripheral Image Sizes for Software Release 13.00 (PO)

Table 10.4-8 5E13 Image Sizes and Configuration Support

IMAGE	KB	BASIC	STANDARD	LOADED	SIGNAL	SM2000
LDSU	92	√	√	√	√	
LDSF	660	√	√	√	√	
+DSC4						
RAF	80	√	√	√	√	
ISTF	60 + 42	√	√	√	√	
LDSU, RAF, ISTF ^a	42	√	√	√	√	
IDCU	742		√	√	√	√
GDSF	366	√	√	√	√	√
SAS	426	√	√	√	√	√
ISLU	474			√		
ISLU2	840			√	√	√
PI	218			√		
PI2	450			√	√	√
PH2	1472			√		
PH3	1156			√		
PH4	1440			√	√	√
SS7 on PSU	3992				√	√
PHV ^d	514			√	√	√
PHA ^d	514			√	√	√
PHV3C ^d	718			√	√	√
PHV4C ^a	1162			√	√	√
LDSF ^b	202					√
GDSF or LDSF ^c	202	√	√	√	√	√
DNUS	1054					√

Notes:

a. If the SM has LDSU, RAF, or ISTF, the 42 KBs is counted only once. Although LDSU was originally segregated as an option, most SMs will require this option. The few SMs that will NOT require this option are SMs that are only equipped with the older LDSU1. The LDSU1 does not support SS7 functionality.

b. LDSF Functionality is provided with all SM2000 SMs. Therefore, if you have SM2000, you will need LDSF with 202 kB and the additional 202 kB if you have GDSF, or LDSF.

c. If the SM has GDSF or LDSF, the 202 kB is counted only once. This code supports the DSC3 functionality.

d. For CDMA in wireless offices only.

10.4.5.2.2 Variable UODD

Another change from previous releases is the sizing of Unprotected Office Dependant Data (UODD). In software releases prior to 5E9(2), UODD had a fixed size for each SM software configuration. UODD is a variable number. The size varies based upon the specific features and number of lines supported in static ODD (non-redundant and redundant). For example, in the 5E8 software release, the UODD for all Basic SMs was one fixed size of 1304 KB. Now each SM has a unique size. The Office Data Assembler (ODA) checks all static relations and totals the UODD required to support those static relations. There is a fixed association between the static data and the related relations stored in UODD.

10.4.5.2.3 Memory Engineering Guidelines

NOTE: Some 5E13 offices may require more than 36 MB for Basic and 40 MB for Standard SM configurations. and 56 MB for Loaded SM configurations. Pay particular attention to Loaded SMs, especially if most peripheral images are loaded and the ODD is beyond the 90% projection. The variance in total Office Dependent Data (ODD) between offices is growing exponentially due to changes in the marketplace. As customers incorporate changes, such as turning offices into "virtual" switches by assigning specific hundreds groups of screening indexes to resellers, the amount of Redundant ODD (RODD) increases at a rate never seen before. In other words, translations for routing and screening are being used in new ways. As more and more routing and screening data is required with the new competitive environment, more RODD will be required. For these reasons, Lucent Technologies is looking for ways to better estimate memory requirements. The existing planning algorithms may require changes to account for the wider spread in ODD. Memory requirements for Basic and Standard SM configurations are being investigated. New memory requirements for these configurations will be provided as they become available.

The following are the memory engineering guidelines for each of the SM configurations. For each configuration, the software release text (non-ODD) requirement without any optional peripherals and with optional peripherals is given with the default ODD sizes. Total memory required = text+NRODD+RODD+UODD+SAB+PO. In order to determine the total amount of memory required, the OP ODD report lists the existing NRODD, RODD, UODD, and SAB. The missing part has always been the text size and now the PO sizes. Base text size is determined by the software configuration. The OP MEMSIZE report will list the software configuration for all SMs in the office. The command DUMP:SM MAP can be used to determine the POs that are equipped. When using the following tables, you may refer to Table A for PO sizes. The total memory includes the text, ODD, and SAB listed in the verbiage plus the PO value in the table to determine the total memory (in MBs) required.

10.4.5.2.3.1 Basic SM

The 5E13 software release text base and patch sizes for the Basic SM are projected to be 21.02 MB + 3.73 MB = 24.75 MB. The ODD size for 90% of the Basic SMs in 5E13 is 8.34 MB or less. The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, and HDSU for a total of .92 MB. The POs for new ships are assumed to be equipped with LDSU, HDSU, GDSF, and SAS for a total of 1.66 MB. Therefore, most Basic SMs will fit in 35 MBs (actual) or less (36 MBs physical). Note that in SMs, reserved SAB is 54KB.

10.4.5.2.3.2 Standard SM

The 5E13 software release text base and patch sizes for the Standard SM are projected to be 22.94 MB + 4.57 MB = 27.51 MB. The ODD size for 90% of the Standard SMs in 5E13 are 8.41 MB or less. The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, HDSU, and IDCU for a total of 1.64 MB. The POs for new ships are assumed to be equipped with LDSU, HDSU, GDSF, SAS, and IDCU for a total of 2.38 MB. Therefore, most Standard SMs will fit in 39 MB (actual) or less (40 MBs physical). Note that in SMs, reserved SAB is 54 KB.

10.4.5.2.3.3 Loaded SM

The 5E13 software release text base and patch sizes for the Loaded SM are projected to be 31.30 MB + 5.89 MB = 37.19 MB. The ODD size for 90% of the Loaded SMs in 5E13 will be 13.50 MB or less. The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, HDSU, IDCU, ISLU, PI, PH2 and PH3 for a total of 4.88 MB. The POs for new ships are assumed to be equipped with LDSU, HDSU, GDSF, SAS, IDCU, ISLU2, PI2, and PH4 for a total of 5.27 MB. The POs for CDMA retrofits are assumed to be equipped with LDSU, ISTF, HDSU, PI2, PH4, PHV, and PHA for a total of 5.10 MB. The POs for CDMA new ships are assumed to be equipped with LDSU, HDSU, PI2, PH4, PHV, PHA, LDSF, GDSF for a total of 6.15 MB. Since Loaded SMs will not equip all the POs, most SMs are projected to fit within 56 —58 MBs (actual) or less (56 — 60 MBs physical). Note that in SMs, reserved SAB is 54 KB.

10.4.5.2.3.4 Signaling SM

This software configuration has been added for SM and VDCX offices that wish to support SS7 signaling on a

Packet Switch Unit (PSU). VCDX offices that do not wish to support SS7 signaling can use the loaded software configuration above. SS7 signaling on PSU requires PH3 protocol handlers. The 5E13 software release text base and patch sizes for the Signaling SM are projected to be 32.75 MB + 6.75 = 39.47 MB. The ODD size for 90% of the Signaling SM in 5E13 will be 11.89 MB or less. The POs are assumed to be equipped with LDSU, HDSU, GDSF, SAS, IDCU, ISLU2, PI2, PH3, PH4, and SS7 on PSU for a total of 10.55 MB. The POs for a new VCDX are assumed to be a total of 11.59 MB. Stand Alone Billing (SAB) memory has been added to the VCDX offices because they must provide the ability to hold at least 72 hours of billing data in stand alone mode. Since Signaling SMs will not equip all the POs, all SMs are projected to fit within 65 MBs (actual) or less (68 MB physical).

10.4.5.2.3.5 Stand Alone Billing Changes

There is a change taking place with Stand Alone Billing (SAB). This change is being made to enhance the management of memory. Actively managing SAB memory emphasizes the need to monitor memory that would store billing records for the duration of a stand alone. There is no change in that when SAB is set to "YES", all unallocated memory is dedicated to SAB. In the past, it was readily available at ODD growth time, "Auto Shrink". In the future, this memory WILL NOT be automatically available. SAB will need to be degrown by the amount needed or new memory added, "No Auto Shrink".

NOTE: There will also be an addition to the SM memory layout called Real Time Billing Memory (RTBM). A default amount of memory will be provided for every SM, whether or not the Long Distance Platform, Real Time Call Detail feature is utilized. The default size is 8 KB for a SM and 288 KB for an SM-2000.

10.4.5.2.4 SM-2000

The 5E13 software release text base and patch sizes for SM-2000 are projected to be 42.63 MB. + 6.10 MB = 48.73. The ODD size for 90% of the SM-2000s will be 55 MB or less. The POs for service provider retrofits are assumed to be equipped with LDSF, DSC3, and DNUS for 6.10 MB. The POs for service provider new ships are assumed to be equipped with LDSF, GDSF, DSC3, DNUS, SAS, IDCU, ISLU2, PI2, and PH4 for a total of 6.26 MB. The POs for a T/CDMA retrofit are assumed to be equipped with LDSU (DSU2), LDSF+DSC4, ISTF, GDSF+DSC3, PI2, PH4, PHV1, and PHA1 for a total of 6.20 MB. The POs for CDMA new ships are assumed to be equipped with LDSF, GDSF, DSC3, DNUS, PI2, PHA, PHV, and PH4 for a total of 7.64 MB. The POs for VCDX retrofits are assumed to be LDSF, GDSF, DSC3, DNUS, ISLU2, PI2, PH4, SAS, IDCU, and SS7 on PSU for a total of 11.64 MB. The POs for a VCDX new ships are assumed to be equipped with LDSF2+DSC4, ISTF, GDSF+DSC3, IDCU, ISLU2, PI2, PH4, PHV1, PHA1, and PHV3C for a total of 12.58 MB. DSC3, DNUS, PI2, PHA, PHV, and PH4 for a total of 7.64 MB. The POs for VCDX retrofits are assumed to be LDSF, GDSF, DSC3, DNUS, ISLU2, PI2, PH4, SAS, IDCU, and SS7 on PSU for a total of 11.64 MB. The POs for a VCDX new ships are assumed to be equipped with LDSF2+DSC4, ISTF, GDSF+DSC3, IDCU, ISLU2, PI2, PH4, PHV1, PHA1, and PHV3C for a total of 12.58 MB.

10.4.5.3 ADMINISTRATION

10.4.5.3.1 Switching Module

10.4.5.3.1.1 SMMAP Command

The SMMAP command, is dump:smmap, sm=x. When reading this command, the start and end address of each image and its associated hashsum (parity check for errors) is listed. Many of the peripheral images listed in Table 10.4-8, are the sum of several individual images that come as a "family". Each member of the family and associated hash sum check are listed in the dump of the SMMAP command.

10.4.5.3.1.2 OP MEMSIZE Command

10.4.5.3.1.2.1 Description

The OP:MEMSIZE command can be used to project memory requirements from release to release. For example, if an office is on software release 5E10 retrofitting to software release 5E11, a software update is loaded which contains the memory projections for 5E11. When the command is run (i.e. using TORELEASE "5E11"), the new memory requirements are calculated and the hardware is checked to determine if additional memory boards are required before the retrofit. The command may also be used to monitor memory growth within a release (i.e. using TO RELEASE "5E101"). The command also lists on a per SM basis, the type and quantity of all memory packs, the software configuration, and whether additional Stand Alone Billing is set to yes. This tool is currently supported for software release 5E11.

10.4.5.3.1.2.2 Input

The OP:MEMSIZE input command is used to list current ODD availability in the AM, SM(s), or CMP, and determine growth values. The format of the command is:

```
OP:MEMSIZE, TORELEASE="5E???"
```

NOTE: It is important that the most current issue of the tool be utilized. The tool continues to go through a refinement process to improve accuracy, reflect hardware/software changes or incorporate enhancements/improvements. Software Update 970002 contains the most current issue for retrofitting to 5E10 and 97003 for retrofitting to software release 5E11. To identify the latest software update (BWM) loaded use the OP:VERSION command. To see the current and previous two software updates refer to page 1950 on the MCC.

10.4.5.3.1.2.3 Process

Once the command is input, the program completes the following steps.

- (1) Figures the differences between the current dict file and the target dict file. If the current and the target are the same then there will be no differences.
- (2) Calculates the size of its UODD, NRODD, and RODD relations. Counts the size of each relation that has a dict file difference and then modifies that total by the difference. For relations with no differences, it just uses the total of the current relation. A minimum of 256K or 30% free space is added to the NRODD and the RODD size and 256K or 35 % free space is added to the UODD size. Note: Free space for the NRODD can be below 30% as you will see in the step 5 but the minimum amount of free space for NRODD is 256K. The total of all UODD, NRODD, and RODD relations, including the projection of how they will change in the target generic is reported in KILO ODD NEEDED column.
- (3) Adds up the ODD (KILO ODD NEEDED), Text, and Peripherals Images sizes, as well as the minimum SABM. Consider this the Projected size.
- (4) Reads GLPMEMSIZE to determine how much memory is in each processor. This is reported as MEG MEM EQUIPPED.
- (5) Compares the amount of memory equipped (MEG MEM EQUIPPED) to the Projected (Projected) size the tool has calculated and the Engineering (Engineered) size that it gets from the spec5E file MIN MEMORY row. This is done to decide if the OP:MEMSIZE output should report a YES or a NO in the MEMORY NEEDED column. If the MEG MEM EQUIPPED is: Greater or equal to both the Projected and Engineered size Less than the Engineered size than the MEMORY NEEDED column will report YES.

Less than Projected but greater than the Engineered, the tool will decrease the amount free space in the NRODD (% FREE column) to a 256 K minimum before it reports that there is a memory problem. This is an attempt to get the projected image to fit in the equipped memory. It will not, however, go below the Engineered size.

The greater of Projected and Engineered will be reported in the MEG TOTAL NEEDED (MIN) column.

The % FREE column will be blank if there the MEMORY NEEDED column is YES. The % FREE column will be 30 or less depending if the Projected NRODD size was decreased as described above.

NOTE: When NRODD free space falls below 20% or 5%, minor or major alarms are activated. The free space calculated by OP:MEMSIZE will automatically set the value for free space for the retrofit. If you wish to override the percent free space that is calculated by the OP MEMSIZE calculation for retrofit, notify your Lucent Regional Engineer to input the value in the EQIM (Switching Module Equipage Form) form. He/she must make the physical change. Remember that all NRODD free space is backup on disk. If you assign 40% versus 30% free space, you will be backing up a lot more data on disk.

When determining the amount of text memory (base text + Peripheral Options) for each SM in 5E9(2) and later, the list of specific peripherals equipped for each SM is required. When up on 5E9(2) and later, the SMMAP command, can be used to list specific peripherals for each SM.

The STP:MEMSIZE command may be executed to stop the invocation of the tool.

10.4.5.3.1.2.4 Output

To report a forecast summary of the memory needed by the office's AM, CMP, and SMs to retrofit to the specified release. The report contains the current memory sizes of all the processors and sizes needed for the target release. Output is sent to the ROP and saved in the /rclog/sodd/ memsize.rep file. The tool will verify if the current and target release data files are available. If not, it will output an error message. The tool will also verify if the hardware on the switch is ready for the retrofit. If not, it will output an error message. Any errors encountered during the execution of the tool on any processor will result in an error message reporting the processors that could not be sized.

The OP:MEMSIZE command will also output the equipment specifics (memory boards & number) for each processor in the office.

10.4.5.3.2 Switch Resource Engineering (SRE) Growable Relations

Another way of keeping memory sizes under control is SRE. A subset of the relations is sized according to individual algorithms, but can be grown (to a larger size) by using recent change view 8.40. The algorithms are designed to accommodate five standard deviations or 99.97% of the SMs. A small group of relations require usage data from traffic engineers. Currently, the two relations that require user input are the OSPS relations COINOT and SRVOT. They request the percent of office traffic for coin, MECH, Listing Services, and QUANTUM calls. Refer to recent change view 8.9 for more information.

The need to grow relations is rare, but may be warranted for the following situations:

- If a service requires an unusual number of tuples for call processing such as call transfer tuples for some AIN services or Automatic Call Distribution (ACD). To prevent SM breakage on a relation, the relation may be grown.
- An office is an extreme outlayer in feature usage such as very large ISDN SMs with greater than five calls per hour and greater than 210 second holding times.
- If a relation needs to be grown, contact Lucent Technologies for assistance. Please keep in mind that the number of affected offices is very small.

Relations are grown using the Translation Guide Form 5547 found in Division 3, Section 5AW Contact Lucent Technologies for assistance in determining the correct size if these relations need to be grown. The following table

presents the relation acronym (Relation), relation name (Name), specific application(s) (Applic.), and a functional description (Description). The description will also point out if the RC/V name on view 8.40 is different from the relation acronym (RC/V:) and where "usage" plays a role in resource consumption (i.e. high use features). Additional SRE information (currently being modified) may be found the the following:

- Recent Change Procedures (235-118-250) Section 10.34
- Recent Change Procedures (235-118-250) Section 10.34

WARNING: The following relations are grown using the Translation Guide Form 5547 found in Division 3, Section 5AW. Contact Lucent Technologies for assistance in determining the correct size if these relations need to be grown.

Table 10.4-9 Switch Resource Engineering Growable Relations

SWITCH RESOURCE ENGINEERING (SRE) GROWABLE RELATIONS			
RELATION	NAME	APPLIC.	DESCRIPTION
ACRECORD	Auxiliary Call RECORD	OSPS	RC/V: ACRD. Stores information used for billing of an OSPS call
ADB	Analog Data Block	ISDN	Stores data for the Shared DN analog member of an ISDN Shared DN group
APB	Associated Process Block	OSP	Stores FEX (future) model information for OSPS calls
APBUF	Application Processor BUFFER	AP, MSS, EDS	Buffer for messages between AM and SMP
APDU	Application Processor Data Unit	TR-303 ISDN	Stores information for Automatic Terminal Setup & TR-303 EOC maintenance messages between RT & 5ESS-2000 Switch
ASPBASE	Advanced Services Platform BASE	AIN, ASP	Stores info about AIN/ASP transactions.-Usage depends on dialed DN (800 call) & other AIN/ASP trigger rates (LNP) -Number of tuples for NSDB, NS_BILL & NS_IDX are derived from ASPBASE.
ATCALL	AuTo CALL	MS, EDS Stores data for MSS/EDS auto call	Stores ISDN call feature data -Usage depends on Shared DN & ACD position call rates
BRCSDB	BRCS Data Block	ISDN	
CDDB	Call Buildup Data Block	BRCS, ISDN	Stores FEX (feature) data on process stack
CCSSTPDB	CCS SeTup Data Block	CCS7	Stores CCS trunk signaling data
CFLNTRM	Call Forwarding LiNe TeRMination	BRCS, CF	RC/V: CFLINT. Stores Call forwarding & another feature data for CF Don't Answer calls
CFSCOP	Call Forwarding System CampOn Process	BRCS, CF	Stores call forwarding, call record & other feature data
CINDX7	Ccs7 INDeX	CCS7	Used for efficient managing ENTRY7 tuples used for CCS7 ISUP maintenance messages.
CLDB	Call Leg Data Block	BRCS, ISDN	Stores FEX (feature) model information -Usage depends on Shared DN, line time slot bridging, PRI & ACD position call rates.
COINOT	Coin Originating Treatment	OSPS	Stores data for originating OSPS coin & other call types-Usage depends on coin & MECH call rate.
CPLR	CouPLeR, PRI	ANNMNTS	Used when a many-to-one relation exists between ports & processes such as many customers listening to one announcement or one wide-band call using many trunks/PRI's.
CQB	Circuit Queuing Block	All	Stores information when queuing for a circuit that is already being used.

CRECORD	Call RECORD	Billing	RC/V: CRD. Stores billing information during call Usage depends on call forwarding call rate
CV_STATE	CallVectoring STATE	OSPS, ACD	RC/V: CVSTATE. Stores data for OSPS ACD call vectoring-Usage depends on time in queue, % of calls which -terminate to an ACD -first terminate to an Intelligent Peripheral and then transfers the call to an ACD.
DALB	D-channel Application Linkage Block	ISDN	Identifies D-channel message with calls - Usage depends on Shared DN, PRI & ACD position call rates.
DBCND	Data Block Calling Number Delivery	ICLID	Stores last incoming calling DN used by ICLID calling number delivery
DISPDB	DISPlay Data Block	ISDN	Stores display information for CPE - Usage depends on Shared DN & ACD call rates.
E911DB	E911 Data Block	E911	Stores data about E911 calls
ENTRY7	ENTRY ccs7	CCS7	Tracks CCS7 ISUP maintenance (blocking, unblocking & reset) messages.
GPFTIME	General Purpose Functional TIMEr	ISDN	Stores data about timers associated with PRI & BRI maintenance
LSCMDB	Large Shared Call Model Data Block	ISDN Shared DN	Stores information about Shared DN group for the Shared DN controlling terminal process
MALLOC	Memory ALLOCation	TR-303 ISDN	Stores information for Automatic Terminal Setup & TR-303 EOC maintenance messages between RT & 5ESS-2000 Switch-used for ASN.1 message en(de)coding
MDB	Model Data Block	BRCS, ISDN	Stores FEX (feature) model Block ISDN information - usage depends on Shared DN, line timeslot bridging, PRI & ACD position call rates
MSMWIDA	Message Service Message Waiting Indicator Data	MSS	Stores call information associated with a MWI activate or deactivate request for inter-switch voice messaging (ISVM)
NSDB	Network Service Data Block	AIN, ASP	RC/V: ASPBASE. Stores routing & billing information for SCP initiated routes (AIN/ASP calls)- number of tuples derived from ASPBASE
NS_BILL	Nunber Service BILLing	AIN, ASP	RC/V: ASPBASE. Stores billing & other information about AIN/ASP trigger part of call - number of tuples derived from ASPBASE
NS_IDX	Number Service InDeX	AIN, ASP	C/V: ASPBASE. Stores data for AIN/ASP calls-number of tuples derived from ASPBAS
OAOTDB	OperAtor services Originating Treatment Data Block	OSPS	Stores originating treatment feature information for OSPS T & A calls
OSPCB	Operating System Process Control Block	All	Stores data about operating system processes - Usage depends on call transfer, EDS, ISDN, display, Shared DN, On Demand B-channel & Busy Line/No Answer call rates
OSTCB	Operating System Timer Control Block	All	Stores data about operating system timers-Usage depends on ACD, OSPS, On Demand, B-channel & Busy Line/No Answer call rates
PHDB	PatH Data Block	All	Stores data on SM time slot path
PHISTORY	Port HISTORY	MAINT	Stores information on out-of-service ports OOS for more than one reason
PTRDB	PoinTeRs to Data Blocks	OSPS	Stores pointers to other OSPS data blocks
PU_ENTRY	Pick Up ENTRY	Call Pickup	RC/V: PUENTRY. Stores information on call pickup queued call
QRYDB	QueRY Data Block	OSPS	Stores data saved across transition strings for the FEX (feature) QUERY mode used when querying the SCP during OSPS calls.
QV_STATE	Queuing & Vectoring STATE	ACD BRCS	RC/V: QVSTATE. Stores data for ACD BRCS call vectoring & ACD BRCS standard queuing - Usage depends on time in queue, % of calls which: - terminate to an ACD - first terminate to an Intelligent Peripheral, and then transfers the call to an ACD.

RTLB	Remote Terminal Linkage Block	TR303 ISDN	Stores information for Terminal ISDN Automatic Terminal Setup & TR-303 EOC maintenance Block messages between RT & 5ESS-2000 Switch.
RTMSGBUF	Remote Terminal MeSsaGe BUffer	TR-303 ISDN	See RTLB
SCMDB	Shared Call Model Data Block	ISDN Shared DN	Stores information about Shared DN group for the Shared DN controlling terminal process
SDAP_SDLSpeed Dial Auto Provisioning Speed Dial List	OSPS	OSPS	RC/C: SDAP. Stores data when updating the speed dial list used for OSPS AT&T calling card calls
SRVOT	SeRVices for Originating Treatment		Stores data for listing services calls for originating treatment and EIS interface - Usage depends on listing service call rates
TATDB	Terminating Attempt Trigger Data Block	AIN ASP	Stores data about AIN/ASP calls which hit a termination trigger
TN_INFO	Termination Notification	AIN ASP	Stores data about an AIN/ASP SCP query

10.4.5.3.3 Memory Worksheets, 5E13

The following worksheet can be used to project 5E13 SM memory sizes from 5E11 SM memory sizes using output from the OP ODD report. For line 1b, feel free to use any growth factor that you deem appropriate. The worksheet defaults to 10%.

Note that OSPS offices may wish to add memory to RODD if they will be installing some of the OSPS special features that reside in RODD.

Worksheet SM Identifier _____

RODD

1. 5E12 NRODD

a. OP:ODD, NRODD used value = _____ KB

b. Multiply line 1a by 1.1 for 5E12 EOP growth = _____ KB

c. Calculate projected 30% free space = _____ KB

(3 * line 1b) / 7

If line 1c < 256 KB, change to 256 KB.

d. Total NRODD (line 1b + line 1c) = _____ KB

UODD

2. 5E12 UODD

a. OP:ODD UODD used value = _____ KB

b. Calculate projected 30% free space = _____ KB

$$(3 * \text{line 2a}) / 7$$

If line 2a < 100 KB, change to 100 KB.

c. Total UODD (line 2a + line 2b) = _____ KB

RODD

3. 5E12 RODD

a. From OP:ODD, RODD used value = _____ KB

b. Calculate projected 30% free space = _____ KB

$$(3 * \text{line 3b}) / 7$$

If line 3a < 256 KB, change to 256 KB.

c. Total RODD (line 3b + line 3b) = _____ KB

4. Total ODD in MB _____ MB

$$\text{Use } (1d + 2c + \text{line 3c}) / 1024$$

5. Total 5E13 Text _____ MB

Complete Appendix A and place total here.

6. Subtotal for SM memory
(ODD + text + SAB) required = _____ MB

Line 4 + Line 5 + for SAB .05 if SM or .73 if SM-2000
and for RTB : .008 if SM or .29 if SM-2000)

)

Line 7 to be added only if additional SAB is required:

7. Additional SAB required

(see SAB below) = _____ MB

8. Total SM memory required (with SAB) = _____ MB

(line 6 + line 7)

Note: / = divide, * = multiply. Roundup to nearest 100th.
 If line 6 is slightly over a board boundary, recalculate NRODD and UODD using 29% free $(2.9 * \text{line}) / 7.1$. If the total still does not fit, recalculate using 1% decrements until there is a fit. If you are not satisfied with the final percent free space, order additional memory. Be aware that NRODD free space < 20% will trigger a minor alarm.

Appendix A

1. Base 5E13 Text

a. Input one of the following: _____ MB

(basic is 24.75, std is 27.51, loaded is 37.19,
 signaling is 39.47, SM-2000 is 48.73)

b. Add if Basic, Std, or Loaded SM,

If LDSU present, enter 92. _____ KB

If LDSF2 present, enter 660. _____ KB

If RAF present, enter 80. _____ KB

If ISTF present, enter 60. _____ KB

If LDSU or RAF or ISTF present,
 enter 42. _____ KB

If SAS present, enter 426. _____ KB

If GDSF present, enter 366. _____ KB

c. Add if Standard or Loaded SM,

If IDCU present, enter 742. _____ KB

d. Add if Loaded SM,

If ISLU present, enter 474. _____ KB

If PI present, enter 218. _____ KB

If PH2 present, enter 1472. _____ KB

If PH3 present, enter 1156. _____ KB

If ISLU2 present, enter 840. _____ KB

If PI2 present, enter 450. _____ KB

If PH4 present, enter 1666. _____ KB

If PHA present, enter 514.
(Wireless only) _____ KB

If PHV present, enter 514.
(Wireless only) _____ KB

If PHV3C present, enter 718.
(Wireless only) _____ KB

e. Add if Signaling SM,

If SS7 on PSU present, enter 3992. _____ KB

If SM, complete steps f, g and h.
If SM-2000 skip to item i.

f. Calculate total peripheral images
in KB. _____ KB

(Add all values for b + c + d + e)

g. Divide line f by 1024 to get total
in MB = _____ MB

h. Total text (line a + line g) = _____ MB

ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

i. If SM-2000,

If LDSF, enter 202. _____ KB

If GDSF, enter 366. _____ KB

If LDSF or GDSF, enter 202. _____ KB

If DNUS, enter 1054. _____ KB

If SAS, enter 426. _____ KB

If IDCU, enter 742. _____ KB

If ISLU2, enter 840. _____ KB

If PI2, enter 450. _____ KB

If PH4, enter 1666. _____ KB

If PHA present, enter 514.
(Wireless only) _____ KB

If PHV present, enter 514.
(Wireless only) _____ KB

If PHV3C present, enter 718.
(Wireless only) _____ KB

If PHV3C present, enter 1162.
(Wireless only) _____ KB

If SS7 on PSU, enter 3992. _____ KB

j. Calculate total peripheral images
in KB. _____ KB

(Add all values for i)

k. Divide line j by 1024 to get total
in MB = _____ MB

1. Total text (line a + line k) = _____ MB

ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

The worksheet will project the amount of memory that you will need for the 5E13 software release. It will be up to you to determine the difference between how much memory you currently have available, based on number and type of memory boards, and how much you will need to provide per the worksheet total. You may use the OP MEMSIZE command to obtain the types and quantity of memory boards for all SMs in the office.

If the difference between the amount required and the amount available is less than .3 MB for SMs, you may want to order more memory because you may be cutting your memory requirements too close or you may want to adjust your NRODD and UODD free space (See following paragraphs.). The .3 MB is a guideline. You may want to increase the number since this is an estimator. For example, if 28 MB is available and the worksheet estimates 27.75 MB needed, it is recommended that you order another memory board. Remember, this worksheet is an estimator. Projecting end-of-period growth is not an exact science.

Note that the OP MEMSIZE tool will be run before the retrofit. If 30% free space for NRODD or UODD will require an additional memory board, the tool will decrease the percent free space for both NRODD and UODD in one percent increments until the memory fits without growing a memory board. If you are not comfortable with the percent free space that OP MEMSIZE calculates, you will need to add more memory and override the free space calculation by requesting the desired amount on the EQIM form (record 5700-1/2).

10.4.5.3.4 Non-Redundant Office Dependent Data (NRODD) Growth-Line 1b

The 10% growth is for lines and features. If you expect a lot of growth or negligible growth, the percent can be adjusted accordingly.

10.4.5.3.5 NRODD Free Space-Line 1c

For retrofits, the free space will automatically be adjusted below the 30% default if 30% would require another memory board. The minimum required for a retrofit is 256 KB (.25 MB). 512 KB (.5 MB) free space (line 1c) should be more than sufficient for a maximum for SMs. SM-2000s would require a larger number. The total NRODD, line 1d, represents the total of NRODD in KB of used + available (free).

If you wish to change the percent free space in this worksheet, you will need to recalculate line 1c. For 25%, change line 1c to: $(2.5 * \text{line } 1b) / 7.5$. For 40%, change line 1c to: $(4 * \text{line } 1b) / 6$.

If you wish to override the percent free space that is calculated by the OP MEMSIZE calculation for retrofit, notify your Lucent Technologies Regional Engineer to input the value in the EQIM (Switching Module Equipage Form) form 5700-1/2 that is described in the TG-5, Division 8, Section 2, Paragraph 2.18. The Regional Engineer must make the physical change. Remember that all NRODD free space is backup on disk. If you assign 40% versus 30% free space, you will be backing up a lot more data on disk. Unprotected Office Dependent Data (UODD) growth: UODD is no longer a fixed size per the software configuration ordered. It is variable based upon the specific relations in non-redundant and redundant ODD. The minimum value for retrofits is 100 KB.

10.4.5.3.6 UODD Free Space-Line 2b

For retrofits, the free space will automatically be adjusted below the 30% default if 30% would require another memory board. Refer to NRODD free space for information on recalculating the free space and overriding the OP MEMSIZE calculation. Remember that OP MEMSIZE will use the same free space value for NRODD and UODD. The minimum value for retrofits is 100 KB. UODD free space is not backed up in disk because the data is transient.

10.4.5.3.7 Redundant Office Dependent Data (RODD) Growth

RODD consists of routing information, e.g. office screening and routing tables. Unless there is growth such as an NPA (Numbering Plan Area) split, RODD remains relatively constant. Therefore, a line for growth was not added. OSPS offices, however, may wish to add memory to RODD if they will be installing some of the OSPS special features that reside in RODD.

10.4.5.3.8 RODD Free Space-Line 3b

A minimum of 256 KB (.25 MB) of free space is required. In most cases, the minimum will be the number used because the calculated value is usually less than 256 KB.

10.4.5.3.9 Total ODD-Line 4

Total ODD is the sum of NRODD + UODD + RODD.

10.4.5.3.10 Total Text-Line 5

Total text consists of base text plus peripheral options. Text for equipped peripheral options will be downloaded at the time of retrofit. Appendix A must be completed to calculate total text size. For 5E11, to determine which peripherals are in the SM, you can use the command SMMAP. If you are unsure as to which peripherals are equipped, you may elect to assume that all are equipped when calculating memory required. This assumption will always provide enough memory, but will also over-engineer in most cases. It will way over-engineer loaded SMs because of the number of possible choices.

10.4.5.3.11 Additional Stand Alone Billing (SAB)-Line 7

Additional SAB is an option for all SMs (including remote SMs, host SMs, optically remote SMs and 2-mile remote SMs in 5E5 and later. The amount of available memory for SAB is the difference between the total amount of available memory per number and type of memory boards and line 6. For example, if 32 MB is available (four 8 MB boards) and the total of line is 30.5, there is 32 - 30.5 MB or 1.5 MB available for SAB. If 2 MB is required and only 1.5 MB is available, SAB will get 1.5 MB unless additional memory boards are provided. To determine the amount of SAB memory required for storage of AMA records. The 54 KB of SAB that all SMs receive is the .05 added in Line 6. SM-2000 SMs receive is the .57 added in Line 6.

EXAMPLE

SM Memory Calculation for Basic SM

SM Identifier: SAMPLE BASIC SM 5E12 to 5E13

NRODD

1. 5E12 NRODD

a. OP:ODD, NRODD used value = 980 KB

b. Multiply line 1a by 1.1 for 5E10 EOP

growth = 1078 KB

c. Calculate projected 30% free space = 462 KB

$(3 * \text{line 1b}) / 7$

If line 1c < 256 KB, change to 256 KB.

d. Total NRODD (line 1b + line 1c) = 1540 KB

UODD

2. 5E12 UODD

a. OP:ODD UODD used value = 1421 KB

b. Calculate projected 30% free space = 609 KB

$(3 * \text{line 2a}) / 7$

If line 2a < 100 KB, change to 100 KB.

c. Total UODD (line 2a + line 2b) = 2030 KB

RODD

3. 5E12 RODD

a. From OP:ODD, RODD used value = 378 KB

b. Calculate projected 30% free space = 256 KB

$(3 * \text{line 3a}) / 7$

(If line 3a < 256 KB, change to 256 KB.)

c. Total RODD (line 3a + line 3b) = 634 KB

4. Total ODD in MB 4.12 MB

Use $(1d + 2c + \text{line 3c}) / 1024$

5. Total 5E13 Text 26.08 MB

Complete Appendix A and place total here.

6. Subtotal for SM memory
 (ODD + text + SAB) required = 30.25 MB

 (line 4 + line 5 + .05 if SM or .73 if SM-2000)
 and RMB .008 if SM or .29 if SM-2000

Line 7 to be added only if additional SAB is required:

7. Additional SAB required
 (see SAB below) = 0 MB

 8. Total SM memory required (with SAB) = 30.25MB

 (line 6 + line 7)

Note: / = divide, * = multiply. Roundup to nearest 100th.
 If line 6 is slightly over a board boundary, recalculate
 NRODD and UODD using 29% free $(2.9 * \text{line}) / 7.1$. If the
 total still does not fit, recalculate using 1% decrements
 until there is a fit. If you are not satisfied with the
 final percent free space, order additional memory. Be aware
 that NRODD free space < 20% will trigger a minor alarm.

Appendix A

1. Base 5E13 Text

- a. Input one of the following: 24.75 MB
 (basic is 24.75, std is 27.51, loaded is 37.19,
 signaling is 39.46, SM-2000 is 48.73)
- b. Add if Basic, Std, or Loaded SM,
- | | |
|---|--------|
| If LDSU present, enter 92. | 92 KB |
| If LDSF2 present, enter 660. | 660 KB |
| If RAF present, enter 80. | 80 KB |
| If ISTF present, enter 60. | 60 KB |
| If LDSU or RAF or ISTF present, enter 42. | 42 KB |
| If SAS present, enter 426. | 426 KB |

If GDSF present, enter 366. _____ KB

c. Add if Standard or Loaded SM,

If IDCU present, enter 742. _____ KB

d. Add if Loaded SM,

If ISLU present, enter 474. _____ KB

If PI present, enter 218. _____ KB

If PH2 present, enter 1472. _____ KB

If PH3 present, enter 1156. _____ KB

If ISLU2 present, enter 840. _____ KB

If PI2 present, enter 450. _____ KB

If PH4 present, enter 1666. _____ KB

If PHA present, enter 514.
(Wireless only) _____ KB

If PHV present, enter 514.
(Wireless only) _____ KB

If PHV3C present, enter 718.
(Wireless only) _____ KB

e. Add if Signaling SM,

If SS7 on PSU present,
enter 3992. _____ KB

If SM, complete steps f, g and h.

If SM-2000 skip to item i.

f. Calculate total peripheral images
in KB. 1360KB

(Add all values for b + c + d + e)

g. Divide line f by 1024 to get total
in MB = 1.33 MB

h. Total text (line a + line g) = 26.08 MB

i. If SM-2000

If LDSF, enter 202. _____ KB

If GDSF, enter 366. _____ KB

If LDSF or GDSF, enter 202. _____ KB

If DNUS, enter 1054. _____ KB

If SAS, enter 426. _____ KB

If IDCU, enter 742. _____ KB

If ISLU2, enter 840. _____ KB

If PI2, enter 450. _____ KB

If PH4, enter 1666. _____ KB

If PHA present, enter 514.
(Wireless only) _____ KB

If PHV present, enter 514.
(Wireless only) _____ KB

If PHV3C present, enter 718
(Wireless only) _____ KB

If SS7 on PSU, enter 3992. _____ KB

j. Calculate total peripheral images
in KB. _____ KB

(Add all values for i)

k. Divide line j by 1024 to get total
in MB = _____ MB

1. Total text (line a + line k) = _____ MB

ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

In this case, more than 35 MB is required. The minimum would be 32 MB for the closest memory board boundary. 32 MB - 30.25 MB leaves approximately 1.75 MB for SAB if additional SAB is desired and another memory board is not desired. If more than 1.75MB of additional SAB is desired, another memory board would be needed. Note that for 5E13 a Basic SM requires 36 MB to be equipped. Which means the SMP23CDM Memory Expansion feature must be initiated, a new SM ordered (MCTU3), or consolidation takes place via Project Renaissance to an SM-2000.

10.5 SM OVERLOAD CONTROLS

10.5.1 DEFINITION

Overload is the 5ESS®-2000 switch condition that occurs when both the call processing and noncall processing loads offered to the system exceed its capacity. The overload condition must be detected and controlled before performance degrades.

There are two types of overload: real-time overload and shared-resource overload. Real-time overload occurs when there is insufficient time for the processor to perform all the work offered to the system. This is the primary overload critical to the system performance, which, if not corrected, leads to delays degrading system performance. Shared resource overload occurs when there is a shortage of shared software resources requested by processes in the system. The tone decoder is the only monitored hardware resource contributing to the resource overload. This type of overload hampers further processing.

In general, a real-time overload is usually caused by the surge of call traffic. A shared resource overload, on the other hand, is usually caused by inadequate resource allocation. However, either overload type can be caused by a software fault.

10.5.2 OBJECTIVES AND STRATEGIES OF OVERLOAD CONTROL

The general objective of overload control is to maximize system performance during periods of overload. More specifically, the purposes of overload control can be stated as follows:

- Ensuring system sanity and responsiveness
- Maintaining a high level of call processing
- Providing a graceful degradation of service, if degradation is inevitable.

To achieve these objectives, the overload control program constantly monitors the usage of the processor real time and the shared software resources. Overload control averages the usage over an appropriate time interval and compares the result with thresholds to determine the presence and the severity level of an overload. Overload control initiates appropriate actions to eliminate or minimize the effect of the detected overload conditions. These actions are a series of incremental controls ensuring a stable level of system performance with graceful degradation, if performance degradation is inevitable.

When real-time overload is detected, the general strategy is to:

- Limit the input of call processing work and, if necessary, the noncall processing work
- Defer the nonessential noncall processing work
- Ensure that a minimum of essential system checks are run to maintain the system sanity.

When resource overload is detected, the general recovery strategy is to:

- Identify and eliminate any resource hog to recover the overloaded resource
- Run sanity checks on the usage of this resource and correct the causing errors
- Reduce call processing and noncall processing activities which require this resource.

All of these control actions are fully automatic and require no immediate intervention by the central office craftsman or surveillance center. However, the operating personnel are informed by overload control about the overload type, overload level, and the control actions. Upon each occurrence or state change of the overload, the master control center (MCC) display pages are updated. Within each 15-minute period, a message is printed at the receive-only-printer (ROP) once an SM goes into overload, if the overload escalates, or if the SM goes out of overload completely. The status of each SM still in overload at the end of a 15-minute period is printed at the ROP along with the overload history report.

10.5.3 SWITCHING MODULE OVERLOAD CONTROL

The SM overload control checks for the following types of overload:

- **SM Real-Time Overload:** The SM real-time overload exists when the SMP lacks sufficient real time to complete all of the work queued without excessive delays.
- **SM Shared Resource Overload:** The SM shared resource overload occurs when the shared software resources required for call processing in the SM are not available because they have been previously allocated for existing calls. The only SM hardware resource monitored for overload is tone receivers. In all software releases, the SM software resources monitored for overload are the message control block (MCB), process control block (PCB), stack control block (SCB) and timer control block (TCB). Several additional software resources related to call features are monitored by overload control.

10.5.3.1 Approach

To respond quickly to a sudden surge in work load, SM real-time overload control monitors SMP real-time usage every 6 seconds. However, to avoid a rapid oscillation of overload states due to statistical fluctuations of call traffic, some hysteresis is built into the overload control mechanism. Overload control compares a moving average real-time usage of four 6-second intervals to predetermined thresholds for determining the overload level. In addition, the overload state changes only at 18-second intervals. That is, once in overload, the current level lasts for at least 18 seconds before it can change to another level. Even under the most severe overload level, the SMP still can process a large amount of call traffic.

10.5.3.2 Overload Levels

There are four overload states for SM real time. The states and their corresponding control actions are listed as follows. The various control actions are described in more detail in the *Details of Control* section.

- **NONE:** There is no SM real-time overload. The SMP has adequate real-time reserve to maintain its normal performance. All processing delays are minimal.
- **MINOR:** The SMP experiences a mild, real-time overload condition. At this level, the SM relies on the automatic tightening of the peripheral control (PC) throttle to reduce the originating and incoming traffic. There are no additional control actions, and this level serves as a high traffic warning.
- **MAJOR:** In a MAJOR overload condition, the PC throttle for originating and incoming calls is tightened further to reduce the traffic input. Nonessential tasks (DNET) in the SM are deferred DNET. The SM also requests the CMP to start avoidance routing (AVRT) in an attempt to reduce the amount of outgoing trunk calls passing through the SM.
- **CRITICAL:** A critical overload is the most severe SM real-time overload. In a CRITICAL SM real-time overload, AVRT and the deferring of nonessential tasks (DNET) are still in effect. However, the PC throttle is overridden by a "super throttle". Reduced Input Acceptance Rate (RIAR). the "super throttle", takes control and provides a strict, fixed level of the traffic input (both line originations and trunk originations) into the SM. The overloaded SM broadcasts to all other SMs to start call-gapping for the calls destined to it.

During extreme system overload conditions such as emergency situations, lines designated "essential" receive a faster service request response than nonessential lines.

To maintain the sanity of the switch, it is necessary to ensure that a minimum amount of real time is allocated to essential low priority tasks. Since call processing runs at higher priorities and may entirely squeeze out the lower priority work, overload control must ensure the realization of this essential minimum allocation. The real-time overload states and their transitions are defined in terms of the amount of real time available in 6-second intervals for low-priority processes, such as various audits, main memory check, and recent changes. These audits are used to detect and to recover from data errors so that the system is not adversely affected. Execution of these noncall processing activities is essential to maintaining the sanity of the switch.

MINOR overload corresponds to about 9 percent of SMP time available for low priority tasks during the last 24 seconds, which is equivalent to a printed SMP occupancy of about 91 percent. MAJOR overload corresponds to about 7 percent for low priority tasks, which is equivalent to about 93 percent of SMP occupancy. CRITICAL overload corresponds to about 5 percent for low priority tasks, equivalent to about 95 percent of SMP occupancy.

10.5.3.3 Details Of Control

10.5.3.3.1 Essential Service Protection (ESP)

The ESP provides priority service to subscriber lines designated by the administrative personnel as "essential." The ESP has traditionally been assigned to subscriber lines with critical emergency functions (police, fire, hospital, network controls, etc.). During system overload conditions (as emergency situations), ESP provides priority subscriber lines faster service request response (shorter dial tone delay) than non-ESP subscribers. When operations personnel enable ESP during overload, dial tone delay is minimized on essential subscriber lines receiving priority origination service. Since the number of lines marked as essential is typically less than 10 to 20 percent, the actions of ESP has limited impact on the quality of service to nonessential lines during overloads, and no impact at all during normal loads.

10.5.3.3.2 PC Throttle for Call Originations

To ensure that each new call is processed properly with minimum delay, an effective control mechanism for the acceptance rate of these new call originations (either originating line or incoming trunk calls, circuit-switched or packet-switched, CCS or non-CCS, etc.) is required. Otherwise, either an instantaneous call arrival rate or a sustained heavy call load can cause too many calls to be processed simultaneously and can result in misdirected or lost calls. Therefore, a self-limiting throttle for call originations, the "PC throttle," limits the maximal input acceptance rate to the SM.

Call originations (both line originations and incoming trunk originations) are throttled by way of a PC variable called *PCc*. Each time a call is originated, *PCc* is decremented by some amount (for example, 100). If *PCc* is below a certain number (for example, 100), no originations are allowed and the new call arrivals must be queued. This waiting contributes to the major part of dial tone delay for line calls. To allow further calls to be processed, roughly speaking, *PCc* is incremented (for example, by 100) whenever the SMP has finished the immediately pending call processing work in the last 100 milliseconds. However, the *PCc* is not allowed to increase beyond an upper limit (for example, 500).

This PC throttle automatically adjusts the call input rate and is closely related to the amount of real time available for the lower priority tasks. When the call load on the SM is well below capacity (that is, SM has real time available and SM occupancy is quite low), the *PCc* value remains near its upper limit most of the time. This allows the SMP to reach a maximal rate for new call originations. On the other hand, as more calls are allowed to originate, the resultant call processing requires additional real time and thus slows down the rate at which the *PCc* variable is incremented. This, in turn, reduces the acceptance rate for new call arrivals. Therefore, when the SM is in MINOR/MAJOR real-time overload, the PC throttle automatically tightens up to reduce the new call originations.

10.5.3.3.3 Defer Nonessential Tasks (DNET)

Many tasks normally performed can be deferred indefinitely during an overload condition. These nonessential tasks consist of the following:

- **Switch Maintenance/Diagnostics:** During SM overload, the acceptance and execution of the maintenance and diagnostic requests are greatly reduced.
- **Terminal Maintenance:** Terminal maintenance is responsible for protecting against degraded service due to problems in trunks, lines, service circuits, and signaling paths. Terminal maintenance performs fault detection, sectionalization, and isolation. The following terminal maintenance work is inhibited during both AM and SM real-time overloads:
 - **Automatic Line Insulation Test (ALIT):** The ALIT provides tip-to-ring, tip-to-ground, and ring-to-ground leakage tests
 - **Automatic Progression Test (APT):** The APT routinely tests trunks, identifies trunk signaling problems, and removes faulty trunks from service.

During an AM real-time overload, all ALIT and APT work for all SMs is inhibited. During an SM real-time overload, ALIT and APT work is inhibited on an individual SM basis. If the line or trunk to be tested is in an overloaded SM, the tests are not performed.

- **AVRT:** For 1-way outgoing trunks (hunted ports), it is possible for the CMP to route calls around overloaded SMs. When an SM goes into a MAJOR/CRITICAL real-time overload, or resource overload, AVRT is activated in the CMP by way of a request from the overloaded SM. In AVRT, the CMP makes 5 attempts to hunt for an idle trunk group member not in the overloaded SM. If this hunt fails, the CMP routes that call through the overloaded SM. However, when the SM is in CRITICAL real-time overload, the AVRT-attempted trunk call may be subject to yet another AM throttle for the termination requests.
- **Reduce Termination Requests (RTRs):** A call termination request for either a terminating line call or an outgoing trunk call is sent from AM to SM for each terminating call. When an SM is in CRITICAL real-time overload, the SM requests the AM to activate the termination request throttle for the overloaded SM. The AM then starts to throttle the termination requests according to a set of predetermined rates. There are four levels of this throttle. The throttled calls are sent to reorder immediately without being queued for retry. Certain types of calls receive preference in getting through this throttle, such as 911- and 0- calls.

The termination request throttle as described remains in effect for the outgoing trunk calls. In addition, a new throttling mechanism is initiated for line termination requests. A line termination request is sent directly from the routing SM to the terminating SM, no longer going through the AM. When the terminating SM is in CRITICAL real-time overload, the SM requests all other SMs to start throttling all the line termination requests destined for the overloaded SM. Because of the fully distributed nature of the routing data base for the terminating line calls, every SM except the RSM could serve as a routing SM for some line termination calls. The four levels of this throttle are functions of the total number of SMs in the switch. The throttled calls are sent to reorder immediately without being queued for retry.

- **Override PC Throttle or Reduce Input Acceptance Rate (RIAR):** When an SM is in CRITICAL real-time overload or in SM resource overload, the dynamic PC throttle for call originations is overridden by a deterministic overload control "super throttle." The call originations (including both lines and trunks) are then reduced to a fixed level of 1800 calls per hour instead of the self-adjusting throughput of the dynamic PC throttle.

10.5.3.4 Most Severe State

One of the objectives of overload control is to maintain a high level of call processing even under the most severe overload situation. At the most severe state of SM real-time overload, both the overload control super throttle for originations and the termination request throttle are activated. The overload control super throttle allows 1800 call originations per hour into the SM while the tightest level of the termination throttle allows 7200 call terminations to the SM. This final traffic level is limited to about 4500 full calls per hour for an SM experiencing even the worst possible real-time overload conditions.

10.5.3.5 General Comments on SM Real-Time Overload

The following are comments regarding SM real-time overload:

- **Symptoms of Real-Time Overload:** During periods of overload, the subscriber may experience delays in dial tone on some calls. Some calls may receive reorder treatment due to the possible call termination throttling or LU termination blockage.
- **ESP:** For those exchanges with ESP enabled, those subscribers designated as "essential" are given preferential originating treatment during system overloads.
- **Minor Real-Time Overload:** The short duration of a MINOR overload is usually caused by uneven traffic bursts. It is just a high traffic warning; no actions are required.
- **Major Real-Time Overload:** Administration and maintenance inputs (such as recent change, diagnostics) should be deferred to a later nonoverload period.
- **Frequent Overloads:** When a frequent (for example, daily) or a long duration (for example, 20 minutes) of MAJOR/CRITICAL overload is experienced, the possible causes of overloads should be investigated (for example, traffic, data base errors, software bugs, hardware faults, etc.) If the cause is traffic, the administrator may consider transferring some of the call load to another SM or look into adding speedup to the SM, if doing so is feasible.
- **SM Initialization:** This is usually caused by software or data base problems or both, and extremely unlikely to be caused by call processing.

10.5.4 SM RESOURCE OVERLOAD CONTROL

Four types of shared SM resources are monitored by overload control:

- Basic data blocks and tone decoders
- Feature data blocks
- ISDN queues
- Packet switch unit resources.

It is possible to increment the number of certain SM software resources if they become exhausted and cause overload conditions.

10.5.4.1 Basic Data Blocks

This group of shared software resources is common to all basic call and noncall processing; included are the MCB, PCB, SCB and TCB. Every 6 seconds overload control monitors the count of free resources for each type. If the free count is less than the threshold, SM enters resource overload for that type.

Upon entering resource overload, the SM takes the following actions to alleviate the overload condition and to recover the resource:

- SM requests CMP to start AVRT
- SM overload control overrides PC throttle to greatly reduce the rate of call originations allowed into the SM
- SM notifies the system integrity monitor. Running at the highest priority, the integrity monitor starts to identify and eliminate the resource hog(s) to recover the nearly exhausted resource, if appropriate.

If any of the resources are exhausted before being detected by overload control, the integrity monitor is informed immediately by the encountering process and takes immediate recovery action.

If the PCB or TCB resource becomes low so as to cause overload or even total resource exhaustion, it will be possible to add in more PCBs or TCBs on a SM. This is discussed in Section 10.5.4.7 , *Software Engineerable Resources* .

10.5.4.2 Tone Decoder (Receiver) Overload

A tone decoder is required for decoding the digits for calls; however, digits coming through an immediate start trunk are handled by the signal processor, not by a tone decoder. The SM tone receiver or tone decoder overload is detected through the number of idle receivers. When tone decoders run out, the permanent signal timing and partial dial timing are shortened (for example, from 20 seconds to 10 seconds) to expedite the freeing of the receivers. When the number of idle tone decoders increases over a threshold value, the timing values are changed back to normal.

10.5.4.3 Feature Data Blocks

This group of shared resources is mainly required by the BRCS and integrated service digital network (ISDN) feature applications. Many dynamic data blocks are included in this group:

- Analog data block (ADB)
- Auxiliary process block (APB)
- BRCS data block (BRCSDB)
- Called buildup data block (CBDB)
- Channel control block communication region (CCBCOM)
- Channel data block (CHDB)
- Calling leg data block (CLDB)
- CPLR
- D-channel application linkage block (DALB)
- Display data block (DISPDB)
- E911 data block (E911DB)
- Large shared call model data block [LSCMDB]
- Model data block (MDB)

- Path data block (PHDB)
- Shared call model data block (SCMDB)
- Time slot data blocks (TSDB).

Depending on the degree of penetration of individual features, the allocation of these resources is calculated dynamically and may vary greatly. The individual resource is monitored immediately following the occurrence of resource exhaustion. During monitoring, if the free count of the resource indicates one unit block available, the SM reports resource overload for this resource and overload control informs system integrity monitor to trigger appropriate recovery action.

If the number of any of these resources becomes so low as to cause overload or even total resource exhaustion, it will be possible to add in more of the resource. This is discussed in Section 10.5.4.7, *Software Engineerable Resources*.

10.5.4.4 ISDN Queues

This group contains five queues or buffers which are used for both circuit-switched and packet-switched ISDN call setups. These are DSL input buffer (DIB), EDSL input buffer (EDIB), Packet-switched line input buffer (XPIB), packet-switched trunk input buffer (PTIB) and Packet Buffer (PkB). They are used for buffering BRI circuit-switched call setups, PRI circuit-switched call setups, packet-switched line call setups, packet-switched trunk call setups, and PH-to-SMP packets, respectively. Each queue length is monitored by overload control every 6 seconds. When an SMP experiences real-time overload, these queues may start to grow. When the queue length exceeds certain thresholds, overload control reports resource overload for the queue and requests that PHs start to throttle new call setup messages. Both the thresholds and throttle levels are incremental.

10.5.4.5 Packet Switch Unit Resources

The packet switch unit (PSU) is the central component in the SM for providing packet switching services in ISDN applications. The PSU contains one packet interface (PI) and up to 80 protocol handlers (PHs). It is recommended to reserve one spare PH per shelf for each PH hardware type equipped on that shelf. The PI serves as the gateway between the SMP and the PHs for call processing, signaling, and control messages. Both real-time and shared buffers in every PH and in the PI are monitored by overload control at 3-second intervals. If, in any PH or PI, the real time is near exhaustion or the count of free resources goes below predetermined thresholds, that PH or PI enters overload. When the PI or any PH is in overload, a summary indication of resource PSU overload is printed with the SM number indicated. To determine the status of the overloaded PI or PHs, see 30-minute traffic report sections 51, 52 and 68.

In general, when a PH is in general overload, overload control starts to incrementally throttle the rate of serving new data packets and new packet-switched call setups offered to that PH. However, when a PH is in extreme overload, circuit-switched call setups also are throttled. When the PI is in overload, overload control starts to incrementally throttle the rate of new call setup requests including both CS and PS entering the overloaded PSU through all access PHs.

10.5.4.6 General Comments on SM Resource Overload

Although real-time overload is usually caused by high call traffic, SM resource overload (except PSU overload) is usually caused by the inadequate allocation of resources, or improper engineering of the equipment on the SM, or in some cases by software problems.

A PSU overload means either one or more PHs or the PI is in overload (either real-time or resources). A PH or PI overload is usually caused by high volume of packet-message traffic. The 30-minute traffic report sections 51, 52,

and 68 describe the packet traffic and processor status for the overloaded PI or PH(s). If any PH frequently enters overload, it should be deloaded.

Some resource overloads may be caused by processor real-time overload. For example, the overload of five ISDN queues: DIB, EDIB, XPIB, PkB, and PTIB is usually caused by the SMP real-time overload. The PSU overload may also be caused by the real-time overload of the PI or one or more PHs.

10.5.4.7 Software Engineerable Resources

It is possible that there are some application(s) with high feature usage running on a SM that could result in some software resources becoming exhausted, resulting in SM resource overload as discussed. Past experience shows that this occurs very rarely. However, there are certain resources, called Software Engineerable Resources (SER), for which there are procedures for allocating additional data blocks (and thus stopping the overload) in case exhaustion does occur. The SER types include all data structures given in Section 10.5.4.3, *Feature Data Blocks* plus the PCB and TCB from Section 10.5.4.1, *Basic Data Blocks*. The following subsections describe how to (1) estimate the additional number of SER data blocks needed to be added in the event exhaustion occurs and (2) how to add in the incremental data blocks. These procedures are part of a methodology which is known as Software Resource Engineering (SRE).

As a caution, before adding in extra data blocks it should be made sure that they are really needed. In the procedures below there are checks which are made to verify that the resource exhaustion does result from a high usage feature and is not due to some software or data problem. However, even if it is found that there is a true resource exhaustion, the exhaustion may occur so infrequently and/or its duration may be so short that it is not worth adding the extra resources. Once the additional data blocks are added in, only a generic retrofit can deallocate the memory assigned to the data. Thus care must be taken that the correct number of data blocks is added in. To help prevent the addition of a large and unnecessary number of data blocks, the following procedures describe how to limit the increase in the number of data blocks to 50 per Recent Change update.

10.5.4.7.1 Determining the Number of Additional Data Blocks Needed

This section discusses how to determine the number of additional data blocks which are needed when a given SER type is exhausted. The steps are as follows:

- (1) It should be verified that the resource exhaustion is due to some high usage feature and that adding in more data blocks will solve the problem (the SRE procedures should not be used to fix a software or data problem). In the following steps there are checks listed that help verify this to be the case. Also make sure that the frequency and/or duration of the exhaustion is high enough to warrant adding the additional resources.
- (2) After it has been determined that additional resources are required, the total number of data blocks of the SER type which are needed must be calculated using the appropriate algorithm. To do this contact the next level of support in order to obtain and get help in using the algorithms. Once the calculation has been performed, call the result of the calculation (the total number of data blocks of the SER type which are needed) TNN (Total Number Needed).
- (3) In RC view 8.40 enter the SM number and SER type, the result of this step being the value displayed for the total number of data blocks of the SER type currently allocated on the SM. Call this result CTN (Current Total Number). This total number should be the sum of the number given by the algorithm when the default "usage" parameter values are used as input plus the number of data blocks which have been previously added manually (the value given by the incremental field in RC view 8.40). Note that for some SER types, the total number displayed may be the above sum rounded up to fill the last data page.
- (4) Subtract the result of step 3 (CTN) from the result of step 2 (TNN), this final result being the number of additional data blocks of the SER type which need to be added on the SM. Call this final result ANN (for Additional Number Needed). ANN must be a positive number. If ANN is a negative number, then recheck the

estimates of the "usage" input parameters and also the calculation. If the recheck still gives a negative result then contact the next level of support or the person who performed the algorithm calculation. Also if ANN turns out to be greater than 20% of CTN, then recheck the "usage" input parameters and the calculations. If the recheck still gives a result greater than 20% then contact the next level of support or the person who performed the algorithm calculation.

10.5.4.7.2 Adding Data Blocks

At this point the number of data blocks of the SER type to add on the SM has been determined. Next the number of SER data blocks on the SM must be incremented by this value. The steps to do this are as follows:

- (1) Go to RC view 8.40 and enter in the SM number and SER type name. The current value for the incremental number of data blocks will be displayed. Call the result of this step CIN (Current Incremental Number). This field will be zero unless the number of data blocks for the SER type has been manually incremented previously.
- (2) Take the final result (ANN) from the last step (step 4) of the previous section 10.5.4.7.1, *Determining the Number of Additional Data Blocks Needed*, and add it to the result of step 1 (CIN), the sum being the result of this step. Call this result INN (Incremental Number Needed).
- (3) Update the incremental field to the result (INN) obtained from the previous step. If the difference between INN and CIN is greater than 50 then multiple updates are needed as there is an upper limit of 50 data blocks which can be added per update.
- (4) After an update has completed, the total field value should also have been increased by the same amount as the incremental field has been increased by (because of data page rounding effects it is possible that the new total value could be unchanged from its value before the update or could have been increased by more than the amount by which the incremental field was increased). When all the updates are done there should no longer be any overloads of this SER type on the SM. If the overloads continue, do not keep on adding data blocks as there could be software problems. If the number of data blocks is believed to be reasonable and overloads continue, then contact the next level of support.

10.5.5 OVERLOAD CONTROL FOR ISDN CALLS

Digital ISDN lines offer both CS calls and PS calls through the Q.931 and X.25 protocols, respectively. Both types of calls are processed by SMP to provide call setup. For PS calls, once the call is set up, the data packets are routed by the autonomous PHs without further use of SMP resources.

10.5.5.1 Circuit-Switched Call Setup

The initial CS call setup message (Q.931) from a user digital subscriber line (DSL), passes through the ISLU, arrives at one of the access PHs, is routed to the PI, and finally is queued in the DIB for SMP processing. When the DIB is in overload, new CS call setup messages are incrementally throttled in the access PHs. When PI packet buffer (PkB) is in extreme overload, the new CS call setup message is denied in the access PHs. In addition, CS call setups are also affected by the most severe state of PH overload.

10.5.5.2 Packet-Switched Call Setup

The PS call setup message (X.25) comes from a user DSL, passes through the ISLU, arrives at one of the access PHs, proceeds to PI, and finally is queued in the XPIB for SMP processing. When the XPIB, PI processor, PI PkB, or PH is in overload, all new PS call setup messages are incrementally throttled in the PH.

Table 10.5-1 displays the real times associated with data packets and call setups. Since the PH capacities are

given in data packets per second, the effect of call setups on the PH occupancy could be accounted for using these tables. However, the rate of call setups for all known and expected applications in the field is negligible compared to the PH capacity, so this should be unnecessary. The real times for data packets are stated for 128 byte packets. The real time per data packet could be up to 1 ms. less for smaller packet sizes.

Table 10.5-1 provides the real times associated with different packet types in the Access Protocol Handler. "Sending" or "Originating" refers to a packet or call from the subscriber, and "receiving" or "terminating" refers to a packet or call delivered to the subscriber. The real-times for data packets assume an inter-SM reference connection. The real-times for intra-APH intra-SM, and inter-APH packets are slightly less.

Table 10.5-1 Access Protocol Handler Real Times

TRAFFIC TYPE	REAL TIME (ms)
Sending a Data Packet (LAPB 128 byte)	12.1
Sending a Data Packet (LAPD 128 byte)	12.7
Receiving a Data Packet (LAPB 128 byte)	11.7
Receiving a Data Packet (LAPD 128 byte)	10.8
Originating Free Packet-Switched Call	50
Terminating Free Packet-Switched Call	50
Originating Billed Packet-Switched Call	100
Terminating Billed Packet-Switched Call	50
Sending a Q.931 Packet	5
Receiving a Q.931 Packet	5

Table 10.5-2 provides the real time associated with different packet types in the inter-SM Protocol Handler. Since billing records are not generated in the inter-SM PH, there is no distinction between billed and free calls. "Sending" or "Originating" refers to packets or calls sent from subscribers on the SM with the inter-SM PH, and "receiving" or "terminating" refers to packets or calls being delivered to subscribers on the SM with the inter-SM PH.

Table 10.5-2 Inter-SM Protocol Handler Real Times

TRAFFIC TYPE	REAL TIME (ms)
Sending a Data Packet (128 byte)	6.1
Receiving a Data Packet (128 byte)	6
Originating Packet-Switched Call	17
Terminating Packet-Switched Call	17

Table 10.5-3 provides the real time associated with different packet types in the X.75' PH. Since billing records are not generated in the inter-SM PH, there is no distinction between billed and free calls. "Incoming" refers to packets entering the PH from the interswitch link, and "Outgoing" refers to packets or call requests delivered by the PH to the interswitch link.

Table 10.5-3 X.75' Protocol Handler Real Times

TRAFFIC TYPE	REAL TIME (ms)
Incoming Data Packet (128 bytes)	11.3
Outgoing Data Packet (128 bytes)	11.6
Incoming Packet-Switched Call	45
Outgoing Packet-Switched Call	41
Incoming Attempt to Invalid Number	24
Incoming Attempt to OOS Port	33

10.5.5.3 Protocol Handler Overload

When the PH is in overload, whether attributable to real-time or resource exhaustion, depending on the severity level of PH overload, the major actions taken by PH include:

- For a minor PH overload:
 - Delay both X.25 and internal data packets

- Deny a portion of new PS call setups (access PH)
 - Activate inter-SM alternate routing
 - Activate interswitch PS trunk alternate routing.
- For a major PH overload:
 - Throttle both X.25 and internal data packets
 - Deny all new PS call setups (access PS)
 - Deny inter-SM PS calls
 - Deny interswitch PS calls.
- For a critical PH overload:
 - All major overload actions and all new CS call setups are throttled.

10.5.6 USER ADMINISTRATION

During periods of overload, the subscriber may experience delays in dial tone or the call may be blocked. The overload control feature minimizes the effect of overload so that the telephone service is affected as little as possible. For exchanges with ESP enabled, subscribers designated as "essential" receive priority originating service during periods of extreme overloads. No line or trunk is permanently blocked or delayed during overloads.

The operating telephone company personnel can make requests by way of the MCC video display terminal for overload status information. The overload status information consists of a list of overload monitors and controls in effect. Whenever the overload status of a processor changes, a message is printed at the ROP and the MCC pages are updated. The MCC Page 109 indicates the status of overload conditions, if they exist, in both the AM, SM, CMP and DL, MCC Page 170 enables the administrator to request specific SM overload status. Page 109 provides the capability to request specific SM overload status and either to allow or inhibit ESP. In addition, manual input messages may also be used to request overload status information and to allow or inhibit ESP for the 5ESS®-2000 switch.

10.6 LINE UNIT

10.6.1 DESCRIPTION

The analog line unit (LU) is a 5ESS®-2000 switch unit which resides in the switching module (SM) and provides connections to customer lines via the main distributing frame. The types of lines which connect to an analog LU include individual lines, party lines, coin lines, and loop or ground start private branch exchange (PBX) central office trunks. Up to 1600 ohms may be connected. (Individual and party lines may have a conductor loop resistance of up to 1500 ohms. Range extension, if necessary, is provided external to the 5ESS®-2000 switch for LU2 and LU3. Lines which cannot be terminated on an LU are integrated services digital network (ISDN) lines, SLC® 96 carrier, remote terminals, and direct inward dialing PBX systems. Each LU may terminate any mix of different line types and requires 64 time slots (of the 512 time slots provided by the time slot interchanger) regardless of the concentration ratio. Each SM can accommodate up to eight LUs, although this is not normally recommended. See 235-060-110, *5ESS®-2000 Switch Engineering Procedures* for a detailed engineering discussion of the LU.

Each line termination on the LU has an associated line equipment number (LEN). This number is used in translations to identify the customer line and to provide a means to access the line. The LEN is composed as follows:

SM L C G S L

Where:

SMN = Switch Module Number (001-192)

L = Line Unit Number (000-007) or SM-2000 (000-042)

C = Concentrator or Grid Number LU3 (0-9) or LU2 (0-7)

G = Switch Group (Grid LU2, LU3), or Number (0-1)

S = Switch Number (0-7)

L = Switch Level Number (0-3)

The terms "concentrator" and "grid" are used synonymously throughout the various 5ESS®-2000 switch documentation. The same is true for the terms grid (LU2 and LU3), switch group, and switch board.

One of three LU models may be used to serve customer lines. These LUs are line unit model 2 (LU2), which can accommodate up to eight concentrators, and line unit model 3 (LU3) which can accommodate up to ten concentrators.

The number of concentrators provided in any of these LUs depends on the concentration ratio desired. This is shown in Table 10.6-1.

The number of lines that can terminate on an LU depends on the concentration ratio. A solid state concentrator (gated diode crosspoint) provides concentration ratios of 10:1, 8:1, 6:1, and 4:1. The corresponding maximum numbers of terminating lines are 640, 512, 384, and 256 per LU, respectively. This represents a maximum of 5120 lines per SM (8 LUs with 640 lines each) using LU3. Each of the four line concentration ratios has its own originating plus terminating (O+T) usage and terminal capacities. The line concentration ratio is based on a break-even hundred call seconds (CCS) per line estimate which reflects the cost benefit of additional LUs versus deloading a given line concentration ratio. Table 10.6-1 provides the line concentration capacities based on the

three primary engineering methodologies. The reduced cost of the LU compared to the increase in line capacity does not justify the use of the 4:1 concentration ratio. Therefore, the 4:1 concentration ratio is not normally recommended.

Table 10.6-1 Line Unit Capacities Per Hour

LU2 C/R	LU3 CONC.	NUMBER C/R C/R	TERMINALS OF CAPACITY	O+T PER	CCS/ LINE CCS CCS/LINE	ECONOMIC (95% FILL)
EVE ONCE A MONTH (4% ORIGINATING OR TERMINATING BLOCKING)						
---	10:1	10 (0-9)	640	1,870	3.1	3.2
8:1	8:1	8 (0-7)	512	1,870	3.8	4.2
6:1	6:1	6 (0-5)	384	1,840	5.0	6.1
4:1	4:1	4 (0-3)	256	1,710	7.0	---
ABS TCBH (1.5% ORIGINATING OR TERMINATING BLOCKING) ^a						
---	10:1	10 (0-9)	640	1,700	2.8	2.9
8:1	8:1	8 (0-7)	512	1,700	3.5	3.9
6:1	6:1	6 (0-5)	384	1,650	4.5	5.5
4:1	4:1	4 (0-3)	256	1,470	6.1	---
HIGH DAY (7% ORIGINATING OR TERMINATING BLOCKING)						
---	10:1	10 (0-9)	640	1,960	3.2	3.4
8:1	8:1	8 (0-7)	512	1,960	4.1	4.4
6:1	6:1	6 (0-5)	384	1,940	5.3	6.4
4:1	4:1	4 (0-3)	256	1,840	7.5	---
Notes: a. The CCS capacities corresponding to 1.5 percent blocking are derated by 2 percent because, on the average, the TCBH measured capacity is about 2 percent lower than the corresponding ABBH measured capacity. Legend: C/R - Concentration Ratio LU2 - Line Unit Model 2 LU3 - Line Unit Model 3 CCS - Hundred Call Seconds O+T - Originating plus Terminating						

The 5ESS[®]-2000 switch can accommodate mixed concentration ratios. The choice of a particular concentration ratio depends on the usage generated by the lines. Should the office characteristics change with time, the LU can be converted to any of the other concentration ratios by changing the number of plug-ins in the LUs.

The number of LUs required for a particular office depends on the number of subscriber lines and the selected concentration ratio based upon the O+T usage per line, and the grade of service desired (i.e. % blocking criteria).

The service criteria and corresponding capacities for the LU are as follows:

- **Average Busy Season (ABS) Time-Consistent Busy Hour (TCBH) Blocking Criteria:** When using the ABS TCBH engineering rules, the LU capacities are stated at 1.5 percent blockage (See Table 10.6-1).
- **High Day (HD) Blocking Criteria:** When using the HD engineering rules, the LU capacities are stated at 7 percent (See Table 10.6-1).
- **Extreme Value Engineering (EVE) Blocking Criteria:** When using the EVE rules, the LU capacities are stated at 4 percent (See Table 10.6-1).

10.6.1.1 Functional Description of Line Unit

In order to properly load the LU, it may be useful to understand how the LU functions and how calls are processed through the LU. The following paragraphs provide a description of the call processing sequence as it applies to the LU, a description of the LU topology, and a discussion of how the path-hunt function is performed.

10.6.1.1.1 Typical Call Processing Description

The talk path for a typical intraoffice line-to-line call is shown in Figure 10.6-1. When one of the lines served by

the LU becomes active (goes off-hook), current is detected on the tip and ring leads.

A path selection process is then required in order to provide dial tone to the originating customer. When an off hook condition is recognized by the switch, a B-link is reserved and an available A-link is selected between the stage 0 switch and a stage 1 switch. Next, an available B-link is selected between the stage 1 switch and a high-level service circuit (HLSC). The HLSC is then accessed to perform the following short-job tests:

- False cross and ground test
- Power cross test
- Party test
- Coin control.

A path is then established through the time slot interchange unit (TSIU) to the universal tone generator (UTG) in the local digital service unit (LDSU) or DSU model 2 (DSU2).

The UTG generates digitally formatted dial tone and passes it to the channel circuit via TSIU. The channel circuit then converts the pulse code modulation (PCM) dial tone data to analog and sends it to the originating subscriber in the form of audible dial tone.

Next, a universal tone decoder (UTD) in the LDSU or DSU2 is connected to the originating line to receive and decode the customer dialed digits.

The customer then dials the desired telephone number, and the dialed digits are collected and translated to identify the terminating telephone. When this is completed, a path selection process is performed in the LU associated with the terminating telephone. An A-link and a B-link are selected in that LU and activated to provide a path to the terminating telephone. A UTG is then connected to the originating line, and an HLSC is connected to the terminating line to perform the following short-job tests:

- False cross and ground test
- Power cross test
- Party test
- Coin control.

Ringing current is then applied from the HLSC to the called party telephone, and audible ringing tone is returned to the calling party via the UTG.

When the called party answers, the ringing current is removed from the called party line; the UTG is removed from the calling party line, and the remainder of talk path is completed. This portion of the talk path consists of a time slot connection through the time multiplexed switch (TMS).

For administrative purposes, the talk path selection (A- and B-links) is the key to call completion since the rest of the network is virtually nonblocking. If the necessary paths are not available for any reason, then the call cannot be completed. The concentration ratio and concentrator loading are important factors to assure that the necessary A- and B-links are available.

10.6.1.1.2 Differences Between LU2 and LU3

The LU3 uses the basic building block (concentrator) from LU2. Several of the circuit packs are interchangeable between the two units. The LU3 adds two additional concentrators (8 and 9) to the existing eight (0 through 7) for

LU2. The addition of the new concentrators changes the B-link random slip multiple. The A-links are unchanged. These two additional concentrators provide the capacity for 640 lines or a 10:1 concentration ratio (640 lines to 64 outputs). The LU3 can also be engineered to serve all of the existing concentration ratios, (4:1, 6:1, 8:1). Because of backplane wiring changes, the 10:1 ratio is only available on LU3. Because of the similarities between the two units, the administration is unchanged except for the two additional concentrators.

The LU2 and LU3 are 2-stage, limited access concentrators (see Figure 10.6-2). The LU2 is partitioned into four concentrator groups, and the LU3 has a total of five as shown in Figure 10.6-2 (sheet 2). For a 10:1 concentration ratio, the 640 lines are partitioned into 10 concentrators of 64 lines. Each group of 64 lines is served by one-half of a concentrator group (one concentrator). As shown in Figure 10.6-2 (sheet 1), a concentrator group consists of two concentrators. A concentrator consists of two switch-group circuit packs (each serving 32 lines). A switch group consists of eight stage-0 switches and four stage-1 switches. The connections between these switching stages are the A-links. The output of the stage-1 switches is the B-links which provide the connection to the service groups (Figure 10.6-2, sheet 3).

With this type of concentrator arrangement, the 640 customer lines may be concentrated down to 64 channel circuits (using LU3 only). However, an individual line does not have access to all 64 channel circuits. Instead, each line in a switch group has a possibility of selecting one of four A-links, and each A-link may be connected to one of eight B-links. This provides a total of 32 possible paths for each customer line as shown in Figure 10.6-3.

A fully equipped LU2 has 8 concentrators which are divided into 16 switch groups. A fully equipped LU3 has 10 concentrators divided into 20 switch groups. Figure 10.6-2 (sheet 2) illustrates the arrangement of a switch group for an LU2 and LU3 concentrator. Each switch group has 32 inputs and 32 outputs. Each of the 32 inputs are connected to a line. The 32 outputs (B-links) are multiplied with the outputs of other switch groups to achieve the required concentration ratio. The switch group is composed of eight 4 by 4 first stage (stage-0) switches and four 4 by 8 second stage (stage-1) switches as shown in Figure 10.6-5 sheets 1 and 2, respectively. In Figure 10.6-5, the 8 stage-0 switches are shown on sheet 1 and are numbered 0 through 7, from left to right. The stage-0 switch has 32 inputs and 16 outputs to provide the first stage of concentration (2:1 concentration ratio). These outputs connect to stage-1 switches and are called A-links. Each A-link is the output from two stage-0 switches and the input of one stage-1 switch (Figure 10.6-5, sheet 2). The outputs from the switch group are multiplied onto 64 paths, one to each channel circuit. These paths are the B-links.

Within the LU, there are two service groups of channel circuits with 32 circuits in each group (Figure 10.6-2, sheet 3). These circuits perform analog to digital conversion functions. From each switch group, 16 of the outputs connect to service group 0 and 16 connect to service group 1.

Figure 10.6-6 specifies how the outputs from 16 switch groups are multiplied onto the B-links through a random slip multiplying arrangement. Sheet 1 of Figure 10.6-6 applies to LU2, and sheet 2 applies to LU3. This multiplying arrangement provides the other point of concentration in the LU. Each row of the table represents a B-link. On each row, there are eight Xs which represent output levels that are multiplied onto each B-link. For example, on B-link 0 of LU2, there are level 0 outputs on switch groups 0, 2, 4, 6, 8, 10, 12, and 14. This indicates that output level 0 on these switch groups all share B-link 0. The table produced for service group 1 is the complement of the table for service group 0. This indicates that output level 0 on switch groups 1, 3, 5, 7, 9, 11, 13, and 15 share B-link 32.

By inspecting Figures 10.6-5 and 10.6-6 more closely, the following relationships that compose the concentrator topology can be observed.

- In Figure 10.6-5, each of the four output levels from every stage-0 switch is the input level for a different stage-1 switch. For a given line and stage-1 switch (corresponding to a B-link), there is only one A-link that can be used. For a given line and A-link, selection of a B-link is limited to those corresponding to output levels on the stage-1 switches to which the A-link is an input.
- An A-link on a switch group can be uniquely identified by its output level from a stage-0 switch and its input level on a stage-1 switch.

- In Figure 10.6-6 (sheet 1), there are 32 Xs in each switch-group column; 16 for service group 0 and 16 for service group 1. The Xs indicate the B-links that can be reached by stage-1 switch outputs for each switch group. Four outputs from each stage-1 switch connect to one service group, and the other four outputs connect to the other service group. For any given output level (0 through 7) on LU2 and (0 through 9) on LU3, on all four stage-1 switches, two of the outputs connect to service group 0 while the other two connect to service group 1.
- The subset of B-links reached by any switch group is not the same as the subset reached by any other switch group.

The notes on Figure 10.6-6 explain how different concentration ratios are achieved. When concentrators 8 and 9 of LU3 are removed, there is an 8:1 concentration ratio as in an LU2. When concentrators 6 and 7 are removed, there is a 6:1 concentration ratio. When concentrators 4, 5, 6, and 7 are removed, there is a 4:1 concentration ratio. When a concentrator is removed, all B-links are affected equally. That is, for every concentrator removed, each B-link has one less X represented on the figure.

10.6.2 ENGINEERING CONSIDERATIONS

10.6.2.1 General

The LU concentration ratios of 10:1, 8:1, 6:1, and 4:1 are available. Each LU has a complement of 64 time slots. Table 10.6-1 presents the LU capacity under each of these concentrations for ABS, EVE, and HD.

NOTE: The capacity of the LU should be monitored as usage approaches the stated capacities. Line moves or growth procedures may be necessary to alleviate hot spots (overloads).

The LU, also referred to as the gated diode crosspoint line unit (GDX-LU), is the interface in the 5ESS®-2000 switch that terminates switched, analog subscribers. The LU provides the coder/decoder (CODEC) function where the analog signal on the subscriber loop is converted to a digital format for passage through the switch. It is used to terminate subscribers within 18 KFT loop length, or subscribers on universal SLC® 96 carrier system via central office terminal (COT).

The LU is not used to terminate:

- Integrated SLC® 96 carrier subscribers; refer to the digital carrier line unit (DCLU) category.
- Private branch exchange-direct inward dialing (PBX-DID); refer to the trunk unit (TU) category.
- Lines requiring an integrated services line unit (ISLU); refer to the analog ISLU and ISDN.

Each LU has access to 64 time slots, one time slot set (TSS) of the switching module time slot interchanger (TSI) via two peripheral interface data buses (PIDBs). Since the LU can be equipped with grids for 256, 384, 512, or 640 line terminations, line concentration ratios (LCRs) of 4:1 (256/64), 6:1 (384/64), 8:1 (512/64), or 10:1 (640/64) result.

10.6.2.2 Coefficient of Variation

This is an optional method for time-consistent busy hour (TCBH) engineering of the LU. This method ensures that variation above or below the engineered load will not cause the office average blocking to exceed the chosen service criteria. This method also derives a specific hundred call seconds (CCS) operating point, which is used for engineering and administration, based upon the total variation in LU TCBH load in the office.

The overall goal of determining an operating point, based upon load variation, is to ensure that a particular grade of

service is achieved (as defined by a chosen blocking criterion) even when high traffic variation increases the average blocking.

The variation in the TCBH load can be characterized by the coefficient of variation (CV) of the line unit CCS. The CV is defined as the standard deviation of the TCBH LU CCS, over all days and units, divided by the mean CCS. This total variation can also be broken down to isolate the day-to-day and the unit-to-unit variations. This allows the administrator to see how much of total variation in the office is attributable to load imbalance across LUs. Reducing the unit-to-unit variation reduces the total CV and allows the office to load more CCS per unit. While the inherent capacity of the LU is fixed, a particular office can calculate an adjusted load, referred to as an operating point, that allows the office to meet its average blocking objective, given the amount of load variation present.

To derive the values for the CV inputs, the engineer must analyze current office LU data to determine the exact CV. For initial offices, it is necessary to analyze data from a similar office to determine the approximate CV.

Good administrative practices, including proper load administration, lowers the unit-to-unit variation, and thus the total office variation. This allows more efficient utilization of the LUs by allowing higher CCS to be loaded without increasing the average blocking of the office. Present methods for taking into account variation in TCBH load provides a mechanism to protect the average blocking. However, it protects service during peak periods only indirectly. Direct protection of service during peak periods can still be achieved only by using either HD or extreme value engineering (EVE).

10.6.2.2.1 Characterizing Load Variation

The overall goal of determining an operating point, based upon load variation, is to ensure that a particular grade of service is achieved even when high traffic variation increases the average blocking.

The variation in the TCBH load can be characterized by the CV of the LU CCS. The CV is defined as the standard deviation of the TCBH LU CCS, over all days and units, divided by the mean CCS. This total variation can also be broken down to isolate the day-to-day and the unit-to-unit variation. This flexibility allows the administrator to see how much of the office total variation is attributable to load imbalance across LU. Reducing the unit-to-unit variation reduces the total CV and allows the office to load more CCS per unit.

10.6.2.2.2 Determining the Coefficient of Variation

The following equations are required for determining an office CV:

Total CV — Exact:

$$Total\ SM\ Calls = \frac{Originating + Outgoing + Incoming + Terminating}{2}$$

Unit-to-Unit CV:

$$CV = \frac{\left[\frac{1}{m-1} \sum_{i=1}^m (\bar{x}_{i.} - \bar{x}_{..})^2 \right]^{1/2}}{\bar{x}_{..}}$$

Day-to-Day CV:

$$CV = \frac{\left[\frac{1}{n-1} \sum_{j=1}^n (\bar{x}_{.j} - \bar{x}_{..})^2 \right]^{1/2}}{\bar{x}_{..}}$$

Total CV — Approximate:

$$CV = \sqrt{CV_U^2 + CV_D^2 + R^2}$$

For existing 5ESS®-2000 switches, Equation 1 directly calculates the total coefficient of variation from office data. Equations 2 and 3 compute the marginal variations across days and units. These CVs are defined to be comparable so that one can observe which contributes most to the total CV when a complete set of 5ESS®-2000 switch data is not available. The total CV typically ranges between 6 and 15 percent.

10.6.2.2.3 Existing 5ESS®-2000 Switches

Offices with existing switches should use Equation 1 to calculate the CV directly from the hourly TCBH data. This equation calculates the CV according to the definition stated in the previous paragraph.

10.6.2.2.4 New Starts and Conversions

New offices or offices converting from other switching systems should use Equations 2 through 4 to estimate the expected CV. These equations allow a new 5ESS®-2000 switch to be engineered using available traffic data and administrative goals to calculate the total CV.

10.6.2.2.4.1 Unit-to-Unit CV (CV_U)

The CV_U should be determined based upon measured variation in other 5ESS®-2000 switches having similar traffic and feature mixes. CV_U can be seen as the variation goal to which the office will be administered. The CV_U should range from 6 to 7 percent in offices administered by class of service. Offices using load-directed assignments practices should see a unit-to-unit variation from 2.5 to 3 percent.

10.6.2.2.4.2 Day-to-Day CV (CV_D)

If an existing switch is being converted to a 5ESS®-2000 switch, the day-to-day CV can be determined from traffic data from the old system. Since CV_D is defined to be independent of the unit variation, it can be calculated on any switch regardless of the size or number of LUs and be used for engineering the switch. New offices should estimate CV_D based upon other 5ESS®-2000 switches with similar traffic characteristics. Day-to-day variation has been observed to range from 3 to 9 percent.

10.6.2.2.4.3 Interaction Term (R)

Since CV_U and CV_D have been defined to be independent, there is a third source of variation which is caused by the interaction between the two dimensions in the CCS data matrix. This interaction between unit-to-unit and day-to-day variation is captured in a third term, which is identified as "R" in Equation 4. The R has been observed to vary from 3 to 8 percent and tends to average around 6 percent. This variation can also be estimated using variation data from offices with similar unit-to-unit and day-to-day variations. This is done by working Equation 4 in reverse:

$$R = \sqrt{CV^2 - CV_U^2 - CV_D^2}$$

10.6.2.2.5 Determining the LU Operating Point

While the inherent capacity of the LU is fixed, a particular office can calculate an adjusted load, referred to as an Operating Point, which allows the office to meet its average blocking objective, given the amount of load variation present. Tables 10.6-2 through 10.6-4 provide the CCS operating point based upon three inputs:

- (1) Blocking criteria
- (2) LU concentration ratio
- (3) Coefficient of variation.

Table 10.6-2 CCS Operating Point for 4:1 Line Units

CV	PERCENT BLOCKING				
	0.5	1.0	1.5	2.0	3.0
.04	1250	1405	1490	1555	1645
.05	1245	1400	1490	1550	1640
.06	1245	1395	1480	1545	1635
.07	1240	1390	1475	1540	1625
.08	1235	1385	1470	1530	1615
.09	1230	1375	1460	1525	1610
.10	1220	1370	1455	1515	1600
.11	1215	1360	1445	1505	1585
.12	1210	1350	1435	1495	1575
.13	1200	1340	1425	1480	1565
.14	1195	1330	1410	1470	1550
.15	1185	1320	1400	1460	1535
.16	1175	1310	1390	1445	1520
.17	1165	1300	1375	1430	1510
.18	1160	1290	1365	1420	1495
.19	1150	1280	1350	1405	1480
.20	1140	1265	1340	1390	1465

Table 10.6-3 CCS Operating Point for 6:1 Line Units

CV	PERCENT BLOCKING				
	0.5	1.0	1.5	2.0	3.0
.04	1485	1600	1665	1715	1780
.05	1480	1590	1660	1710	1770
.06	1470	1585	1650	1700	1760
.07	1465	1575	1640	1690	1750
.08	1455	1565	1630	1675	1735
.09	1445	1550	1615	1665	1725
.10	1435	1540	1605	1650	1710
.11	1420	1525	1590	1635	1690
.12	1410	1510	1575	1620	1675
.13	1395	1495	1560	1600	1655
.14	1385	1480	1540	1585	1640
.15	1370	1465	1525	1565	1620
.16	1355	1450	1505	1545	1600
.17	1340	1435	1490	1530	1580
.18	1325	1415	1470	1510	1560
.19	1310	1400	1455	1490	1540
.20	1295	1380	1435	1470	1520

Table 10.6-4 CCS Operating Point for 8:1 and 10:1 Line Units

CV	PERCENT BLOCKING				
	0.5	1.0	1.5	2.0	3.0

.04	1560	1660	1720	1760	1815
.05	1555	1650	1710	1750	1805
.06	1545	1640	1700	1740	1795
.07	1535	1630	1690	1725	1780
.08	1525	1620	1675	1710	1765
.09	1510	1605	1660	1695	1750
.10	1500	1590	1645	1680	1735
.11	1485	1575	1625	1660	1715
.12	1470	1555	1610	1645	1695
.13	1455	1540	1590	1625	1675
.14	1435	1520	1570	1605	1655
.15	1420	1500	1550	1585	1630
.16	1405	1485	1530	1560	1610
.17	1385	1465	1510	1540	1585
.18	1370	1445	1490	1520	1565
.19	1350	1425	1470	1500	1545
.20	1335	1405	1450	1480	1520

The blocking criteria included are those supported in 5ESS®-2000 Switch Digital Ordering and Planning System (DOPS) and are reasonable for ABS engineering. An explanation for the equation underlying these tables follows. Note that the values for C and K are based on the load service curve for the appropriate concentration ratios. Equations for these curves and a discussion of their use in deriving the Operating Point tables are provided.

The LU Operating Point (OP) is defined as: $OP = C - K \times (\text{Mean CCS} \times CV)^2$ Where:

- C is the CCS capacity from the appropriate load service curve based on the blocking criterion chosen.
- K is a constant derived from the appropriate load service curve, given the following:

Concentration	K
4:1	.00224
6:1	.00298
8:1,10:1	.00340

- Mean CCS is the average TCBH load over all LUs and days.
- CV is the Coefficient of Variation as described in the previous section.

Since the office LUs will be engineered according to the calculated OP, it is assumed that each LU will eventually be loaded to the OP. Thus in the previous equation, OP can be set equal to Mean CCS:

$$OP = C - K \times (OP \times CV)^2$$

The following equation defines OP explicitly in terms of C, K, and CV.

$$OP = \frac{\sqrt{1 + 4 \times C \times K \times CV^2} - 1}{2 \times K \times CV^2}$$

An important observation is that using the 1.5 percent blocking criteria, for 6:1, 8:1, and 10:1 LUs, if the CV is 6 percent or less, the operating point equals or exceeds the current advertised capacity. For 4:1 LUs this relationship is true if the variation is 8 percent or less.

10.6.2.2.6 Load Service Curves and Derivation of CCS Operating Points

Tables 10.6-2, 10.6-3, and 10.6-4 contain CCS operating points based on the LU capacities associated with the historic Lucent load-service curves. These curves were generated by simulation models and verified by field data. These curves show percent blocking as a function of the CCS load per hour. As CCS traffic on the LU increases, percent blocking also increases. This blocking behavior depends on the LCR of the LU being considered. The

following equations approximate these curves by defining the percent blocking (B) as a function of CCS load per hour (C), or alternately, by defining CCS load (C) as a function of blocking (B). Figure 10.6-4 illustrates the percentage of terminating blockage as a function of usage.

4:1 LCR:

$$B = .015e^{\left[\frac{C - 1500}{223}\right]}$$

or

$$C = 1500 + 223 \ln \left[\frac{B}{.015} \right]$$

6:1 LCR:

$$B = .015e^{\left[\frac{C - 1680}{168}\right]}$$

or

$$C = 1680 + 168 \ln \left[\frac{B}{.015} \right]$$

8:1/10:1 LCR:

$$B = .015e^{\left[\frac{C - 1735}{147}\right]}$$

or

$$C = 1735 + 147 \ln \left[\frac{B}{.015} \right]$$

In the paragraph "Determining the LU Operating Point," the letter C represents the LU capacity for a particular blocking criteria, as defined in the previous equations. The value of C is the capacity with no load variation, that is, CV equals 0. It is these capacities which are used as the basis for determining the operating points in Tables 10.6-2, 10.6-3, and 10.6-4.

10.6.2.2.7 Selection of Line Concentration Ratio

In general, a determination of the LCR is required based upon the economics of different concentration ratios. The

DOPS historically has provided economic breakpoints between concentration ratios, based on CCS per line. The engineer should generally perform the LU engineering using the indicated Line Concentration Ratio (LCR), and if the CCS per line is near a breakpoint, then engineer for the LCR on the other side of the breakpoint. These breakpoints are based upon hardware costs only and do not take into account software right-to-use fees per SM.

Tables 10.6-5, 10.6-6, and 10.6-7 show the break points given that a CV and the percent blocking have been selected. These tables should be used as general guidelines for selecting the LCR. These values were determined by dividing the current break point for each blocking criteria by the LU capacity and multiplying by the CCS OP corresponding to the selected variation and blocking.

Table 10.6-5 Economic Breakpoints for CVE 4:1 vs 6:1 LCR

CV	PERCENT BLOCKING				
	.5	1.0	1.5	2.0	3.0
.04	4.95	5.27	5.50	5.64	5.87
.05	4.93	5.24	5.48	5.62	5.84
.06	4.90	5.22	5.45	5.59	5.80
.07	4.88	5.19	5.42	5.56	5.77
.08	4.85	5.16	5.38	5.51	5.72
.09	4.82	5.11	5.33	5.48	5.69
.10	4.78	5.07	5.30	5.43	5.64
.11	4.73	5.02	5.25	5.38	5.57
.12	4.70	4.97	5.20	5.33	5.52
.13	4.65	4.92	5.15	5.26	5.46
.14	4.62	4.88	5.09	5.21	5.41
.15	4.57	4.83	5.04	5.15	5.34
.16	4.52	4.78	4.97	5.08	5.28
.17	4.47	4.73	4.92	5.03	5.21
.18	4.42	4.66	4.86	4.97	5.14
.19	4.37	4.61	4.81	4.90	5.08
.20	4.32	4.55	4.74	4.83	5.01

Table 10.6-6 Economic Breakpoints for CVE 6:1 vs 8:1 LCR

CV	PERCENT BLOCKING				
	.5	1.0	1.5	2.0	3.0
.04	3.51	3.74	3.90	3.95	4.07
.05	3.50	3.71	3.87	3.92	4.05
.06	3.48	3.69	3.85	3.90	4.03
.07	3.45	3.67	3.83	3.87	3.99
.08	3.43	3.65	3.79	3.83	3.96
.09	3.40	3.61	3.76	3.80	3.93
.10	3.37	3.58	3.73	3.77	3.89
.11	3.34	3.54	3.68	3.72	3.85
.12	3.31	3.50	3.65	3.69	3.80
.13	3.27	3.47	3.60	3.64	3.76
.14	3.23	3.42	3.56	3.60	3.71
.15	3.19	3.38	3.51	3.55	3.66
.16	3.16	3.34	3.47	3.50	3.61
.17	3.12	3.30	3.42	3.45	3.56
.18	3.08	3.25	3.37	3.41	3.51
.19	3.04	3.21	3.33	3.36	3.47
.20	3.00	3.16	3.28	3.32	3.41

Table 10.6-7 Economic Breakpoints for CVE 8:1 vs 10:1 LCR

CV	PERCENT BLOCKING					
	.5	1.0	1.5	2.0	3.0	4.0
.04	2.68	2.84	2.95	3.02	3.11	3.19
.05	2.67	2.82	2.94	3.01	3.09	3.18
.06	2.66	2.80	2.92	2.99	3.07	3.16
.07	2.64	2.78	2.90	2.96	3.05	3.13
.08	2.62	2.77	2.88	2.94	3.02	3.10
.09	2.60	2.74	2.85	2.91	3.00	3.07
.10	2.58	2.72	2.83	2.89	2.97	3.04
.11	2.56	2.69	2.79	2.85	2.94	3.01
.12	2.53	2.66	2.77	2.83	2.90	2.97

.13	2.50	2.63	2.73	2.79	2.87	2.94
.14	2.47	2.60	2.70	2.76	2.83	2.90
.15	2.44	2.56	2.66	2.72	2.79	2.86
.16	2.41	2.54	2.63	2.68	2.76	2.82
.17	2.38	2.50	2.59	2.65	2.71	2.78
.18	2.35	2.47	2.56	2.61	2.68	2.74
.19	2.32	2.43	2.52	2.58	2.65	2.70
.20	2.29	2.40	2.49	2.54	2.60	2.66

10.6.2.2.7.1 Recommendations for Communities of Interest

A community is a group of jointly administered LUs having common traffic characteristics. As a result, they should be considered together for engineering purposes. The method discussed for determining an OP should not be used on an office-wide basis where multiple communities are known to exist.

For instance, when determining an office CV, RSM and ORMs should not be included. This approach is compatible with current engineering procedures because DOPS engineering for RSMs and ORMs is performed separately from the host office.

10.6.2.2.7.2 Recommendations for High Day

Offices currently using HD engineering can continue to do so. Some offices which were not previously HD limited may become so if the calculated operating point is greater than the current LU capacity. Conversely, if the operating point is lower than the current LU capacity, the office which was previously HD limited may no longer be so.

10.6.3 ASSIGNMENT GUIDELINES

10.6.3.1 General Description

The analog LU provides two limited resources: lines (terminations) and traffic capacity (usage measured in CCS). The number of line units engineered per office is based on the average CCS per line, concentration ratio, terminations, and CCS capacity of the line unit. Once the CCS/line is determined, the concentration ratio is selected which has a fixed line termination and traffic capacity values. For the LU, the usage determines which resources are expected to exhaust first.

For a better understanding of the limiting resource, the following examples show how assignment of lines may impact the utilization of engineered line equipment and CCS capacity. Our examples will use an 8:1 concentration ratio LU, with a line capacity of 512 lines and a traffic capacity 1,700 CCS ABS.

- (1) If the average CCS per line is less than 3.32 ($1,700 \text{ CCS}/512 = 3.32 \text{ CCS per line}$), the line capacity will be reached before the usage capacity. This example shows 100% line termination and CCS capacity utilization.
- (2) If the CCS per line is greater than 3.32, the reverse is true. For example, at 3.9 CCS per line, each LU can serve 435 working lines ($1,700 \text{ CCS}/3.9 \text{ CCS per line} = 435 \text{ lines}$). This example shows 100% CCS capacity and 85% line termination utilization.

The first assignment objective in the preceding example is obvious: assignment rules should limit line assignments to 1,700 CCS per LU.

The second objective is more obscure: in order to achieve the average lines per unit, the assignments must be based on the assumption that the traffic is uniform. In practical terms, this means that all LUs will look roughly alike in terms of mixtures of high and low usage lines, and will reflect the mixture of the office.

The importance of the second objective can be made clearer by an illustration (although an admittedly unrealistic one) based on the numbers used in the preceding example.

Consider a LU2 office engineered for 870 installed lines operating at the 3.9 CCS per line of the example. Assume, also, that 100 of the lines are high usage (data terminals, for example) operating at an average 18 CCS per line. Notice the impact on line termination capacity by assignment of the high CCS lines in one LU.

- (1) The arbitrary assignment of these high usage lines to one of the installed LUs will exhaust the traffic capacity of that unit at 94 lines ($1,700 \text{ CCS} / 18 \text{ CCS per line} = 94 \text{ lines}$). This LU has terminations that are trapped (unusable) due to exhausted CCS capacity.
- (2) The attempted assignment of remaining lines to the second LU creates a "trapped CCS capacity" situation due to the much lower average CCS of the remaining lines. This means that the 512 terminations in this LU are exhausted before the 1,700 CCS capacity of the LU is reached. Further, there are a total of 870 lines to be assigned and the office has suffered a loss of 264 lines of capacity ($870 - 512 - 94 = 264$). This loss occurred even though the first assignment objective was met.

Thus, for the preceding example, the assignment guidelines are:

- (1) Limit assignments to 1,700 CCS per unit.
- (2) Since the CCS/line is 3.9 ($1700/3.9$), the average assignments to 435 ($870 \text{ lines} / 2 \text{ LUs} = 435$) lines per unit.
- (3) Maintain a uniform mix of lines over all LUs in order to achieve 1 and 2.

If these guidelines are followed, the full engineered CCS and line termination capacity can be achieved.

Within each switch group, lines should be assigned by class of service (or expected load) to the stage-0 switches in the following order:

SWITCH 0 - 1 - 4 - 5 - 2 - 3 - 6 - 7 - 0 - 1, etc.

As line assignment begins on the switch group, no competition for A-links is realized until an assignment is made for switch 2. This assignment and all subsequent assignments cause competition for A-links. This can also be seen in Figure 10.6-5.

This sequence spreads the load evenly across the A-links as shown in Figure 10.6-5.

On initial and growth cutover jobs, class of service balancing should be used while assigning lines to LUs. While assigning lines from a given class, business for example, first assign lines to SMs; within an SM across the LUs in the SM; within an LU across two switch groups; and within a switch group across the eight switches. The order to be used while assigning lines across eight switches is as shown previously.

NOTE: It is not necessary to limit the number of SMs to spread IDP (Centrex) and MLHGs. It is still necessary to spread lines over Line Units, concentrators, Switch Groups, Switches, and Levels.

An exception to this procedure is the lines for any customer group sharing the business and residence custom services (BRCS) individualized dialing plan (IDP). The lines of such a group are the same class of service (business) but should be assigned to only a few SMs in the office to avoid unnecessary data duplication, and also to maintain satisfactory recent change and time of day response times. However, within the SM, these lines are assigned according to the previously described guidelines. For further information, refer to "Memory Implications" elsewhere in this section and to 235-190-101 - *Business and Residence Modular Features*.

Essential service lines (fire and police department, operating rooms, switching offices, coin lines, etc.) are assigned in the same manner with no more than one line assigned to a switch. Since an office is not expected to have more than 25 percent essential service lines, the preceding procedure automatically ensures that no more than one essential line is assigned to any switch.

Overloads due to improper load distribution in the SM are avoided by balancing the loads in the LUs. The 5ESS®-2000 switch does not employ junctors; therefore, it is not required that the loads be equal. The load is spread across the LUs by CCS per class of service to maximize the use of terminals. If the load approaches or exceeds capacity on the channel circuits or B-links, customers may experience dial tone delay or blockage.

It is important to avoid overloading individual LUs in the 5ESS®-2000 switch. This can be done through usage-directed line assignments. Initially, line assignments should be distributed as uniformly as possible according to class of service. After cutover, reassignments may be made according to measured usage. New line assignments should be made to the LUs with the lightest loads. To avoid stranding capacity, termination fill and class of service should be considered. Lines with high-usage classes of service (PBX and business lines for daytime busy hours and residence lines for evening busy hours) should be assigned to LUs with relatively low termination fill.

10.6.3.2 Initial Loading Guidelines

To load analog lines in an LU, the switch administrator must consider classes of service, loading groups, switches, and levels.

- Class of service - Lines with similar calling characteristics.
- Loading group - One or more LUs into which a group of line classes is to be loaded using a single concentration ratio. A loading group is the number of switch groups in the LUs of a single concentration. One 8:1 LU contains 16 switch groups. A growth of 7 LUs at 8:1 concentration provides 112 switch groups or 3,584 maximum line terminations.
- Switch group - Eight switches, each of which contains four levels. Each switch group contains 32 lines.

Special loading is not necessary, if all lines in the loading group have the same average CCS per line. Prior to assignment on the switch, it is recommended to perform a CCS per class of service study in the Busy Season before cutover. The CCS per class of service study data should be utilized in the creation of the loading pattern. Also, when using an operational support system for assignment, update the CCS values in the system.

NOTE: However, a loading pattern is necessary when there are wide differences in the average CCS per line class code.

Figure 10.6-5 (sheet 1) illustrates a single switch group within the LU. Each switch group has 32 terminations that are divided into a switch and level. The loading sequence indicates the proper load pattern needed to administer an LU.

Notice that the load pattern is broken into switch pairs, that is, 1,2,3,4. This results in a switch order of 0,1,4,5,2,3,6,7. This pattern ensures that the high CCS line classes have maximum accessibility through the A-link.

Create a loading pattern assigning high CCS line classes to switch 0 level across the office, then proceed to switch 1 level 0, etc. When using an operational support system for assignment, verify the assignment algorithm is consistent with the switch order of 0,1,4,5,2,3,6,7.

For example, assume you are loading two line classes — 16 lines with high CCS and 16 lines with low CCS. If you load the 16 high CCS lines first in a conventional manner of switch 0, level 0 through to switch 3, level 3 and all 16 links go off-hook simultaneously, 4 lines would be denied access to an A-link (specifically, A-Links 1,3,9,11). By loading in the recommended switch sequence of 0,1,4,5,2,3,6,7, all lines have access to an A-link.

NOTE: To minimize blocking of calls, loading must be done in a specific pattern. Since dialing habits vary for different line classes, the loading pattern should create a mix of classes within any one switch group. The purpose of the loading pattern is to make sure that all switch groups look alike to utilize the equipment

more efficiently and at the same time minimize blocking.

10.6.3.2.1 Loading Requirements

Listed below are the recommended steps needed for the administrator to assign lines. Note that this information also helps the equipment engineer decide what concentration ratio is needed for the office:

- First the number of switch groups in the loading group must be determined. For example, if an office is experiencing a growth job of seven 8:1 LUs, then there will be $16 = 112$ switch groups. See Figure 10.6-2 (sheet 2). IDS See Figure 10.6-2. This figure shows two switch groups for every concentrator: 8:1 concentration requires 16 switch groups (SWGs), 6:1 concentration requires 12 SWGs, and 4:1 concentration requires 8 SWGs.
- The next step is to determine the number of end-of-period (EOP) lines in the loading group. Since the forecasting and planning engineers have generated this information before ordering the LUs, the administrator needs to know this information to be sure that the EOP terminations are not exceeded when assigning lines.
- Identify and prioritize the class of service to be included in each loading group by determining the average CCS/main station (MS) for each class of service. For example:
 - Business CCS/MS = 4 (**Note:** Assignment to centrex lines is limited by memory and therefore should be assigned within a certain number of SMs.)
 - Residence CCS/MS = 2
- Arrange class of service in order of priority (highest CCS/MS = first priority).
- Before loading the loading group, the number of EOP lines for each class of service must be determined. Depending on the growth of the office, it is very important to know how much equipment utilization will be used up at the EOP study to be prepared for future growth.
- Determine the administrative spare factor. If used, the equipment will have space available for things like unforeseen growth for each particular class of lines. Also, allowances should be made for inward and outward movement of main stations and spare terminals to permit rearrangement for loading purposes.
- Now the administrator is ready to fill out the loading priorities worksheet, Parts 1 and 2 (Figure 10.6-7, sheets 1 and 2) which run through each step mentioned previously.
- After Parts 1 and 2 are completed, this information is used to complete the worksheet, Part 3 (Figure 10.6-7, sheet 3). Part 3 determines where a line will go in the loading group.
- Follow the numbered steps on the worksheet. First priority line class code (such as MLHG) uses steps 1 and 2. The remaining assignments use steps 3 through 7. When assigning the first and remaining prioritized line class codes, enter the information in the table on sheet 4 of Figure 10.6-7 after completing steps 2 and 7.
- Under the column ASSIGNMENT in row 1 will be the amount of available lines in switch 0, level 0 of the loading group. This number has already been determined from Column F in Part 2 (Figure 10.6-7, sheet 2) of these worksheets.
- After completing step 2 of Part 3 (Figure 10.6-7, sheet 3), enter the information in the table shown on sheet 4 of Figure 10.6-7. After step 2, take the number of lines for one line class code and assign the lines to switch 0, level 0 in all LUs until the limit is reached from Column F. Next, assign the rest of the lines to switch 1, level 0. If additional lines remain, begin assigning lines to switch 4, level 0. If there are no more lines and more lines can be assigned to switch 1, level 0, then fill this row with the next class of service.

- The "Whole Number" in steps 1 and 6 indicate how many full rows are assigned to a particular line class code, and steps 2 and 7 indicate how many partial assignments a row should have for the same particular line class code.

10.6.3.2.2 Maintaining LU Load Balance

NOTE: When loading is completed, monitor the office closely for changes in the growth pattern or increased CCS/network access lines (NAL) and ensure the load is spread over all the LUs. A good class of service spread provides better use of the equipment and better customer service.

Existing office loading patterns should be reviewed, as necessary, to maintain the integrity of the loading pattern. As new classes of service are established, estimate the expected CCS, then do a study to validate the average CCS Generated. Each office is unique and should not be duplicated. Verify the operational support system assignment algorithm used for assignment of series hunt, MLHG, and Centrex.

The following key indicators are important to ensure that the LUs remain in proper balance. This list contains key items to monitor after loading the LU:

- Check for dial tone delay (TRFC30 Section 4) and terminating blockage (TRFC30 Section 11). Log the terminating blockage and dial tone speed delay to identify if blockage is occurring. Dial tone delay and terminating blockage are reduced when a good class of service balance is achieved.

The LU2 is a 2-stage, limited access concentrator. Blockage may occur at either the A- or B-link. Two types of link blockage can occur. First, the four A-links that are accessible by any one line can be busy. Secondly, if an A-link is available for the line, the B-links (which are multiplied to four, six, eight, or ten switch groups, depending on the LU concentration ratio) may not be accessible by the selected A-link. To avoid this situation, it is important to ensure that the LU is not overloaded. Furthermore, the total CCS load should be distributed as evenly as possible across all LUs to minimize unit-to-unit variation. Keeping the loads on all LUs having the same traffic capacity within a reasonable range is sufficient to avoid this type of service blockage. If A- and B-link blockages do occur, collect measurements on a switch group basis (TRFC30 Section 144) to more precisely isolate the problem.

The switch administrator should monitor the LU (TRFC30 Sections 11 and 144) data to ensure that the LUs are not loaded over the desired capacity level. Daily busy-hour measurements can be compiled to monitor the load balance.

- For problems with high dial tone delay and low terminating blocking, check the occupancy of the switch module processors (SMPs). Half-hour occupancy readings higher than 70 percent (TRFC30 Section 13) for the SMP may mean that the SMP is being overloaded under peak calling conditions. Such overloads may produce customer complaints of terminating blocking and slow dial tone.

Also, check the TRFC30 reports for out of service (maintenance usage) equipment which may cause line origination problems. For more information on dial tone delay, SM occupancy, and out-of-service equipment, review the read-only printer printouts and the OMS5E reports, if they are available from the SCC. These reports provide information about SM status and other vital information relating to the LU.

- If assignment systems such as Computer System for Main frame Operations (COSMOS) are used, ensure that the CCS/class of service parameters that provide load-directed assignments accurately reflect customer calling usage. This can be done by performing CCS per class of service studies.
- Inhibit new assignments into the SMs with consistently high CCS, dial tone delay, and terminating blockage.
- If EADAS data is available, review the CCS values from the LU EVE report. This report provides the highest CCS reading obtained per LU for a 24-hour period and can be used to validate the busy hour of the office

compared to the busy hour of the LU. This information can also be used for time of day balancing. For example, one LU may be used heavily at 7 PM only. As a result, it would be efficient to assign new business customers with a busy hour of 11 AM to this LU.

- To ensure that one LU is not used constantly for assignment thus causing it to overload or block consistently, update the USAGE status for each LU into the line assignment system. Traffic 30 Section 11 provides a total LU usage report.
- Check the spread of heavy-usage customers in LUs that are having troubles with blockage or exceeding the LU capacity. How many MLHGs are assigned in the LUs? Are the MLHG terminals spread within all the LUs in the SMs? Identify all MLHGs and other heavy-usage lines within a troubled LU.
- Do not assign consecutive MLHG terminals in the same LU (that is, terminal 1, terminal 2). Unless the MLHG is a uniform call distribution (UCD) group, terminal 1 will generate the heaviest usage, then terminal 2, etc. Always assign a good mix of terminals within the LUs. This principle should be applied to series line hunts, heavy usage lines, and centrex customers also.
- If there are problems with LUs containing MLHGs, busy studies should be set up on each MLHG to determine if group overflows are occurring. If so, more lines may be required in those groups.
- Identify the LUs with the highest usage CCS/NAL. This is done by either of two methods. Either process identifies the LUs with heavy and light usage and where lost capacity can be regained:
 - Take the total busy hour CCS/LU (TRFC30 Section 11) divided by the number of working network access lines in the LU; For an 8:1 concentration ratio, the CCS/MS should not exceed 3.9 ABS TCBH. compare this with the CCS/main station break point chart.
 - Plot individual LU on a graph, using LU busy hour CCS (TRFC30 Section 11) and working network access lines.
- The LU concentrator utilization measurements (LUCUM) may be used to identify high usage customers. Activate LUCUM on both high and low usage LUs to move high usage lines from one LU to a low usage LU. For more information on the activation and the limitations of LUCUM and BCI, see *Engineering and Administrative Considerations*.
- *The blocked call indicator (BCI) feature can also be used to determine which LU needs the LUCUM feature activated. For more information on the activation and the limitations of LUCUM and BCI, see Engineering and Administrative Considerations.*
- *The LU/ISLU Load Administration Measurements feature can be used to monitor LU half grids or service groups. Section 144 of TRFC30 provides usage counts based on a 100 second scan for each switch group for up to 4,000 switch groups. This measurement allows the administrator to perform load administration of the LUs. For more information on the activation and the limitations of Section 144, see Engineering and Administrative Considerations.*

To use TRFC30 Section 144 for load balancing:

Set up weekly studies using TRFC30 Section 144 during the busy hour for each day of the week or collect half hour data all week to validate the busy hour for all the LUs in the office or for a portion of the LUs (no more than 4,000 switch groups can be studied at a time). Analyze the Section 144 data using one of the following balancing processes:

- (1) For offices with 8:1 concentration ratios, each switch group in the office or the study group should be balanced to average 53 CCS (1700 CCS (8:1 MAX ABS TCBH)/2 = 850 CCS; 850 CCS (30 Min)/16 (switch

groups) = 53.125 CCS. Assign lines to switch groups that average under 53 CCS and stop assignments to switch groups that average 53 CCS. If the switch group is averaging above 53 CCS, deload the switch group or use the following balancing process.

- (2) Within one 8:1 LU, the average of the 16 switch groups can equal 53 CCS, and this implies that some switch groups will be greater than 53 CCS, at the same time others will be less. This process may be harder to track because the value of each switch group in one LU will be different.

Table 10.6-8 indicates the switch group average CCS capacity (30 Min) for each engineered LU capacity.

Table 10.6-8 LU Switch Group Average Capacity (Section 144)

NO. OF SWITCH GROUPS	LU CONC. RATIO	4% EVE		1.5% ABS TCBH		7% HD	
		LU CAP (30 MIN) CCS	SWITCH GROUP aVG. CCS	LU CAP (30 MIN) CCS	SWITCH GROUP AVG. CCS	LU CAP (30 MIN) CCS	SWITCH GROUP AVG. CCS
20	10:1	935	46.75	850	42.50	980	49.00
16	8:1	935	58.43	850	53.12	980	61.25
12	6:1	920	76.66	825	68.75	970	80.83
8	4:1	855	106.87	735	91.87	920	115.00

Section 144 is output to the EADAS channel. Once Section 144 is activated, raw traffic data on usage is sent directly to EADAS, when requested, every 30 minutes. From EADAS, only selected data is sent to other downstream processors for load balancing. Table 10.6-8 should be used for setting thresholds for exception reports for EADAS and capacity for line assignment systems at the switch group level.

10.6.3.3 Memory Implications

NOTE: It is not necessary to restrict assignment of IDP (Centrex) and MLHGs lines to a specified number of SMs. It is still necessary to spread lines over Line Units, Concentrators, Switch Groups, Switch, and Levels.

In the 5ESS®-2000 switch, data common to groups of lines, specifically BRCS IDP groups, is stored in the SMs. This data is stored whenever one or more lines of the group are served by that SM. This requires some effort to assign lines such that groups are not spread uniformly to all SMs. Uniform assignment of lines results in excessive duplication of data. This, in turn, results in poor use of SM memory and some minor degradation in recent change response time.

Lines for any customer group sharing the BRCS IDP are assigned in a different manner than other lines. The lines of such a customer group are of the same class (business), but should be assigned to only a few SMs in the office in order to avoid unnecessary data duplication, and also to maintain satisfactory recent change and time-of-day change response times. However, within an SM, the lines should be assigned in the same manner as other lines. Assigning IDP lines in this manner avoids data duplication and maintains satisfactory response times for abbreviated dialing plans, automatic route selection (ARS) routing patterns, private facility access (PFA) data, and measurements.

Private facilities (for example, tie trunks, and foreign exchange lines) provided for a BRCS customer group require access to common data. As a result, IDP data must reside in each SM that terminates BRCS private facilities. The IDP data must be loaded into an SM with BRCS private facilities even if no BRCS IDP lines terminate on that SM.

The number of SMs to which a BRCS IDP group is assigned depends on the size of the group. The guidelines shown in Table 10.6-9 may be used. These guidelines assume an equal balance of LUs across the SMs.

Table 10.6-9 BRCS Group Assignment

GROUP SIZE	SMs
Less than 10	2

10 to 25	3
25 to 50	4
50 to 100	6
100 to 200	10
200 to 500	12
500 to 1,000	15
More than 1,000	20 or more

As an example, suppose a customer group that shares a BRCS IDP has 30 lines. Then, according to Table 10.6-9, these lines should be assigned to four SMs in the office. Procedures for assigning other types of lines would require these lines to be spread across as many as 30 SMs in the office. These guidelines may be altered based on the number of SMs available in a particular office. Table 10.6-9 describes how a specific BRCS group should be assigned. In general, BRCS customers should be spread across the entire office.

10.6.4 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

Sections 4, 11, and 144 of the 30-minute traffic report provide data for monitoring the LU usage. Additionally, the EADAS EVE report provides usage and busy-hour identifications. This data may be collected periodically (daily, weekly, etc.) and evaluated to determine if corrective actions are required. Initially, the corrective actions may consist of directed assignments or collection of disconnects. These actions should be based on the LU percent of capacity or the number of terminating blocked calls. The LUs with high call blocking or nearing capacity should be checked for high maintenance usage on the A-links and B-links, usage exceeding LU capacity, and administration rebalance.

10.6.4.1 Terminating Blocking

Traditionally, matching loss is used as a measure of customer attempts that do not complete because the switching machine cannot provide a talking and/or service path. For this measurement to be pegged, the called line must be idle and a service circuit must be available.

The matching loss indicator is not employed in the 5ESS[®]-2000 switch because the only significant network blocking in the entire 5ESS[®]-2000 switch occurs in the LU. Instead, a percentage of terminating blocking indicator is used. (See TRFC30 Section 11.) This indicator is based on the count of terminating calls which fail to complete because of A- or B-link unavailability. The measurement is made for each LU. This indicator is well suited since the LU capacity is far less than that of the TSI-TMS network which makes the LU the limiting unit. Additionally, terminating calls are given priority to originating calls because terminating calls, which are nearly completed, have used more resources than originating calls.

The percentage of terminating blocking is calculated as follows:

$$\text{Percent Terminating Blocking} = \frac{\text{TMBLK}(\text{Section 11})}{\text{TMCALL}(\text{Section 11})} \times 100$$

Where:

TMBLK = Terminating Blocking Peg Count

TMCALL = Terminating Call Peg Count

The terminating blocking peg count is registered when an unsuccessful attempt is made to seize an A- or B-link because none are available. The terminating blocking measurements are found in section 11 of the 30-minute traffic report. The LUs should be investigated when terminating blockage exceeds the percent grade of service established for your office.

If terminating blocking occurs, the maintenance usage of the particular LU should be checked. If maintenance

usage is not a factor, then the capacity or administration of the LU should be checked. If the LU is at or near capacity and causing the service degradation, the LU should be monitored closely. The appropriate response depends on factors such as expected growth and the length of time until the busy season. Severe overloading may require deloading of the LU.

The LUCUM report provides the ability to request traffic measurements on individual concentrators to determine where blocking is occurring. These measurements can be used to determine which lines are being affected and how the load may be redistributed to alleviate the situation. These measurements may be obtained for up to 20 switch groups at a time (640 lines). These measurements are found in section 90 of the 30-minute traffic report and may be allowed or inhibited as necessary. Included in these measurements are: total originating and terminating attempts, total originating and terminating blockages, and total usage. For additional information concerning LUCUM see the section on *Engineering and Administrative Considerations*.

The blocked call indication (BCI) report provides an indication of originating and terminating network blockage. It is similar to the LENO1 feature of the 1A ESSTM switch. These reports, provided as an output message on the ROP, indicate which lines are experiencing A- or B-link blockages in the concentrators. For additional information concerning BCI see the section on *Engineering and Administrative Considerations*.

10.6.4.2 Dial Tone Delay Peg Count

In the 5ESS[®]-2000 switch, Section 4 of the 30-minute traffic report (DTDPC) is an indication of the ability of the machine to provide dial tone to customers within 3 seconds during the measuring interval. It is the primary measurement for evaluating the capability of providing originating customer service. Each call in the 5ESS[®]-2000 switch is sampled for dial tone delay, and the number of calls sampled is recorded by the dial tone delay sample count (DTDSC). However, the DTDPC count is incremented only when an originating customer experiences dial tone delay of more than 3 seconds. Both DTDSC and DTDPC are available for each SM. These measurements are obtained from the 30-minute and 15-minute traffic reports. The LUs should be investigated when DTD exceeds the percent grade of service.

The receipt of dial tone indicates only the readiness of the SM. It is possible, though highly improbable, that the administrative module or communication module (AM/CMP) could have problems which may cause the customer to experience post dial tone processing delay. Section 4 of the 30-minute traffic report provides measurements related to system delay (specifically blockage due to overload).

Typically, the most common reason for excessive dial tone delay is blocking in the LUs A- or B-links. Blocking in the HLSC or UTD is also possible, but this is not as likely as LU blockage. Another remote possibility for excessive dial tone delay is high SMP occupancy. If the dial tone delay peg count is excessive and if the tone decoder attachment delay is zero, then the SMP can be eliminated as the source of the trouble.

10.6.4.3 Reorder

The calls sent to reorder (REORD) count represents the number of calls sent to reorder tone. This count is similar to NOCKT in that it represents lost calls due to unavailable resources. This count does not isolate the trouble; instead, it indicates that overflow and usage counts for other resources should be observed. Some calls may be routed to reorder instead of announcements. Those calls do not represent calls lost due to unavailable resources. If this type of routing is employed, the value of the REORD count as a key service indicator is reduced. The reorder measurement is found in section 4 of the 30-minute traffic report.

10.6.4.4 Measurement Reports

The ROP provides a hard copy of input and output messages. This is where the output of the TRFC30 reports are provided. The sections of the TRFC30 report that are beneficial to an LU study are those listed:

- Section 4: Dial tone speed

- Section 6: Ineffective attempts
- Section 8: High level service circuits
- Section 9: Tone decoders
- Section 11: Line unit
- Section 13: Processor occupancy
- Section 26: BRCS usage
- Section 27: Customer-originated recent change measures
- Section 29: BRCS feature measures
- Section 30: Terminal group measure
- Section 31: Individual dialing plan
- Section 32: Simulated facility group
- Section 33: Attendant group
- Section 34: Multiline hunt group (MLHG)
- Section 90: Line counts
- Section 144: Switch Group measurements.

10.6.5 FEATURE IMPACT

Since LU resources are based solely on the quantity of lines and the network usage, the implementation of new features has no impact on LUs.

Shared analog DN is the capability of allowing an analog call appearance to show up on an ISDN terminal. Analog shared DN impacts real time in the SM and it should be loaded in an LU with the understanding of the current capacity available in the SM. When an analog shared DN goes off-hook more processes take place in setting up the call than when a regular analog line goes off hook because the switch has to determine which ISDN terminal has the call appearance. Improper loading can cause real time, termination, and CCS capacity problems in the LU as well as in the SM.

10.6.6 TRANSITION IMPACT

Since the 5ESS[®]-2000 switch network, TSIU and TMS, is virtually nonblocking; and since there are no junctor rearrangements required, LU deloading prior to a growth procedure, or LU rebalancing after a growth procedure is unnecessary.

10.6.7 LINE UNIT WORKSHEETS

10.6.7.1 Line Unit CCS Load Worksheet

This worksheet (Figure 10.6-8) gives the percent use of the line units total office CCS load today and at the EOP. If the office has mixed concentration ratios, the switch administrator should calculate a percent utilization for (1) each ratio, and (2) the total office.

The following paragraphs identify the columns of the Analog Line Units - CCS Load worksheet and describe the calculations required to complete the worksheet.

- (A) Concentration Ratio: The various concentration ratios available.
- (B) Engineering Blocking Criteria: The blocking criteria used to engineer this component. Valid entries are: 0.5, 1.0, 1.5, 2.0, 3.0, 4.0, 5.0, 10.0, 15.0, and 20.0.
- (C) Line Units Installed per Concentration Ratio: The number of line units installed per concentration ratio. Obtain the number from the switch or the TEO (telephone equipment order).
- (D) CCS Capacity for Each Concentration Ratio: The stated CCS capacity for each concentration ratio based on the percent blockage. See Table 10.6-10.

Table 10.6-10 Maximum CCS Capacity per Line Unit

CONC. RATIO	PERCENT BLOCKING ^a		
	1.5	4	7
4:1	1470	1710	1840
6:1	1650	1840	1940
8:1	1700	1870	1960
10:1	1700	1870	1960

Notes:

a. The CCS capacities corresponding to 1.5 percent blocking are derated by 2 percent because, on the average, the TCBH measured capacity is about 2 percent lower than the corresponding ABBH measured capacity.

- (E) Office CCS Capacity: The CCS capacity of the office. This figure is the total of each concentration ratio capacity.

LU's Installed per Concentration Ratio <i>Column C</i>	×	CCS Capacity per Concentration Ratio <i>Column D</i>	=	Office CCS Capacity <i>Column E</i>

- (F) Main Station Demand Today: The number of main stations working in the office today. Obtain the number from the current working main station report.
- (G) CCS Usage Demand Today: The line unit CCS usage demand that the office is running today. Obtain this number from the office engineering data.

CCS per MS Today <i>Column H</i>	×	MS Demand Today <i>Column F</i>	=	CCS Usage Demand Today <i>Column G</i>

- (H) CCS per Main Station Today: The originating plus terminating CCS usage per main station that the office is running today. Obtain figure from the current office engineering data, or calculate by:

CCS Demand Today <i>Column G</i>				CCS/MS Today <i>Column H</i>
		=		
MS Demand Today <i>Column F</i>				

- (I) Main Station Demand - EOP: The main stations working at the end of the engineering period, or the highest main station demand in the engineering period. Obtain number from office forecast terminal report. If forecasted figure does not track with the actual growth, a new forecast will be needed.
- (J) CCS per Main Station - EOP: The originating plus terminating CCS usage per main station at which the office is forecasted to be running by EOP. Obtain figure from office forecast data. This forecasted figure may not track with the actual office CCS per main station. If this happens, a new forecast for CCS per main station will be needed.

(K) CCS Usage Demand - EOP: The CCS usage demand that the office will serve at EOP.

MS Demand EOP <i>Column I</i>	×	CCS/MS EOP <i>Column J</i>	=	CCS Usage Demand EOP <i>Column K</i>

(L) Main Station Capacity Today: The number of main stations that the office is capable of serving today, based on the total office CCS capacity.

Office CCS Capacity <i>Column E</i>	=	Main Station Capacity Today <i>Column L</i>
CCS/MS Today <i>Column H</i>		

(M) Main Station Capacity - EOP: The number of main stations that the office is capable of serving at the EOP.

Office CCS Capacity <i>Column E</i>	=	Main Station Capacity <i>Column M</i>
CCS/MS EOP <i>Column J</i>		

(N) CCS Load Percent Utilization Today: The maximum CCS load that will be utilized today based on the current CCS per main station.

CCS Demand Today <i>Column G</i>	× 100 =	CCS Load Percent Utilization <i>Column N</i>
Office CCS Capacity <i>Column E</i>		

(O) CCS Load Percent Utilization - EOP: The maximum CCS load that will be utilized by EOP based on the forecasted CCS per main station.

CCS Demand EOP <i>Column K</i>	× 100 =	CCS Load Percent Utilization <i>Column O</i>
Office CCS Capacity <i>Column E</i>		

10.6.7.2 Line Unit Terminations Worksheet

This worksheet (Figure 10.6-9) provides the percent utilization of analog lines currently and also at the EOP. If the office has mixed concentration ratios, the switch administrator may need to calculate: (1) a percent utilization for each concentration ratio, plus (2) the total office. If the office growth is not tracking with the forecast, a new forecast is needed to ensure accurate capacity for EOP.

The following paragraphs identify the columns of the Analog Line Units - Terminations worksheet and describe the calculations required to complete the worksheet:

- (A) Concentration Ratio: The various concentration ratios available with line units. Use the concentration ratio(s) appropriate for the office.
- (B) Line Units Installed per Concentration Ratio: The number of line units per concentration ratio installed in the office. Obtain number from the switch, or the TEO (telephone equipment order).
- (C) LENS per Ratio: The number of LENSs (line equipment numbers) or terminations installed per concentration ratio.
- (D) LENSs Installed: The number of LENSs installed in the office per concentration ratio. The total of this column gives the total installed LENSs.

LU's Installed per	LENSs per	LENSs

Concentration Ratio <i>Column B</i>	×	Ratio <i>Column C</i>	=	Installed <i>Column D</i>

- (E) Percent Administrative Margin: Percent of installed LENS required for administrative purposes, e.g., inward and outward movement of main stations, spare terminals to permit rearrangement for loading purposes. Obtain value from the TEO. Use decimal representation of the percentage.

- (F) LEN Capacity: The number of LENS available for use.

LENS Installed <i>Column D</i>	×	1 - Administrative Margin <i>Column E</i>	=	LEN Capacity <i>Column F</i>

- (G) Main Station to Line Ratio: A ratio of the expected main station to LEN requirements. This column applies only where party line demand exists. For all other cases, the ratio is 1:1.

Current Main Stations <i>Current Lines</i>	or	EOP Main Stations <i>EOP Lines</i>

- (H) Main Station Capacity: The number of main stations that the office is capable of serving.

LEN Capacity <i>Column F</i>	×	MS/Line Ratio <i>Column G</i>	=	MS Capacity <i>Column H</i>

- (I) Main Station Today: The main stations working in the office today. Obtain the number from the current working terminal report.
- (J) Main Station Demand - EOP: The main stations working at the end of the engineering period, or the highest main station demand during the engineering period. Obtain the number from the office forecast terminal report. (Actual office growth may not track with the forecast terminal report. If this is the case, a new forecast is needed.)
- (K) Termination Percent Utilization Today: The maximum number of LENS being utilized today.

MS Demand Today <i>Column I</i>	×	100 =	Terminations Percent Utilization Today <i>Column K</i>
MS Capacity <i>Column H</i>			

- (L) Termination Percent Utilization - EOP: The maximum number of LENS that will be utilized during the period. (This is usually the number from the end of the engineering period.)

MS Demand - EOP <i>Column J</i>	×	100 =	Terminations Percent Utilizations - EOP <i>Column L</i>
MS Capacity <i>Column H</i>			

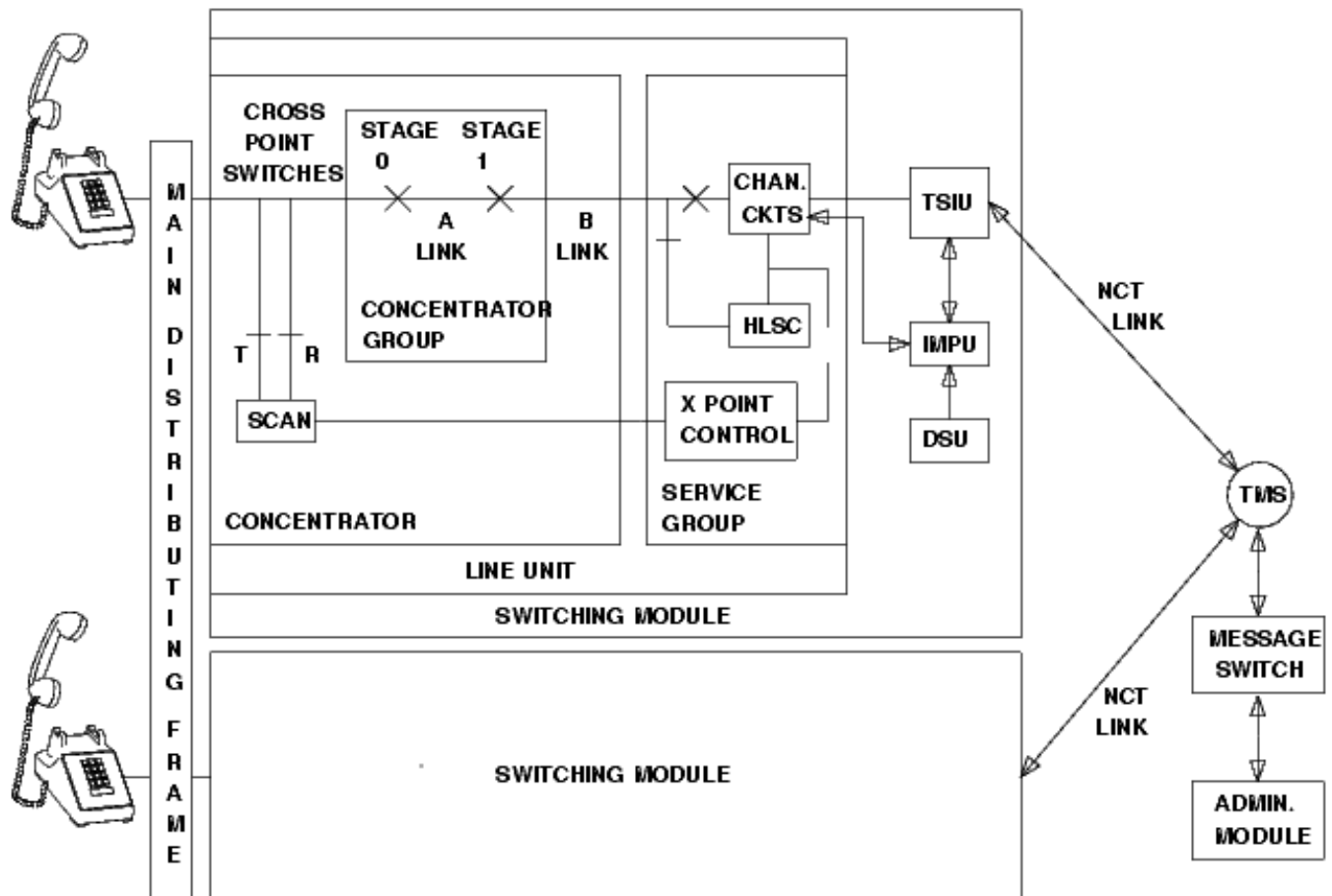
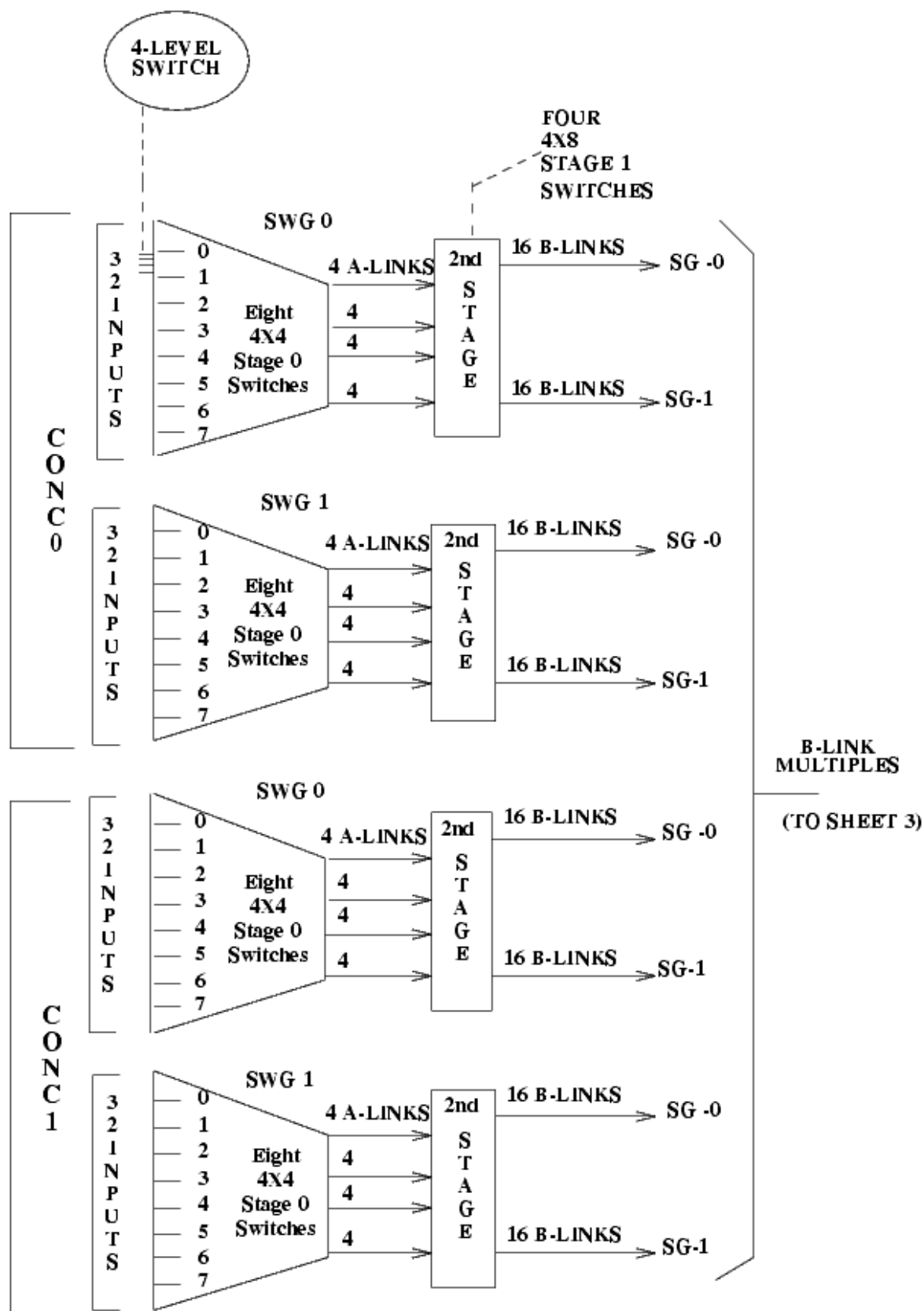
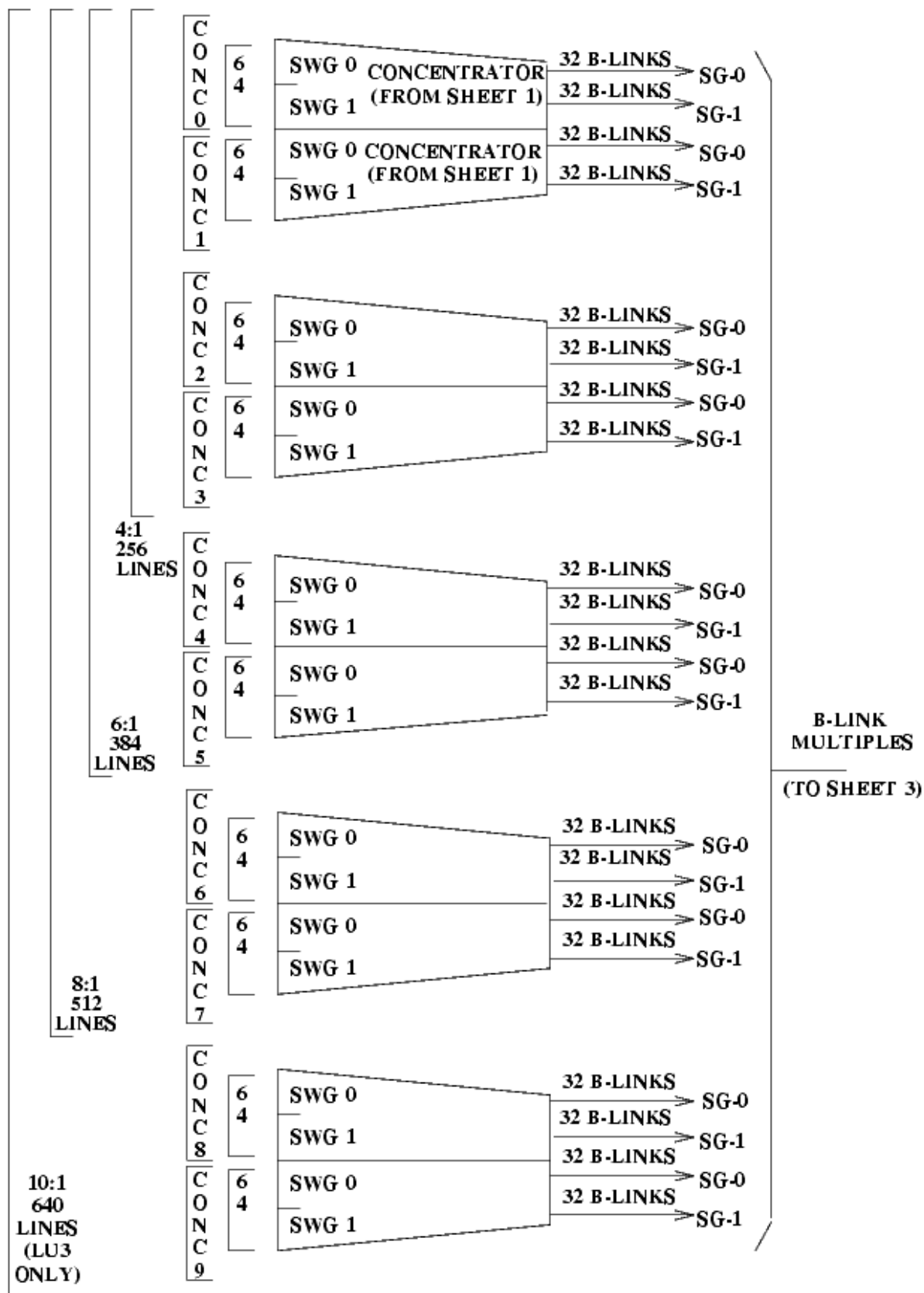


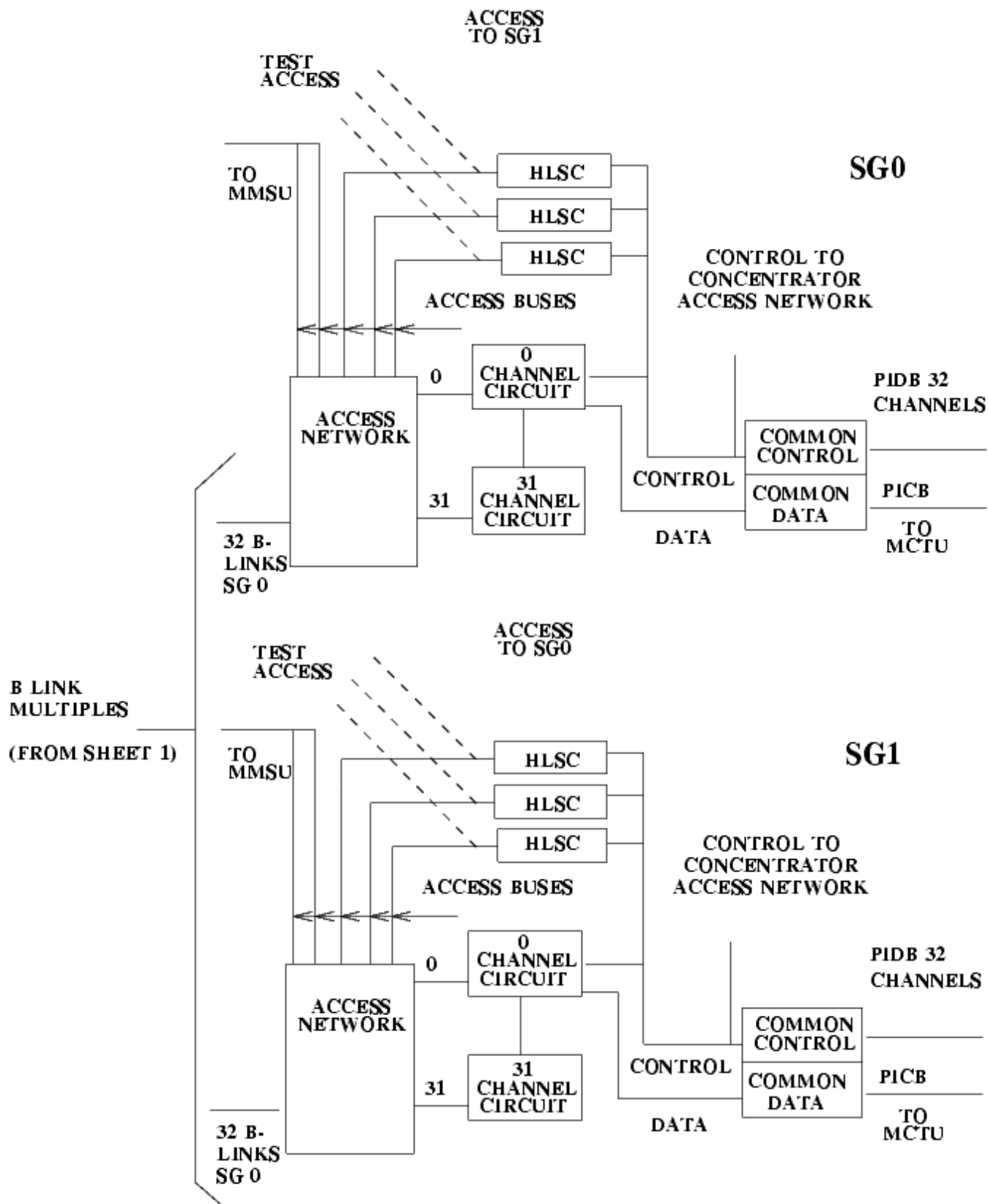
Figure 10.6-1 Typical Intraoffice Line-to-Line Talk Path



A. DETAILED VIEW OF TWO CONCENTRATORS



B. LINE UNIT CONCENTRATOR EQUIPAGE



C. LINE UNIT ACCESS NETWORK AND CHANNEL CIRCUITS

Legend:

CONC	-	Concentrator
HLSC	-	High-Level
LEN	-	Line
LU	-	Line
MCTU	-	Module
MMSU	-	Modular
PICB	-	Peripheral
PIDB	-	Peripheral
SG	-	Service
SM	-	Switch
SWG	-	Switch
TSI	-	Time
Breakdown	LEN	
SM	(001-192)	
LU	(0-7)	
CONC	or	
SWG	(0-1)	
SWITCH	(0-7)	
LEVEL	(0-3)	

Line Unit Service Groups Each LU contains two Service Groups SG0 and SG1 Each SG includes: One Access Network A maximum of 3 High-Level Service Circuits 32 Channel Circuits One Common Data Circuit One Common Control Circuit

Figure 10.6-2 LU2 and LU3 Concentrator Arrangements

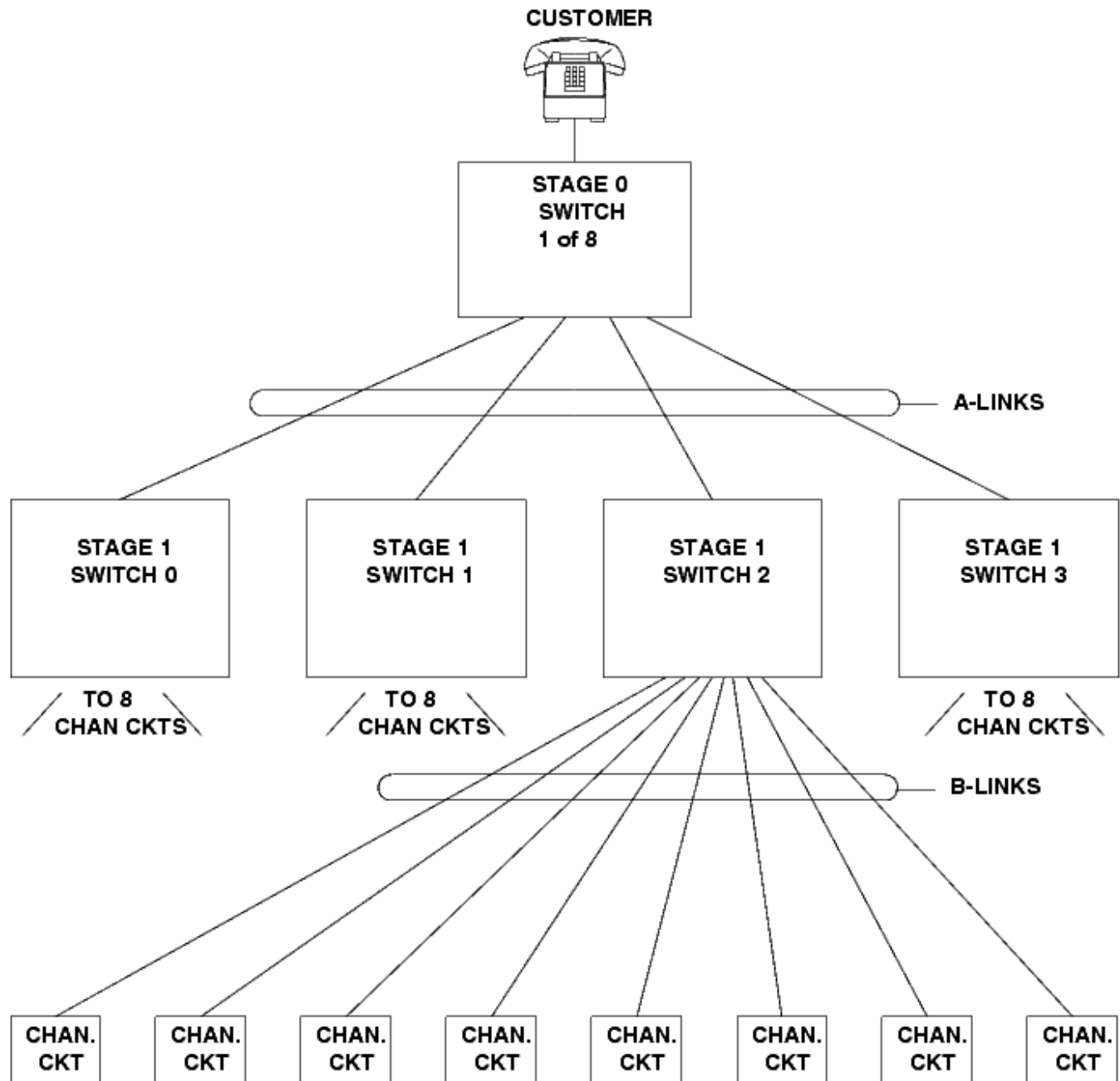
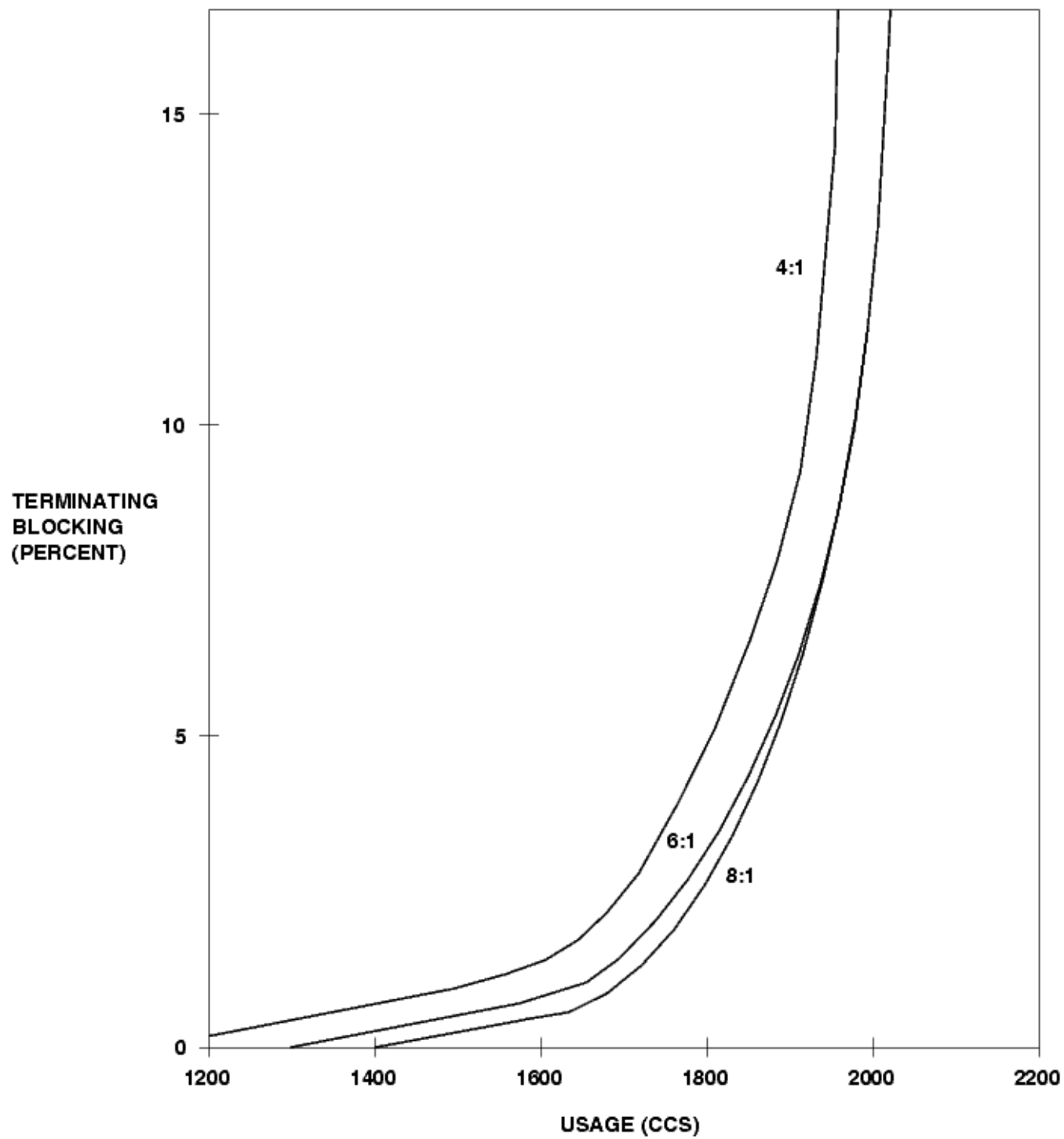


Figure 10.6-3 Typical 5ESS -2000 Switch Concentration (32 Total)



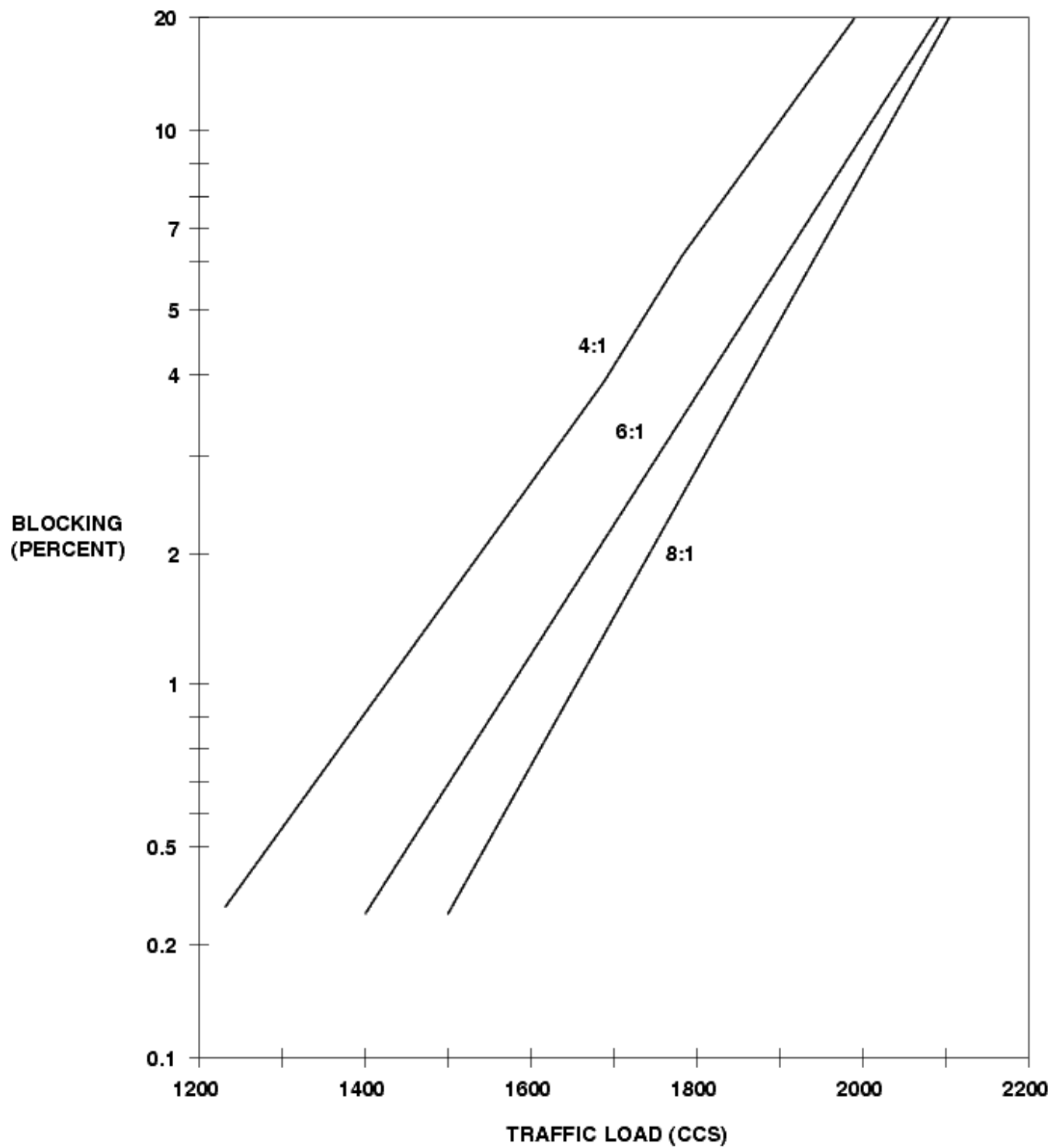
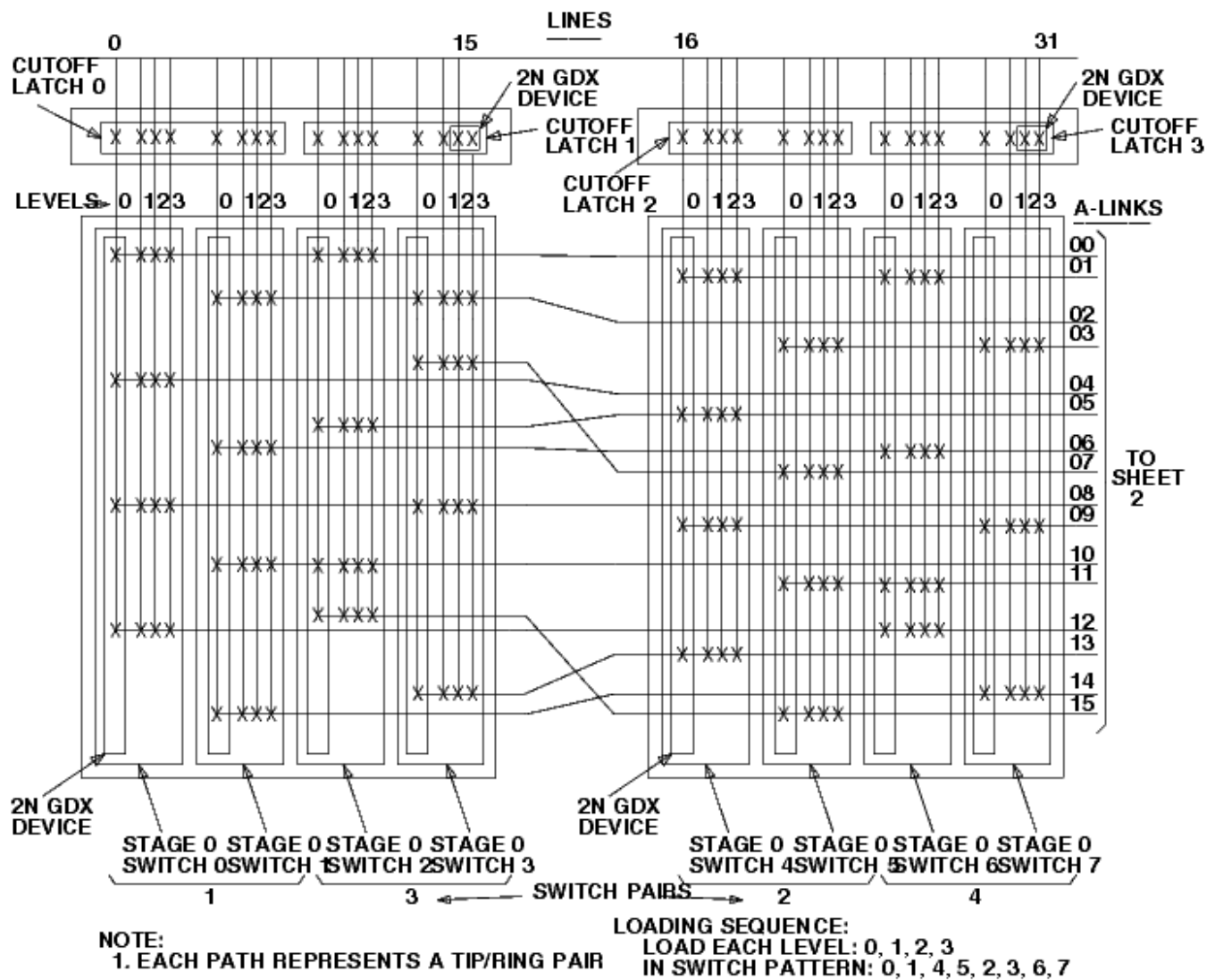
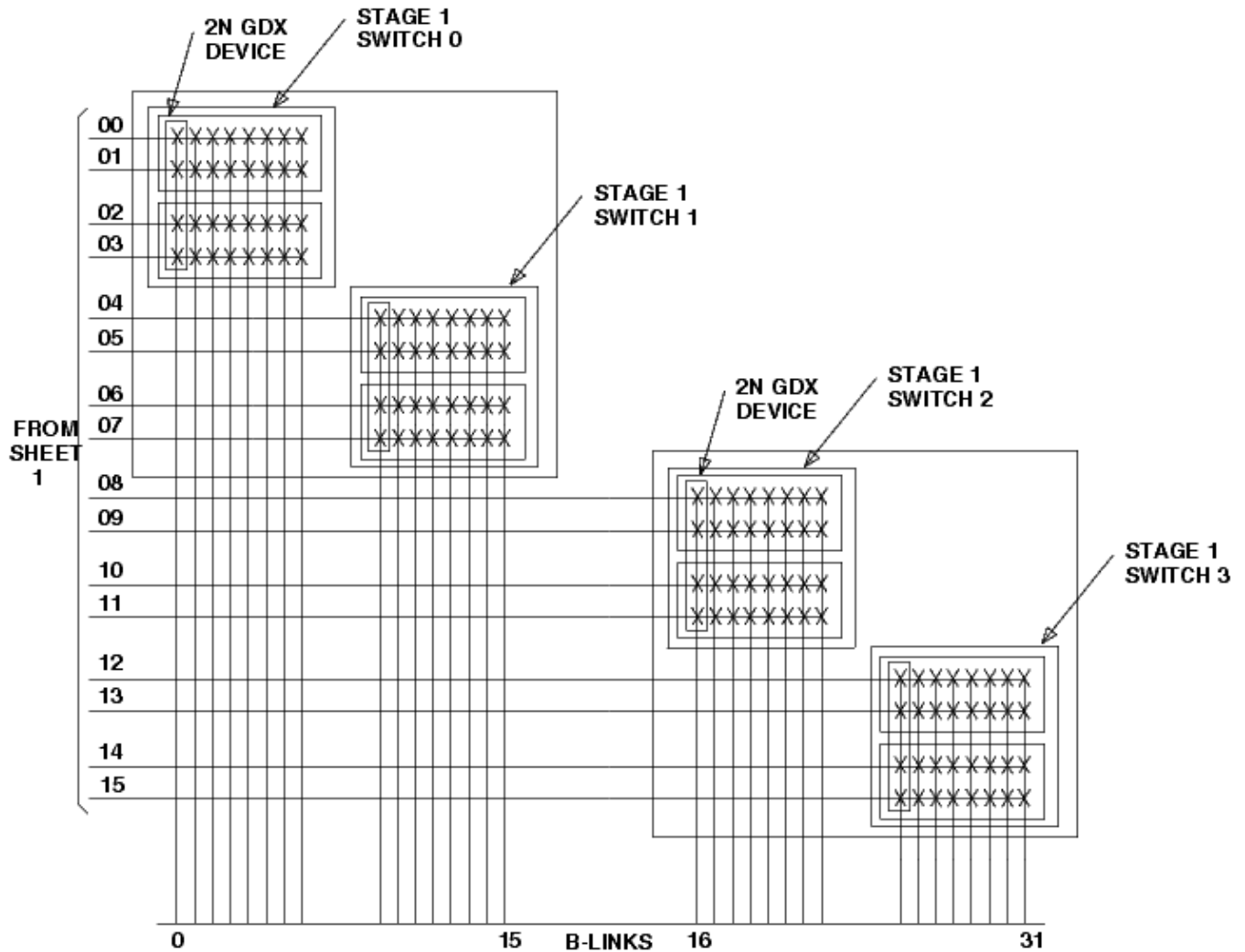


Figure 10.6-4 LU Load Service Curves



**NOTE:**

1. EACH PATH REPRESENTS A TIP/RING PAIR

B. STAGE 1 SWITCHES

Figure 10.6-5 LU2 and LU3 Concentrator Switch Stages

SERVICE GROUP		STAGE 1 SWITCH		CONC		CONC		CONC		CONC		CONC		CONC		CONC		CONC	
OUTPUT LEVEL		B-LINK NUMBER		0		1		2		3		4		5		6		7	
				SW GRP 0	SW GRP 1	SW GRP 2	SW GRP 3	SW GRP 4	SW GRP 5	SW GRP 6	SW GRP 7	SW GRP 8	SW GRP 9	SW GRP 10	SW GRP 11	SW GRP 12	SW GRP 13	SW GRP 14	SW GRP 15
0	0	0	0	X		X		X		X		X		X		X		X	
		1	1		X	X			X		X		X	X			X		X
		2	2	X			X	X			X	X			X	X			X
		3	3		X		X		X	X			X		X		X	X	
		4	4	X		X			X		X	X		X			X		X
		5	5		X	X		X		X			X	X		X		X	
		6	6	X			X		X	X		X			X		X	X	
		7	7		X		X	X			X		X		X	X			X
	1	0	8		X		X		X		X		X		X	X		X	
		1	9	X			X	X		X		X			X		X		X
		2	10		X	X			X	X			X	X		X			X
		3	11	X		X		X			X	X		X			X	X	
		4	12		X		X	X		X			X		X		X		X
		5	13	X			X		X		X	X			X		X	X	
		6	14		X	X		X				X	X				X	X	
		7	15	X		X			X	X		X		X		X			X
	2	0	16		X	X		X		X		X			X		X		X
		1	17	X		X		X		X		X		X	X	X		X	
		2	18		X		X	X			X	X		X			X	X	
		3	19	X			X		X	X			X	X		X			X
		4	20		X	X			X		X	X			X	X		X	
		5	21	X		X		X		X		X		X		X		X	X
		6	22		X		X		X	X		X		X		X			X
		7	23	X			X	X			X		X	X			X	X	
	3	0	24	X			X		X		X		X	X			X		X
		1	25		X		X	X		X		X		X		X		X	
		2	26	X		X			X	X			X		X		X	X	
		3	27		X	X		X			X	X			X	X			X
		4	28	X			X	X		X			X	X		X		X	
		5	29		X		X		X		X	X		X			X		X
		6	30	X		X		X			X		X		X	X			X
		7	31		X	X			X	X		X			X		X	X	
1	0	0	32		X		X		X		X		X		X		X		X
		1	33	X			X	X		X		X		X	X		X		X
		2	34		X	X			X	X			X	X			X	X	
		3	35	X		X		X		X	X		X		X				X
		4	36		X		X	X		X			X		X	X		X	
		5	37	X			X		X		X	X		X		X		X	
		6	38		X	X		X			X		X	X		X			X
		7	39	X		X			X	X		X		X			X	X	
	1	0	40	X		X		X		X		X		X			X		X
		1	41		X	X		X		X		X	X		X		X		X
		2	42	X			X	X			X	X			X		X	X	
		3	43		X		X		X	X			X		X	X			X
		4	44	X		X			X		X	X		X		X		X	
		5	45		X	X		X		X		X	X			X		X	X
		6	46	X			X		X	X		X		X	X		X		X
		7	47		X		X	X			X		X		X		X	X	
	2	0	48	X			X		X		X		X	X		X		X	
		1	49		X		X	X		X		X		X			X		X
		2	50	X		X			X	X			X		X	X			X
		3	51		X	X		X			X	X			X		X	X	
		4	52	X			X	X		X			X	X			X		X
		5	53		X		X		X		X	X		X		X		X	
		6	54	X		X		X		X		X		X		X	X		X
		7	55		X	X			X	X		X			X	X			X
	3	0	56		X	X		X		X		X		X	X		X		X
		1	57	X		X			X		X		X		X		X		X
		2	58		X		X	X			X	X		X		X			X
		3	59	X			X			X	X		X	X			X	X	
		4	60		X	X			X		X	X			X		X		X
		5	61	X		X		X		X			X		X	X		X	
		6	62		X		X		X	X		X		X			X	X	
		7	63	X			X	X			X		X	X		X			X

NOTES:

1. EACH X REPRESENTS A B-LINK ELECTRICAL NODE (2-WIRE TIP AND RING)
2. EACH SW GRP PACK CONTAINS 32 OUTPUT LEVELS, 16 CONNECT TO SERVICE GROUP 0 AND 16 CONNECT TO SERVICE GROUP 1
3. EACH B-LINK CONNECTS TO EIGHT SW GRP PACKS
4. A UNIT CONTAINING 16 SW GRP PACKS HAS AN 8:1 CONCENTRATION RATIO
5. REMOVE CONCS 6 AND 7 FOR A 6:1 CONCENTRATION RATIO
6. REMOVE CONCS 4, 5, 6, AND 7 FOR A 4:1 CONCENTRATION RATIO

SERVICE GROUP	STAGE 1 SWITCH	OUTPUT LEVEL	B-LINK NUMBER	CONC																			
				0		1		2		3		4		5		6		7		8		9	
				SW GRP 0	SW GRP 1	SW GRP 2	SW GRP 3	SW GRP 4	SW GRP 5	SW GRP 6	SW GRP 7	SW GRP 8	SW GRP 9	SW GRP 10	SW GRP 11	SW GRP 12	SW GRP 13	SW GRP 14	SW GRP 15	SW GRP 16	SW GRP 17	SW GRP 18	SW GRP 19
0	0	0	8	X		X		X		X		X		X		X		X		X		X	
		1	1		X	X			X		X		X	X		X		X		X	X		
		2	2	X			X				X	X			X		X		X	X		X	
		3	3		X		X		X	X			X		X		X	X		X			X
		4	4	X		X			X		X	X		X		X		X		X	X		
		5	5		X	X			X		X		X	X		X		X		X		X	
		6	6	X			X		X	X		X			X		X	X		X		X	
	1	7	7		X		X	X			X		X		X	X		X	X		X		
		8	8	X			X		X		X		X		X	X		X		X			X
		9	9	X			X	X		X		X		X		X	X		X	X		X	
		10	10		X	X			X	X			X	X		X		X		X	X		
		11	11	X		X		X			X	X		X		X	X		X		X	X	
		12	12		X		X	X		X			X		X		X	X		X	X		
		13	13	X			X		X		X	X		X		X	X		X	X		X	
	2	14	14		X	X		X			X		X	X		X		X		X		X	
		15	15	X		X			X	X		X		X		X		X		X	X		
		16	16		X	X		X		X		X		X		X		X	X		X		
		17	17	X		X		X		X		X	X		X	X		X	X		X		
		18	18		X		X	X			X	X		X		X		X		X		X	
		19	19	X			X		X	X		X	X		X		X		X	X		X	
		20	20		X	X			X	X	X		X	X		X		X		X		X	
	3	21	21	X		X		X		X		X	X		X	X		X	X		X		
		22	22		X		X		X	X		X		X		X		X		X	X		
		23	23	X			X	X			X		X	X		X	X		X		X	X	
		24	24	X			X		X		X	X		X	X		X	X		X	X		
		25	25		X		X	X		X		X		X		X	X		X		X	X	
		26	26	X		X			X	X			X		X	X		X	X		X		
		27	27		X	X		X			X	X		X	X		X	X		X	X		
1	0	28	28	X			X	X		X		X	X		X	X		X		X	X		
		29	29		X		X		X		X	X		X	X		X	X		X	X		
		30	30	X		X		X		X		X	X		X	X		X	X		X		
		31	31		X	X			X	X		X		X		X	X		X	X		X	
		32	32		X		X		X		X		X		X		X	X		X	X		
		33	33	X			X	X		X		X		X	X		X	X		X		X	
		34	34		X	X			X	X			X	X		X	X		X		X	X	
	1	35	35	X		X		X		X	X		X		X		X		X	X		X	
		36	36		X		X	X		X			X	X		X		X		X		X	
		37	37	X			X		X		X	X		X		X		X	X		X		
		38	38		X	X		X			X	X		X	X		X		X	X		X	
		39	39	X		X		X	X		X		X		X		X	X		X	X		
		40	40	X		X		X		X		X		X		X		X		X	X		
		41	41		X	X		X		X		X	X		X	X		X	X		X		
	2	42	42	X			X	X			X	X		X		X	X		X	X		X	
		43	43		X		X		X	X			X		X	X		X	X		X	X	
		44	44	X		X			X	X		X	X		X		X	X		X		X	
		45	45		X	X		X		X		X	X		X	X		X	X		X	X	
		46	46	X			X		X	X		X		X	X		X	X		X	X		
		47	47		X		X	X			X		X		X		X	X		X		X	
		48	48	X			X		X		X	X		X	X		X	X		X		X	
	3	49	49		X		X	X		X		X		X		X	X		X	X		X	
		50	50	X		X			X	X			X	X		X	X		X	X		X	
		51	51		X	X		X			X	X		X		X	X		X	X		X	
		52	52	X			X	X		X		X	X		X	X		X	X		X	X	
		53	53		X		X		X		X	X		X	X		X	X		X	X		
		54	54	X		X		X		X		X	X		X	X		X	X		X	X	
		55	55		X	X			X	X		X		X	X		X	X		X	X		
2	0	56	56		X	X		X		X		X		X	X		X	X		X	X		
		57	57	X		X			X		X		X	X		X	X		X	X		X	
		58	58		X		X	X			X	X		X	X		X	X		X	X		
		59	59	X			X			X	X		X	X		X	X		X	X		X	
		60	60		X	X			X		X	X		X	X		X	X		X	X		
		61	61	X		X		X		X			X	X		X	X		X	X		X	
		62	62		X		X		X	X		X		X	X		X	X		X	X		
		63	63	X			X	X			X		X	X		X		X	X		X	X	

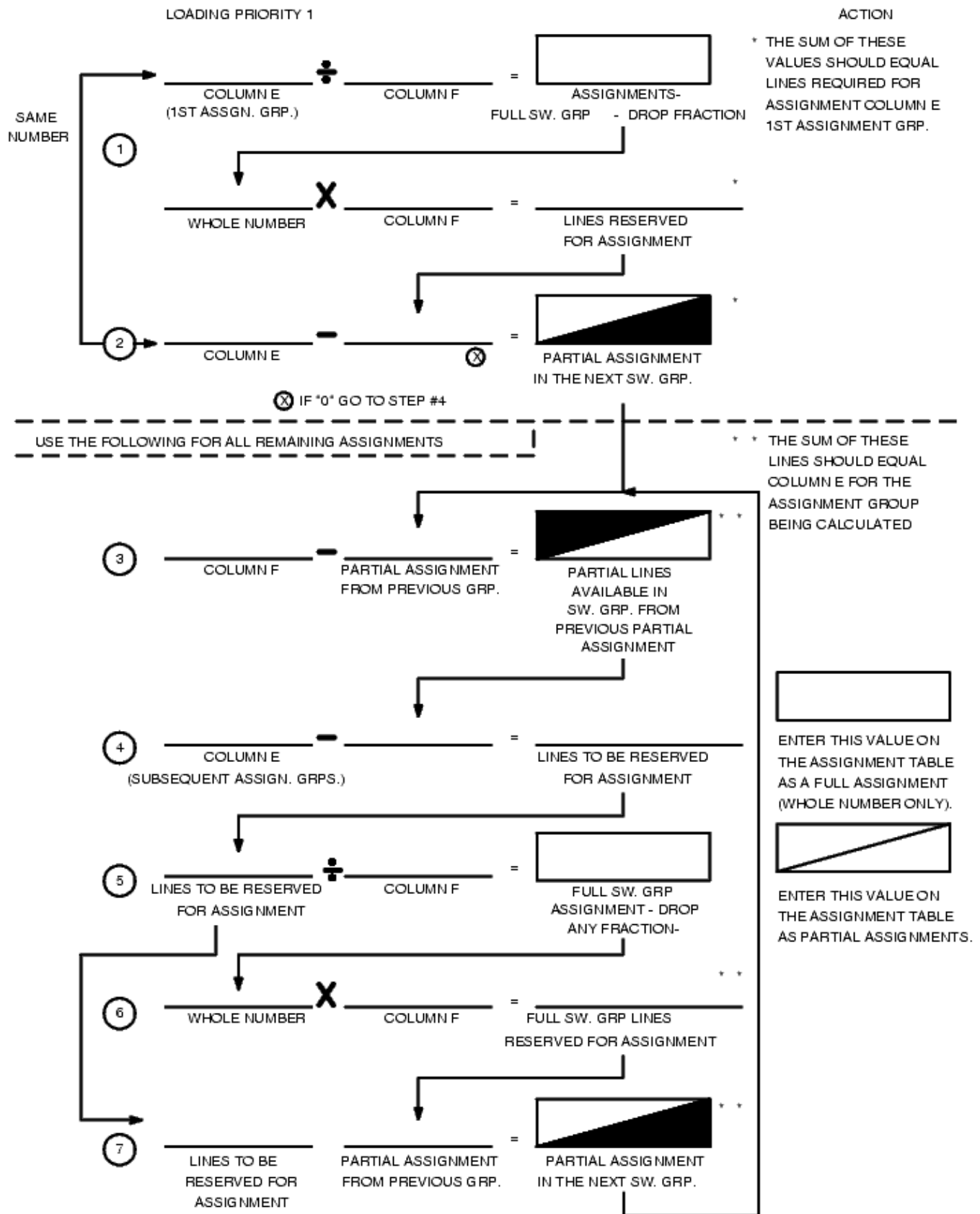
NOTES:

1. EACH X REPRESENTS A B-LINK ELECTRICAL NODE (2-WIRE TIP AND RING)
2. EACH SW GRP PACK CONTAINS 32 OUTPUT LEVELS, 16 CONNECT TO SERVICE GROUP 0 AND 16 CONNECT TO SERVICE GROUP 1
3. EACH B-LINK CONNECTS TO TEN SW GRP PACKS
4. A UNIT CONTAINING 20 SW GRP PACKS HAS A 10:1 CONCENTRATION RATIO
5. REMOVE CONCS 8 AND 9 FOR AN 8:1 CONCENTRATION RATIO
6. REMOVE CONCS 6, 7, 8, AND 9 FOR A 6:1 CONCENTRATION RATIO
7. REMOVE CONCS 4, 5, 6, 7, 8, 9, FOR A 4:1 CONCENTRATION RATIO

Figure 10.6-6 B-Link Random Slip Multiples

STEP	DESCRIPTION	INSTRUCTIONS										
1	NUMBER OF EOP LINES IN THE LOADING GROUP. 											
2	NUMBER OF SWITCH GROUPS IN THE LOADING GROUP. $\frac{\text{NUMBER OF LUS}}{\text{CR FACTOR}} \times \text{CR FACTOR} = \text{SWITCH GROUPS}$ <table border="1"> <thead> <tr> <th>IF CONCENTRATION RATIO</th><th>THEN CONCENTRATION RATIO FACTOR</th></tr> </thead> <tbody> <tr> <td>4:1</td><td>8</td></tr> <tr> <td>6:1</td><td>12</td></tr> <tr> <td>8:1</td><td>16</td></tr> <tr> <td></td><td>20</td></tr> </tbody> </table>	IF CONCENTRATION RATIO	THEN CONCENTRATION RATIO FACTOR	4:1	8	6:1	12	8:1	16		20	ENTER FIGURE ON EACH LINE IN COLUMN F.
IF CONCENTRATION RATIO	THEN CONCENTRATION RATIO FACTOR											
4:1	8											
6:1	12											
8:1	16											
	20											
3	CLASSES OF SERVICE TO BE INCLUDED IN EACH LOADING GROUP (AND APPROXIMATE CCS USAGE).											
4	ARRANGE CLASSES OF SERVICE IN ORDER OF PRIORITY.	ENTER CLASS IN COLUMN B TO CORRESPOND WITH PRIORITY NUMBER IN COLUMN A.										
5	EOP LINES BY CLASS OF SERVICE.	ENTER APPROPRIATE FIGURES IN COLUMN C.										
6	ADMINISTRATIVE SPARE FACTOR. $1 + \frac{\text{DESIRED PERCENTAGE IN DECIMAL FORM}}{\text{ADMINISTRATIVE SPARE FACTOR}} = \text{ADMINISTRATIVE SPARE FACTOR}$	ENTER FACTOR ON EACH LINE IN COLUMN D.										
7	EOP LINES (PER CLASS OF SERVICE) TO BE ASSIGNED TO EACH SWITCH GROUP. (COLUMN E WHICH EQUALS COL. C X COL. D)	USE LOADING PRIORITIES WORKSHEET.										
8	SWITCH GROUP ASSIGNMENT TABLE.	COMPLETE TABLE USING RESULTS FROM LOADING PRIORITIES WORKSHEET CALCULATIONS.										

A	B	C	D	E	F
LOADING PRIORITY	CLASS OF SERVICE	LINES BY CLASS-OF-SERVICE PER SWITCH GROUP			
		FORECASTED EOP LINES	ADMIN. SPARE FACTOR	EOP LINES INCLD. SPARE C X D = E	NUMBER OF SWITCH GROUPS
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
ETC.					



ASSIGNMENT ORDER	SWITCH	LEVEL	ASSIGNMENT
1	0	0	
2	1	0	
3	4	0	
4	5	0	
5	2	0	
6	3	0	
7	6	0	
8	7	0	
9	0	1	
10	1	1	
11	4	1	
12	5	1	
13	2	1	
14	3	1	
15	6	1	
16	7	1	
17	0	2	
18	1	2	
19	4	2	
20	5	2	
21	2	2	
22	3	2	
23	6	2	
24	7	2	
25	0	3	
26	1	3	
27	4	3	
28	5	3	
29	2	3	
30	3	3	
31	6	3	
32	7	3	

Figure 10.6-7 Loading Priorities Worksheet

OFFICE _____

DATE _____

EOP _____

*SESS™ SWITCH: EQUIPMENT UTILIZATION

ANALOG LINE UNITS CCS LOAD

[Based On Load]

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
CONC RATIO	ENG CRL- TERIA	LINE UNITS INSTALLED FOR EACH CONC RATIO	CCS CAPACITY PER CONC. RATIO	OFFICE CCS CAPACITY	ERLANG USAGE TODAY			ERLANG USAGE DATA EOP			MAIN STATION CAPACITY		CCS LOAD PERCENT UTILIZATION	
					MS DEMAND	CCS DEMAND	CCS/MS	MS DEMAND	CCS/MS	CCS DEMAND	TODAY	EOP	TODAY	EOP
NOTE 1	NOTE 2	NOTE 3	NOTE 4	C X D = E	NOTE 5	NOTE 6	$\frac{G}{F} = H$	NOTE 6	NOTE 6	$I \times J = K$	$\frac{E}{H} = L$	$\frac{E}{J} = M$	$\frac{G}{E} \times 100 = N$	$\frac{K}{E} \times 100 = O$
4:1														
6:1														
8:1														
10:1														
TOTAL														

Notes:

1. Complete lines for each concentration ratio represented in the office.
2. Enter blocking criteria used to engineer office.
3. Obtain from switch or TEO.
4. Obtain from Table, MAXIMUM ERLANG CAPACITY PER LINE UNIT.
5. Obtain from current working main station report.
6. Obtain from exchange forecast terminal data.

Figure 10.6-8 Line Units CCS Load Worksheet

OFFICE _____
 DATE _____
 EOP _____

*3ESS™ SWITCH EQUIPMENT UTILIZATION

ANALOG LINE UNITS TERMINATIONS
 [Based On Line Equipment Numbers (LEN)]

A	B	C	D	E	F	G	H	I	J	K	L
CONCENTRATION RATIO	LINE UNITS INSTALLED FOR EACH CONC RATIO	LENS PER RATIO	LENS INSTALLED	PERCENT MARGIN ADMINISTRATION (DECIMAL)	LEN CAPACITY	MAIN STATION TO LINE RATIO	MAIN STATION CAPACITY	MAIN STATION DEMAND		TERMINATION PERCENT UTILIZATION	
								TODAY	EOP	TODAY	EOP
NOTE 1	NOTE 2		$B \times C = D$	NOTES 2	$D \times E = F$	NOTE 3	$F \times G = H$	NOTE 4	NOTE 5	$\frac{I}{H} \times 100 = K$	$\frac{J}{H} \times 100 = L$
4:1		256									
6:1		384									
8:1		512									
10:1		640									
TOTAL											

Notes:

1. Use each line that is pertinent to the exchange.
2. Obtain from the switch to TEO.
3. For party line demand only. (Current MS "Current Lines or EOP MS "EOP Lines)
4. Obtain from current working terminal report.
5. Obtain from exchange forecast terminal report.

Figure 10.6-9 Line Units Terminations Worksheet

10.7 ACCESS INTERFACE UNIT

10.7.1 DESCRIPTION

The Access Interface Unit (AIU) represents an integrated and consolidated product approach to creating an all-purpose line interface unit for the SM/SM-2000. The AIU allows the switch customer more flexibility and efficiency in engineering the 5ESS®-2000 switch to meet individual equipment requirements. With the introduction of SM-2000, it is possible to integrate advanced wide band services, based upon existing standards and protocols into the 5ESS®-2000 switch. There is a need to develop synergy resulting in a single line interface product that not only meets the needs of different customers, but one that is flexible enough to address the fast-evolving communication network.

With the existing line unit peripherals (LU3/ISLU), selection of a specific unit is based upon customer parameters such as CODEC/Line, Traffic, PPM, Sparing and other termination requirements (RB, Loop Length, Balance Networks etc.). With the AIU, it is no longer necessary to select an individual unit type to address particular traffic needs. The AIU provides the flexibility for all switch engineers to configure one unit to handle all types of subscriber interfaces without being tied to the limited capabilities of dedicated unit types. Also, changes in traffic demand can be met without changing entire units. The AIU is a new, multiple interface (PIDB/DPIDB/PICB etc.) based line unit, that is supported by the SM/SM-2000. The AIU's architecture enables the customer to address the basic as well as the most advanced services of the existing ISLU and Line Units.

10.7.1.1 Functional Description of AIU

10.7.1.1.1 General

All common equipment is centralized on a single COMMon DATA and Control (COMDAC) circuit pack, one for each service group. All remaining packs are application packs. In the 5E11 software release, the only application packs supported by the AIU are analog Line Packs (LPs), coin phone service packs, and Ringing Generators (RGs). The double-wide Ring Generators are put in place of application packs 16, and 17, and 18 and 19 of the first AIU installed. The ring generators in one AIU can provide power ringing for a total of three AIUs, the AIU in which the RGs are installed, and two additional ones. The 5E12 software release adds ISDN U Card capability. In the future, other application packs may be developed. Analog line ringing is provided by two RGs, one for each service group, located in a AIU subrack. For remote applications such as the Expansion AIU, it is possible to have ringing provided external to the EAIU by the ringing plant. Available pack types are shown in Table 10.7-1

Table 10.7-1 AIU TYPES

PACK	FUNCTION	FEATURE	NOTE
Programmable Analog Line Pack ("Z" Pack)	Terminates up to 32 analog line customers	97-5E-3116	Programmable pack
Ringing Generators	Provides ringing for up to 3 AIUs with analog customers.	97-5E-3116	Does not support Multifrequency, Multitparty or high voltage ringing.
Coin/Analog Line Pack	Terminates up to 16 coin/POTS customers	99-5E-2758	
ISDN - 2B1Q U Line Pack (ANSI)	Terminates up to 16 "U" ISDN customers	99-5E-2855	
ADSL Pack	Terminates 2 ADSL customers		
Metallic Access Pack	Permits Metallic Testing		

10.7.2 ENGINEERING CONSIDERATIONS

10.7.2.1 General

The AIU shelf is a double-height unit, but is only half as deep as the standard SM/SM-2000 shelves. Therefore, a standard LTP cabinet can be modified to hold three AIU units. A new cabinet and cable rack are available allowing

up to 6 AIUs to be placed in one cabinet. In this configuration, Main Distribution Frame (MDF) wiring is connected at the front of the unit. This is a departure from previous 5ESS®-2000 switch peripheral unit designs where these cables were connected to the back of the unit. This new arrangement allows units to be placed back to back in the new AIU cabinet, therefore allowing more units to be placed in one cabinet.

The AIU is available in two orderable configurations, the AIU cabinet with three or six units, and the AIU cabinet with two or four units. Heavy traffic applications require the two/four configuration. ***If more than 8 PIDBs are assigned per AIU, AIU units can only be mounted in a two or four unit configuration.***

The AIU will improve SM processor real time performance in that the AIU will not contribute to the SMP "No Load". A different line scanning technique is employed, along with other improvements, which further reduce the SMP "work load". Current estimates indicate that the real time improvement for the AIU (vs. LU3) will be in the 20% range

10.7.2.1.1 5 DOPS

AIU and EAIU hardware engineering is supported by DOPSMOD on the SM and SM-2000. EAIU engineering is supported in the DOPSMOD release. High CCS applications are also supported in DOPSMOD release 9.0.

10.7.2.1.2 SM Environment —AIU

In the SM the AIU may be engineered to take advantage of DI concentration. In this case, although the COMDACs will run Active/Active, the engineering utilizes a load-sharing principle. This is similar to ISLU/2 engineering. This provides an added advantage in that if one COMDAC fails, the other would be able to handle the engineered load with no degradation in service. Engineering is done at 40% ABS for 1 and 2 PIDB pairs and 43% ABS for PIDB pairs 3 - 6. Engineering is done at 45% HD for pairs 1 - 6. This assumes the ABS to HD ratio is within the 1.19 range. For ABS this equates to each TS carrying 14.4 CCS (.40 E) ABS ($36 \times .40 = \text{CCS}$ or $1 \times .40 = \text{E}$) for PIDB pairs 1 and 2 and 15.5 CCS (.43 E) ABS ($36 \times .43 = \text{CCS}$ or $1 \times .43 = \text{E}$) for PIDB pairs 3 - 6. For HD, this equates to each TS carrying 16.2 CCS (.45 E) HD ($36 \times .45 = \text{CCS}$ or $1 \times .45 = \text{E}$) for PIDB pairs 1 - 6. Caution should be observed in engineering however, since the COMDACs and the SMP have no physical constraints to keep them from using all TSs that are available on equipped PIDBs. Thus, traffic above engineered limits will be carried as long as TSs are available on the Peripheral Time Slot Bus (PTSB). (This is the connection between a DI and the TSI. Each PTSB is strictly limited to 256 TSs. In setting up a call, the SMP first looks for one of these TSs to be available before assigning a TS to the unit making the request. Any equipped trunks on the SM will automatically require an appropriate quantity of TSs to be available to them and these are not available for other types of calls.) This means that if the offered load is greater than anticipated, call processing resources for other units in the SM (including other AIUs) could be adversely affected. Since concentration occurs as TSs are assigned on the PTSB and then on PIDBs, the following can be used to calculate the maximum number of customers per AIU and the required PIDBs based on traffic requirements. Tables 10.7-2, 10.7-3, 10.7-4, 10.7-15, 10.7-16, 10.7-17 and 10.7-18 may be used to calculate traffic capacity for the SM environment. These tables also reflect the physical impact of multiple PIDBs on the unit. At times the TSs available on the PIDBs will yield a physical 1:1 (or greater) concentration ratio. Where this occurs, it is indicated by a 1:1 in the table.

It should be noted that this is effective primarily in cases where traffic is low. For high traffic levels in an SM environment, it may be more efficient to utilize the SM-2000 engineering loading principles. This is not prohibited.

Table 10.7-2 PIDB Capacity SM 40% (pairs 1 & 2) /43% (pairs 3-6) Occupancy (ABS) (CCS)

PIDB PAIR	1	2	3	4	5	6
CCS	921.6	1843.2	1843.2	3968	4960	5952

Table 10.7-3 PIDB Capacity SM 43% (pairs 1 & 2) /45% (pairs 3-6) Occupancy (CCS)

PIDB PAIR	1	2	3	4	5	6
CCS	992	1984	3110.4	4147.2	5184	6220.8

Table 10.7-4 PIDB Capacity SM 43% (pairs 1 & 2) /45% (pairs 3-6) Occupancy (CCS)

PIDB PAIR	1	2	3	4	5	6
CCS	992	1984	3110.4	4147.2	5184	6220.8

10.7.2.1.3 SM-2000 Environment AIU

In the SM-2000 environment, there is no concentration at the DX. Thus, there is no consistent advantage in engineering the AIU as a load-shared device. Engineering is done at 80% ABS for PIDB pairs 1 and 2, and 85% ABS for PIDB pairs 3 - 6. Engineering is done at 90% HD for PIDB pairs 1 - 6. This assumes the ABS to HD ratio is within the 1.19 range. Note that traffic patterns running above the engineered load will result in blockage, and failure of a COMDAC will result in increased concentration in that AIU. Tables 10.7-5, 10.7-6, 10.7-7, 10.7-11, 10.7-12, 10.7-13 and 10.7-14

Table 10.7-5 PIDB Capacity SM-2000 80% Occupancy (ABS) (CCS) for PIDB pairs 1 and 2, 85% Occupancy (ABS) (CCS) for PIDB pairs 3 - 6.

PIDB PAIR	1	2	3	4	5	6
CCS	1843.2	3686.4	5875.2	7833.6	9792	11,750

Table 10.7-6 PIDB Capacity SM-2000 80% Occupancy (ABS) (CCS) for PIDB pairs 1 and 2, 85% Occupancy (ABS) (CCS) for PIDB pairs 3 - 6.

PIDB PAIR	1	2	3	4	5	6
CCS	1958.4	3916.8	6220.8	8294.4	1036.8	12441.6

Table 10.7-7 PIDB Capacity SM-2000 90% Occupancy (HD) (CCS)

PIDB PAIR	1	2	3	4	5	6
CCS	2073.6	4147.2	6220.8	8294.4	10368	12441.6

10.7.2.2 Expansion AIU

The Expansion Access Interface Unit (EAIU) allows AIU units to be placed in the central office outside the current 28 foot PIDB length limit. This functionality helps with administration of traffic when existing AIUs need to be moved to other SM-2000s because of increased traffic demand. Also, the EAIU does not use PIDB ports, so the SM-2000 switch fabric can still be accessed even though all PIDB ports are in use. These capabilities are accomplished by connecting the EAIU to the DNU-S. The only AIU hardware change required to convert to an EAIU is different COMDAC, called RCOMDAC, packs to support DS1s instead of the COMDACs that support PIDB connections for the AIU. All other EAIU hardware is the same as the AIU. The EAIU is not supported on the SM. The EAIU terminates only on the SM-2000/EXM-2000. It connects through another peripheral unit in the host MCTSI. It can connect through the Digital Network Unit - SONET (DNU-S) only. The EAIU is not currently supported on the SM.

10.7.2.2.1 Integrated Metallic Testing For EAIU

This feature provides a test Application Pack for the Remote AIU that allows the testing of subscriber lines in the remote. The functionality it provides is similar to the SLIM2. If EAIUs are provisioned within the host office, existing host test resources may be used. If the EAIU is located at a remote location, SLIM-2 functionality can be provided by using a Test Access Pack (TAP). This pack occupies one application pack position on a given EAIU, and can service up to 8 EAIUs at a given location. This is an integrated solution that utilizes the control time slots on the primary DS1s (that are connected between the DNU-S at the host and the DS1 COMDACs in the EAIU). If MLT type testing is desired, non-integrated test equipment must be used.

10.7.2.2.1.1 Scan and Distribute points for EAIUs

Within the each EAIU, there are eight (8) scan points, and two distribute points. Of the eight scan points, six are user defined, and two are fixed. Of the two distribute points, one is user defined and one is fixed. (These

functions are built into the EAIU COMDAC. No additional packs are necessary).

10.7.2.2.2 EAIU Traffic Capacity Calculations

Like the PIDB COMDACs, the DS1 RCOMDACs support up to 12 connections, provisioned in pairs. As such, the traffic capacity of the EAIU is calculated differently than the AIU. On the first pair of DS1s, 23 traffic carrying time slots are available per DS1 (one time slot per DS1 is reserved for control). On the remaining DS1s, all 24 time slots are available to carry traffic. Like PIDBs, DS1 time slots are engineered at 90% occupancy high day. The EAIU can be provisioned with a minimum of traffic carrying time slots to a maximum of traffic carrying time slots. The formula for calculating EAIU traffic capacity is:

(Number of DS1s x 24 channels per DS1) -

2 control channels, equals Total Traffic Carrying DS0s

Total Traffic Carrying DS0s x 36 CCS per DS0 x .90 = HD capacity

EAIU engineered at High Day capacity.

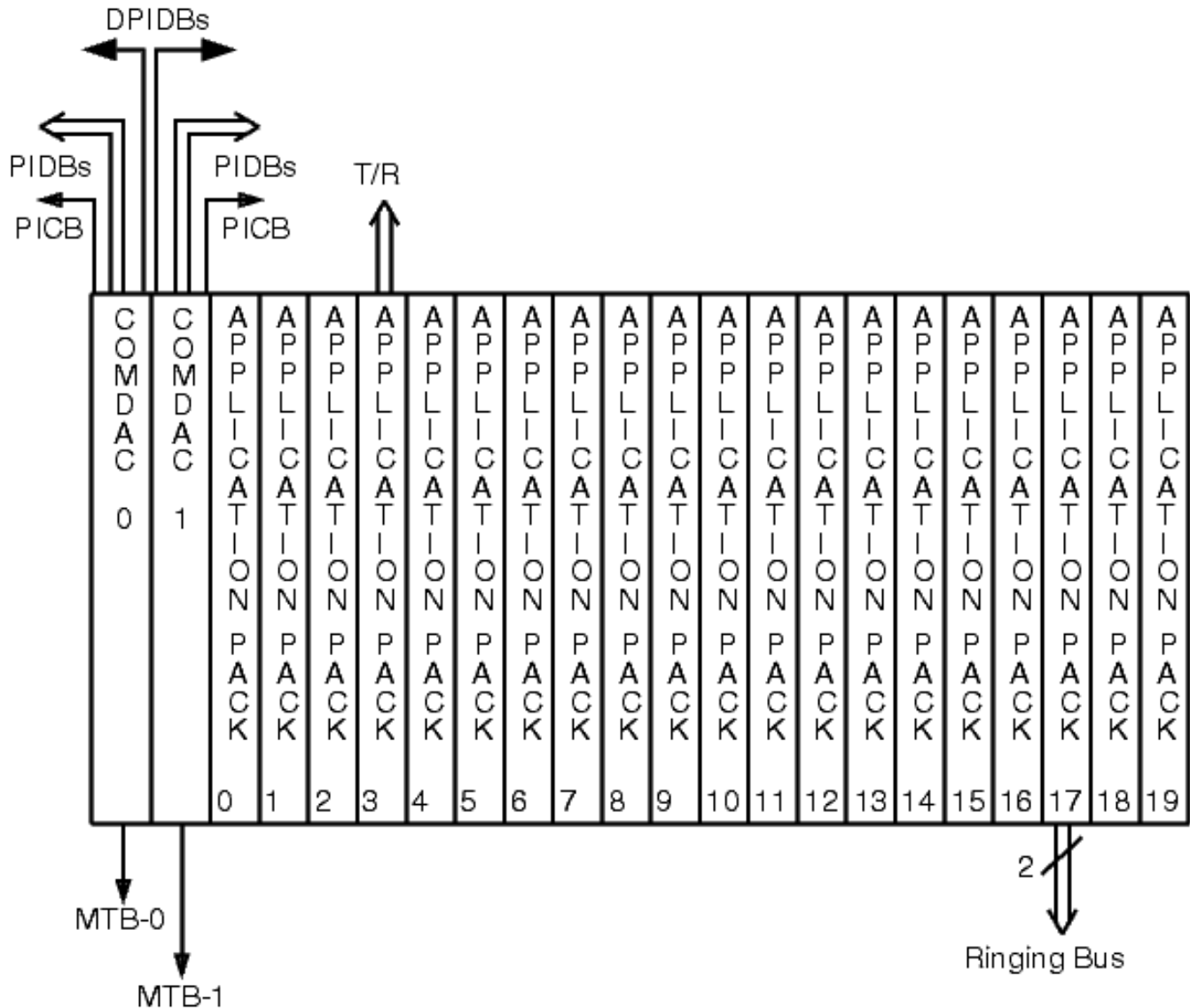


Figure 10.7-1 AIU Shelf Layout

Each AIU contains up to 20 application packs. In the 5E11 software release, these packs may be Line Packs, Coin Line Packs, or Ring Generators. In the 5E12 software release, ISDN U Card packs are added. The Ring Generator does not terminate any customer lines, but it is considered an application pack. In the initial release, two Ring Generator packs replace four Line Packs in the AIU, thereby reducing the unit capacity by four packs. The 640 line capacity of the AIU is reduced by 64 for every four pack positions occupied by two Ring Generators. Ring Generator packs equipped on one AIU are designed to handle the ringing generation requirements for up to two other AIU shelves.

The COMDAC provides a control interface between the SMP and the application packs. In addition the COMDAC contains a space switch providing a concentration and mapping function to route the time slots from the application packs onto the PIDBs. The two COMDACs normally operate in an ACTIVE-Major/ACTIVE-Standby mode, where each COMDAC serves half the APs. The APs provide the interface to the subscriber lines. The AIU feature provides a LP for the analog (Z) interface, and a LP supporting U.S. Coin Phones. The POTS Z-pack supports 32 lines with per-line Codec functionality. Each of the LPs provides a time switch allowing any line circuit to be connected to any time slot on the AP-COMDAC data bus. In addition the APs can select what COMDAC to connect the data bus to on a per time slot basis.

The PIDBs associated with the AIU can be provisioned in groups of two in a range from 2 - 12. PIDBs are arranged ACTIVE - ACTIVE, and as such, all are adding traffic carrying capacity. Each PIDB requires a Time Slot Interchange (TSI) port on the SM. For the SM-2000, simplex PIDB engineering is recommended. For the SM, redundant is recommended. The simplex method provides the greatest engineered capacity, where the redundant method allows 1/2 Time Slot Set increments for each AIU. The redundant method is recommended for the SM TSI provides the option for a 2:1 concentration (31 peripheral side PIDB ports and 16 equivalent PIDBs to the network).

For the SM-2000, the "per PIDB" capacities are as follows:

- ABS = 864 CCS, High Day = 1036.8 CCS, Max. 136 PIDBs per SM-2000, or 16 PIDBs per SM.
- The redundant SM, the "per PIDB" capacities are as follows: ABS = 437 CCS, High Day = 518.4 CCS, Maximum 30 PIDBs per SM.
- Each AIU requires two PICBs, one to each COMDAC.

10.7.2.3 ISDN Capability For 5E12 Software Release

Engineering of ISDN services on the AIU adds the considerations of DPIDB provisioning. Therefore, expected traffic loads will impact the optimal provisioning and administration philosophy used to deploy ISDN on the AIU.

10.7.2.3.1 DPIDB Provisioning

DPIDBs are provisioned on the AIU through ports on the COMDAC, and contend with PIDBs for the 12 available ports. As in the ISLU, DPIDBs are duplicated. AIUs use dual DPIDB paths where Time Slots on both sides are busied and reserved so if COMDACs are switched, or one is lost, the path switches rapidly to the other side. EAIUs use the simplex DPIDB config. where the DPIDB path is re-established on loss of one of the RCOMDACs as an example, a fully-loaded AIU, with ISDN lines and no special packet services, would have 320 BRIs, and require 6 DPIDBs. This is calculated as follows:

- Calculate $(320 \text{ BRIs} \div 4 \text{ BRIs per DPIDB Time Slot}) \div 32 \text{ Time Slots per DPIDB}$. The results of this calculation rounded up to the next number is 3 DPIDBs.
- Duplicate the DPIDBs = 6 DPIDBs per fully loaded AIU
- In this case, the AIU would have the capacity for 6 PIDBs. (12 ports minus 6 for DPIDBs) or about 19.4 CCS per BRI. This assumes High Day engineering and 90% PIDB occupancy. If additional CCS is required, reducing the number of BRIs (in the AIU) at or below 256 BRIs reduces the DPIDB requirements to two pair.
- $(256 \text{ BRIs} \div 4 \text{ BRIs per TS} \div 32 \text{ TS per DPIDB}) \times 2 = 4 \text{ DPIDBs}$
- DPIDB resources are engineered in the same manner as the ISLU. Each Basic Rate Interface (BRI) requires 1/4 Time Slot for D-channel access. Each Permanent Packet B-channel requires a nailed up TS. On-Demand-B (ODB) TS requirements are based upon the offered load of all ODB users within the unit. In effect, a pool of DPIDB TSs are sized for ODB traffic. The number of DPIDBs required is calculated by dividing total number of DPIDB TSs by 32 (the number of Time Slots per DPIDB).

10.7.2.3.1.1 DPIDB Time Slot Assignments

The 5ESS[®]-2000 switch can do automatic assignment of DPIDB Time slots. This is illustrated in table 10.7-8. In order for this to occur, the following pattern is assumed for D Channel assignments:

Table 10.7-8 DPIDB AUTO ASSIGNMENT

APPLICATION PACK 16 Customers	TIME SLOT ASSIGNMENT	GROUP ASSIGNMENT
0, 4, 8, 12, 16	0, 4, 8, 12, 16, 20, 24, 28	X
1, 5, 9, 13, 17	1, 5, 9, 13, 17, 21, 25, 29	Y
2, 6, 10, 14, 18	2, 6, 10, 14, 18, 22, 26, 30	Z
3, 7, 11, 15, 19	3, 7, 11, 15, 19, 23, 27, 31	T

Manual assignment of both D and B channel TSs can always be performed. In general, if ISDN packs are assigned from 0 - 7, then from 8 - 15, then from 16 - 19; then there will be no problem in using the automatic assignment. Where trouble will occur and automatic assignment will fail is illustrated by the following (using the 5E distribution):

- ISDN packs are installed as AP 0, 1, 8, and 19. One DPIDB is equipped.
- Automatic assignment will fail to assign D channels for customers on pack 8 since this pack expects to use the same TSs as pack 0. The available TSs are: 2, 10, 18 and 26. Customers on pack 8 may be manually assigned to these TSs.

If care is taken in equipping packs, automatic assignment will succeed. The following illustrates this:

- ISDN packs are installed as AP 0, 1, 9, and 19. One DPIDB is equipped.
- There will be no problem using the automatic assignment feature, as each pack will utilize a different set of TSs for its D Channels.

In the above instance, if any PPB or ODB had been equipped, at least one additional DPIDB pair would be required. It is extremely important to note that:

- DPIDB TSs must be engineered for the total anticipated ISDN load including all PPB and ODB access.
- Changes in customer assignments (addition of customer terminations not planned in the original engineering, or addition of customer services such as PPB that were not planned for in the original engineering) will require reengineering of the DPIDBs to insure that sufficient are available.
- Automatic assignment assumes that a pack is fully equipped with customers and that customers are installed in groups of 4. This is also a good engineering practice for this unit.

10.7.2.3.2 T1 Facilities

The following table illustrates the capacity of the T1 facility from the EAIU:

Table 10.7-9 EAIU T1 CAPACITIES 90% HD

NUMBER OF DS1	MAX POT CCS
Facility Pairs	Carried
2	3045.6
3	4600.8
4	6156
5	7711.2
6	9266.4

10.7.2.3.3 ISDN Impact on Slots to LOCAL COMDACs

From each pack location, there are 64 time slots available for use to both COMDACs. This is different from the POTS arrangement, and allows all 16 DSLs to be provisioned as 2B+D without contention for time slots. A fully loaded ISDN line pack with 2B+D users would require time slots for B-channels and 8 TSs for D-channels (for Duplex configuration, 4 TSs on each PCM. Therefore, no contention exists for time slots on the Pulse Code

Modulation (PCM) highway (the connection between the ISDN line pack and the COMDACs). The only exception occurs when a large number of PPB channels are provisioned on the same pack. Each PPB channel requires 2 nail-up time slots plus a 1/2 time slot for "D" channel access (1/4 on each side). If 16 BRIs are equipped on a given ISDN line pack, 72 channels are required, and therefore will not fit. In this case, the pack must be de-loaded to 14 BRIs. POTS lines provide no contention as there are a total of 32 lines and 32 time slots to the COMDACs.

10.7.2.3.4 EAIU ISDN Considerations

As with the AIU, packet time slots must be engineered before circuit switch capacity is tested against expected loads. This is to ensure "D" channel connectivity for call set-up, etc. For the EAIU, the packet time slots are duplicated and carried on the DS1s connected through a multiplexer to the DNU-S. They are then nailed up through the TSI for termination on the Packet Switch Unit. This is a variation from the AIU where specific COMDAC ports must be dedicated to DPIDBs. Packet time slots and time slots used for circuit switch traffic may reside on the same DS1 facility.

10.7.2.4 Quick Assymetric Digital Subscriber Line (QADSL)

10.7.2.4.1 Overview

The Quick ADSL Solution provides combined broadband data and narrowband telephony service for subscribers on the 5ESS—2000 Switch by using the ANSI standard T1.413 ADSL Specification. This technique puts the broadband data on the same subscriber loop through the use of Discrete MultiTone (DMT) modulation at frequencies above 4 KHz. Splitters at both ends of the loop separate the narrowband and broadband signals. The broadband data is carried in the form of ATM cells on Permanent Virtual Circuits (PVCs). In order to have a solution available in the required time frame, this offer will make use of OEM equipment packaged in a 5ESS—2000 AIU cabinet.

10.7.2.4.2 AIU Cabinet Configuration

The AIU cabinet has space for six shelves, three in the front and three in the back. The configuration chosen for the QADSL project has two OEM ADSL shelves and one Lucent POTS shelf in the front of the cabinet, and three OEM ADSL shelves in the back. The ADSL shelf has 18 slots for line cards, but only 16 will be used for the QADSL project, since it makes the numbers work out better and simplifies the cabling arrangement. Two slots will be left empty. The OEM shelf provides terminations for alarms (6 outputs and 2 inputs), but these won't be used in the QADSL solution. All alarm information will be transported through the Element Manager. This is consistent with the operations plan for the eventual broadband AIU solution. The first version of the ADSL line cards that will be available will support two subscriber lines and will occupy two slots in the ADSL shelf, for a total of 16 ADSL lines per shelf. The next generation of ADSL cards will also support two subscriber lines, but will only occupy one slot, thus allowing for 32 ADSL lines per shelf.

10.7.2.4.3 Element Manager

The first version of the ADSL line cards available support two subscriber lines and occupy two slots in the ADSL shelf, for a total of 16 ADSL lines per shelf. The next generation of ADSL cards will also support two subscriber lines, but will only occupy one slot, thus allowing for 32 ADSL lines per shelf.

10.7.2.5 Assymetric Digital Subscriber Line (ADSL)

ADSL provides combined broadband data and narrowband telephony service for subscribers on the 5ESS®-2000 switch by using the ANSI standard T1.413 ADSL Specification. This technique puts the broadband data on the same subscriber loop through the use of Discrete MultiTone (DMT) modulation at frequencies above 4 KHz. Splitters at both ends of the loop separate the narrowband and broadband signals. The broadband data is carried in the form of ATM cells on Permanent Virtual Circuits (PVCs).

10.7.2.5.1 AIU Cabinet Configuration

The AIU cabinet has space for six shelves, three in the front and three in the back. The configuration chosen for ADSL has two OEM ADSL shelves and one Lucent POTS shelf in the front of the cabinet, and three OEM ADSL shelves in the back. The ADSL shelf has 18 slots for line cards, but only 16 are used. Two slots are left empty. The OEM shelf provides terminations for alarms (6 outputs and 2 inputs), but these are not used. All alarm information is transported through the Element Manager.

The ADSL AIU 3 unit cabinet configuration. In the 5ESS—2000 Switch cabinet, is the maximum number of units equipped. The SM-2000 Front Access Cabling (FAC) cabinet can accommodate the 3 unit configuration or up to 6 units with the rear of the cabinet equipped identically to the front as shown, with the units back to back. The bottom shelf contains 2 COMDAC circuit packs, the Asynchronous transfer mode Feeder Multiplexer (AFM) circuit pack, and the Application Pack (AP) POTS circuit pack dedicated to the 8 adjacent ADSL AP circuit packs. The remainder of this shelf is different from the 2 shelves above because it can accommodate up to 5 AIU AP circuit packs. These 5 packs can be of any functional type e.g. ISDN, analog (POTS), coin, ppm, etc. These packs can also be mixed within these 5 locations as well. It should be noted that for remote applications, the Test Access Pack TAP circuit can be used in the location shown to support remote testing applications. The two Ringing Generator circuit packs are used to supply ringing to the POTS lines associated with the three shelf unit.

The middle shelf is similar to the bottom shelf, it contains 2 COMDAC circuit packs which are necessary to support the POTS calls associated with the ADSL lines. The AFM circuit pack will serve the data associated with the ADSL call for the 16 ADSL AP circuit packs in this shelf. One AP POTS circuit pack will be provided to serve as the interface to the 5ESS —2000 Switch for the 8 ADSL circuit packs shown adjacent to it. The AP POTS circuit pack is the same POTS pack used in the standard AIU configuration for analog line interfaces (e.g. LPZ100B or equivalent). The ADSL AP terminates the ADSL lines.

The top shelf is identical to the middle shelf with respect to the circuit pack configurations.

It should be noted that the ADSL unit is dedicated to the ADSL application described. This means that it can not be converted to a full AIU (non-ADSL) application by only changing out the AP types. The tip/ring cabling to the MDF is different between the types of units and is not easily interchangeable. A cabling harness, connected between the MDF cable and circuit packs is also required in the ADSL application.

10.7.2.5.2 Subscriber Loop Arrangement

The first version of the ADSL line cards that support two subscriber lines occupies two slots in the DSL shelf, for a total of 16 ADSL lines per shelf. The next generation of ADSL cards (available later in 1998) will also support two subscriber lines, but will only occupy one slot, thus allowing for 32 ADSL lines per shelf. The cable harness connects the five ADSL shelves and the POTS shelf in the cabinet together to provide the combined ADSL/POTS service. The harness is designed for the single slot cards, and thus provides service for up to 32 subscribers per shelf. The same harness also works for the dual slot cards. When dual slot cards are used, half the pairs in each cable will be unused. The customer's loop (tip and ring) comes from the main distributing frame and is connected to the appropriate plug in the cabinet. The wiring harness then connects the tip and ring to the appropriate port of an ADSL shelf, where it is carried to the ADSL pack via the shelf backplane. The line card contains a splitter, which separates out the POTS signal (baseband 4 KHz signal). The wiring harness then takes the POTS signal from the ADSL shelf to the appropriate port of a pack in the POTS shelf. The POTS signals from each ADSL shelf all terminate on the same line card in the POTS shelf. The POTS shelf contains five POTS line packs, providing the narrowband service for up to 160 subscribers, and two Ring Generator Units (RGUs), which supply the ringing for those customers. This is a standard 5ESS®-2000 Switch AIU POTS shelf. The other slots in this shelf are not be used for ADSL subscribers, but are available for any miscellaneous use the service provider may have for them.

10.7.2.5.2.1 Feeder Arrangement

Each ADSL shelf contains an Access Interface Module (AIM) that multiplexes the broadband data (ATM cells) from

all the subscribers on the shelf and connects to the network. There are two kinds of AIMS: Network AIMS (N-AIMS) and Shelf AIMS (S-AIMS). The N-AIMS produce a DS3 output carrying the ATM cells to the network. The S-AIMS produce an internal form of the signal that can be carried to an N-AIM and multiplexed onto its DS3 interface. This allows the traffic for multiple shelves to be carried on a single link. For ADSL, four of the ADSL shelves in the cabinet will have S-AIMS and one will have an N-AIM. The signals from each S-AIM in the cabinet will be connected to the N-AIM via a daisy chain arrangement.

10.7.2.5.3 Element Manager

As another part of the ADSL capability, Lucent Technologies produces an Element Manager (EM), which is used for OAM of the ADSL equipment. This equipment connects to the N-AIM shelves and communicates via the Simple Network Management Protocol (SNMP). Both a 10BaseT and an ATM PVC interface are available. From an operations point of view, the N-AIM is the master controller for its shelf and all subsequent (S-AIM) shelves. The EM does not connect to the "telephony side" of the 5ESS[®]-2000 switch. The operations and maintenance of the broadband service (done by the EM) and of the narrowband service (done through the 5ESS[®]-2000 switch) are completely independent. Any coordination of these services has to be done by the service provider. The EM is software that runs on commercially available workstation equipment. Technicians at the EM will be able to configure the system, activate and deactivate service, receive alerts about equipment failures and query for the status of the system.

10.7.2.5.4 ADSL Administration

There are traffic considerations for both the POTS service and the broadband data service on the lines. For the POTS service there is no difference from any other POTS line on an AIU. Data service is limited by the fact that the data (upstream and downstream) for all the subscribers in the cabinet must fit into the DS3 link to the network. All users can not receive data at the full rate of their ADSL line simultaneously. In this case, blocking occurs outside the switch at the point where all the data enters onto the DS3 pipe coming into the switch. The office engineer may want to provide a particular grade of service by choosing an "overbooking factor" and keeping the sum of customer data rates from exceeding this factor. By choosing smaller overbooking factors, the engineer can give better grades of service. For example: Desired maximum overbooking factor = 10. The cabinet has 40 subscribers with maximum data rate of 6 MB/s and 120 customers with maximum data rate of 1.5 MB/s. Total theoretical maximum data rate = $40 \times 6 + 120 \times 1.5 = 420$ MBs. Divide by 45 MB/s (DS3 rate) to get 9.3 as the overbooking factor. In this example the desired maximum overbooking factor is not exceeded. Similarly, in the upstream direction, it is possible that there will be more data received from subscribers than the unit can send in the DS3 pipe. If this happens, the unit will drop some data and force the user's PC to retransmit the data later. In actuality, this case is much less likely than the downstream blocking, since the upstream data rates for ADSL are smaller than the downstream ones. The office engineer should be aware of the fact that data loss and retransmission can occur if there are a lot of very heavy users on the same cabinet. However, this would occur in only a very few cases.

fully equipped ADSL shelf (see the top shelf of Figure 1) can accommodate a maximum of 64 combined ADSL/POTS. It should be noted that the AFM packs can be linked or "daisy-chained" together (see Figure 2) to take advantage of minimizing the usage of DS3/E3 facilities. The user needs to be aware that the AFM pack multiplexes the ADSL broadband ADSL lines and as a result care needs to be taken to insure that the combined broadband ADSL lines do not exceed the bandwidth of the DS3/E3 facility. The bottom shelf (Figure 1) should be the first shelf equipped if growing the BADSL equipment is desired since the AFM pack in this shelf will provide the DS3/E3 interface to the ATM switch. The remaining AFM packs will be "daisy-chained" (see Figure 2) to this AFM pack to gain access to the ATM switch.

10.7.2.5.4.1 Traffic and Capacity Impacts

The capacity of the Broadband ADSL (BADSL) AIU can be calculated as follows:

- The total capacity of a full ADSL shelf with a combined POTS/ADSL line configuration is 64 lines (16 ADSL APs x 4 ADSL lines per ADSL AP)

- The total capacity of the half - ADSL shelf is 192 lines (160 lines from assumed 5 standard POTS AIU line packs + 32 lines from the ADSL POTS pack).
- The total capacity of the 3 shelf configuration is 320 lines (64 lines (from top shelf) + 64 lines (from middle shelf) + 32 lines (ADSL in lower shelf) + 160 lines (from 5 POTS packs in lower shelf)).
- The total capacity of the cabinet is 640 lines (2 x 320 lines); this applies to a fully equipped 6 shelf ADSL Broadband cabinet..
- Each shelf of the BADSL AIU requires 2 PICB pairs, therefore each cabinet requires 6 PICB pairs.
- The total number of cabinets that a SM-2000 can support is 7 since there are a maximum of 43 PICB pairs per SM-2000.
- Two PIDBs per shelf (top and middle) should be adequate to support the 64 lines per shelf. If more AIU AP packs are equipped (see bottom shelf), then the PIDB engineering rules as shown in this chapter should be used.
- Each BADSL (E)AIU shelf will require 2 MH time slots for control.

10.7.3 AIU GENERAL ADMINISTRATION CONSIDERATIONS

The AIU was specifically designed to reduce the amount of administration effort needed to maintain the engineered traffic carrying capacity of the unit. By design, there is virtually a 1:1 ratio of time-slots to lines through the AIU. Concentration is done where the line packs are connected to the PIDBs via a space switch. Therefore, the administration effort will be to ensure that the total AIU load is not exceeding the engineered capacity.

The AIU introduces a new line circuit naming scheme, AIUEN,

AIU,LC:SM#(1-192)-(E)AIU#(0-125)-LINE PACK#(0-19)-LINE CKT#(0-31)

New and changed Recent Change views support the AIU and its new line circuit naming scheme. Recent Change is updated to support traffic measurements for the AIU. A new Study Group has been created for the AIU. Also, new sections have been created for the 30 minute traffic report for AIU measurements.

A new section is provided for the AIU, which provides measurement data for traffic administration, to evaluate subscriber line traffic on an AIU. Either 640 individual terminations or all terminations on one AIU may be studied at one time.

A new section has been created for the AIU. It provides a special study on Application Packs (AP) in an AIU. This can be used for AIU AP load balancing. A maximum of 100 AIUs may be included per study group. APs grown into an AIU, which is included in a study group, is automatically added to the study group once it is in operation.

Tables are shown which show various CCS capacities available for different numbers of packs equipped in the AIU and different numbers of PIDBs equipped. They are tables 10.7-11 10.7-12 , 10.7-13 , 10.7-14 for SM 2000 and tables 10.7-15 , 10.7-16 , 10.7-17 and 10.7-18 for the SM environment.

NOTE: When consulting these tables be sure you are using the proper table for SM, or SM-2000, depending on which type of SM you are working with.

10.7.3.1 AIU Types

Configuration requirements for the AIU vary depending on the pack equipage. While the unit easily supports "mixing" of analog and ISDN line packs, advance consideration should be given if this is to be supported. Note that when engineering a single AIU shelf, and mixing analog and ISDN packs, Ringing Generators must be provided

and fewer PIDBs can be equipped than when the unit is equipped with all analog packs. One AIU shelf can provide Ring Generator support to two other additional AIU shelves as well. The presence of even one ISDN customer on an AIU requires that a DPIDB access to the PSU(2) must be provided. These types are shown in table 10.7-10.

Table 10.7-10 AIU TYPES

AIU TYPE	REQUIREMENTS	DATA	APPLICATION PACKS/ "FIRST" AIU
"Z" Analog Only	*Ring Generation Generation Required *No DBIDB reserved	PIDB = 2 to 12	16 Analog Packs
"E" ISDN only	*No Ring Generation Required	PIDB = 2 to 10 DPIDB = 2 to 10 PIDB + DPIDB = 4 to 12	20 ISDN Packs
"M" Mixed	*DPIDB reserved/equipped *Ring Generation Equipped or Reserved *PIDB restricted	PIDB = 2 to 10 DPIDB = 2 to 10 Total PIDB + DPIDB = 4 to 12	16 Analog or ISDN Packs

10.7.3.1.1 Traffic Engineering

A section 216 has been created for the 30 minute traffic report. This section measures the circuit switched Z-interfaces (analog) and U-interface (digital) specified for screens 13.7 and 13.8 of Recent Change View for the Expanded Access Interface Unit (EAIU).

- SM: (Switching Module Identifier 1 through 192)
- AIU: (AIU Identifier 0 through 125, or EAIU 0 through 125))
- TMATT: (AIU Terminating Circuit Call Attempts) This peg count is the number of attempts to terminate a circuit-switched call to an AIU line (Z-Interface).
- TMBLK: (AIU Terminating Circuit Calls Blocked) This peg count is the number of terminating circuit-switched (Z-Interfaces) call attempts that failed due to the inability to select an idle time slot.
- TOTUSG: (AIU Total Circuit-Switched Usage) This is the total usage (100-second scan) of the peripheral interface data bus (PIDB) time slots used for circuit- switched calls (Z-Interfaces).
- MTUSG: (AIU Circuit Maintenance Usage) This maintenance usage (100-second scan) is the amount of time the PIDB time slots are out of service.
- RGOVL (Ring Generator Overload) This peg count is the number of times a terminating call is blocked due to a ring generator overload condition for a line on an AIU.
- DIGATT: (Digit attempt) This peg count measures the number of attempts to terminate a circuit-switched call to an (E)AIU line (U and T interfaces).
- DIGBLK: (Digit Blockage) This peg count measures the number of terminating circuit-switched call attempts that failed due to the inability to select an idle time slot (U and T interfaces).
- DIGUSG: (Digit Usage) This 100 second scan count is the number of 7 PIDB time slots used for circuit-switched calls to of from BRIs (U and T interfaces).

A section 217 has been created for the 30 minute traffic report. This section measures *individual* lines specified

through screens 13.7 and 13.8 of Recent Change View.

- SM: (Switching Module Identifier 1 through 192)
- AIU: (AIU Identifier 0 through 125, or EAIU 0 through 125))
- AP: (Application Pack (AP) 0 through 19)
- LC: (Line circuit number 0 through 31)
- ORIG REQ: (Originating Requests) This peg count is the number of originating requests per line (Z, U, and T interfaces).
- SETUP DELAY: (Setup Delay) This peg count measures the number of times that a switching module took more than three seconds responding to a setup request (Z, U, and T interfaces)
- TERM: (Terminating Calls) This peg count is the number of Z line terminating paths through the (E)AIU (Z, U, and T interfaces) .
- USAGE: (Originating and terminating usage.) This 100 second scan is the usage for originating and terminating circuit switched voice and/or data calls in units of hundred call seconds (CCS) (Z, U, and T interface).
- ORIG BLKD: (Originating Request Attempts Blocked) (Count ID = 5) This overflow count is the number of originating attempts (which are retried), before dial tone, due to AIU path unavailability. A busy condition is not considered an originating block (Z, U, and T interfaces).
- TERM BLKD: (Terminating Calls Blocked) (Count ID = 6) This overflow count is the number of terminating calls which failed due to an AIU terminating path unavailability. When a call is blocked, the originator receives the appropriate failure treatment (that is, reorder). A busy condition is not considered a terminating block (Z, U, and T interfaces).

A section 218 has been created for the 30 minute traffic report. This section measures *all lines specified on a specific AIU* through screens 13.7 and 13.8 of Recent Change View. This section is a special study section.

- SM: (Switching Module Identifier 1 through 192)
- AIU: (AIU Identifier 0 through 125, or EAIU 0 through 125))
- AP: (Application Pack (AP) 0 through 19)
- LC: (Line circuit number 0 through 31)
- ORIG REQ: (Originating Requests) This peg count is the number of originating requests per line (Z, U, and T interfaces).
- SETUP DELAY: (Setup Delay) This peg count measures the number of times that a switching module took more than three seconds responding to a setup request (Z, U, and T interfaces)
- TERM: (Terminating Calls) This peg count is the number of Z line terminating paths through the (E)AIU (Z, U, and T interfaces) .
- USAGE: (Originating and terminating usage.) This 100 second scan is the usage for originating and terminating circuit switched voice and/or data calls in units of hundred call seconds (CCS) (Z, U, and T interface).

- ORIG BLKD: (Originating Request Attempts Blocked) (Count ID = 5) This overflow count is the number of originating attempts (which are retried), before dial tone, due to AIU path unavailability. A busy condition is not considered an originating block (Z, U, and T interfaces).
- TERM BLKD: (Terminating Calls Blocked) (Count ID = 6) This overflow count is the number of terminating calls which failed due to an AIU terminating path unavailability. When a call is blocked, the originator receives the appropriate failure treatment (that is, reorder). A busy condition is not considered a terminating block (Z, U, and T interfaces).

A section 228 has been created for the 30 minute traffic report. This section provides measurements per (E)AIU for ISDN switching of the DPIDB in the 30-minute traffic report. The shelf and AIU are specified through Screens 13.7 and 13.8 of RCV for the A DPIDB.

- SM: (Switching Module Number (1 through 192)
- SHELF: (Packet Switch Unit (PSU) Shelf Identifier)
- AIU: (EAIU/AIU Module Number 0 through 125
- ATMP: (DPIDB Time Slot Attempts) This peg count measures the number of attempts to seize a DPIDB time slot to set up an On-Demand-B-channel (ODBE) connection.
- USG: This 100 second scan count measures the ODBE usage of a DPIDB.
- OVFL: (DPIDB Time Slots unavailable) This peg count measures the number of attempts to seize a timeslot to set up the On Demand B-channel (ODB) which were denied because idle time slots were not available.

These reports study the (E)AIU line station set, allowing a service provider administrator to evaluate (E)AIU line assignment problems. These sections are not intended to be used for marketing studies of end user Directory Numbers (DNs) as a result of shared DN's or secondary DN's appearing on the same station set and other station sets. These are special study sections and by default are inhibited for collection.

In addition, the AIU software supports the following standard measurements.

- The Office Totals report described in 235-070-100 , Appendix 1, 6.4, Section 3.
- The System Access Delay report described in 235-070-100 , Appendix 1,6.5, Section 4.
- The Processor Performance report described in 235-070-100, Appendix 1, 6.14, Section 13.
- The Customer Directory Number Counts report described in 235-070-100, Appendix 1, 6.111, Section 128.

Details of these new study groups and measurements are covered in 235-070-100 A1, *Administration and Engineering Guidelines* , Appendix 1.

Table 10.7-11 Maximum CCS/Customer PIDB Capacity SM-2000 80% (ABS) for PIDBs 1 - 4, 85% (ABS) for PIDBs 6 - 12

Packs	20	19	18	17	16	15	14	13	12	11
Lines	640	608	576	544	512	480	448	416	384	352
Pidbs										
2	2.88	3.03	3.2	3.39	3.6		4.11	4.43	4.8	5.24
						3.84				
4	5.76	6.06	6.4	6.78	7.2	7.68	8.23	8.86	9.6	10.47
6	9.8	9.66	10.2	10.8	11.48	12.24	13.11	14.12	15.3	16.7

8	12.24	12.88	13.6	14.4	15.3	16.32	17.49	18.83	20.4	22.25
Equipage in 2/4 cabinet										
10	15.3	16.11	17.00	18.00	19.13	20.4	21.86	23.54	25.5	27.82
12	18.36	19.33	20.4	21.6	22.95	24.48	26.23	28.25	1:1	1:1
This table applies to SM-2000s only										

Table 10.7-12 Maximum CCS/Customer PIDB Capacity SM-2000 80% (ABS) for PIDBs 1 - 4, 85% (ABS) for PIDBs 6 - 12

Packs	10	9	8	7	6	5	4	3	2	1
Lines	320	288	256	224	192	160	128	96	64	32
Pidbs										
2	5.76	6.4	7.2	8.23	9.6	11.52	14.4	19.2	1:1	1:1
4	11.52	12.8	14.4	16.46	19.2	23.4	1:1	1:1	1:1	1:1
6	18.36	20.4	22.95	26.23	1:1	1:1	1:1	1:1	1:1	1:1
8	24.48	27.2	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1
Equipage in 2/4 cabinet										
10	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1
12	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1
This table applies to SM-2000s only										

Table 10.7-13 Maximum CCS/Customer PIDB Capacity SM-2000 90% (HD)

Packs	20	19	18	17	16	15	14	13	12	11
Lines	640	608	576	544	512	480	448	416	384	352
Pidbs										
2	3.24	3.42	3.60	4.05	4.32					5.89
4	6.48	6.84	7.20	7.62	8.10	8.64	9.26	9.97	10.80	11.78
6	9.72	10.27	10.80	11.44	12.15	12.96	13.89	14.95	16.20	17.67
8	12.96	13.69	14.40	15.25	16.20	17.28	18.51	19.94	21.60	23.56
Equipage in 2/4 cabinet										
10	16.20	17.11	18.00	19.60	20.25	21.60	23.14	24.92	27.0	29.45
12	19.44	20.53	21.60	22.87	24.30	25.92	27.77	29.91	1:1	1:1
This table applies to SM-2000s only										

Table 10.7-14 Maximum CCS/Customer PIDB Capacity SM-2000 90% (HD)

Packs	10	9	8	7	6	5	4	3	2	1
Lines	320	288	256	224	192	160	128	96	64	32
Pidbs										
2	6.48	7.20	8.10	9.26	10.80	12.96	8.10	10.80	1:1	1:1
4	12.96	14.40	16.20	18.51	21.60	25.92	1:1	1:1	1:1	1:1
6	19.44	21.60	24.30	27.77	1:1	1:1	1:1	1:1	1:1	1:1
8	25.92	28.80	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1
Equipage in 2/4 cabinet										
10	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1
12	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1	1:1
This table applies to SMs only										

Table 10.7-15 Maximum CCS/Customer PIDB Capacity SM 40% (pairs 1&2) /43% (pairs 3-6) ABS

Packs	20	19	18	17	16	15	14	13	12	11
Lines	640	608	576	544	512	480	448	416	384	352
Packs										
2	1.44	1.52	1.60	1.70	1.80	1.92	2.06	2.22	2.40	2.62
4	2.88	3.03	3.20	3.40	3.60	3.84	4.11	4.43	4.80	5.24
6	4.65	4.89	5.17	5.48	5.81	6.20	6.64	7.15	7.75	8.45
8	5.62	6.53	6.89	7.3	7.75	8.27	8.86	9.54	10.33	11.27
Equipage in 2/4 cabinet										
10	7.75	8.16	8.75	9.12	9.69	10.33	11.07	11.92	12.92	14.09
12	9.3	9.79	10.33	10.94	11.63	12.4	13.29	14.3	15.5	16.91
This table applies to SMs only										

Table 10.7-16 Maximum CCS/Customer PIDB Capacity SM 40% (pairs 1&2) /43% (pairs 3-6) ABS

Packs	10	9	8	7	6	5	4	3	2	1
Lines	320	288	256	224	192	160	128	96	64	32
Pidbs										

2	2.88	3.20	3.60	4.11	4.80	5.76	7.20	9.60	14.4	1:1
4	5.76	6.40	7.20	8.23	9.6	11.52	14.4	19.2	1:1	1:1
6	9.30	10.33	11.63	13.29	15.5	18.6	23.25	1:1	1:1	1:1
8	12.4	13.78	15.5	17.71	20.67	24.8	1:1	1:1	1:1	1:1
Equipage in 2/4 cabinet										
10	15.5	17.2	19.38	22.14	25.38	1:1	1:1	1:1	1:1	1:1
12	18.6	20.67	23.25	26.57	1:1	1:1	1:1	1:1	1:1	1:1
This table applies to SMs only										

Table 10.7-17 Maximum CCS/Customer PIDB Capacity SM 45% HD

Packs	20	19	18	17	16	15	14	13	12	11
Lines		608	576	544	512	480	448	416	384	352
	640									
Pidbs										
2	1.62	1.71	1.80	1.91	2.03	2.16	2.31	2.49	2.70	2.95
4	3.24	3.42	3.60	3.81	4.05	4.32	4.63	4.98	5.40	5.89
6	4.86	5.13	5.40	5.72	6.08	6.48	6.94	7.48	8.10	8.84
8	6.48	6.84	7.20	7.62	8.10	8.64	9.26	9.97	10.80	11.78
Equipage in 2/4 cabinet										
10	8.10	8.55	9.0	9.53	10.13	10.80	11.57	12.46	13.50	14.73
12	9.72	10.27	10.8	11.44	12.96	12.96	13.89	14.95	16.20	17.67
This table applies to SMs only										

Table 10.7-18 Maximum CCS/Customer PIDB Capacity SM 45% HD

Packs	10	9	8	7	6	5	4	3	2	1
Lines	320	288	256	224	192	160	128	96	64	32
Pidbs										
2	3.24	3.60	4.05	4.63	5.40	6.48	8.10	10.80	16.20	1:1
4	6.48	7.20	8.10	9.26	10.80	12.96	16.20	21.60	1:1	1:1
6	9.72	10.80	12.15	13.89	16.20	19.44	24.30	1:1	1:1	1:1
8	12.96	14.40	16.20	18.51	21.60	25.92	1:1	1:1	1:1	1:1
Equipage in 2/4 cabinet										
10	16.20	18.00	20.25	23.14	27.00	1:1	1:1	1:1	1:1	1:1
12	19.44	21.60	24.30	27.22	1:1	1:1	1:1	1:1	1:1	1:1
This table applies to SMs only										

10.8 HIGH-LEVEL SERVICE CIRCUIT

10.8.1 DESCRIPTION

The high-level service circuits (HLSCs) reside in the line units (LUs) and integrated services LUs (ISLUs). An LU contains four, five, or six HLSCs depending on engineering. These circuits perform short duration functions (250 ms) during call setup and disconnect such as:

- Originating and terminating calls
 - Power cross tests (outside)
 - False cross and ground test (inside)
 - Party test
 - Coin control
- Disconnecting calls
 - Restore verify (inside).

Additionally, these circuits perform power ringing operations on terminating calls. The ringing cycle is shown in Figure 10.8-1, and the sequence of functions performed by the HLSC during a typical SM-to-SM call are shown in Figure 10.8-2. Since only 2 seconds are required for ringing a given line during the 6-second cycle, the remaining time can be used to perform the other functions or to ring other lines. Six HLSCs can ring up to 18 lines (allowing for the silent interval) at the same time. Since the HLSC is a time-shared resource, call holding times from switches which have non-time-shared service circuits must be divided by three to properly calculate HLSC CCS for the 5ESS®—2000 switch.

An ISLU equipped with analog Z-cards uses HLSCs for short duration functions only; ringing is provided by the ringing generator. The ISLUs with ISDN lines only (T- and U-cards) do not require HLSCs for these functions. However, an ISLU equipped with U-cards does require two HLSCs to perform high current tests on the U-card. ISLUs equipped with only T-cards do not require HLSCs.

10.8.2 ENGINEERING CONSIDERATIONS

The HLSCs are provisioned uniformly on the basis of four, five, or six per LU. They are used for short durations (500 ms) during call setup and for 2-second intervals admitting line access to Type I ringing. The HLSCs are time shared, ringing up to 18 lines simultaneously, three per HLSC. The high day projected capacity of six HLSCs at P.001 blocking is 86 CCS. These capacities are shown in Table 10.8-1.

If these capacities are reached or exceeded, customers may experience excessive dial tone delay or be routed to reorder. The solution to this condition is to reduce the load on the LU or to add more HLSCs (if possible). Each LU is equipped with a minimum of four HLSCs; this is required due to the rapid decline in capacity in the event one HLSC is out of service. If an LU were equipped with only three HLSCs, and one went out of service, there would not be sufficient resources for power ringing.

Table 10.8-1 LU HLSC Capacities

0.05 percent OAM			0.1 percent HD		
HLSC			HLSC		
4	5	6	4	5	6
40	65	82	43	68	86

Table 10.8-2 provides the CCS capacities for ISLUs utilizing Z-cards.

Since the HLSCs do not provide ringing for the ISLU, the CCS requirement will be significantly less than for the LU. Therefore the ISLU is equipped with from two to four HLSCs. The ISLU can be physically equipped with up to six HLSCs, allowing spares to be provided. An ISLU equipped with both Z- and U-cards does not require additional HLSCs for U-card testing.

Table 10.8-2 Z-Card HLSC Capacities (CCS)

HLSCs	0.1 PERCENT HD	0.05 PERCENT OAM
2	11.9	12.8
3	17.9	19.3
4	40.0	43.0

Section 8 of the 30-minute traffic report contains the HLSC data. The total usage measurement should be monitored to identify any groups approaching capacity. This section includes HLSC measurements for both the LU and the ISLU.

10.8.3 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

10.8.3.1 Short Job and Ringing Overflows and Total Usage

The short job and ringing overflows and total usage measurements are made for the HLSCs. These measurements, which are considered key service indicators, are found in Section 8 of the 30-minute traffic report. The short jobs are those line tests performed by the HLSC at origination, termination, and disconnect. The HLSC also performs ringing functions for lines. Multiple short job overflow counts may be made for any call that incurs an HLSC blocking.

The effects of HLSC overflows vary based on the function resulting in an overflow. The affects are as follows:

- Ringing overflows are recorded when an HLSC cannot be obtained to provide power ringing to the terminating line. Before the overflow is recorded, the ringing job is rescheduled to try again later (a few hundred milliseconds later). This usually results in a successful HLSC selection so that an overflow is not registered. If an overflow is registered, the call is routed to reorder as a lost call.
- Originating short job overflows result in call delays. Since all originations are queued, failure to obtain an HLSC results in an overflow, and the call remains queued while an attempt is made to select another HLSC. Multiple overflows occur as long as no HLSC is available. Further, if the delay lasts more than 3 seconds, a dial-tone delay is also recorded.
- Terminating short job (restore/verify) overflows are not service affecting. This job is deferrable, and in cases of heavy load, it is automatically eliminated to ensure HLSC availability for originating and ringing jobs.

10.8.3.2 Other Measurements

Other measurements in Section 8 of the 30-minute traffic report include a peg count of the number of times the HLSC is used and the total usage and maintenance usage. These measurements are made for each LU in each SM.

10.8.4 FEATURE IMPACT

PEGCT(8) register is incremented by 2 or 3 pegs per call: 1 peg for the originating caller, 1 or 2 pegs for the terminating party (1 for ringing and 1 for disconnect). The disconnect test is initiated if the call is answered. The usage register includes the measurement of allocated circuit usage.

10.8.5 TRANSITION IMPACT

Since each LU contains dedicated HLSCs, the addition of new LUs automatically provides the additional HLSCs. Therefore, growth procedures have no impact on HLSCs. If an LU has less than six HLSCs installed and it is determined that additional HLSCs are required, the new circuits can be added without affecting the existing circuits. For details on this growth procedure, refer to the following documents:

- 235-105-231 - *Hardware Change Procedures*
- 235-118-XXX - *Recent Change Procedures*
- 235-600-30X - *Equipment Configuration Data*.

10.8.6 HIGH-LEVEL SERVICE CIRCUIT WORKSHEET

The worksheet shown in Figure 10.8-3 should be used to calculate the percent utilization of the HLSCs (total office CCS (hundred call seconds) load today and at the end of period (EOP). If the office has mixed concentration ratios, each concentration ratio may have a different number of HLSCs installed; this would require separate calculations for each group and for the office total.

The following paragraphs identify the columns of the HLSC worksheet and describe the calculations required to complete the worksheet.

- (A) **HLSC Installed per LU:** The number of HLSCs installed per LU. (If the switch was engineered with mixed concentration ratios, the number of HLSCs may change.) Obtain number from the switch. This number will be 4, 5, or 6 HLSCs per LU.
- (B) **Engineering Criteria:** The engineering criteria used to determine equipment capacities.
- (C) **HLSC CCS Capacity per Line Unit:** The stated CCS capacity for the number of HLSCs installed per LU. Obtain number from Table 10.8-1.
- (D) **Number of LUs Equipped With 4, 5, or 6 HLSCs:** The number of line units installed in the office per concentration ratio. Obtain the number from the switch or the TEO (telephone equipment order).
- (E) **Office HLSC CCS Capacity:** The HLSC CCS capacity of the office.

HLSC CCS Capacity per LU	×	LUs Equipped with 4, 5, or 6 HLSCs	=	Office HLSC CCS Capacity
Column C		Column D		Column E

- (F) **CCS Usage Data Today - Main Station Demand:** The main stations working in the switch today. Obtain the number from the current working terminal report.
- (G) **CCS Usage Data Today - CCS Demand:** This is the CCS demand on HLSC today. This value may be read from the current office engineering data or calculated.

MS Demand	×	CCS/MS Today	=	CCS Demand Today
Column F		Column H		Column G

- (H) **CCS Usage Data Today - CCS per Main Station:** The HLSC CCS usage per main station of the office today. This figure can be taken from the current office engineering data.

CCS Demand Today			=	CCS/MS Demand Today
Column G				Column H
MS Demand Today				
Column F				

- (I) **CCS Usage Data EOP - Main Station Demand:** The main stations forecasted to be working in the switch at EOP, or the highest main station demand during the engineering period. Obtain the number from the office forecast terminal report.
- (J) **CCS Usage Data EOP - CCS per Main Station:** The HLSC CCS usage per main station at which the office is forecasted to be handling by EOP. Since main stations and CCS per main station may grow at different rates, projections of future demand for each must be made separately.
- (K) **CCS Usage Data EOP - CCS Demand:** The CCS demand on HLSC at the EOP. To calculate:

MS Demand EOP Column I	x	CCS/MS Demand EOP Column J	=	CCS Demand EOP Column K

- (L) **Main Station Capacity - Today:** The main station capacity that the HLSCs are capable of handling today, based on the current CCS per main station per HLSC.

Office HLSC CCS Capacity Column E				MS Capacity Today Column L
		=		
SSC/MS Today Column H				

- (M) **Main Station Capacity - EOP:** The main station capacity that the HLSCs are capable of handling at the EOP, based on the forecasted main station and CCS per main station per HLSC.

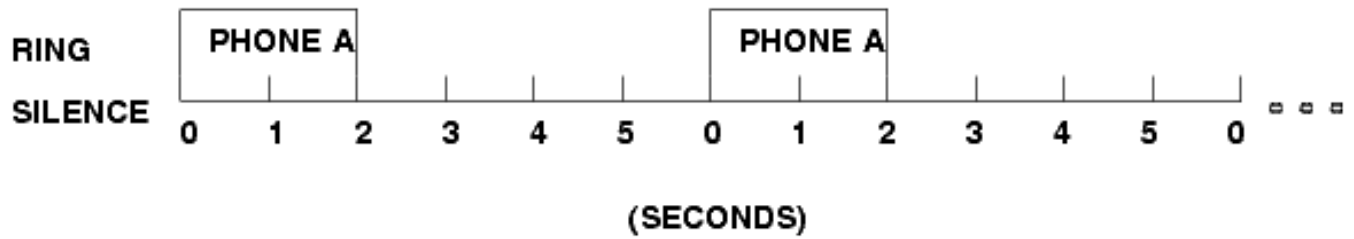
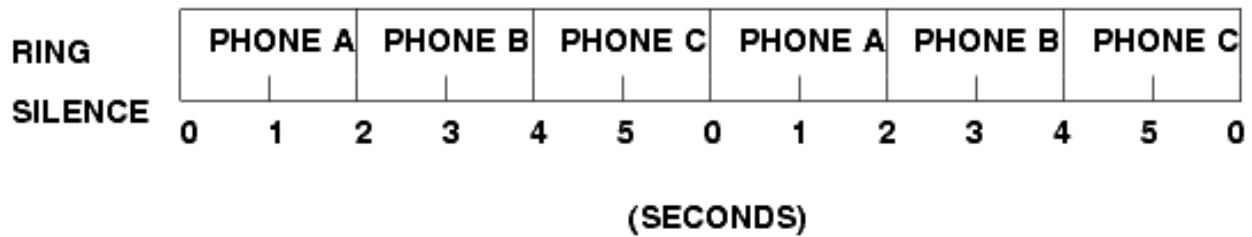
Office HLSC CCS Capacity Column E		MS Capacity EOP		
		=		Column M
CCS/MS Capacity EOP Column J				

- (N) **CCS Load Percent Utilization Today:** The maximum utilization of the HLSC capacity that is being used today.

CCS Demand Today Column G				CCS Load Percent Utilization Today Column N
		x 100 =		
Office HLSC CCS Capacity Column E				

- (O) **CCS Load Percent Utilization - EOP:** The maximum utilization of the HLSC during the period.

CCS Demand EOP Column K				CCS Load Percent Utilization EOP Column O
		x 100 =		
Office HLSC CCS Capacity Column E				

**A. HLSC RINGING PHONE A****B. HLSC RINGING PHONES A, B, C****Figure 10.8-1 High-Level Service Circuit Ringing Cycle**

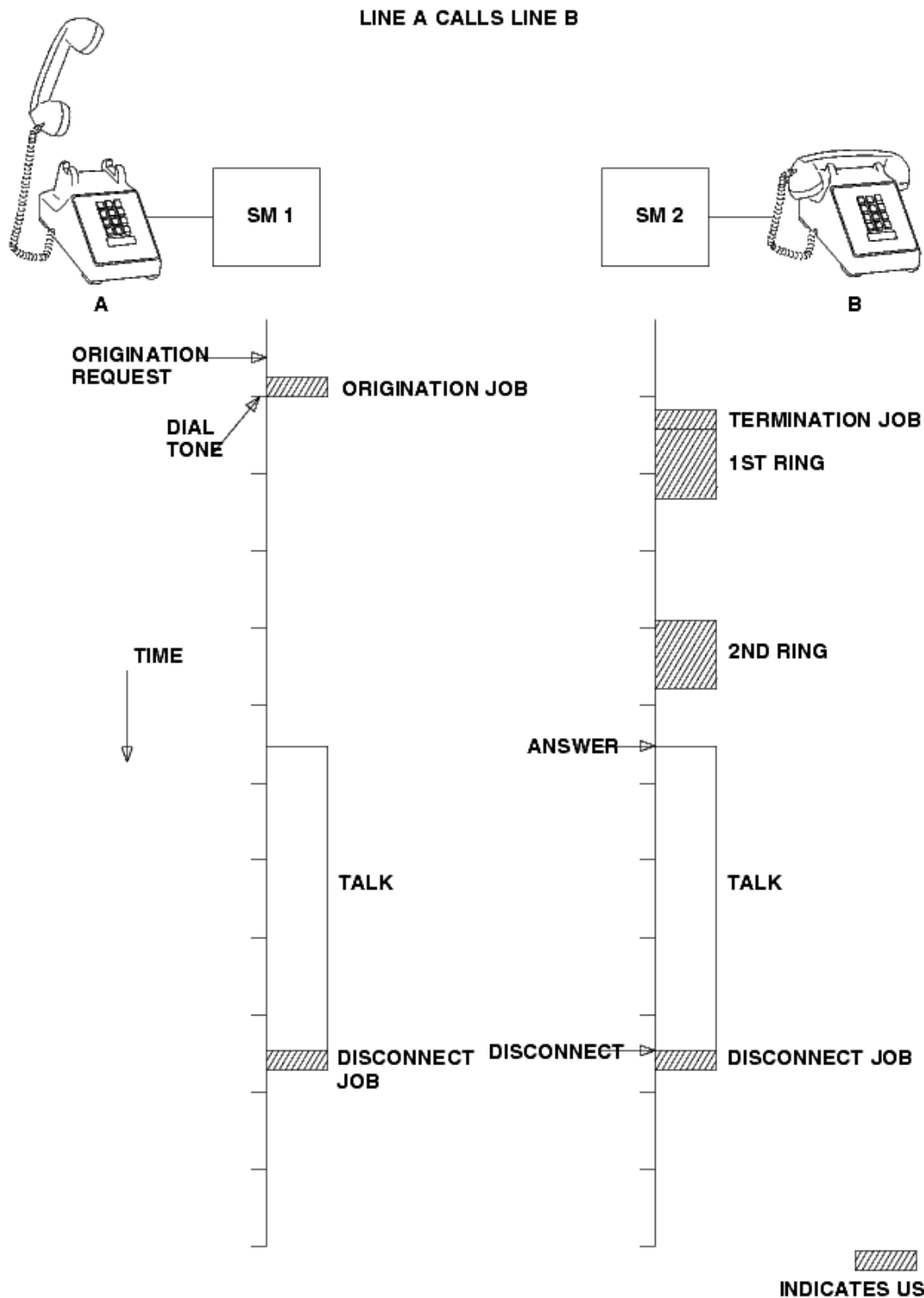


Figure 10.8-2 Sequence of HLSC Tasks

OFFICE _____

DATE _____

EFFECTIVE DATE

FROM _____ TO _____

*SEST™ SWITCH: EQUIPMENT UTILIZATION

HIGH LEVEL SERVICE CIRCUITS (HLSC)

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
HLSCs INSTALLED PER LU	ENGI NEERING CRITERIA	HLSC OCS CAPACITY PER LU	LUs EQUIPPED WITH 4, 5, OR 6 HLSCs	EXCHANGE HLSC OCS CAPACITY	OCS USAGE DATA TODAY			OCS USAGE DATA EOP			MAIN STATION CAPACITY		OCS LOAD PERCENT UTILIZATION	
					MS DEMAND	OCS DEMAND	OCS/MS $\frac{G}{F} = H$	MS DEMAND	OCS/MS	OCS DEMAND	TODAY	EOP	TODAY	EOP
	NOTE 1	NOTE 2	NOTE 1	C X D = E	NOTE 3	NOTE 4	$\frac{G}{F} = H$	NOTE 5	NOTE 6	I X J = K	$\frac{E}{H} = L$	$\frac{E}{J} = M$	$\frac{G}{E} \times 100 = N$	$\frac{K}{E} \times 100 = O$
4														
5														
6														
TOTAL														

NOTES:

1. Obtain from switch or TEO.
2. Obtain figure from Table, CRITERIA FOR HLSC ENGINEERING.
3. Obtain figure from current working terminal report.
4. Obtain from current exchange engineering data.
5. Obtain from exchange forecast terminal report.
6. Calculate based on forecast HLSC data.

Figure 10.8-3 High-Level Service Circuit Worksheet

10.9 DIGITAL CARRIER LINE UNIT

10.9.1 INTRODUCTION

The *SLC*[®] 96 carrier system serves a group of up to 96 subscribers at a remote location. The system consists of the following: a *SLC*[®] 96 carrier remote terminal (RT) at the remote location, T1 transmission facilities (DS1-rate digital lines) between the RT and the *5ESS*[®]-2000 switch office, and a digital carrier line unit (DCLU) that connects the T1 facilities directly into the *5ESS*[®]-2000 switch. The *SLC*[®] 96 carrier system can serve single and multiparty lines, coin lines, and special service lines.

The *SLC*[®] 96 carrier RT terminates up to 96 analog customer lines at a remote location from the *5ESS*[®]-2000 switch. The function of the RT is to perform analog to digital conversion of the 96 customer lines and to multiplex them onto the equipped DS1 digital lines which terminate at the DCLU.

A *SLC*[®] 96 carrier system operating in Mode I (carrier only) provides no concentration at the RT, and provides 96 T1 line channels (24 channels per T1 line) to the *5ESS*[®]-2000 switch office via 5 T1 lines (4 active and 1 optional standby). A *SLC*[®] 96 carrier operating in Mode II (carrier concentrator) provides 2:1 digital concentration at the RT and provides 48 T1 line channels (24 channels per T1 line). The *SLC*[®] 96 carrier system operating in Mode III provides no concentration at the RT, and provides 48 dedicated 64 Kbps channels per RT over 48 time slots on 3 DS1 rate digital lines (2 active plus 1 protection line). The DCLU does not support RTs operating in Mode III.

The following types of customer lines can be served by the *5ESS*[®]-2000 switch via the *SLC*[®] 96 carrier remote terminals:

- Single-party lines using loop signaling
- Two-party lines (including operator number identification and automatic number identification)
- Eight-party lines
- Special service lines [wide area telephone service (WATS) lines, nondirect inward dialing, direct inward dial (DID) and private branch exchange (PBX) trunks].

10.9.1.1 General Description

The DCLU is a peripheral unit of the *5ESS*[®]-2000 switch and provides direct interfaces to digital facilities (T1 carrier lines) and to *SLC*[®] 96 carrier remote terminals. This capability eliminates the need for the *SLC*[®] 96 carrier central office terminal (COT); thereby saving the expense and space required for this equipment. The functions provided by the COT have been integrated into the DCLU for the *5ESS*[®]-2000 switch. The DS1 digital carrier lines from the *SLC*[®] 96 carrier system RTs connect directly through the main distributing frame (MDF), office repeater bay (ORB), and digital signal cross connect (DSX) bay to terminate on the specially designed DCLU. Within the DCLU, each DS1 (1.544 MB/sec) line terminates on a subscriber digital facility interface (SDFI). The connections between the DCLU and the *SLC*[®] 96 carrier RT are shown in Figure 10.9-1.

The T1 lines terminating on the DCLU may be from *SLC*[®] 96 carriers operating in an unconcentrated mode (Mode I) or a concentrated mode (Mode II). A *SLC*[®] 96 carrier operating in Mode I employs five T1 lines (four active and one standby) while operation in Mode II employs three T1 lines (two active and one standby). One DCLU can terminate T1 lines from up to six *SLC*[®] 96 carrier remote terminals.

10.9.1.2 DCLU Topology

The DCLU consists of two service groups (SGs). Each SG multiplexes up to 15 T1 lines (12 active and 3 standby)

from up to 6 SLC[®] 96 carrier remote terminals onto 1 or 2 peripheral interface data buses (PIDBs). Figure 10.9-2 provides a block diagram of the DCLU. Each SG operates independently except during a failure mode or during call overflow. During either of these two events, another SG may process time slots from the affected SG. If one SG fails, the working SG carries traffic for both SGs at a reduced service level. Depending on the number of RTs and working lines per RT, the concentration varies as shown in Tables 10.9-1 and 10.9-2. The maximum concentration ratio for Mode II operation is 9:1, and the maximum concentration ratio for Mode I operation is 4.5:1.

Each T1 line from a SLC[®] 96 carrier is terminated at the 5ESS[®]-2000 switch by an SDFI which provides functions unique to the SLC[®] 96 carrier application.

10.9.1.3 DCLU Nail-Up Capability

The DCLU also has a "nail-up" capability. The ability to interconnect or "nail-up" DS0 ports between the DCLU and the digital line trunk unit (DLTU) peripheral units is provided as part of the 5E4 software release. A nailed-up circuit is similar to a stable switched call, except that the 5ESS[®]-2000 switch allows in-band signaling to pass through unaltered. Nailed-up calls are not disconnected when a phone goes on-hook or as a result of any other station activity. Nail-up requires no external hardware, but its use reduces the number of available network paths. Nail-up circuits are established via recent change/verify (RC/V) assignments within the 5ESS[®]-2000 switch data base. In the 5E4 software release, the 5ESS[®]-2000 switch supports the following types of nail-up:

- DCLU to DCLU
- DCLU to DLTU.

Figure 10.9-3 shows some of the various ways that circuit nail-up can be implemented.

The majority of special services that can be nailed-up fall into three categories:

- Off-premises station
- Private line data
- Foreign exchange.

One type of nail-up circuit is for off-premises station, a completely nonswitched circuit (Figure 10.9-3, sheet 1) which may be intraoffice or interoffice. There are also a large variety of foreign exchange circuits that may be nailed-up through the DLTU as shown in Figure 10.9-3, sheet 2. Various other types of nail-up applications are shown in Figure 10.9-3, sheet 3.

10.9.2 ENGINEERING CAPABILITIES

The DCLU provides the direct interface between SLC[®] 96 carrier Mode I and/or Mode II remote terminals and the 5ESS[®]-2000 switch. The DCLU is composed of two SGs. Each DCLU multiplexes the T1 lines from up to six SLC[®] 96 carrier remote RTs onto two or four PIDBs for a maximum line concentration ratio of 9:1 or 4.5:1, respectively. The amount of concentration, a function of both the number of RTs and PIDBs per DCLU, is determined from Tables 10.9-1 and 10.9-2. Note that this concentration is the total concentration including the 2:1 concentration at the SLC[®] 96 Mode II RT.

Table 10.9-1 DCLU Equipment Capacity per Hour - Mode I

BLOCKING CRITERIA ^a						TOT AL	CONC . RATIO	NO. LINES	DCLU TSS	DCL U TS	RT s
1.5%		4%		7%							
CCS/	TOTA	CCS/	TOTAL	CCS/	TOTA						

LIN E	L CC S	LINE	CC S	LI NE	L CC S	SDF I 4 ACT .1 STB Y					
3.19	1,837	3.41	1,964	3.53	2,033	30	9	576	1	64	6
3.83	1,838	4.08	1,958	4.24	2,035	25	7.5	480	1	64	5
4.79	1,839	5.10	1,958	5.30	2,035	20	6	384	1	64	4
6.93	3,992	7.25	4,176	7.44	4,285	30	4.5	576	2	128	6
8.31	3,989	8.69	4,176	8.92	4,285	25	3.75	480	2	128	5
10.36	3,978	10.85	4,166	11.14	4,278	20	3	384	2	128	4
13.78	3,969	14.43	4,156	14.8	4,265	15	2.25	288	2	128	3
20.56	3,947	21.54	4,136	22.12	4,247	10	1.5	192	2	128	2
Notes: a. a. Capacities assume 100% fill.											

Table 10.9-2 DCLU Equipment Capacity per Hour - Mode II

BLOCKING CRITERIA ^a						TOTAL SDFI 4 ACT. 1 STBY.	CONC. RATIO	NO. LINES	DCLU TSS	DCLU TS	RTs
1.5%		4%		7%							
CCS/ LIN E	TOTAL CCS	CCS/ LI NE	TOTAL CCS	CCS/ LIN E	TOTAL CCS						
3.06	1,763	3.27	1,883	3.40	1,958	18	9	576	1	64	6
3.65	1,752	3.90	1,872	4.09	1,963	15	7.5	480	1	64	5
4.52	1,736	4.83	1,855	5.04	1,935	12	6	384	1	64	4
6.61	3,807	6.93	3,992	7.13	4,107	18	4.5	576	2	128	6
7.83	3,758	8.21	3,941	8.45	4,056	15	3.75	480	2	128	5
9.51	3,652	10.0	3,840	10.32	3,963	12	3	384	2	128	4
10.02	2,886	11.07	3,188	11.7	3,375	9	2.25	288	2	128	3
—	—	—	—	—	—	—	1.5	192	2	128	2
Notes:											
a. Capacities assume 100% fill.											

The lower CCS per line of the Mode II loading reflects the 2-stage concentration provided by a 2:1 concentration at the RT coupled with the additional concentration at the DCLU. When mixing remote terminals of both modes in the same DCLU, the more conservative Mode II loading guidelines should be used. This is recommended to provide equitable service to both Mode I and Mode II RT customers.

10.9.3 ASSIGNMENT GUIDELINES

10.9.3.1 Estimating CCS Usage for SLC[®] 96 Carrier Remote Terminals

Before remote terminals can be assigned to DCLUs, the hundred call seconds (CCS) usage at each individual remote terminal should be estimated. This is necessary to ensure that the load presented by the remote terminals can be spread across the DCLUs as evenly as possible. The following formula can be used for that purpose:

$$\text{CCS usage at RT} = A \times B$$

Where:

A = number of lines terminating at RT at peak of engineering period

B = CCS usage per line at peak of engineering period.

Notice that the CCS usage estimated for the RT is the peak-of-engineering-period usage (typically occurring at the end of the engineering period) since the values used for the number of lines and the CCS usage per line correspond to that time.

10.9.3.2 Assigning Remote Terminals to DCLUs

Each termination on the DCLU has an associated subscriber loop equipment number (SLEN). The SLEN number breaks down as follows:

SMN D R CN

Where:

SMN = Switching Module Number (1-192)

D = DCLU Number (0-7)

R = Remote Terminal Number (1-6)

CN = Channel Number (1-96).

The following procedure describes how the RTs in a 5ESS®-2000 switch office can be assigned to the DCLUs in the office. In this procedure, the number of RTs in the office is m and the number of DCLUs is n .

- First, estimate the remote terminal CCS (RTCCS) value for each RT according to the preceding formula.
- Rank order the RTCCS values labeling the highest RTCCS as RTCCS(1); the next highest value RTCCS as RTCCS(2); etc., the lowest valued RTCCS(m). In this rank order, equal RTCCS values may be arbitrarily assigned as long as they are assigned sequentially.
- Number the DCLUs as DCLU(1), DCLU(2),..., DCLU(n).
- Assign the remote terminal with RTCCS(1) to DCLU(1), the remote terminal with RTCCS(2) to DCLU(2), etc., RTCCS(n) to DCLU(n). At this point, all DCLUs have a single RT assigned to it. Continue the assignment process by assigning the highest valued RTCCS to the DCLU with the most available capacity until all RTs have been assigned. This assignment procedure spreads the CCS load across the DCLUs as evenly as possible.

In some instances, it may be possible to obtain a better balance in total CCS assigned to DCLUs by selective switches of RT assignments. The administrator is encouraged to "fine-tune" the assignments whenever possible.

10.9.3.3 Switching DCLU Assignments

It is possible that an RT DCLU may exceed its capacity. In that situation, it may be appropriate to move one or more RTs to other DCLUs. Care should be taken to insure the new DCLU has sufficient capacity to handle the moved RTs. The RT transferring procedure given below is applicable for DCLUs engineered for Mode I RTs, Mode II RTs, or for a mixture of the two. Note that the following steps (1 through 4) are done off-line:

- (1) Grow (define in office data base) DCLU if it does not already exist.
- (2) Grow DFIs.
- (3) Grow RT to be transferred in Step 1.
- (4) Create batch file of line equipment numbers (LENs) to be transferred.
- (5) During off-busy hours, execute batch file and move T1 lines at the DSX bay.

After the new assignment is completed, it is important to verify that the DCLU CCS capacity has not been exceeded. Additionally, if the RTCCS values change beyond expectation, it may be necessary to move the RT in question to another DCLU.

10.9.3.4 DCLU Nail-Up Circuit Assignment

Nail-up of circuits through the 5ESS®-2000 switch requires that certain relevant data about special service circuits be recorded. This includes port appearances, channel unit types, facilities used and provisioning coefficients. This information is needed for numerous reasons including: tracking of facility utilization, making circuit changes, troubleshooting, and maintenance purposes. Port information can be accessed internally via OP:NAILUP message. (Refer to *Input message Manual* 235-600-700 for details concerning the OP:NAILUP message.) In addition to record keeping, nailed-up circuits need to be monitored for traffic administration. The number of nailed-up circuits per DCLU and SM must be carefully watched to maintain proper load balance and operational economy. No more than 25 percent of available time slots on a DCLU, or SM should be used for nail-up circuits. One of the simplest methods for traffic administration is to maintain a given fixed concentration ratio. For example, assume that the desired concentration ratio is 8:1 on a DCLU and that one port of a nail-up circuit passes through the DCLU. To maintain the 8:1 concentration ratio, the number of switched circuits on the DCLU must be reduced by 7 every time a circuit is nailed up. If both ports of a nail-up circuit terminate on the DCLU, the number of switched circuits must be reduced by 14.

10.9.4 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

Section 20 of the 30-minute traffic report provides traffic usage measurements per SLC® 96 carrier remote terminal. Additionally, Section 21 of the 30-minute traffic report provides measurements on a per-DCLU basis. Refer to Appendix 1 of this manual for descriptions of these measurements.

Part 9 of the 24-hour plant report provides an ISMNAIL AUTO measurement which provides a count of the number of inter-SM nail-up restorations.

The key service indicator for the DCLU is the percentage of terminating calls blocked. This requires a calculation based on the number of calls blocked (TERMBLK) and total number of attempts (TERMATT). These measurements are found in Section 21 of the 30-minute traffic report. The calculation is:

$$\frac{TERMBLK}{TERMATT} \times 100 = \text{Percent of terminating calls blocked}$$

10.9.5 FEATURE IMPACT

The subscribers connected to the SLC[®] 96 carrier RT have access to the same features as subscribers connected directly to the 5ESS[®]-2000 switch. The assignment of features to the RT lines have no impact on the 5ESS[®]-2000 switch other than the possible need for additional memory.

10.9.6 TRANSITION IMPACT

Whenever changes are made to the channel units or the RTs, these changes must be reflected in the 5ESS[®]-2000 switch data base. Changes are entered via the RC/V facility. The types of growth procedures associated with DCLU and SLC[®] 96 carrier services are as follows:

- (1) RT growth
- (2) Channel unit growth
- (3) Moving a DS1 line between subscriber digital facility interfaces (SDFIs)
- (4) Transfer of an RT from one DCLU to another
- (5) Mode change of an RT
- (6) Transfer an RT from LU to DCLU
- (7) Transfer subscribers from cable to RT on DCLU
- (8) Cutover from another office (COT to DCLU)
- (9) Cutover from an analog CO to COT on a 5ESS[®]-2000 switch
- (10) Growth of universal SLC[®] 96 carrier systems on a 5ESS[®]-2000 switch.

The first two procedures cover all hardware growth via the RC/V procedures and provide the basis for all the other procedures. The RC/V procedures required for making these changes are found in the *Recent Change Procedures Manuals* - 235-118-XXX.

Procedures 3, 4, and 5 are all rearrangements strictly from integrated SLC[®] 96 carrier system to integrated SLC[®] 96 carrier systems and involve growing and degrowing of RTs, SDFIs, as well as hardware modifications. Procedures 6 and 7 involve rearrangements on the 5ESS[®]-2000 switch which result in the use of an integrated SLC[®] 96 carrier system arrangement. The remaining procedures involve either two different switches or two different offices. For details concerning the growth procedures, refer to 235-105-23X - *Hardware Change Procedures*; for details related to cutover procedures, refer to 235-105-200 - *Pre-cutover and Cutover Procedures*.

10.9.7 DIGITAL CARRIER LINE UNIT WORKSHEET

Capacity determination for DCLUs cannot be based on the following:

- The number of terminations
- The total of digital lines in the office
- The total office CCS (hundred call seconds) per digital line.

This is due to the outside plant looking at the RT (remote terminal) as a cable and pair facility. Further, some RTs may have all 96 positions working while others may have only 50 positions working. The only way to get accurate capacity values is to perform capacity determinations based on:

- The RT capacity of six
- Measured CCS capacity of each DCLU
- Engineered CCS/line values.

The worksheet shown in Figure 10.9-4 assumes the engineered concentration ratio and the number of RTs for each concentration ratio will not change except when the engineering criteria is changed. This approach forces the equipment utilization to be performed on the DCLU.

The following paragraphs identify the columns of the DCLU worksheet and describe the calculations required to complete the worksheet:

- (A) **SM Number:** The switching module ID number that serves this DCLU. Obtain this number from the switch or the TEO (telephone equipment number).
- (B) **DCLU Number:** The DCLU ID number. Obtain this number from the switch or the TEO.
- (C) **Engineered Concentration Ratio:** Obtain this number from the TEO.
- (D) **RTs per DCLU - Engineered Capacity:** Obtain this number from the DCLU equipment capacity table.
- (E) **RTs per DCLU - Today:** The number of RTs that are working in each DCLU. Obtain this information from the switch or the TEO.
- (F) **RTs per DCLU - EOP:** The number of RTs forecasted to be in service at the end of the engineering period. Obtain this information from a SLC® 96 carrier forecast.
- (G) **DCLU Working Lines - Engineered Capacity:** Obtain this number from the DCLU equipment capacity table. To obtain this number, read the engineered concentration ratio from *Column C* into the table.
- (H) **DCLU Working Lines - Today:** The number of DCLU lines working today. Obtain this number from the switch or the office data.
- (I) **DCLU Working Lines - EOP:** The number of DCLU lines forecasted to be in service at the end of the engineering period. Obtain this number from the digital line forecast.
- (J) **CCS per DCLU - Engineered Capacity:** The CCS capacity of the DCLU based on the DCLU equipment capacity table. To obtain this number, read the engineered concentration ratio from *Column C* of this worksheet into the table.
- (K) **CCS per DCLU - Today:** The CCS usage figure at which this DCLU is operating today. Obtain this information from the office data.
- (L) **DCLU CCS per Line - Engineered Capacity:** Obtain this number from the office forecast, or use the following equation:

Engineered Capacity CCS per DCLU <i>Column J</i>	=	Engineered DCLU CCS per Line <i>Column L</i>
Engineered Capacity <i>Column G</i>		

- (M) **DCLU CCS per Line - Today:** Obtain this number from the office data records or use the following equation:

CCS per DCLU Today Column K	=	DCLU CCS per Line Today Column M
DCLU Working Lines Today Column H		

(N) **Percent Utilization DCLU CCS - Today:** To calculate this percentage:

CCS per DCLU Today Column K	× 100 =	Percent Utilization DCLU CCS - Today Column N
Engineered Capacity CCS per DCLU Column J		

(O) **Percent Utilization DCLU CCS - EOP:** Obtain number from the switch or calculate:

DCLU Lines EOP Column I	×	CCS per Line Column L		Percent Utilization DCLU CCS - EOP
DCLU Lines EOP Column I	×	CCS per Line Column L	× 100 =	Percent Utilization DCLU CCS - EOP Column O
Engineered Capacity CCS per DCLU Column J				

(P) **Percent Utilization RT - Today:** Calculate using the following equation:

RTs per DCLU - Today Column E	× 100 =	Percent Utilization RTs - Today Column P
Engineered Capacity RTs per DCLU Column D		

(Q) **Percent Utilization RTs - EOP:** Calculate using the following equation:

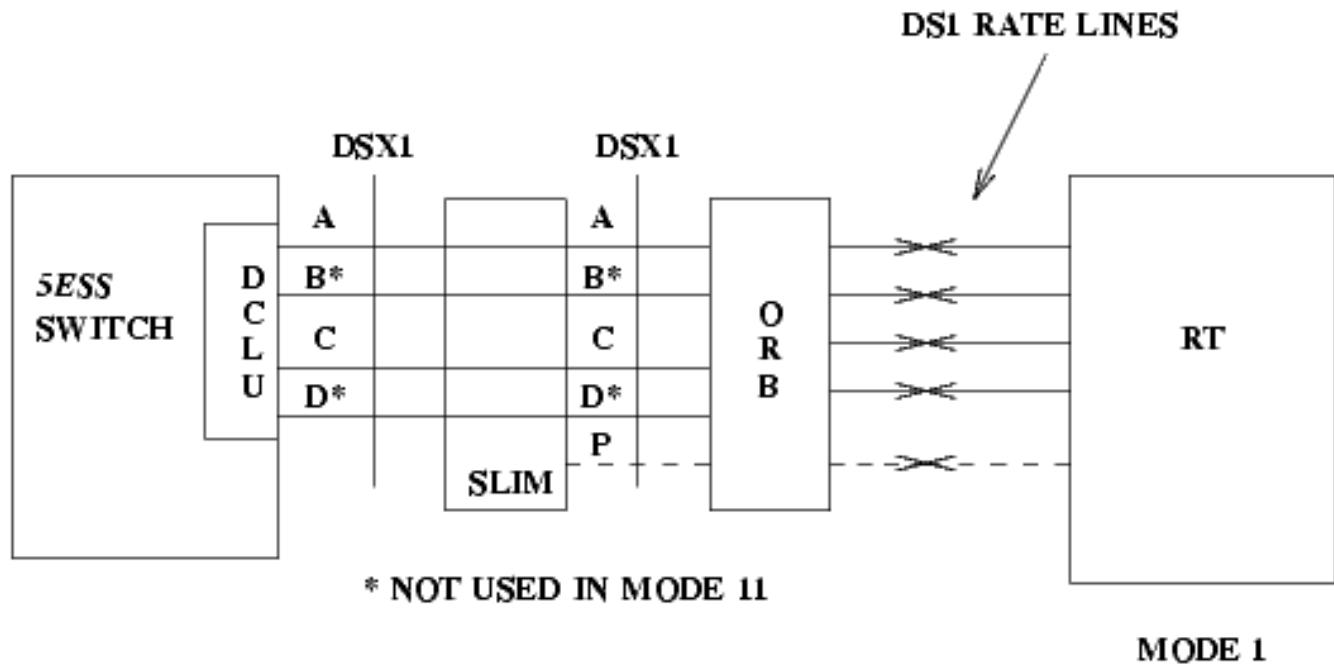
RTs per DCLU - EOP Column F	× 100 =	Percent Utilization RTs - EOP Column Q
Engineered Capacity RTs per DCLU Column D		

(R) **Percent Utilization Lines - Today:** To Calculate:

DCLU Working Lines - Today Column H	× 100 =	Percent Utilization Lines - Today Column R
Engineered Capacity DCLU Working Lines Column G		

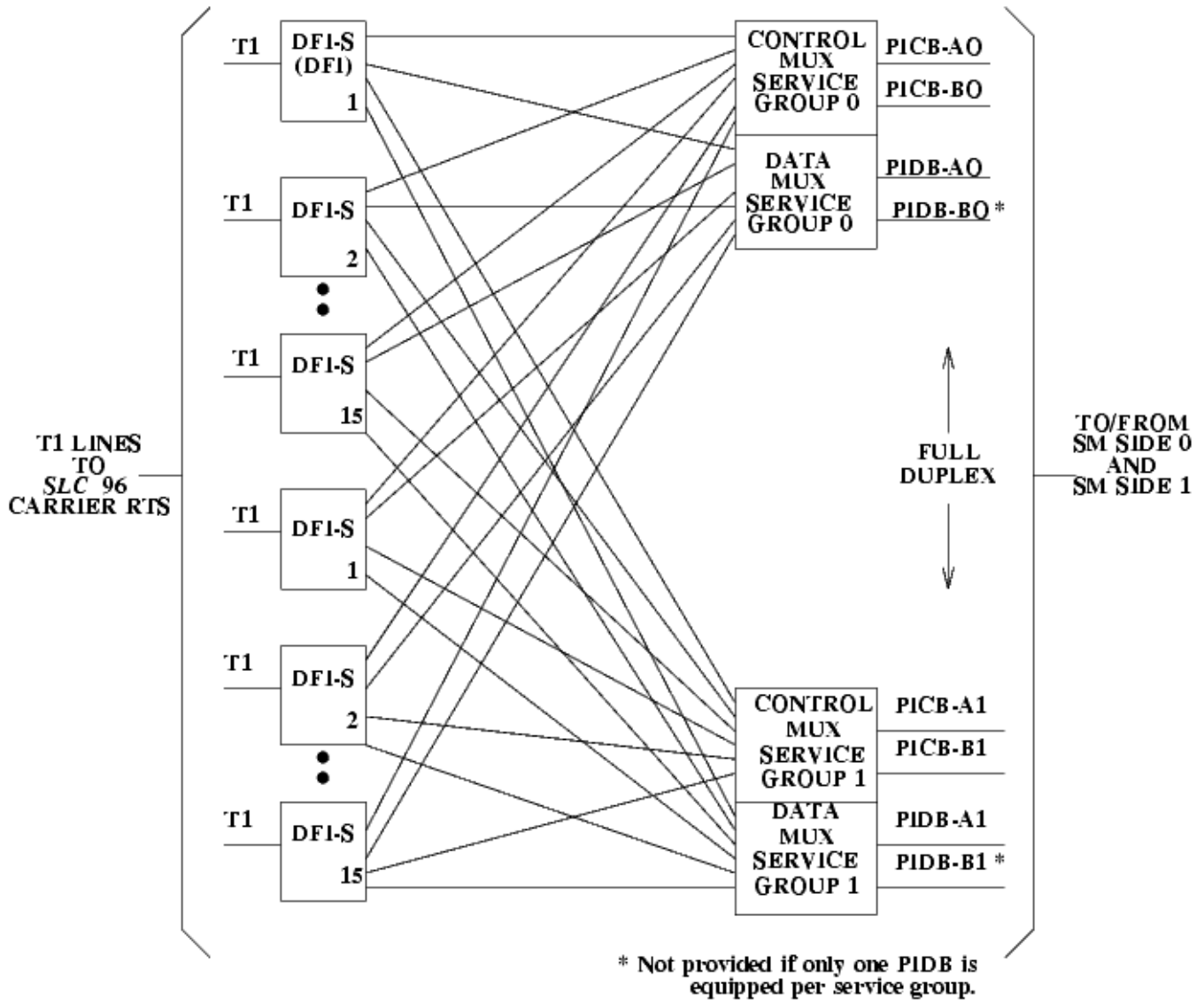
(S) **Percent Utilization Lines - EOP:** Calculate using this formula:

DCLU Working Lines - EOP Column J	× 100 =	Percent Utilization Lines - EOP Column S
Engineered Capacity DCLU Working Lines Column G		

**LEGEND:**

DCLU - DIGITAL CARRIER LINE UNIT
 SLIM - SUBSCRIBER LOOP INTERFACE MODULE
 ORB - OFFICE REPEATER BAY
 RT - REMOTE TERMINAL
 P - PROTECTION (STANDBY)

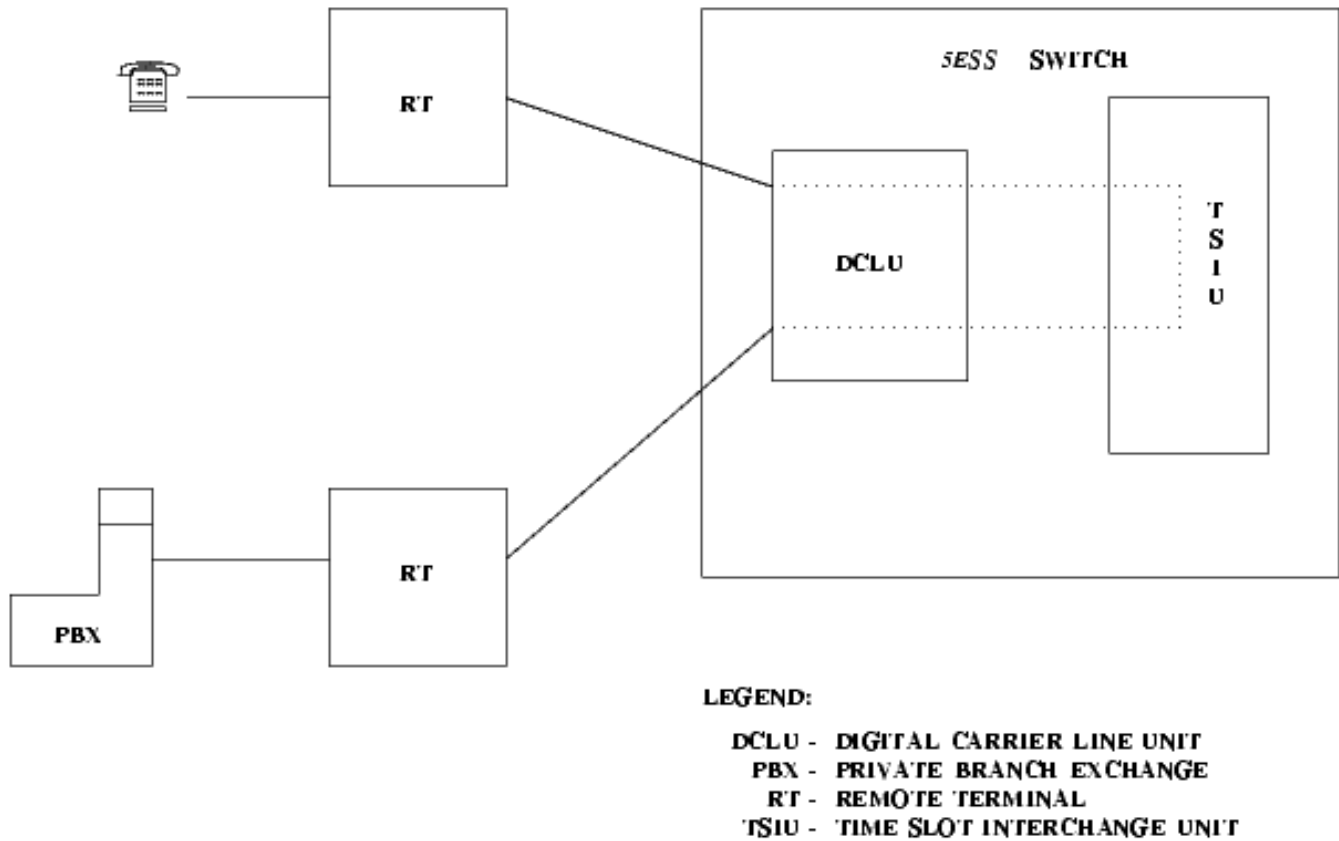
Figure 10.9-1 Connections Between DCLU and SLC 96 Carrier Remote Terminal



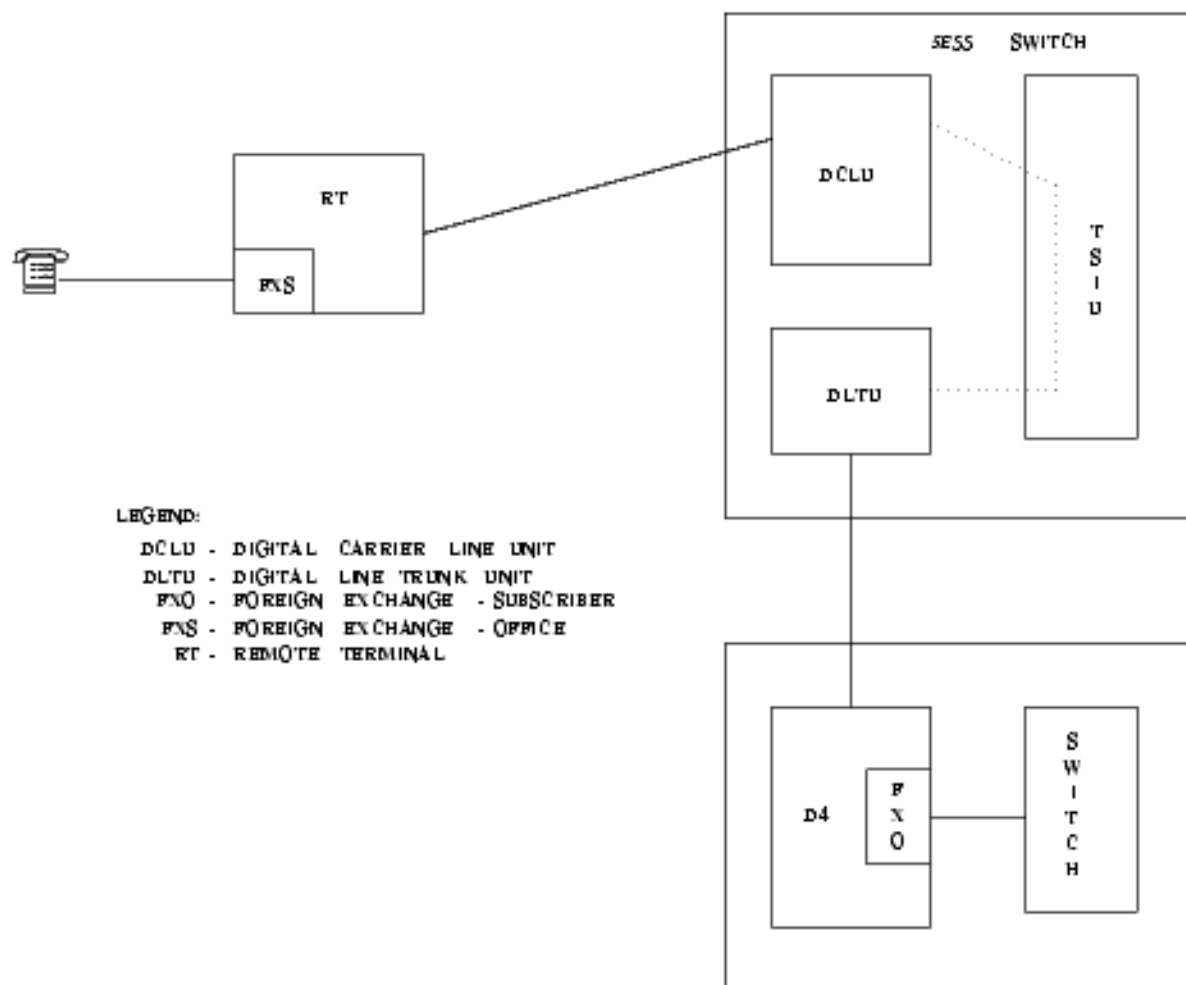
LEGEND:

DFI - DIGITAL FACILITY INTERFACE
 MUX - MULTIPLEX
 PIDB - PERIPHERAL INTERFACE DATA BUS
 RT - REMOTE TERMINAL
 SM - SWITCHING MODULE

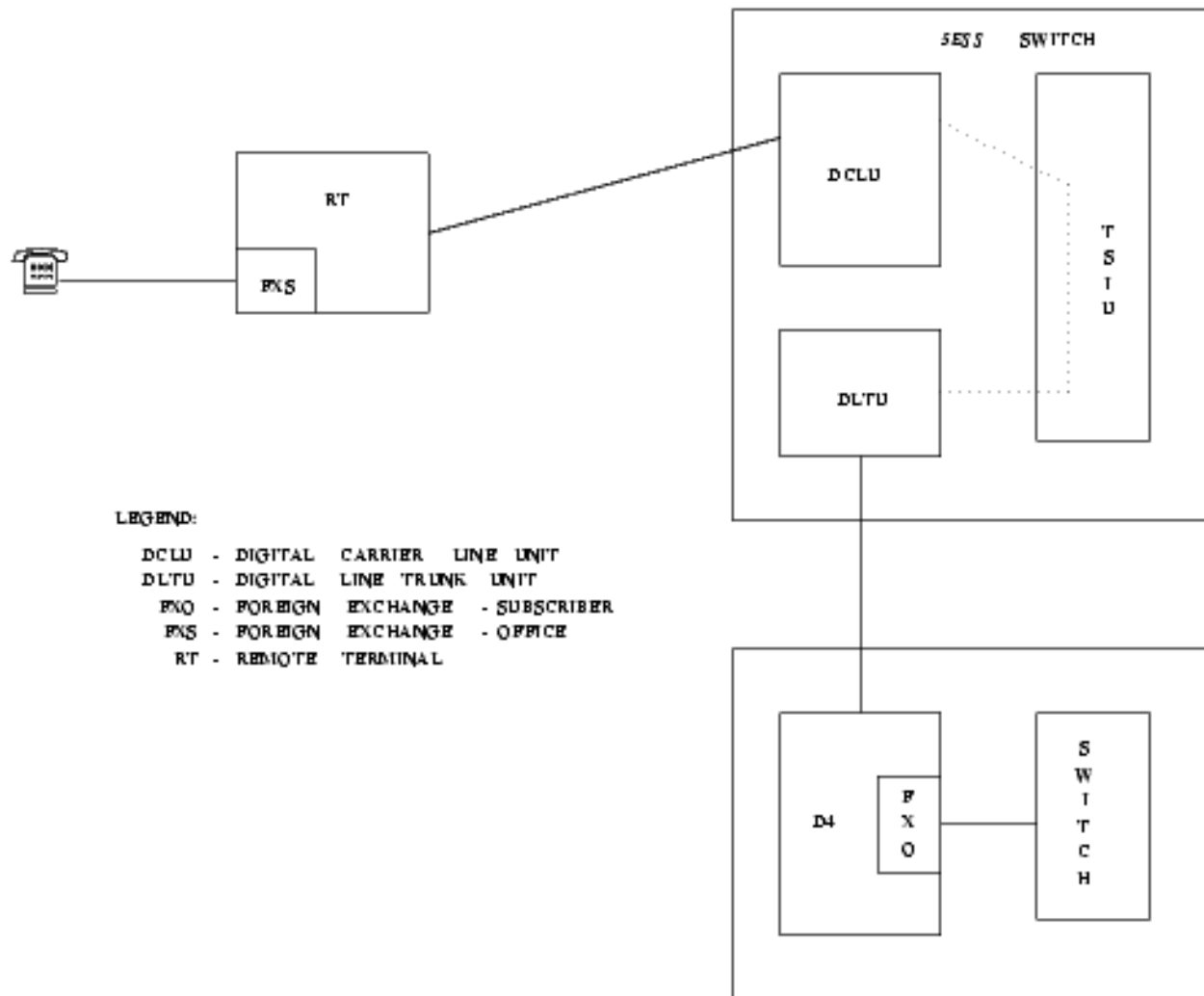
Figure 10.9-2 DCLU Block Diagram



A. Intraoffice Off-Premises Nail-Up Application



B. Foreign Exchange Nail-Up Application



B. Foreign Exchange Nail-Up Application

Figure 10.9-3 DCLU Nail-Up Applications

FROM _____ TO _____

DIGITAL CARRIER LINE UNIT (DCLU)

[illegible]

5. Obtain from office data.

Figure 10.9-4 Digital Carrier Line Unit Worksheet

10.10 TRUNK UNIT

10.10.1 DESCRIPTION

The trunk unit (TU) provides for the termination of analog trunks. The TU provides termination capabilities for interoffice local or toll traffic, trunks to switchboards, operators, PBX direct inward dialing (DID), access from local test desk, and announcement machines. A TU provides up to 64 time slots and 64 trunk terminations. The number of TUs required is determined by the number of analog interexchange trunk terminations, plus one terminal for each announcement channel, two terminals for each local test desk test trunk, and two terminals per each local trunk and line work station (TLWS).

Each TU circuit pack has four trunk circuits (except those for test trunks which have two). Trunk circuits have been developed to provide an interface to the following nine multipurpose trunk types:

- Loop supervision, outgoing, 2-wire, local
- Loop supervision, outgoing, 2-wire, toll
- Loop supervision, incoming, 2-wire, local
- Loop supervision, incoming, 2-wire, toll
- E&M supervision, 2-wire, local
- E&M supervision, 2-wire, toll
- E&M supervision, 4-wire, local
- E&M supervision, 4-wire, toll
- Release link trunks (Centralized Attendant Services feature)
- Test trunk.

10.10.2 ENGINEERING CONSIDERATIONS

The TU provides 64 time slots and up to 64 trunk terminations. Some of these terminations may be used for announcement channels, local test desk trunks, and local TLWS terminations. The TU has 16 slots for TU circuit packs, with each circuit pack providing 4 trunk terminations (except for the test trunk circuit pack which provides 2 terminations). The TU provides no concentration. There is a time slot available for each trunk termination. Trunk members should be spread across trunk units for even distribution. Although there is no concentration, SM and AM/CMP real time is affected by trunk group assignment.

10.10.3 ASSIGNMENT GUIDELINES

Analog trunks served by a TU may be associated with trunk groups, carrier group alarm (CGA) groups, or other services independent of the placement within the switching modules (SMs). or reliability purposes, spreading of trunks serving the same or similar traffic may be desirable; however, this is not a system requirement.

Each termination on a TU has an associated terminal equipment number (TEN). This number is used in translations to locate and identify the particular trunk to which it is assigned. This TEN is composed as follows:

SMN T G P C

Where:

SMN = Switching Module Number (0-192)

T = Trunk Unit Number (0-7)

G = Service Group (0-1)

P = Position (0-7)

C = Trunk Circuit (0-3)

10.10.3.1 Spreading Calls Among Trunk Groups

To better spread calls among trunk groups use the following guidelines:

- Divide the number of trunks in the trunk group by the number of TUs installed in the office. This provides the number of trunk group members per TU.
- Spread the members across all TUs as indicated in Table 10.10-1.
- Continue these assignments in this manner until all trunks are assigned.

Table 10.10-1 Trunk Group Assignment Order: TU

SM NUMBER	TU NUMBER	TRUNK MEMBERS			
1	0	1	5	9	13
2	0	2	6	10	14
3	0	3	7	11	15
4	0	4	8	12	16

The use of these guidelines keeps the SMPU from overload due to excessive call volumes and spreads the trunk groups for service protection.

10.10.4 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

There are many sections of the 30-minute traffic report which contain measurements directly related to trunk traffic activity. These sections are listed below and described in detail in 235-070-100, *Appendix 1, Traffic and Plant Measurements*:

- Section 5 - Call Type Information
- Section 12 - Trunk Group
- Section 24 - Inter-LATA Carriers - Tandem Trunks
- Section 55 - Queuing for Trunk Group Measures
- Section 56 - Trunk Group Queuing Announcement Measures
- Section 92 - Packet Switching Trunk Group

10.10.5 FEATURE IMPACT

The TU is not normally impacted by the use of features or the implementation of new features. If there are exceptions however, they will be described in the next paragraph(s).

10.10.6 TRANSITION IMPACT

Existing TUs are not impacted by growth procedures.

10.10.7 TRUNK UNIT TERMINATIONS WORKSHEET

The following paragraphs identify the columns of the trunk units - terminations worksheet (Figure 10.10-1) and describe the calculations required to complete the worksheet:

(A) **Installed Trunk Units:** The total number of trunk units (TUs) installed in the office. Obtain this information from the switch, or telephone equipment order (TEO).

(B) **Installed Circuit Pack Positions:** The number of total circuit pack positions.

Installed Trunk Units <i>Column A</i>	×	Circuit Pack Positions Per TU (16)	=	Installed Circuit Pack Positions <i>Column B</i>

(C) **Installed Test Packs:** The number of test trunk circuit packs installed in the office. These packs will contain two trunks per pack. Obtain this number from the switch, or the TEO.

(D) **Installed Trunk Pack Positions:** The total number of available trunk circuit positions (four circuits per pack) that are in the office.

Installed Circuit Pack Positions <i>Column B</i>	-	Installed Test Pack Positions <i>Column C</i>	=	Installed Trunk Pack Positions <i>Column D</i>

(E) **Office Trunk Capacity:** The total number of trunks that the office has the capacity to terminate (four circuits per pack).

Installed Trunk Pack Positions <i>Column D</i>	×	4 =	Office Trunk Capacity <i>Column E</i>

(F) **Total Working Trunks Installed:** The total number of working circuits (four per pack) in the office today. Obtain this number from the trunking records, or the switch.

(G) **Available Spare Trunks:** The total spare trunks in the office.

Office Trunk Capacity <i>Column E</i>	-	Total Working Circuits <i>Column</i>	=	Available Spare Trunks <i>Column G</i>

(H) **Forecasted Trunks EOP:** The total number of trunks forecasted for the end of the engineering period, or the peak analog trunks required during the engineering period including PBX-DID (private branch exchange - direct inward dialing) trunks. Obtain this number from the trunk forecast.

(I) **Percent Utilization of Circuits Today:** The percent of the analog trunks installed that is being used today.

Total Working Trunks <i>Column</i>				Percent Utilization of Circuits Today <i>Column I</i>
Office Trunk Capacity <i>Column E</i>		×	100 =	

(J) **Percent Utilization of Circuits EOP:** The percent of the analog trunks installed that will be used at the end of the engineering period.

Total Forecasted Trunks <i>Column H</i>		Percent of Utilization of Circuits EOP <i>Column J</i>
<u>Office Trunk Capacity</u> <i>Column E</i>	× 100 =	

OFFICE _____

DATE _____

EFFECTIVE DATE

FROM _____ TO _____

“SESS™” SWITCH EQUIPMENT UTILIZATION

TRUNK UNITS TERMINATIONS

A	B	C	D	E	F	G	H	I	J
INSTALLED TRUNK UNITS	INSTALLED CIRCUIT PACK POSITIONS	INSTALLED TEST PACKS (2 CIRCUITS PER PACK)	INSTALLED TRUNK PACK POSITIONS (4 PER PACK)	OFFICE TRUNK CAPACITY (4 PER PACK)	TOTAL WORKING TRUNKS INSTALLED	AVAILABLE SPARE TRUNKS	FORECASTED TRUNKS EOP	PERCENT UTILIZATION OF CIRCUITS	
								TODAY	EOP
NOTE 1	A X 16 = B	NOTE 1	B C = D	D X 4 = E	NOTES 1, 2	E F = G	NOTE 2	$\frac{F}{E} \times 100 = I$	$\frac{H}{E} \times 100 = J$

NOTES:

- 1. Obtain from switch or TEO
- 2. Obtain from trunking records

Figure 10.10-1 Trunk Unit Terminations Worksheet**10.10.8 ANALOG TRUNK UNIT (ATU)**

The Analog Trunk Unit (ATU) is needed on the SM-2000 to support the 13A Announcement interface, Trunk Testing interfaces, and other services provided by analog trunk units in the 5ESS[®]—2000 switch Switching Modules. The ATUs on an SM-2000 provide the ability to port most features and peripherals from a 5ESS[®]—2000 SM to the SM-2000. The ATU provides the same service to SMs and SM-2000, and will be transparent to the end user. The Analog Trunk Unit may terminate up to 64 metallic and analog carrier trunk circuits allocated between two service groups on a single equipment shelf.

10.10.8.1 Analog Trunk Unit Architecture

The Analog Trunk Unit (ATU), a peripheral unit in the 5ESS[®]—2000 switch Switching Module, may terminate up to 64 metallic and analog carrier trunk circuits allocated between two service groups in a single shelf equipment, see Figure 10.10-2. Each service group consists of four functional blocks - the trunk circuitry, control and data interface facility, test and access, and power supply. A service group can be equipped with its own appropriate set of trunk circuits, otherwise, the two service groups are identical.

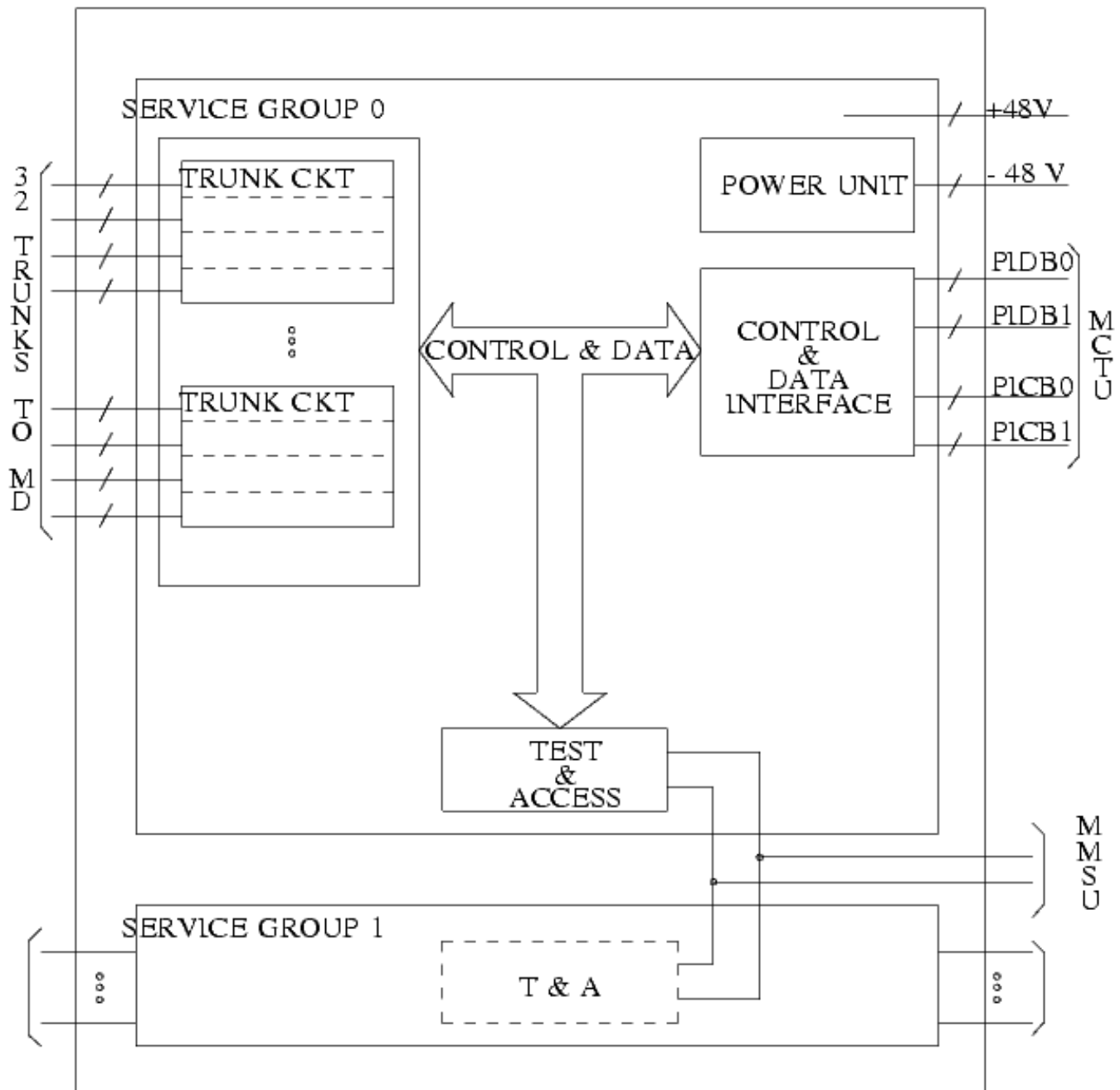


Figure 10.10-2 Analog Trunk Unit Block Diagram

The Analog Trunk Unit (ATU) has four hardware interfaces as follows:

- Two pairs of wires connect the distributing frame (D) to each trunk circuit.
- Two pairs of wires connect the Modular Metallic Service Unit (MMSU) to the ATU.
- -48 volts power feeders which connect the frame fuse panel to the ATU.
- The Peripheral Interface Data Bus (PIDB) and Peripheral Interface Control Bus (PICB) connect the ATU and the MCTSI, providing data transmission and synchronization and control.

See Figures 10.10-3 and 10.10-4 .

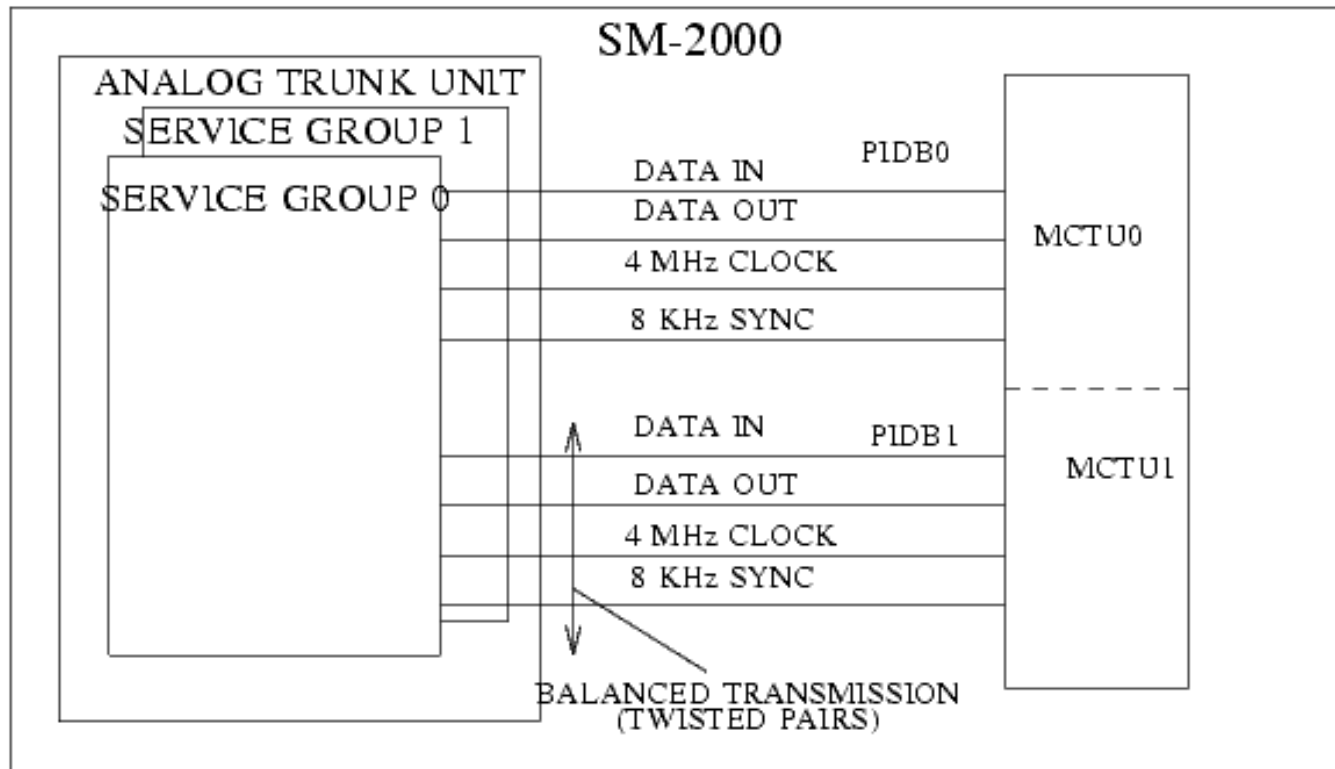


Figure 10.10-3 ATU PIDB Interface to SM-2000

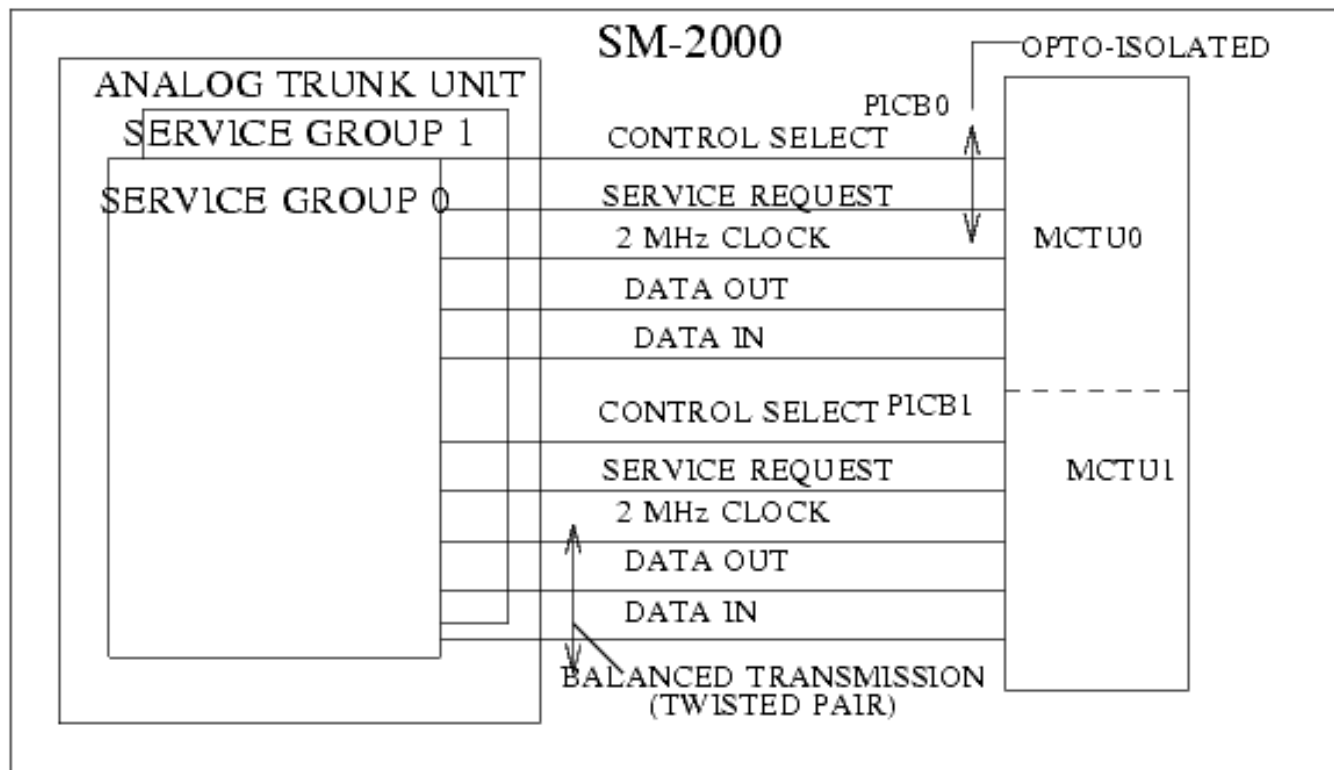


Figure 10.10-4 ATU PICB Interface to SM-2000

10.10.9 COMBINED SERVICES UNIT

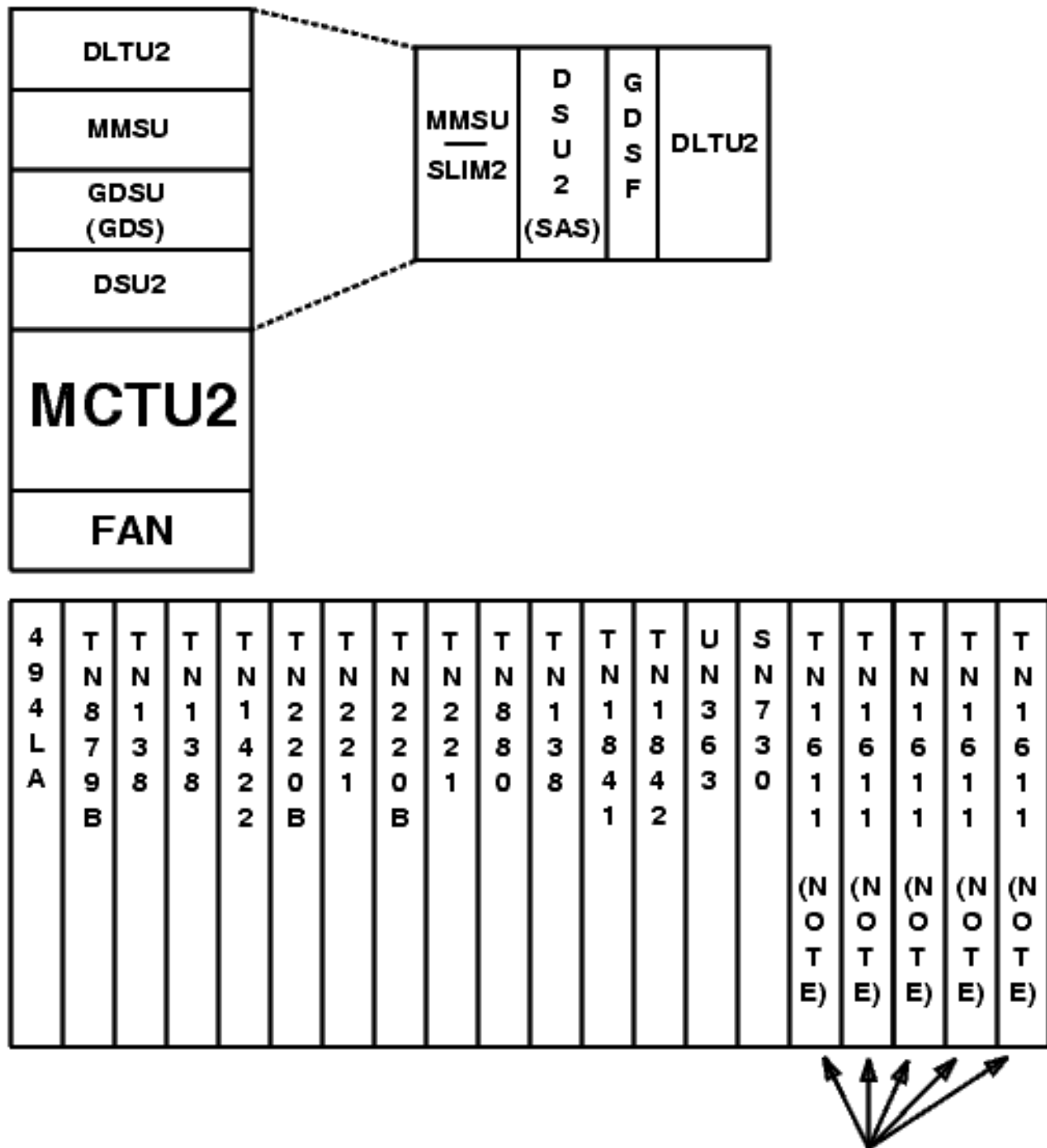
10.10.9.1 Feature Overview

The following is a brief description of the CSU feature. The repackaging will combine functions of the DLTU, MMSU, DSU2-SAS and the GDSF in one shelf, thereby eliminating three backplanes (see Figure 10.10-5). The new shelf will be compatible with existing DLTU2, DSU2 and GDSU units in the same office and in the same SM or in different SMs. Although intended principally for the small site market, growth of these sites to more conventional office configurations necessitate that this unit and its global services be compatible with the same functionality provided by existing units.

An exception is made for the MMSU in the repackaged shelf feature. Similar to the remote MSU in RSM applications, the repackaged version will have only one service group, thereby making it incompatible with the standard MMSU which has two service groups. Therefore, if office growth to conventional configurations necessitate greater metallic services, the standard MMSU will need to be provided and the MMSU portion of the repackaged service circuit shelf will be degrown.

The MMSU portion of the CSU contains only a single service group. If a single SM office grows to a configuration requiring more extensive metallic services (two service groups), the standard MMSU will need to be provided and the MMSU portion of the CSU will be degrown.

If the office grows to more than one SM, it may retain the MMSU in the CSU unit. However, if there is a need to have two service groups in order to meet the need of expanded metallic services, a standard MMSU will have to be provided. This may be provided in a different SM than the SM containing the CSU/MMSU. There is no need to degrow the CSU/MMSU in this case; they are compatible.



**NOTE: THESE BOARDS MAY BE EITHER
TN1611s OR TN1612s**

Figure 10.10-5 Typical Shelf Reduction

10.10.9.2 Combined Services Unit Dependencies

To realize the maximum benefit from this project, the new shelf design is predicated on the availability of: (1) the GDSF circuit pack and its TT, TT2, IST and conference circuit functionality, and (2) the SLIM circuit pack

development. Both of these developments are targeted for the same release as this repackaged shelf. An office may still be engineered with the repackaged shelf to provide what may be available within the repackaged shelf and supplemented with other existing units to provide the necessary service functionality.

10.10.9.2.1 Service Provider Perspective

This unit will support up to five DFI2 type circuit packs for trunking purposes, one GDSF circuit pack arranged to provide trunk testing and conference circuit functionality, 250 seconds of RA capability, metallic testing by way of SLIM with optional compensator circuit pack and up to 64 scan points and 64 signal distribute points as shown in Figure 10.10-6 .

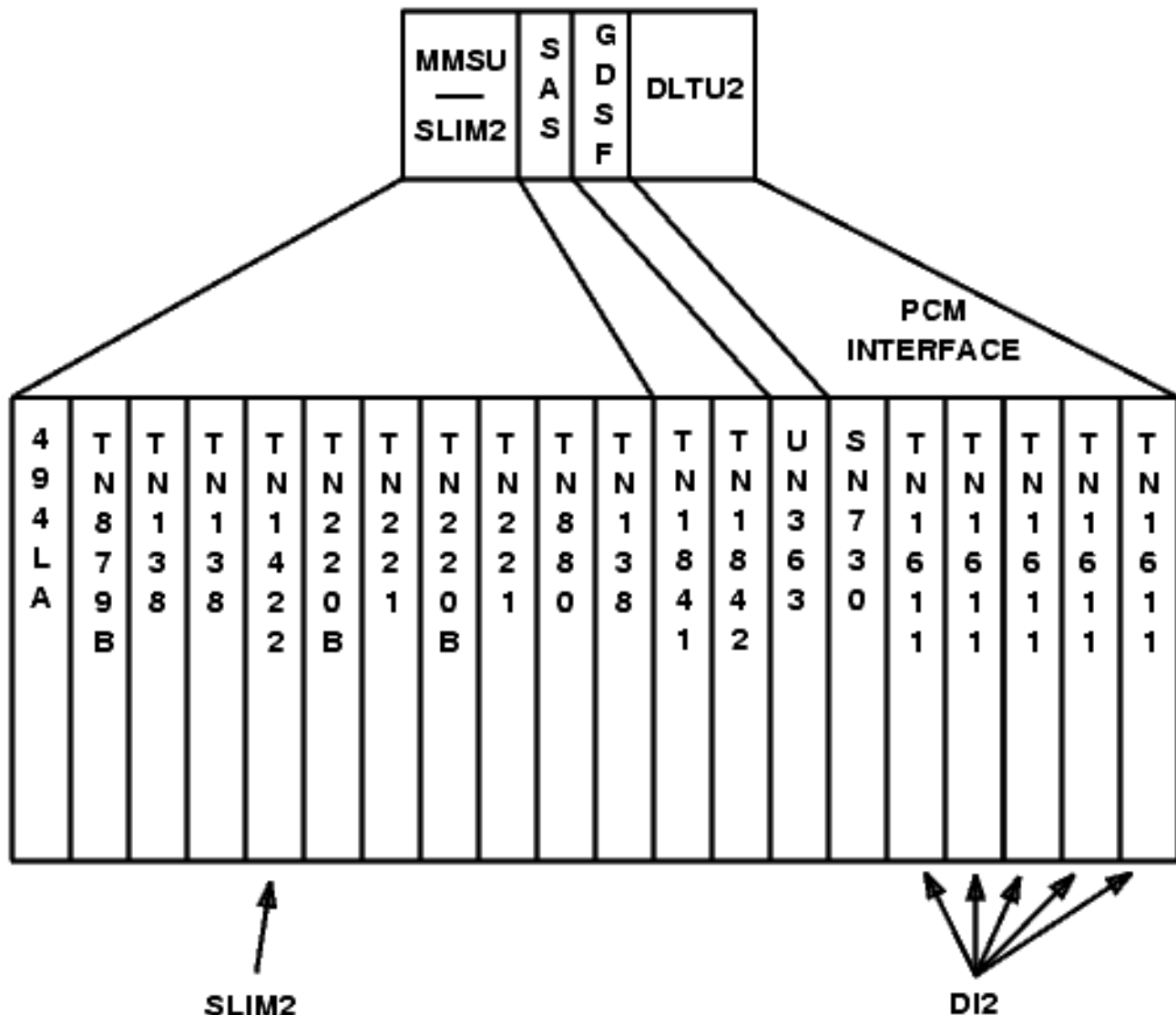


Figure 10.10-6 Combined Services Unit

10.10.9.3 System Architectural Constraints and Impacts

The repackaging will combine functions of the DLTU2, MMSU, SAS and the GDSF in one shelf, thereby eliminating three backplanes. The new shelf will be compatible with existing DLTU2, DSU2-RAF, and GDSU units in the same office and in the same SM or in different SMs. This configuration is intended principally for the small site market,

and growth of these sites to more conventional office configurations necessitate that this unit and its global services be compatible with the same functionality provided by existing units.

An exception is made for the MMSU in the repackaged service circuit shelf. Similar to the remote MSU in RSM applications, the repackaged version will have only one service group thereby making it incompatible with the standard MMSU which has two service groups. Therefore, if office growth to conventional configurations necessitate greater metallic services, the standard MMSU will need to be provided and the MMSU portion of the repackaged service circuit shelf will be degrown.

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If the office grows to more than one SM, it may retain the MMSU in the CSU unit. However, if there is a need to have two service groups in order to meet the need of expanded metallic services, a standard MMSU will have to be provided. This may be provided in a different SM than the SM containing the CSU/MMSU. There is no need to degrow the CSU/MMSU in this case; they are compatible.

10.10.10 TRUNK AND LINE WORKSTATION METALLIC TEST CAPABILITY

This feature addresses the problem of providing an effective method of providing metallic (electrical) testing capabilities to maintenance personnel who use the Trunk and Line Workstation (TLWS) to do such testing.

10.10.10.1 Background

The Trunk and Line Workstation is a switch-based testing capability,

Currently, the metallic (electrical) test functions are provided to the TLWS capability by the Directly Connected Test Unit (DCTU), an electrical measuring device which provides the measurements for the TLWS capability. The DCTU provides a basic set of testing functions for the TLWS capability and an expanded set of functions which are used by the Integrated Mechanized Loop Testing (IMLT) System, an operations systems dedicated to line testing. The expanded set of tests, which are used by the IMLT system via an I/O port interface to the switch, include testing capabilities more detailed and sophisticated than the set provided for the TLWS user. (Unlike the TLWS interface, the IMLT system uses computer analysis to help interpret the results of the measurements.)

Currently, the switch also provides the Automatic Line Insulation Test (ALIT) capability which provides scheduled, automatic testing of lines. ALIT uses its own measurement hardware and switch software to test all analog lines in an office on a scheduled, periodic basis. The testing hardware is the ALIT pack.

Subscriber Line and Instrument Measurement (SLIM), is accessed via the TLWS video terminal. The terminal may be located at the switch location or remote from the switch. This feature provides a TLWS testing capability, which provides functions as nearly equivalent as possible to that provided by the existing DCTU-based testing capability, and provides functions similar to those now provided by the ALIT feature.

The TLWS testing functions which are currently provided by the DCTU-based TLWS feature and are provided by SLIM are listed below as follows:

- Voltage, resistance, and capacitance measurement
- Distance to Open measurement
- Coin phone testing - detect, collect, return coin; home totalizer
- Monitor for short function
- Send ROH

- Ring Line
- Perform all "line" tests on lines on Integrated Subscriber Loop Carrier systems.
- Cause trunk on hook, trunk off hook signals on trunks
- Add, drop, and change mode of Talk and Monitor phone

The following functions which are currently available at the TLWS are not provided by this feature:

- Ringer Count (The function is rarely used in the current telephone company environment)
- Perform "line" tests on lines on non-integrated Subscriber Loop Carrier systems (The function is not readily provided by the SLIM testing device).

This feature functions with the DCTU-based measurement system and the ALIT scheduled testing capability. Both DCTU and SLIM measurement systems may be employed in the same switch. The SLIM-based system will be used via a different TLWS display page than that currently used to do testing via the DCTU-based system. The scheduled testing capability provided by the SLIM feature will be controlled via different Recent Change views and parameters than those which control the ALIT feature.

The SLIM testing capability consists of the measurement hardware, the supporting software, and the technician interfaces to do line testing and display the results.

It is planned to equip all 5ESS[®]—2000 switches with the software capability to support this feature as part of the TLWS feature. The actual implementation of the feature will require the purchase and installation of SLIM measurement devices.

The Routine Mode testing capability which is provided by this feature is a secured feature.

10.10.10.1.1 Feature Overview

10.10.10.1.1.1 General

This feature provides metallic (electrical) testing via the Trunk and Line Workstation interface. This feature is intended to be available either as an addition to or as an alternative to the TLWS metallic testing capability provided by the DCTU and ALIT testing capability.

In Operator Interactive Mode, or manual mode, the user accesses the electrical testing capabilities provided by this feature via a different display page on the TLWS terminal than that which accesses metallic testing provided by the DCTU. On an SM/SM-2000 with only this feature for metallic testing, the user would only use the display pages associated with this feature. Attempts to run tests that use the DCTU would not work. Similarly, on a SM/SM-2000 with only the DCTU testing capability, attempts to execute tests associated with the SLIM capability would not work. An SM/SM-2000 with both this feature and DCTU based testing will allow testing on either metallic testing page, selected by the user. The SM/SM-2000 will determine whether the DCTU-based testing capability and/or the SLIM based capability is available based on the testing hardware equipped in the SM/SM-2000.

The metallic access network, which is provisioned by the service provider, may be configured so that a specific line is accessible by only the DCTU testing device, only the SLIM testing device, or by either device. An attempt to use a testing device which cannot access the selected line or trunk, will fail and a display response will indicate the reason for failure.

The user will have access to a comparable set of testing capabilities on either the DCTU based TLWS pages or the

SLIM based testing pages.

In Routine Mode, or automatic mode, this feature also provides a capability to set up and run a scheduled set of tests on analog lines. The user specifies the tests to be run, the thresholds which determine a pass/fail result, the lines to be tested, and the day and time the tests are to be run. The user defines the tests and the schedule by entering data via the Recent Change system. The scheduling capability can be provided in addition to the ALIT capability. In that case, it will be possible to run both scheduled line testing systems at the same time.

10.10.10.1.2 End-User Scenarios

A maintenance technician at the SM/SM-2000 site or at a remote location will be notified of a problem with a line or trunk. The technician will investigate that problem by various techniques. Most commonly, the technician will use the TLWS to determine the electrical characteristics of the line to assess the condition of the line and identify the source of the problem which was conveyed to the technician.

When the technician uses the TLWS to do the electrical testing, he or she may use the testing provided by this feature or the testing provided by the DCTU if both are available on the SM/SM-2000. This feature provides most of the TLWS capabilities which are provided by the DCTU, so the choice between the two testing systems (if both are available) will most likely be a matter of individual preference based on past experience with one or the other systems. The two systems provide similar electrical measurements with similar results. The TLWS pages and control procedures differ slightly.

10.10.10.1.2 Service Provider Perspective

10.10.10.1.2.1 Feature Overview

The service provider view of this feature consists of hardware modules which must be installed in the SM/SM-2000 and software which provides the TLWS pages by which the feature is used. The service provider determines the number of hardware modules to be installed to meet the testing needs of the switch.

10.10.10.1.2.2 Operational User

The testing systems engineer decides how many of the hardware modules to install and in which Modular Metallic Service Units(MMSUs) to install them. The service provider, who installs the hardware and configures the SM/SM-2000 data, would be a Recent Change technician or a switch maintenance technician.

10.10.10.1.2.3 Service Provider Scenarios

The service provider who equips this feature installs the testing units in the SM/SM-2000 by inserting SLIM hardware packs in the MMSU chassis after installation of the appropriate Metallic Test Bus network. The hardware packs are the instruments which actually make the electrical measurements and convey them to the TLWS software. The service provider must provision the switch data, via Recent Change, to indicate to the 5ESS®-2000 switch where the SLIM units are located and how to communicate with them.

10.10.10.2 Network Impacts

10.10.10.2.1 Operations Systems Impacts

This feature does not directly interact with any operations systems, however, several systems could be impacted. Systems which are normally able to use Input/Output commands will have the ability to execute the new TLWS functions via the corresponding Input commands which are associated with all TLWS functions. Similarly, new output reports will occur to provide the results of this testing activity. The systems which have access to TLWS input and output messages are as follows:

- Total Network Management (TNM) system (formerly Switching Control Center System)
- TOPAS

The Recent Change activity associated with provisioning the feature would most likely be done by maintenance technicians, not by a provisioning OS. (The rationale is that this is a very special purpose, very infrequent provisioning task).

This feature does not provide an interface to the line testing OS, MLT. Service providers who intend to use MLT for line testing must either use non-integrated MLT, or must specifically choose and order the DCTU option in place of or in addition to this feature.

10.10.10.2.2 Feature Summary

This feature provides electrical testing capabilities via the Trunk and Line Work Station using the SLIM measurement system. This feature will provide the SLIM-based testing capability in addition to the existing DCTU-based testing on the SM/SM-2000.

This feature will implement the SLIM capabilities in the 5ESS®-2000 switch by using the SLIM hardware, the SLIM support software, and the SLIM TLWS display screens. This feature provides the following:

- (1) Provide the "Operator" mode and "Routine" mode of the SLIM feature.
- (2) Send "Receiver off Hook".
- (3) Add, Drop, and control the Mode of the Talk and Monitor phone.
- (4) Execute coin phone tests - detect coin, collect coin, return coin, and home totalizer.
- (5) Monitor for Short.
- (6) Modify the TLWS display screens to be consistent.
- (7) Add the ability to test trunks from the SLIM TLWS display screens.
- (8) Add the ability to test lines on Integrated Subscriber Loop Carrier (ISLC) systems, if the systems are implemented with bypass pairs for metallic testing and those pairs terminate on a Test Bus Control Unit (TBCU).

The ability to test lines on non-integrated SLC® systems, which is currently provided by the DCTU-based testing capability will not be provided by this feature. (This function would require hardware changes to the SLIM testing device which cannot be made at this time.)

The feature involves incorporating new hardware into the switch. The SLIM pack is designed to mount in the MMSU assembly. The SLIM pack is able to mount in any of the positions in the MMSU assembly which are normally available for application packs (16 positions per shelf). SLIM packs are supported in all SM types which can support an MMSU. This includes SM, RSM, ORM, SM-2000, EXM-2000. The SLIM packs interface to the 5ESS®—2000 switch via the PICB control bus which serves the MMSU.

The MMSU(2) can be equipped in configurations of one to four shelves. Each shelf has 16 positions for packs, 8 positions in each of two service groups. (The common circuits which serve each shelf do not occupy any of the aforementioned 16 positions per shelf.) The maximum configuration has 32 positions in each of two service groups.

The SLIM packs connect to the metallic testing network via backplane connections. The connection via the

backplane is different than the DCTU configuration. The DCTU is a separate peripheral whose ports connect to the metallic network via Metallic Test Buses (MTBs). Figure 10.10-7 illustrates typical access paths for a SLIM to Line Unit connection and for a DCTU to Line Unit connection.

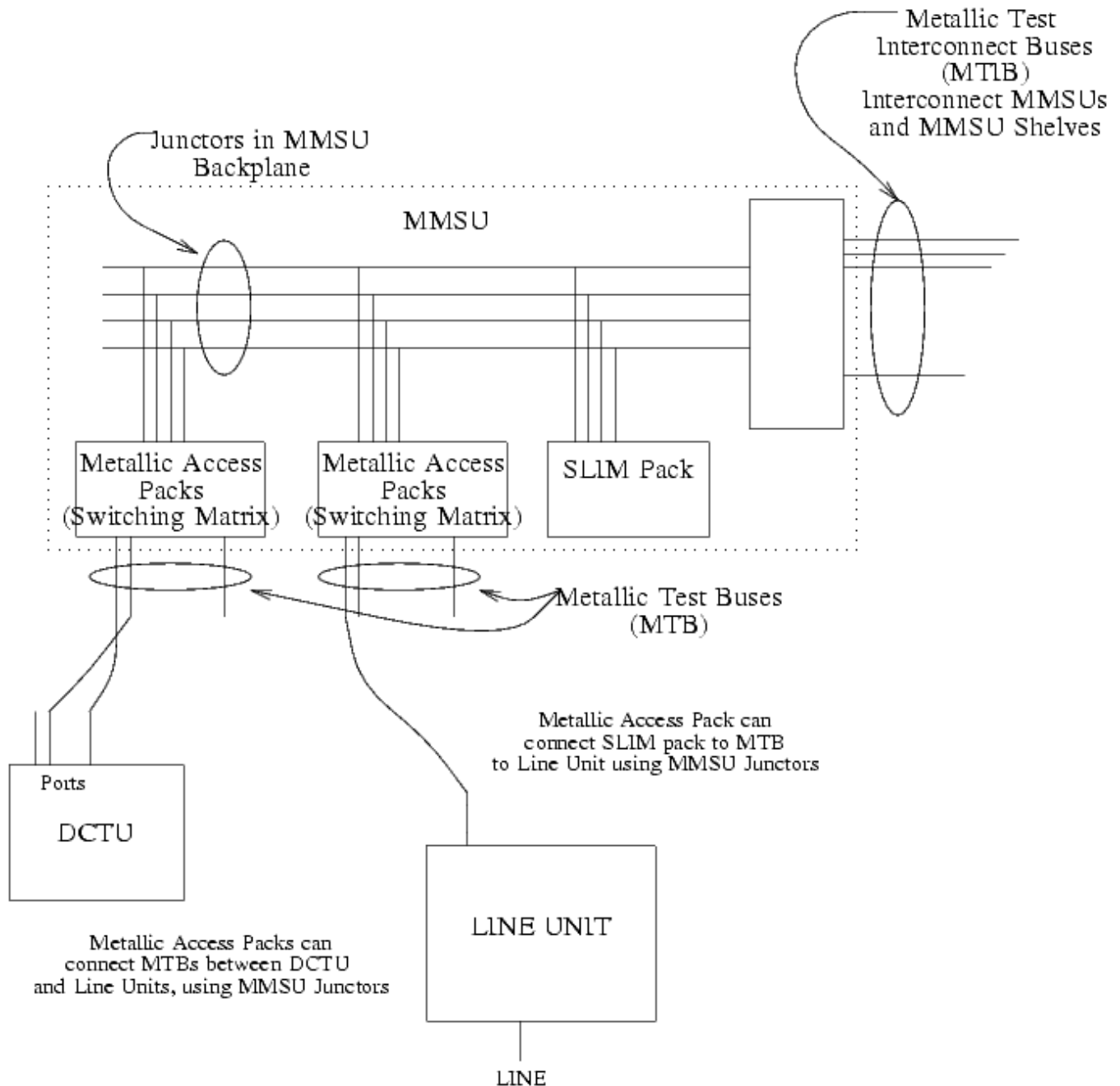


Figure 10.10-7 Metallic Access Network Connections

10.10.10.2.3 Interactions and Transparencies with Other Features

The SLIM-based testing feature in the 5ESS®-2000 Switch is an addition to the DCTU-based metallic testing feature and ALIT scheduled testing capability already provided. The DCTU-based testing capability will still be available and usable in a switch in which both DCTU and SLIM testing devices are equipped. The user may use SLIM-based testing or DCTU-based testing via selections made at the TLWS interface. The ALIT testing capability

will still be available and usable in a switch which is so equipped. If both the SLIM and the DCTU-based testing features are implemented in the same switch, it is possible to use both features. When multiple sources of testing activity are in progress simultaneously, access to a line, or to testing equipment is on a first come first served basis. If testing equipment is not available at the time of a test request, the request should be rejected. For interactive testing, the port to be tested must be manually seized via the existing TLWS pages for seizing ports, namely, pages 4000 and 4100. After the port is seized, it is possible to select the various pages which are available to perform tasks (for example "Transmission", "Supervision", "Metallic", and "Jacks") while the port is seized. The task selection options include both types of metallic testing pages (DCTU based or SLIM based). An indication of metallic testing functions which can be selected, based on whether the switch is equipped with both the DCTU and SLIM testing capabilities or only the DCTU or only the SLIM testing capability, is given. In addition to the marking, an attempt to select a function which is not equipped in the switch results in an explanatory error message.

10.10.10.3 System Architectural Constraints and Impacts

This feature is designed to fit into the existing switch architecture. The measurement hardware, the SLIM packs, are to be located into positions in the existing MMSU. The only constraints, which the existing architecture imposes are the total number of positions available in the MMSU and the number of metallic access paths available to connect a SLIM measurement unit to the metallic network. These constraints impact the feature but are not particularly unique to this feature.

MMSU positions are shared by several types of equipment, therefore, the number available for SLIM packs is dependent upon switch configuration decisions made by the service provider to meet the needs of a particular switch. It is estimated that the maximum configuration will meet the needs of large 5ESS[®]-2000 switch configurations.

Similarly the number of metallic access paths available to the SLIM pack is limited by the inherent network configuration of the MMSU, primarily the backplane junctors for connecting each pack to other devices in the network. This limitation is identical to that encountered by the DCTU in which each port interconnects with other devices via the same backplane junctors. There are two engineering rules that are important when using the SLIMs for routine mode testing:

- Only ten concurrent routine mode session should be scheduled. If more than ten are scheduled for the same time, only ten will be run.
- Only two SLIMs per service group shelf is recommended if they are to be used for routine mode. This is necessary to eliminate metallic access junctor contention.

10.11 DIGITAL LINE AND TRUNK UNIT

10.11.1 INTRODUCTION

10.11.1.1 DLTU

The digital line and trunk unit (DLTU) provides a direct interface between T1-carrier and the 5ESS[®]-2000 switch and is devoted to two distinct functions: interoffice trunking and remote switching module (RSM) to host umbilicals. Each switching module (SM) may be equipped with a maximum of two fully loaded DLTUs. One DLTU has the capacity to terminate 10 T1 spans, each span requiring one digital facility interface (DFI) board. Each DFI is allocated 24 time slots, one per voice channel. A fully loaded DLTU consisting of 10 DFI boards is allocated four time slot sets (TSS), the equivalent of half of an SM.

The DLTU is mounted in the line trunk peripheral (LTP) cabinet and functions as the system interface for T1 carrier lines that operate at 1.544 MHz and carry 24 digital trunks. This arrangement eliminates the need for channel banks. The carrier facilities may be used for interoffice trunks, RSM umbilicals, or links between SMs of a multimodule RSM. Each SM may be equipped with a maximum of two DLTUs. A DLTU may contain ten DFIs. A DFI provides the following functions:

- Terminates digital trunks
- Converts between T1 carrier format and the data time-slot format
- Performs idle time-slot stuffing.

A DFI has a 32 time-slot peripheral interface data bus (PIDB) interface to the time-slot interchanger (TSI) and a peripheral interface control bus (PICB) interface to the control interface (CU). Each DFI terminates one T1 line. The T1 carrier has 24 channels of information multiplexed onto it.

In one direction a DFI distributes 24 channels onto a 32 time-slot PIDB by "stuffing" every fourth (idle) time slot. Four different patterns of "stuffed" time slots are required to stagger the arrival of idle time slots at the TSI. Each DFI is programmable into any of the four "stuffing patterns."

In the other direction, the DFI takes 24 of the 32 time slots from the PIDB and places them on a T1 carrier.

The DLTU may interface with a large number of existing digital transmission terminals (DTTs). These DTTs may be grouped into the following categories:

- **Autonomous-Nonintelligent:** These terminals have no local intelligence, but are capable of operating without control from the DLTU. Typical examples of autonomous-nonintelligent DTTs are:
 - D1D channel banks
 - D2 channel banks
 - D3 channel banks.
- **Autonomous-Intelligent:** These terminals operate under control of a local intelligence. When a DLTU interfaces a DTT in this category, coordination between the two is required. Typical examples of autonomous-intelligent DTTs are as follows:
 - 1 ESSTM switch digital carrier terminal
 - 4ESSTM switch digital carrier frame

- Another 5ESS®-2000 switch DLTU
- Digital access cross-connect and switch.

- **Subordinate-Intelligent:** These terminals have some local intelligence, and operate under direction from the SM processor. An example of a subordinate-intelligent DTT is the RSM.

In terminating T1 carrier to the system, standard cross-connections require an office repeater bay (ORB) and a digital cross-connect (DSX-1) span or frame. A T1 span enters the 5ESS®-2000 switch through a DFI circuit pack mounted in the DLTU; DFIs (ANN 5) for RSM umbilicals, and DFIs (ANN 1 or ANN 3) for interoffice trunks.

10.11.1.2 DLTU2

The DLTU2 (digital line and trunk unit — model 2), available beginning with software release 5E5, provides a direct interface between T1-carrier and the 5ESS®-2000 switch devoted to two distinct functions: interoffice trunking and RSM-to-host umbilicals. Each SM may be equipped with a maximum of one fully loaded DLTU2. Each DLTU2 has the capacity to terminate 20 T1-spans. The DLTU2 is a 1-shelf unit having positions for 10 DFI2 circuit packs (2 circuits per pack). Each DFI2 circuit is allocated 24 time slots per circuit, one per voice channel. A fully loaded DLTU2 consists of 10 DFI2 boards and is allocated 8 TSSs, the equivalent of an SM. This makes 1 DLTU2, when it is equipped with 10 DFI2 packs, equal to 2 DLTUs fully equipped.

10.11.2 ENGINEERING CONSIDERATIONS

The DLTU provides direct interfaces to T1 digital facilities that serve as interoffice trunks or RSM umbilicals. The DLTU is equipped with circuit packs called DFIs which provide the direct interfaces. A different DFI circuit pack code is used depending on whether the interface is for interoffice trunks or RSM umbilicals.

Ten RSM umbilical DFIs may be reserved per DLTU to ensure that the maximum umbilical size of 20 T1 spans can be reached. All the umbilicals for an RSM must terminate on the same SM.

Each DLTU terminates up to ten 1.544 MB/s digital facilities with 24 channels each. A fully loaded DLTU (10 DFIs) uses 240 channels. A DLTU is engineered in multiples of 64 SM time slots. Each DFI terminates one digital trunk carrying traffic at the DS1 (1.544 MB/s) rate. A fully loaded DLTU with 10 DFIs is allocated 256 SM time slots.

In the case of an RSM umbilical, a single DLTU can provide connections for up to 256 time slots of the RSM network control and timing (NTI) link.

The method for engineering DLTUs is to allocate T1 lines in sets of eight or ten and provide one DLTU to mount the DFIs thus allocated. Fully loaded DLTUs (10 DFIs) are allocated 256 SM time slots. Partially loaded DLTUs are allocated sufficient SM time slots in sets of 64 to serve the T1 channels (for example, 8 DFIs in one DLTU require 192 time slots).

Refer to "Engineering Considerations" for "Fractional DS1 Switching" in the ISDN SOFTWARE UPDATES section to engineer an SM for wideband service. These engineering considerations apply to the three SM configurations:

- **Basic SM** supporting interoffice trunk terminations (digital trunks using ISUP signaling, not PRI) or in a tandem switching environment
- **Standard SM** also supporting interoffice trunk terminations (digital trunks using ISUP signaling, not PRI) or in a tandem switching environment
- **Loaded SM (ISDN)** supporting end-user PRI access.

In each of these configurations, the NCT link occupancy must be controlled by leaving some time slots unoccupied. To determine the quantity of unoccupied time slots refer to the "Engineering Considerations" for "Fractional DS1 Switching" in the ISDN SOFTWARE UPDATES section.

10.11.2.1 DLTU

The general method for engineering a DLTU is to optimize the total number of SM TSSs required to serve the T1 lines and to allocate any remaining TSSs, unassigned in partially loaded DLTUs, to other interface units. Efficient allocation of TSSs generally results in fewer SMs.

If the 5ESS®-2000 switch is predominantly a local (line) office, the most efficient utilization of time slots is to assign either three TSSs per DLTU (192 time slots for 192 T1 trunks or umbilical trunk); or if a paired DLTU is required, to assign six TSSs (384 time slots for 384 T1 trunks or umbilicals) for non-ISDN SMs.

The assignment of three TSSs per DLTU fully utilizes time slot resources. In the paired DLTU configuration, two TSSs are available for assignment to other units. Note that reserving time slots in the SMs containing the DLTU could be considered. One reason for this may be the anticipated growth of RSM umbilicals in the DLTU.

All umbilical trunks from an RSM must connect to the same host SM. The host SM can serve more than one RSM. If growth occurs in an RSM, and the host SM had its time slots fully allocated, the engineer would have to rehost the RSM umbilicals to another SM.

If the 5ESS®-2000 switch is predominantly a toll office, the purpose of the DLTU engineering is to fully utilize equipment. One or two fully equipped DLTUs utilize four TSSs (256 time slots) or eight TSSs (512 time slots).

A fully equipped DLTU with 10 DFI circuits for either T1 trunks or umbilicals uses 240 time slots (24 time slots per T1 line or umbilical). The SM allocates four TSSs (256 time slots) on the peripheral side of the time slot interchange (TSI) to the DLTU which results in 16 time slots not being used. With two DLTUs in the SM (also called paired DLTU) 32 time slots are not used.

The basic approach used by the engineering rules is to take inputs derived by the traffic engineer, calculate equipment quantities, and through a series of warning messages indicate any potential for optimization. It is important to recognize that the engineering rules develop a working configuration. Warning messages only indicate that a situation exists which an engineer may wish to investigate further. They do not preempt engineering judgment, but do assist in making sound decisions. If the Digital Ordering and Planning System (DOPS) does not generate any warning messages, the job should be considered optimum.

10.11.2.2 DLTU2

The general approach for engineering the DLTU2 is to optimize the total number of SM TSSs required to serve the T1-lines and to allocate any remaining TSSs, unassigned in partially loaded DLTU2s, to other interface units. Efficient allocation of TSSs generally results in fewer SMs.

If the 5ESS®-2000 switch is predominantly a local (line) office, the most efficient use of time slots is to assign either 3 TSSs, (4 DFI2 circuit packs, 192 time slots) or to assign 6 TSSs, (8 DFI2 circuit packs, 384 time slots) per DLTU2 for non-ISDN SMs. For 5E5 and later software releases, DFI time slots may be recaptured for PSU nail-up time slots.

The assignment of 3 or 6 TSSs per DLTU2 fully uses time slot resources. Reserving time slots in the SMs containing the DLTU2 may be considered for anticipated growth of RSM umbilicals in the DLTU2. All umbilical trunks from an RSM must connect to the same host SM. The host SM can serve more than one RSM. If growth occurs in an RSM, and the host SM has fully allocated time slots, the RSM umbilicals must be rehosted to another SM. The host DLTU2 can terminate both umbilicals and trunks, but not on the same DFI2.

Each host DFI2 carrying a control time slot (CTS) from an RSM can have only one CTS assigned per circuit pack

for each RSM. The other circuit on those DFI2s may be assigned as a CTS from another RSM. An RSM has 2 or 4 umbilicals carrying CTSSs. These umbilicals must terminate in DFI2-R circuit pack positions 1 and 2, or in positions 1 through 4. The second circuit on these packs should not be used. See Figure 10.11-1.

If the 5ESS®-2000 switch is predominantly a toll office, the purpose of the DLTU2 engineering is to use the equipment fully. One fully equipped DLTU2 uses 8 TSSs (512 time slots). A fully equipped DLTU2 having 10 DFI2 packs (2 circuits per pack) for either T1-trunks or umbilicals uses 480 time slots (24 time slots per T1-line or umbilical). The SM allocates 8 TSSs (512 time slots) on the peripheral side of the TSI to the DLTU2, resulting in 32 time slots not being used. Time slots not committed are available for nail-up time slot assignments at the PSU (software releases 5E5 and later). See Tables 10.11-1 and 10.11-2.

Table 10.11-1 DFI Assignment Considerations

DFI GROUP SIZE	RESERVED DFI (^a)	EXCESS DFI CAPACITY (^b)	TSS	DFIs ASSIGNED		LOCKED OUT DFIs IN SMs WITH			
				IN 1ST DLTU	IN 2ND DLTU	0	1	2	3
						UNALLOCATED TSS (^c)			
NONPAIRED DLTU (^d)									
1	2	1	1	1	NA	8	5	2	0
2	2	0	1	2	NA	8	5	2	0
3	5	2	2	3	NA	5	2	0	0
4	5	1	2	4	NA	5	2	0	0
5	5	0	2	5	NA	5	2	0	0
6	6	2	3	6	NA	2	0	0	0
7	8	1	3	7	NA	2	0	0	0
8	8	0	3	8	NA	2	0	0	0
9	10	1	4	9	NA	0	0	0	0
10	10	0	4	10	NA	0	0	0	0
PAIRED DLTU (^d)									
11	13	2	5	8	3	7	4	2	0
12	13	1	5	8	4	7	4	2	0
13	13	0	5	8	5	7	4	2	0
14	16	2	6	8	6	4	2	0	0
15	16	1	6	8	7	4	2	0	0
16	16	0	6	8	8	4	2	0	0
17	18	1	7	9	8	2	0	0	0
18	18	0	7	10	8	2	0	0	0
19	20	1	8	10	9	0	0	0	0
20	20	0	8	10	10	0	0	0	0
Notes:									
a. Cabled DFI slots.									
b. Excess capacity available for future plug-in growth. Except in rare cases, it is unreasonable to size DLTU TSS groups larger than the minimum sum of DFIs in a group to be assigned. This optimizes TSS.									
c. Permanently unassignable DFI slots based on the quantity of TSS not assigned to other interface units.									
d. Any DFI group larger than ten requires two DLTUs to be paired on an SM. Fewer SMs than DLTUs require the pairing of DLTUs.									

Table 10.11-2 DFI2 Assignment Considerations

T1 GROUP	TS AVAILABLE FOR PSU NAIL-UP	TSS	DFI2 ASSIGNED IN DLTU2
1	8	0.5	1
2	16	1.0	1
3	24	1.5	2
4	0	1.5	2
5	8	2.0	3
6	16	2.5	3
7	24	3.0	4
8	0	3.0	4
9	8	3.5	5

10	16	4.0	5
11	24	4.5	6
12	0	4.5	6
13	8	5.0	7
14	16	5.5	7
15	24	6.0	8
16	0	6.0	8
17	8	6.5	9
18	16	7.0	9
19	24	7.5	9
20	32	8.0	10

10.11.3 ASSIGNMENT GUIDELINES

The DLTUs are nonblocking and provide no concentration. Trunk members should be spread across all available DFIs for the best real time performance in the AM/CMP and SMP. The assignment of trunk groups throughout the DLTUs should be diversified whenever possible to ensure some degree of service in the event of a particular unit failure. This is especially true in the DLTU2 because of the additional T1s per DFI.

Each termination on the DLTU or DLTU2 has an associated digital equipment number (DEN). The DEN is composed as follows:

SMN D I CN

Where:

SMN = Switching Module Number (0-192)

D = DLTU Number (0-7)

I = DFI Number (1-10)

CN = Channel Number (1-48)

10.11.3.1 DLTU

All DFIs in one DLTU must be assigned to one data interface (DI). The DFIs may be assigned in groups. These groups are arbitrary groupings of T1 spans which may include both trunks, ICLs, and RSM umbilicals. However, group sizes greater than ten (five or more time-slot sets) always require two DLTUs to be paired on the same SM. Otherwise, two DLTUs are not assigned in the same SM unless there are more DLTUs than there are SMs. Group sizes greater than ten DFIs (four time-slot sets) should only be created when umbilicals from a single RSM require such a group size. Group sizes greater than eight should only be created when either an RSM umbilical group larger than ten exists, or a pure toll office situation exists. Table 10.11-1 provides DFI assignment considerations.

Those time-slot sets in an SM which are not required to serve DFIs may be assigned to other interface units (IUs). This assignment rule allows time-slot sets to be used efficiently and can sometimes save the cost of purchasing an additional SM. However, when time-slot sets are assigned to other IUs, they are no longer available for subsequent assignment to the DLTU. Those DFI locations on the DLTU become permanently unassignable because there are no time-slot sets available to serve them. Table 10.11-1 identifies the quantity of DFIs that are permanently unassignable based on the number of time-slot sets in an SM that are unallocated (not assigned to other IUs). Total time-slot demand in the office is minimized by decreasing the number of unassignable DFIs.

10.11.3.2 DLTU2

The DFI2s in one DLTU2 can be assigned to two data interfaces (DI). The DFI2s may be assigned in groups. These groups include trunks, ICLs, and RSM umbilicals. Group sizes greater than four TSS can use the DLTU2 for an RSM umbilical group larger than ten umbilicals, or for a pure toll office. Table 10.11-2 provides DFI2 assignment considerations.

10.11.3.3 Spreading Calls Among Trunk Groups

To better spread calls among trunk groups use the following guidelines:

- Divide the number of trunks in the trunk group by 24 (24 trunks per DFI pack.)
- Spread the DFI packs across all possible DLTUs.
- Spread the trunk members across all DFI positions as shown in Table 10.11-3.
- Continue these assignments in this manner until all trunks are assigned.

Table 10.11-3 Trunk Group Assignment Order: DLTU or DLTU2

SM NUMBER	DLTU NUMBER	DFI POSITION	TRUNK MEMBERS			
1	0	1	1	5	9...89	93
2	0	1	2	6	10...90	94
3	0	1	3	7	11...91	95
4	0	1	4	8	12...92	96

The use of these guidelines keeps the SMPU from overload due to excessive call volumes and spreads the trunk groups for service protection.

10.11.4 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

There are many sections of the 30-minute traffic report which contain measurements directly related to DLTU traffic activity. These sections are listed as follows:

- Section 12 - Trunk Group
- Section 16 - Digital Line and Trunk Unit
- Section 24 - Inter-LATA Carriers - Tandem Trunks
- Section 55 - Queuing for Trunk Group Measures
- Section 56 - Trunk Group Queuing Announcement Measures
- Section 92 - Packet Switching Trunk Group

See the Primary Service Indicators and Measurement Threshold section for additional information.

10.11.5 TRANSITION IMPACT

As DFI circuit packs are added to directly interface with more T1 lines, they should be installed sequentially within a DLTU. Additionally, recent changes must be made to enter the data into the data base to assign the DLTU and the DFIs. For further information concerning this growth procedure, refer to the following documents:

- 235-118-XXX - *Recent Change Procedures*

- 235-105-230 - *Hardware Change Procedures*
- 235-600-300 - *Equipment Configuration Data Manual*.

10.11.6 STUFFING PATTERN

When adding a DFI pack to a DLTU, the stuffing pattern must be correct or blockage will occur. Unidentified office blockage may be seen if the stuffing pattern is incorrect. The stuffing pattern (A, B, C, or D as shown in Table 10.11-4) is assigned for all new offices by Lucent Technologies. In an existing office, the stuffing pattern must be added by Recent Change at the time that the DFI pack is added to the office.

Table 10.11-4 Idle Time Slots

STUFFING PATTERN	IDLE TIME SLOTS							
A	0	4	8	12	16	20	24	28
B	1	5	9	13	17	21	25	29
C	2	6	10	14	18	22	26	30
D	3	7	11	15	19	23	27	31

Each DFI pack is assigned to a PIDB; the PIDB is assigned to a data interface (DI). Since a DFI pack has only 24 time slots and the PIDB has 32, eight time slots are unused (idle). A stuffing pattern is assigned to each DFI pack to handle the idle time slots. To prevent time slot blockage, the patterns must be spread equally over all working DFI packs in a DLTU.

10.11.7 DIGITAL LINE TRUNK UNIT TERMINATIONS WORKSHEET

10.11.7.1 DLTU

The following paragraphs identify the columns of the DLTU worksheets (Figures 10.11-2 and 10.11-3) and describe the calculations required to complete them.

- (A) DLTU TSS: The DLTU available TSSs.
- (B) DFI Packs per TSS: The number of DFI packs that may be installed per TSS.
- (C) Installed DLTUs per TSS: The number of DLTUs installed in the office that were engineered at various TSSs. Obtain this information from the switch or TEO.
- (D) Installed in DFI Positions: The number of DFI positions installed in this office. To calculate:

DFI Packs Per TSS	×	Installed DLTUs Per TSS	=	Installed DFI Positions
<i>Column B</i>		<i>Column C</i>		<i>Column D</i>

- (E) Working DFIs per TSS: The total working DFIs per TSS. Obtain information from switch or TEO.
- (F) Available Spare DFI Positions: The DFI positions not being used today. To calculate this number:

Installed DFI Positions	-	Working DFIs Per TSS	=	Available Spare DFI Positions
<i>Column E</i>		<i>Column E</i>		<i>Column F</i>

- (G) Forecasted DS1 Inputs EOP: The total number of DS1 inputs forecasted to EOP, including RSM umbilicals. Enter only field for total.
- (H) Percent Utilization of DFI - Today: The percent of the DFI packs installed that are being used today. Enter only in field for total.

Total Working DFI Packs Installed <i>Column E Total</i>	$\times 100 =$	Percent Utilization of DFI - Today <i>Column H</i>
Total Installed DFI Positions <i>Column D</i>		

- (I) Percent Utilization of DFI - EOP: The percent of the DFI packs installed that will be used at the end of this engineering period. Enter only in field for total.

Forecasted DS1 Inputs EOP <i>Column G</i>	$\times 100 =$	Percent Utilization of DFI - EOP <i>Column I</i>
Total Installed DFI <i>Column D</i>		

10.11.7.2 DLTU2

The following paragraphs identify the columns of the DLTU2 worksheet (Figure 10.11-2) and describe the calculations required to complete the worksheet.

- (A) DLTU2 TSS: The DLTU2 available TSSs.
- (B) DFI-2 Packs per TSS: The number of DFI-2 packs that may be installed per TSS.
- (C) Installed DLTU2s per TSS: The number of DLTU2s installed in the office that were engineered at various TSSs. Obtain this information from the switch or TEO.
- (D) Installed in DFI-2 Packs: The number of DFI-2 packs installed in this office. To calculate:

DFI-2 Packs Per TSS <i>Column B</i>	×	Installed DLTU2s Per TSS <i>Column C</i>	=	Installed DFI-2 Positions <i>Column D</i>

- (F) Available Spare DFI-2 Positions: The DFI-2 positions not being used today. To calculate this number:

Installed DFI-2 Packs <i>Column D</i>	-	Working DS1s Per TSS <i>Column E</i>	=	Available Spare DFI-2 Positions <i>Column F</i>

- (G) Forecasted DS1 Inputs EOP: The total number of DS1 inputs forecasted to EOP, including RSM umbilicals. Enter only field for total.
- (H) Percent Utilization of DFI-2 - Today: The percent of the DFI-2 positions installed that are being used today. Enter only in field for total.

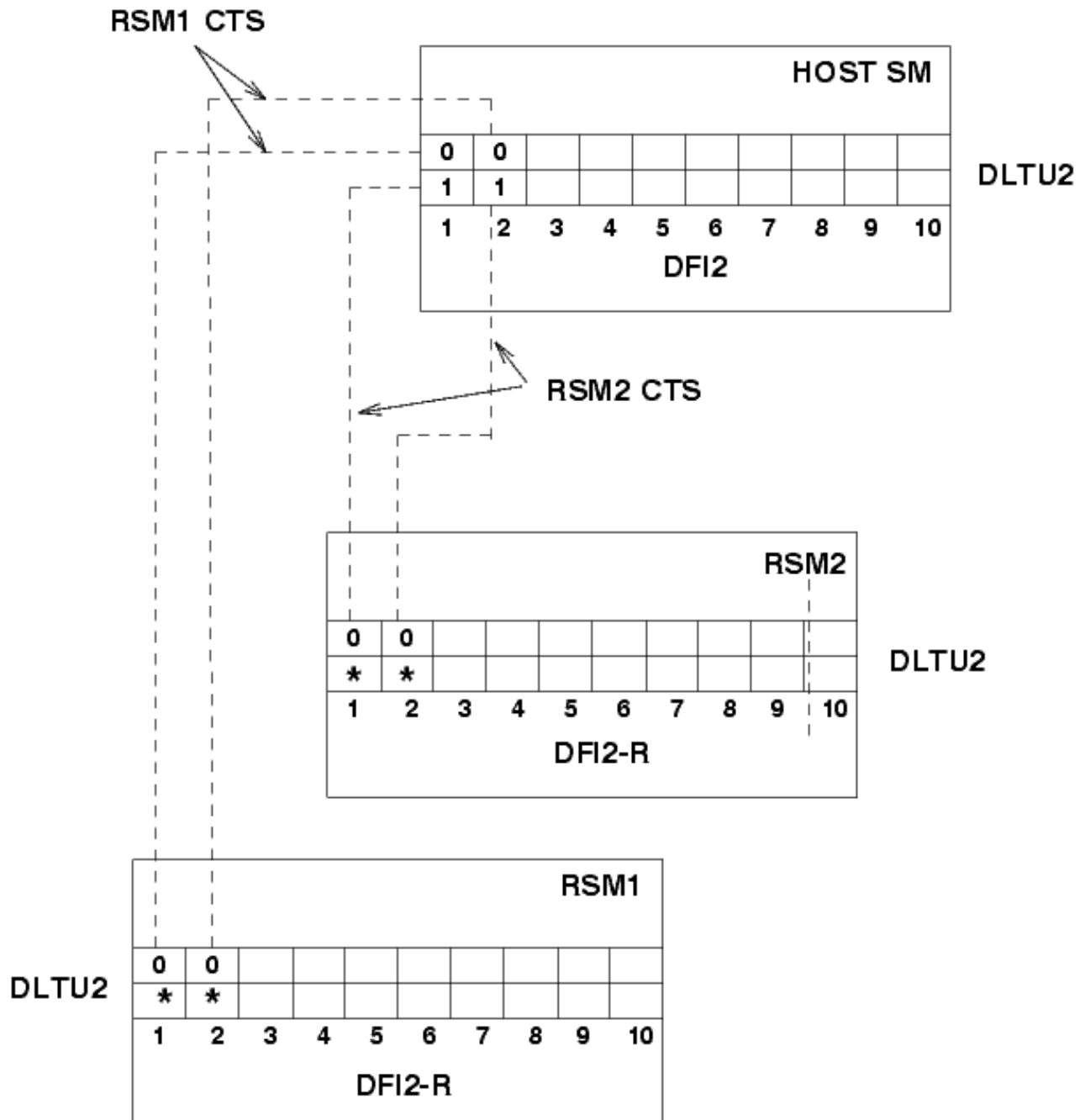
Total Working DS1s Packs Installed Column E Total Total Installed DFI-2 packs <i>Column D</i>	× 100 =	Percent Utilization of DFI-2 - Today <i>Column H</i>

- (I) Percent Utilization of DFI-2 - EOP: The percent of the DFI-2 packs installed that will be used at the end of this engineering period. Enter only in field for total.

Forecasted DS1 Inputs EOP <i>Column G</i>	$\times 100 =$	Percent Utilization of DFI-2 - EOP

Total Installed DFI-2
Column D

Column I



NOTES:

1. POSITION 1 OF THE RSM CTS SHOULD NOT BE USED.
2. DFI2 POSITIONS 1 AND 2 MUST CONTAIN THE SAME FUNCTIONALITY.
3. T1 GROUPS FUNCTIONALITY INCLUDES RSM CTS, RSM UMBILICAL, AND TRUNKS.

Figure 10.11-1 DLTU2 RSM Assignment

OFFICE _____

DATE _____

EFFECTIVE DATE _____

5ESS SWITCH: EQUIPMENT UTILIZATION

FROM _____ TO _____

DIGITAL LINE AND TRUNK UNIT (DLTU) TERMINATIONS

A	B	C	D	E	F	G	H	I
DLTU TSS	DFI PACKS PER TSS	INSTALLED DLTUs PER TSS	INSTALLED DFI POSITIONS	WORKING DFIs PER TSS	AVAILABLE SPARE DFI POSITIONS	FORECASTED DS1 INPUTS EOP	PERCENT UTILIZATION OF DFI	
		NOTE 1	NOTE 1	NOTE 1	D-E = F		TODAY $\frac{E}{D} \times 100 = H$	EOP $\frac{G}{D} \times 100 = I$
1	2							
2	5							
3	8							
4	10							
5	13							
6	16							
7	18							
8	20							
TOTAL								

NOTE:

1. Obtain from switch or TEO.

Figure 10.11-2 DLTU Terminations Worksheet

OFFICE _____

DATE _____

EFFECTIVE DATE _____

5ESS SWITCH: EQUIPMENT UTILIZATION

FROM _____ TO _____

DIGITAL LINE AND TRUNK UNIT 2 (DLTU2) TERMINATIONS

A	B	C	D	E	F	G	H	I
DLTU TSS	DFI-2 PACKS PER TSS	INSTALLED DLTU2s PER TSS	INSTALLED DFI-2 PACKS	WORKING DS1s PER TSS	AVAILABLE SPARE DFI-2 POSITIONS	FORECASTED DS1 INPUTS EOP	PERCENT UTILIZATION OF DFI	
		NOTE 1	NOTE 1	NOTE 1	(D-E)2 = F		TODAY $\frac{E}{(DX2)} \times 100 = H$	EOP $\frac{G}{(DX2)} \times 100 = I$
1	1							
2	3							
2.5	4							
4	5							
4.5	6							
6	8							
7	9							
8	10							
TOTAL								

NOTE:

1. Obtain from switch or TEO.

Figure 10.11-3 DLTU2 Terminations Worksheet

10.12 GLOBAL DIGITAL SERVICES

10.12.1 GENERAL

Global digital services consist of equipment physically contained in one or more switching modules (either SM or SM-2000) that is accessed by other SMs/SM-2000s within the switch. This equipment includes 3- and 6-port conference circuits and transmission test facilities (TTFs).

The functions once provided by the GDSU are provided by a single circuit pack called the global digital service function (GDSF) circuit pack. This section provides descriptions of both the GDSU and the GDSF.

10.12.2 GLOBAL DIGITAL SERVICE UNIT

10.12.2.1 UNIVERSAL CONFERENCE CIRCUITS

The universal conference circuits (UCCs) are equipped in the global digital service unit (GDSU) and are located in one or more switching modules (SMs). The types of UCCs consist of 3-port and 6-port conference circuits. The maximum number of GDSUs per office is limited to 32 through software release 5E5. In software release 5E6, the switch supports 64 GDSUs, and in software release 5E7, 128.

The UCCs are provided on a per-office basis. A maximum of 8 GDSUs, which contain UCCs may be installed in the SM. For non-OSPS offices, the 3-port conference circuits are used for 3-way calling (multiway features), local test desk access, attendant console, multi-button key sets, central attendant service, line time slot bridging, and E911. For OSPS offices, the 3-port conference circuits are used for operator verification and service evaluation functions. The UCCs are engineered for a blockage of 0.1 percent ABS.

Six-port conference circuits are used specifically for 6-way station-controlled conference and attendant conference and are engineered based on traffic usage. The CCS usage for the 6-port circuits may be estimated based on the expected penetration of the conference calling features of business and residence custom services (BRCS). The 6-port circuits are not used to replace 3-port circuits or to perform the same type of functions. The data related to 6-port and 3-port conference circuits are also shown in Section 10 of the 30-minute traffic report.

10.12.2.2 ENGINEERING CONSIDERATIONS

The GDSU contains the UCCs that perform functions for all lines and/or trunks in the system. The transmission test facility (TTF) circuit packs are also equipped on the GDSU. The number of TTF circuits equipped in the GDSU determines the quantity of UCCs which can be equipped in each of the two service groups. Each GDSU service group has space for up to seven circuits.

The calculation of 3-port conference circuit requirements is identical to that of 3-port conference circuits in other systems with the exception that 3-way calling, service observing, and operator verification are the only 5ESS®—2000 switch features requiring them. The engineering criteria are a probability of blocking of 0.05 at 85 percent occupancy OAM (P.001 ABS). At least one conference circuit is required. In small to moderate offices, only one GDSU may be required.

The UCCs, each containing two or five 3-port conference circuits or two 6-port conference circuits, utilize time slots remaining after allocation to the TTF and measurement (responder) packs. If required, additional GDSUs are provided, each having a capacity of ten 3-port conference circuits (or five 6-port conference circuits). Each unit is allocated 64 module time slots [two peripheral interface data buses (PIDBs)].

The GDSU contains 2 service groups of 32 time slots each. These service groups may be engineered in several ways depending on the needs, but the total of 32 time slots must not be exceeded per group. There are five different circuit packs available. To maximize the utilization of time slots, several combinations are available. These circuit packs and the associated time-slot requirements are provided in Table 10.12-1.

Table 10.12-1 GDSU Capacities

CIRCUIT PACK TYPE	TITLE	TIME SLOTS USED
TTF	Transmission Test Facility	10
R ^a	Responder	4
U ^b	3-port, 2 circuits/pack	6
6	6-port, 2 circuits/pack	12
U2 ^b	3-port, 5 circuits/pack	15
Notes:		
a. Required if TTF is equipped.		
b. U and U2 circuit packs cannot be mixed within the same service group.		

Each 6-port is assigned six time slots. One 6-port conference circuit cannot be used as two 3-port circuits. Like the 3-port conference circuits, the 6-port conference circuits are engineered based on usage. The 6-port conference circuits can be mixed with the 3-port conference circuits. The CCS usage of the 6-port conference circuit may be estimated based on the penetration of the multiway calling feature of BRCS.

10.12.2.3 ASSIGNMENT GUIDELINES

No assignments are required for UCCs.

10.12.2.4 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

Section 10 of the 30-minute traffic report contains measurements concerning the UCCs. Measurements are provided for 3-port and 6-port conference circuits.

The conference circuit overflow (CCOFL) count represents the number of times that requests for a 3- or 6-port conference circuits cannot be served due to unavailability. This situation has no effect on plain old telephone service (POTS) calls but it does affect such features as 3-way calling, conference calling, etc. The CCOFL measurement is considered to be a key service indicator.

For further description of the UCC measurements, refer to 235-070-100 *Traffic and Plant Measurements Appendix 1*.

10.12.2.5 FEATURE IMPACT

The penetration of 3-way Calling and Multiway Calling features have a great impact on the usage of 3- and 6-port circuits. Other features which have an impact on these UCCs include multiway features, attendant features, centralized attendant services, line time slot bridging, E911, and release link trunks.

The line time slot bridging (LTSB) feature uses the 3-port conference circuits. When the office is engineered via 5 DOPS, the traffic engineer must enter a value for the number of LTSB lines that are to be assigned.

When a line is assigned the LTSB feature, 3-port conference circuits are used only when both locations or the directory numbers are active on the call. So, when one location or directory number is active on a call, the 3-port conference circuit is not used.

The impact that the LTSB feature has on the 3-port circuits varies per application as follows:

- **Permanent Lines** — This application could be a residence and a business, each with a different directory number, using the same line. The 3-port conference circuit is used each time both directory numbers use the telephone. This application has the potential to be the greatest user of 3-port conference circuits.
- **Temporary Lines** — This application could be a line working at two locations; for example, a customer moving but keeping the same directory number. This application uses the 3-port conference circuits, but will

have little impact. The service is temporary and usually the customer is at one or the other location. The only time that the 3-port conference circuit is used is when both locations are active on a call.

- **Cable Transfers** — This application could be used for reallocation of cables and pairs. Since only one location would be used there would be no impact on the 3-port conference circuits.

For further information concerning the Line Time Slot Bridging feature, refer to 235-190-102 *Business and Residence Non-Modular Features*. For further information concerning these features, refer to 235-190-101 - *Business and Residence Modular Features*.

10.12.2.6 TRANSITION IMPACT

Growth procedures have no particular impact on UCCs except in cases where additional customers are added, and those customers are allowed to use the features which employ UCCs. In that case, it is necessary to consider the available UCC capacity before allowing the new customers to use those features.

For further information relating to growth, refer to the following documents:

- 235-118-XXX - *Recent Change Procedures*
- 235-105-231 - *Hardware Change Procedures*
- 235-600-30X - *Equipment Configuration Data*.

10.12.2.7 GLOBAL DIGITAL SERVICE UNIT WORKSHEET

The following paragraphs identify the columns of the GDSU worksheet (Figure 10.12-1) and describe the calculations required to complete the worksheet.

- (A) Circuit Type: The type of circuit, which will be either 3-port or 6-port conference circuits.
- (B) Engineering Blocking Criteria: The engineering blocking criteria used to engineer this component. Valid entries include the following percent blocking values: 0.05, 0.1, 0.5, 1.0, 1.5, 2, 3, 4, 5, 6, 7, 8, 9, and 10.
- (C) Circuits Installed - Total: The quantity of conference circuits installed in the office, including circuits required for service observing and operator verification. Obtain from switch or telephone equipment order (TEO).
- (D) Circuits Installed - SO/OV: This column applies only to 3-port conference circuits. One circuit is provided for each service observing trunk installed in the office, plus one circuit is provided for operator verification. Enter the total number of such circuits in this column. Obtain data from the switch or TEO.
- (E) Circuits Installed - Traffic: The quantity of conference circuits provided to meet traffic demand.

Circuits Installed Total Column C	-	Circuits Installed SO/OV Column D	=	Circuits Installed Traffic Column E

- (F) CCS Capacity Installed - Total: The CCS capacity of the total number of components installed in the office (Column C). Read capacity from appropriate Poisson Table as indicated in Column B.
- (G) CCS Capacity Installed - Traffic: The CCS capacity of the circuits provided to meet traffic demand (Column E). Read capacity from appropriate Poisson Table as indicated in Column B.
- (H) CCS Usage Data Today - Main Station Demand: The number of 3-port or 6-port main stations working in the switch today. Since 3-port and 6-port conference circuits are also used by RSMs, this number must include

3-port or 6-port main stations. Obtain number from office records.

- (I) **CCS Usage Data Today - CCS Demand:** Today's CCS demand on the 3-port or 6-port conference circuits. Use value from the current office engineering data. The office engineering data includes the usage generated by the service observing and operator verification trunks. These trunks are not used in calculating the CCS capacity because of the minimal amount of CCS usage generated.
- (J) **CCS Usage Data Today - CCS per Main Station:** The 3-port or 6-port conference circuits CCS usage per main station at which the office is running today. To calculate:

$\frac{\text{CCS Usage Data - Today CCS Demand}}{\text{CCS Usage Data - Today MS Demand}}$ <i>Column I</i> <i>Column H</i>	=	$\frac{\text{CCS Usage Data - Today CCS/MS}}{\text{CCS Usage Data - Today CCS/MS}}$ <i>Column J</i>

- (K) **CCS Usage Data EOP - Main Station Demand:** The number of forecasted 3-port or 6-port main stations to be working in the switch at EOP, or the highest demand in the engineering period. Take the number from the forecast.
- (L) **CCS Usage Data EOP - CCS per Main Station:** Number represents the 3-port or 6-port conference circuits CCS usage per main station at which the office is forecasted to be running at EOP. Since main station and CCS per main station may grow at different rates, projections of future demand for each must be made separately. Obtain data from office forecasts.
- (M) **CCS Usage Data EOP - CCS Demand:** The CCS demand on the 3-port or 6-port conference circuit at EOP. To calculate:

$\frac{\text{CCS Usage Data - EOP MS Demand}}{\text{CCS Usage Data - EOP MS Demand}}$ <i>Column K</i>	×	$\frac{\text{CCS Usage Data - EOP CCS/MS}}{\text{CCS Usage Data - EOP CCS/MS}}$ <i>Column L</i>	=	$\frac{\text{CCS Usage Data - EOP CCS Demand}}{\text{CCS Usage Data - EOP CCS Demand}}$ <i>Column M</i>

- (N) **Main Station Capacity - Today:** The main station capacity that the 3-port or 6-port conference circuits are capable of handling today, based on the current CCS per main station. To calculate:

$\frac{\text{CCS Capacity Installed - Traffic}}{\text{CCS Usage Data - Today CCS/MS}}$ <i>Column G</i> <i>Column J</i>	=	$\frac{\text{MS Capacity - Today}}{\text{MS Capacity - Today}}$ <i>Column N</i>

- (O) **Main Station Capacity - EOP:** The main station capacity that the 3-port or 6-port conference circuits are capable of handling at EOP, based on the forecasted main stations and CCS per main station. To calculate:

$\frac{\text{CCS Capacity Installed - Traffic}}{\text{CCS Usage Data - EOP CCS/MS}}$ <i>Column G</i> <i>Column L</i>	=	$\frac{\text{MS Capacity - EOP}}{\text{MS Capacity - EOP}}$ <i>Column O</i>

- (P) **CCS Usage Percent Utilization - Today:** The maximum CCS load that is being used today. To calculate:

$\frac{\text{CCS Usage Data - Today CCS Demand}}{\text{CCS Capacity Installed Traffic}}$ <i>Column I</i> <i>Column G</i>	× 100 =	$\frac{\text{CCS Usage Percent Utilization - Today}}{\text{CCS Usage Percent Utilization - Today}}$ <i>Column P</i>

(Q) **CCS Usage Percent Usage - EOP:** The maximum CCS load that will be used during the period. To calculate:

CCS Usage Data - EOP CCS Demand <i>Column M</i>			

CCS Capacity Installed <i>Column G</i>	× 100 =		CCS Usage Percent Utilization - EOP <i>Column Q</i>

OFFICE _____
DATE _____
EFFECTIVE DATE
FROM _____ TO _____

"SESS"™ SWITCH EQUIPMENT UTILIZATION

GLOBAL DIGITAL SERVICE UNITS (GDSU) CONFERENCE CIRCUITS

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
CIRCUIT TYPE	ENGINEERED CRITERIA	CIRCUITS INSTALLED			CCS CAPACITY INSTALLED		CCS USAGE DATA TODAY			CCS USAGE DATA EOP			MAIN STATION CAPACITY		CCS USAGE PERCENT UTILIZATION	
		TOTAL	SO/OV	TRAFFIC	TOTAL NOTE 6 BASED ON COL C	TOTAL NOTE 6 BASED ON COL E	MS DEMAND NOTE 3	CCS DEMAND NOTE 4	CCS/MS $\frac{I}{H} = J$	MS DEMAND NOTE 5	CCS/MS NOTE 5	CCS DEMAND $K \times L = M$	TODAY $\frac{G}{J} = N$	EOP $\frac{G}{L} = O$	TODAY $\frac{I}{G} \times 100 = P$	EOP $\frac{M}{G} \times 100 = Q$
		NOTES 1, 2	NOTES 1, 2	C D = E												
3 PORT CONF.																
6 PORT CONF.			0													

- NOTES:
1. Obtain the number from the switch.
 2. Obtain the number from the TEO.
 3. Obtain the number from the Office Records.
 4. Obtain the number from the Office Engineering Data.
 5. Obtain the number from the Office Forecasts.
 6. Read this capacity from the appropriate Poisson Table, per entry in Column B for specified column data.

Figure 10.12-1 Global Digital Service Unit Worksheet**10.12.3 GLOBAL DIGITAL SERVICE FUNCTION**

The GDSF combines functionalities that were provided by separate circuit packs such as Transmission Test Facility (TTF), Integrated Services Test Facility (ISTF), 3 Port Conference Circuit (3PORT_CONF) and 6 Port Conference Circuit (6PORT_CONF) in GDSU and DSU2. With GDSF, a DSC3 (UN363) can provide all of these functionalities from a single circuit pack. GDSF can coexist in a 5ESS®-2000 Switch already equipped with GDSU and/or DSU2.

The intended purpose of the GDSF software is to replace the circuit packs associated with TTF, ISTF, 3PORT_CONF and 6PORT_CONF and to consolidate hardware by utilizing newer technology. DSU2 is still used, in addition to DSC3, whenever there is a need to provide announcement.

The GDSF functionalities are also available in the SM. The DSC3 (UN363) packs are mounted in a new unit, introduced in the 5E10 software release, called Combined Service Unit (CSU).

Because many functionalities can be provisioned in a DSC3 (UN363), it is important that they be adequately engineered and various functionalities spread over several DSC3 (UN363) packs. For reliability, at least two DSC3 (UN363) packs are equipped in the SM-2000. In smaller offices with only one SM, a spare DSC3 (UN363) pack should be available for quick replacement.

A summary of Local and Global Digital Services Functions is shown in Table 10.12-2.

Table 10.12-2 Summary of Global Digital Services Functions (GDSF) - 5E10

FUNCTION	UNIT	PACK	PIDB	MAX. PACKS
SM AFTER GDSF SOFTWARE ^a				
3/6 port conf., TTF & ISTF	CSU	DSC3	1 or 2 /pack	1
SM BEFORE GDSF SOFTWARE ^a				
3/6 port conf. TTF ISTF	GDSU GDSU DSU2	UCC TTF ISTF	2 per GDSU 2 per GDSU 1 /pack	Engineerable Engineerable Engineerable
SM-2000 POST GDSF SOFTWARE ^a				
3/6 port conf., TTF & ISTF ^b	DSU3	DSC3	4 /pack	32
Notes:				
a. GDSF can coexist with GDSU and DSU2.				
b. Up to DSU3 shelves; up to 4 LDSF DCS3 packs, and up to 32 GDSF DSC3 packs.				

Only Universal Conference Circuit (3/6 port) functionality of GDSF is available starting with the 5E10 software release. TTF and ISTF functionality will be available, approximately three months later, by a software update, for both the SM and the SM-2000.

10.12.3.1 GLOBAL SERVICES

The circuit pack DSC3 (UN363) and associated Local Digital Services Function (LDSF) software provides increased capacity for local digital services to meet increased demand of SM-2000. These local functions are: Local Tone Generator, Digit Receptor and Transreceiver and Voice Band Services. In the 5E10 software release and in the subsequent software update, additional GDSF software is introduced to provide global digital services functions for both SM and SM-2000 on the same DSC3 (UN363) circuit pack. The functionalities provided by the GDSF are:

- 3 Port Conference Circuit
- 6 Port Conference Circuit

- Transmission Test Facility (TTF)
- Integrated Services Test Facility (ISTF).

10.12.3.2 Engineering

10.12.3.2.1 Recent Change

The GDSF can be readily provisioned via Recent Change (RC) to perform TTF, ISTF and Conference Circuit (CC) functions interchangeably. Since there are no specific circuit packs required for specific functions, a simple provisioning change can provide needed functionality.

10.12.3.2.1.1 Predefined Configuration

The assignment of the functionality is done via RC/V. The GDSF has eight types of predefined configurations, a subset of which is used for the U. S. market. The SM-2000 uses four PIDBs, but the SM can be configured with one or two PIDBs. The maximum capacity of the GDSF is 32 UN363 packs per SM-2000 and one UN363 pack per SM. See Tables 10.12-3 and 10.12-4.

Table 10.12-3 Predefined GDSF Circuit Configurations - SM-2000

CONFIG	CC (^a)	TTF		ISTF		EQUIPMENT	COMMENT
TYPE NO	TS	BASE	+2	XMT	XLB	CKT (^b)	
GDSF-SM 2000 CONFIGURATION							
1	128	0	0	0	0	0	Conf. only
2 ^c	30	0	2	0	0	0	Conf. & TTF
4	60	0	0	10	44	3	Conf. & ISTF
5	30	2	0	4	32	1	Conf., TTF & ISTF
7	0	0	0	16	32	4/5	ISTF only
8	60	0	2	0	0	0	Conf., TTF
Notes:							
a. Time slots available for combinations of 3 or 6 port conference circuits. Only 126 time slots used out of 128 available time slot.							
b. Equivalent ISTF conventional circuit packs.							
c. Provides more 105 tests.							

Table 10.12-4 Predefined - GDSF Circuit Configurations - SM

CONFIG TYPE NO.	CC TS	TTF		ISTF		EQUIPMENT	COMMENT
		BASE	+2	XMIT	XLB	CKT. (a)	
GDSF-SM CONFIGURATION - ONE PIDB							
1	32	0	0	0	0	0	Conf. only
2 b	0	0	2	0	0	0	TTF
4	0	0	0	4	28	1	ISTF only
5	0	2	0	4	8	1	TTF & ISTF
6	24	0	0	6	2	2	Conf. & ISTF
7	24	1	0	0	0	0	Conf. & TTF
8	12	0	1	4	4	1	Conf., TTF & ISTF
GDSF-SM CONFIGURATION - TWO PIDBs							
1	64	0	0	0	0	0	Conf. only
2 b	30	0	2	0	0	0	TTF
4	0	0	0	8	56	2/3	ISTF only
5	0	4	0	4	28	1	TTF & ISTF
6	30	0	0	12	22	4	Conf. & ISTF
7	48	2	0	0	0	0	Conf. & TTF
8	30	0	1	4	16	1	Conf., TTF

The following are the engineering rules for the GDSF-SM-2000:

- The DSC3 pack is a global resource, and is not required in every SM-2000 (since it can be accessed by any other SM-2000/SM in the office).
- Full functionality of GDSF is not supported in Remote SM (RSM, ORM or EXM). The ISTF functionality can be provided in the Remote SM.
- Up to 32 GDSF-SM-2000 DSC3 packs can be supported in an SM-2000. (This is the software limit. It would be highly unlikely to approach this limit since the GDSF-SM-2000 is a global resource.)
- GDSF-SM-2000 DSC3 packs are equipped in the DSU3. DSC3 pack slots in the DSU3 are shared with DSC3s providing LDSF in the SM-2000. A DSU3 consists of six fuse groups with up to three DSC3s per fuse group.
- Each GDSF-SM-2000 DSC3 pack requires four PIDBs and one PICB, all of which are duplexed.
- The supported GDSF-SM-2000 circuit configuration types are covered in Table 10.12-5. The configuration types provide the supported mix of 3/6 port conferencing, and testing with TTF and ISTF.
- Up to 42 3-port conference circuits can be assigned on a GDSF-SM-2000 DSC3.
- Up to 21 6-port conference circuits can be assigned on a GDSF-SM-2000 DSC3.
- For applications requiring TTF service function to support trunk testing, DSC3 DSP resources may be shared (for example, configuration types 2, 5, and 8) assuming both types of tests do not need to be run concurrently. Concurrent test requirements by the customer would require additional DSP resources and provisioning of additional GDSF-SM-2000 DSC3s
- The number of GDSF-SM-2000 DSC3s needed to support conferencing and testing can be calculated.
- The GDSF-SM-2000 DSC3 can coexist with GDSU and DSU2 hardware per office, on an SM-2000 basis.

Table 10.12-5 SM-2000 and SM GDSF Capacities

CIRCUIT TYPE	MAXIMUM CAPACITY PER		
	UN363	SM-2000	(a)
3-port Conference Circuits	42	1344	1800
6-port Conference Circuits	21	672	250
Tone Generator (TNGEN) Circuits	48	1536	b
Tone Transceiver (TNXCVR) Circuits	16	512	b
Guard-Data-Guard (GDTNXCVR) Circuits	6	192	b
ISTF XMIT (ISTFXMIT) Circuit	16	512	b
SM GDSF CAPACITIES - ONE PIDB			
3-port Conference Circuits	10	10	1800
6-port Conference Circuits	5	5	250
Tone Generator (TNGEN) Circuits	24	24	b
Tone Transceiver (TNXCVR) Circuits	12	12	b
Guard-Data-Guard (GDTNXCVR) Circuits	4	4	b
ISTF XMIT (ISTFXMIT) Circuits	6	6	b
ISTF Loop Back (ISTFLB)	28	28	b
SM GDSF CAPACITIES - TWO PIDBs			

3-port Conference Circuits	20	20	1800
6-port Conference Circuits	10	10	250
Tone Generator (TNGEN) Circuits	24	24	b
Tone Transceiver (TNXCVR)Circuits	12	12	b
Guard-Data-Guard (GDTNXCVR) Circuits	4	4	b
ISTF XMIT (ISTFXMIT) Circuits	6	6	b
ISTF Loop Back (ISTFLB)	28	28	b
Notes:			
a. Software limit.			
b. In the table, office maximum means that no specific maximum exists, but the number of logical test ports available and trunk group/member maximums will limit the number of these circuit types that can be equipped in an office.			

10.12.3.2.3 Recommendations

10.12.3.2.3.1 GDSF-SM

- For VCDX SM configurations, one GDSF-SM DSC3 is recommended. As previously noted, the CSU supports one GDSF-SM DSC3.
- For "non-VCDX" SM configurations (hosts), a minimum of two GDSF-SM DSC3s is recommended per office for reliability. Since only one GDSF-SM DSC3 is supported per SM, additional GDSF-SMs/CSUs need to be distributed across different SMs.
- Since conferencing and testing are typically required in most offices, it is recommended that configuration type 8 (which provides a mix of all supported functions) be initially provisioned. Type 7 could also be provisioned if ISTF is not required (for example, offices without C7 or ISDN). For "non-VCDX" SM configurations, additional GDSFs may be required based on the requirements of a particular application.

10.12.3.2.4 GDSF-SM-2000

- A minimum of two GDSF-SM-2000 DSC3s is recommended per office for reliability. [Note - only one GDSF-SM-2000 DSC3 may be provided with specific SM-2000 configurations (for example, VCDX-SM-2000)]
- Since conferencing, and (analog/digital) testing are typically required in most offices, it is recommended that configuration type 5 (which provides a mix of all supported functions) be initially provisioned as the minimum two GDSF-SM-2000 DSC3s. Type 2 or 8 could also be provisioned if ISTF is not required (without C7 or ISDN). Additional GDSFs may be required based on the requirements of the particular application.
- GDSF-SM-2000 DSC3 packs should be distributed among different SM-2000s, if possible for reliability reasons.
- For VCDX-SM-2000, CM2C configurations, or offices with only a single SM-2000/DSU3, it is recommended that the two GDSF-SM-2000 DSC3s be distributed across separate fuse groups in the DSU3.

10.12.3.3 Hardware

10.12.3.3.1 Digital Services Circuit Model 3 (DSC3) in SM-2000

Digital Services Circuit Model 3 is used in SM-2000 to provide local digital services function. The capability of this circuit is expanded by downloading of global digital services function software in the circuit pack. The DSC3

(UN363) are mounted in the DSU3 unit and must be provisioned according to the predefined configurations.

10.12.3.3.2 Numbering of GDSF SM-2000

The GDSF has its own numbering universe of 32 Service Groups. An SM-2000 can have a maximum of 32 DSC3s (UN363s). The DSC3 (UN363) provisioned as LDSF must be mounted in base DSU3 shelf in the SM Controller (SMC) cabinet. Any DSC3s (UN363) provisioned as GDSFs over and above the 18 slots available in the base DSU3 must be mounted in the LTP cabinet.

10.12.3.3.3 GDSF In The SM

In the the SM, the DSC3s (UN363s) are mounted in the Combined Services Unit (CSU). Only one UN363 can be mounted in a CSU and is always numbered 0 (zero).

10.12.3.4 Software

10.12.3.4.1 GDSF Circuit Configurations

GDSF circuit configurations for GDSF-SM-2000 and GDSF-SM are provided in Tables 10.12-3 and 10.12-4 . (The current GDSF circuit configurations are preliminary and subject to change at a later date.) The GDSF (like the LDSF and ISTF) is a pumpable peripheral. Therefore, the Digital Signal Processor (DSP) configuration information needs to be provided (and coordinated) as input parameters to the ODA engineer, to insure the correct GDSF service types are provisioned on a DSC3 basis. (for example, the mapping of the specific configuration type for each GDSF engineered).

The number of conference channels (CC) supporting 3/6 port conferencing are provided in Table 10.12-5 .

For testing, the mapping of the existing TTF and ISTF services to equivalent GDSF service types are highlighted as follows:

- With the TTF, the basic TTF includes one responder. Up to two additional responders can be engineered with the TTF. The equivalent GDSF configurations for TTF are noted as BASE (for the basic) and BASE+2 (with 2 additional responders) in Tables 10.12-3 and 10.12-4 . The mapping of TTF to the GDSF circuit configurations only supports an equivalent BASE+2, with no equivalent for a TTF with only one additional responder. Therefore, a configuration type which includes a BASE+2 TTF needs to be provided for cases requiring a TTF with only one additional responder.
- With ISTF, the two different service types supported are transmit (XMIT) and loopback (XLB).

10.13 LOCAL DIGITAL SERVICE UNIT

10.13.1 TONE DECODERS

10.13.1.1 Description

The tone decoder (TD) resides in the local digital service unit (LDSU) of the switching module (SM). The TDs perform digit reception and decoding functions for dial pulse and touch-tone originating calls from lines. Additionally, they perform touch-tone multifrequency and dial pulse (except bylink) digit reception from incoming trunk calls. (Incoming bylink digits are received by the signal processor in the SM processor unit.)

Tone decoders are used on a per-call basis and are engineered. This is done by estimating the total touch-tone multifrequency, multifrequency (MF), and originating and nonbylink incoming dial pulse once-a-month (OAM) or average busy season (ABS) and high day (HD) usage, and allocating that usage to each required SM. Per-SM usage is read into Poisson 0.03 blocking probability tables [time-consistent busy hour (TCBH) engineering criteria are blocking probability of 0.01 ABS or 0.05 HD, whichever is limiting], and the resulting circuit requirement is increased by four to accommodate expected decoder usage variation that occurs between modules and is caused by unit loading. (There are 14 circuit positions in the LDSU which are available for TDs. Each TD circuit pack contains two or four TDs depending on the software release and LDSU model employed.)

On each of the two DSU2 boards there are 7 digital signal processors (DSPs). These DSPs may be configured for tone generating, tone decoding, or tone transceivers functions. The default configuration is one DSP per board for tone generation (equivalent to the DSU1). The transceivers are engineered and spread among the DSU2s. The remaining DSPs are the decoders. Each DSP converted to a decoder is equivalent to 5 servers. Usually 5 or 6 DSPs are assigned to the tone decoder function. This is the equivalent of 60 to 50 decoder servers.

10.13.1.2 Engineering Considerations

The TD circuits are provided on a per-SM basis. For 2 TD circuits per pack, an SM can be equipped with up to 28 TD circuits to provide an OAM capacity of 681 hundred call seconds (CCS). For 4 TD circuits per pack, an SM can be equipped with up to 56 TD circuits for a corresponding OAM capacity of 1,540 CCS. Normally, fewer than 28 circuits per SM are engineered based on the projected load. Because the ratio of lines to trunks varies somewhat among SMs, the volume of usage varies among tone decoder groups. (A higher ratio of lines generally means higher tone decoder usage.) This variance is accounted for in the engineering procedures by determining the average tone decoder group size needed, then adding a safety margin to all groups to cover the highest expected SM load.

Tone decoder data is provided by Section 9 of the 30-minute traffic report. The tone decoders should be monitored for any groups that approach or exceed capacity.

When the tone decoders exceed capacity, originating calls suffer. Originating customers cannot be provided dial tone if a tone decoder is not available. Corrective actions may include the addition of more tone decoders, or moving tone decoders from one SM to another.

10.13.1.3 Assignment Guidelines

Tone decoder circuits are installed on a per-SM basis. The only assignments required are those assignments which indicate to the software release that the additional TDs are available.

10.13.1.4 Measurements and Primary Service Indicators

10.13.1.4.1 General

Tone decoder measurements are found in Section 9 of the 30-minute traffic report. Additionally, Section 4 of the

30-minute traffic report contains TD and dial tone speed measurements related to system access delay. 235-070-100, *Traffic and Plant Measurements, Appendix 1* provides additional information concerning these measurements.

10.13.1.4.2 Tone Decoder Attachment Delay

Tone decoders are used to perform dial pulse and touch-tone digit collection from lines. Additionally, they perform MF and dial pulse (except bylink) digit collection from trunks. For nonbylink trunks, the tone decoder attachment delay (TDAD) measurement is the equivalent of dial tone delay for lines.

The TDAD is a count of the number of times, during the measuring interval, that TDAD exceeded 3 seconds.

NOTE: CCS7 trunks use the tone transceivers. The TDAD measurements do not apply.

10.13.1.4.3 Dial Tone Delay

In the 5ESS[®]-2000 switch, the dial tone delay peg count (DTDPC) is an indication of the ability of the machine to provide dial tone to customers within 3 seconds during the measuring interval. It is the primary measurement for evaluating the capability of providing originating customer service. Each call in the 5ESS[®]-2000 switch is sampled for dial tone delay, and the number of calls sampled is recorded by the dial tone delay sample count (DTDSC). However, the DTDPC count is incremented only when an originating customer experiences dial tone delay of more than 3 seconds. Both DTDSC and DTDPC are available for each SM. These measurements are obtained from Section 4 of the 30-minute traffic report.

It should be noted that receipt of dial tone indicates only the readiness of the SM. It is possible, though highly improbable, that the administrative module or communication module (AM/CMP) could have problems which may cause the customer to experience post dial tone processing delay. Section 4 of the 30-minute traffic report provides measurements related to system delay (specifically blockage due to overload).

Typically, the most common reason for excessive dial tone delay is blocking in the LU. Blocking in the HLSC or UTD is also possible, but this is not as likely as LU blockage. Another remote possibility for excessive dial tone delay is high switching module processor (SMP) occupancy. If the dial tone delay peg count is excessive and if the tone decoder attachment delay is zero, then the SMP can be eliminated as the source of the trouble.

10.13.1.4.4 Tone Decoder Total Usage and Overflow

The tone decoder total usage (TOTUSG) count provides the usage for tone decoder groups. This count represents the sum of the traffic and maintenance usage for the group. Tone decoder usage varies according to the line-to-trunk ratio on the SM.

Tone decoders should be monitored for any groups that approach or exceed capacity (1442 CCS per 56 decoders at 1.0 percent blocking). When the tone decoders exceed capacity, originating calls suffer. Originating customers cannot be provided dial tone if a tone decoder is not available. Corrective actions may include the addition of more tone decoders, or moving tone decoders from one SM to another.

10.13.1.5 Feature Impact

The use of features or implementation of new features has no effect on TDs except in the event that the features cause an increase in call volumes.

10.13.1.6 Transition Impact

Tone decoder circuits are installed on a per SM basis. Data base changes are required to indicate the availability of the additional TDs to the software release. Information related to growth of TDs can be found in the following documents:

- 235-118-XXX - *Recent Change Procedures*
- 235-105-231 - *Hardware Change Procedures*
- 235-600-30X - *Equipment Configuration Data*.

10.13.2 REVERTIVE PULSE TRANSCEIVERS

10.13.2.1 Description

The revertive pulse (RP) transceivers may be employed in the 5ESS[®]-2000 switch LDSU to provide RP signaling. This method of signaling originated with panel offices and is present in No. 1 Crossbar and the 1/1A ESSTM switch. This allows the 5ESS[®]-2000 switch to process originations from, and terminations to offices which use RP signaling.

Three types of interoffice RP connections are supported in the 5ESS[®]-2000 switch. These are:

- End office to end office
- End office to tandem office
- Tandem office to end office.

Each trunk carries the same number of selections. The RP trunks are maintained in RP trunk groups, and the trunks are 1-way only. Further, all RP trunks are digital trunks; analog RP trunks are not supported. If necessary, D4 channel banks may be used to convert analog trunks to digital trunks.

When an RP call is detected, the RP trunk is connected to the selected RP transceiver through the time slot interchanger (TSI). The RP transceiver has a dedicated time slot to provide the required signaling function. The RPs are generated at the terminating end of the trunk, and the transmitting office counts the pulses and transmits the start and stop signals to the terminating office.

The signaling interface between the RP trunks and the RP transceivers consists of the "A" and "B" signaling bits of the T1 digital trunks. The possible A-B states and their meaning are given in Table 10.13-1.

Table 10.13-1 T1 Signaling Bit States for Revertive Pulse Signaling

A	B	STATE
ORIGINATING OFFICE TRANSMITTING A-B		
0	0	Stop Pulsing (Open Loop)
1	1	Start Pulsing (Trunk Seizure)
TERMINATING OFFICE TRANSMITTING A-B		
0	1	Normal Battery Without Pulse
0	0	Normal Battery With Revertive Pulse
1	0	Reverse Battery

The RP transceiver is capable of transmitting and receiving the RP selections via the "A" and "B" signaling bits. It also performs the various handshake protocols and timing required for RP signaling.

10.13.2.2 Engineering Considerations

Each LDSU service group may have one RP transceiver circuit board. Each board contains 32 RP transceiver circuits; however, all of these circuits need not be equipped in the SM. When fully equipped, the service group can handle 32 concurrent RP calls. This may be any combination of originating or terminating calls.

The real time required by an RP call is approximately the same as other trunk calls, in both the AM and the SM.

10.13.2.3 Assignment Guidelines

The RP transceivers are installed in the LDSU. Assignments are not required other than the recent change procedures required to indicate the availability of these circuits. Each RP trunk must have the appropriate assignments made through the recent change procedures. Refer to 235-118-XXX - *Recent Change Procedures* for these assignments.

10.13.2.4 Measurements and Key Service Indicators

Section 25 of the 30-minute traffic report contains measurements associated with the RP transceivers. These measurements include peg count, usage, overflow, and maintenance usage. These measurements are taken for each SM. 235-070-100, *Traffic and Plant Measurements, Appendix 1* provides additional information concerning these measurements.

10.13.2.5 Feature Impact

The use or implementation of features has no impact on RP transceivers.

10.13.2.6 Transition Impact

The RP transceivers are not affected by growth procedures other than the growth of RP trunks which provide additional load for the transceivers. The measurements should be monitored subsequent to that type of growth to ensure that overflow situations do not occur.

The growth of RP transceivers may be done through the installation of additional RP transceiver circuits (if necessary) and defining them in the data base. This is done through recent change procedures. Refer to the following documents for information related to these growth procedures:

- 235-118-XXX - *Recent Change Procedures*
- 235-105-231 - *Hardware Change Procedures*
- 235-600-30X - *Equipment Configuration Data*.

10.13.3 LOCAL DIGITAL SERVICE UNIT WORKSHEET

The following paragraphs identify the columns of the LDSU worksheet (Figure 10.13-1) and describe the calculations required to complete the worksheet.

- (A) Decoders Installed per SM: The number of tone decoders installed per SM. In some offices, the last SM may have a different number of tone decoders than the other SMs in the office. Obtain this number from the switch or the telephone equipment order (TEO).

$\text{Decoders per SMs} + \text{Decoders in Last SM} = \text{Total Decoders Column A}$

- (B) Engineered Blocking Criteria: The blocking criteria used to engineer this component. Valid entries include the following percents blocking: 0.05, 0.1, 0.5, 1.0, 1.5, 2, 3, 4, 5, 6, 7, 8, 9, and 10.
- (C) CCS Capacity per SM: The CCS capacity from the appropriate Poisson Table, based on the number of UTDs (universal tone decoders) installed per SM and the percent blocking.

- (D) Number of SMs Installed: The number of SMs installed in the office. Obtain this number from the switch or the TEO.
- (E) Total Exchange CCS Capacity: The total CCS capacity of the installed UTD for the office. To calculate:

CCS Capacity Per SM <i>Column C</i>	×	Number SMs Installed <i>Column D</i>	=	Total Office CCS Capacity <i>Column E</i>

- (F) CCS Usage Data Today - Equivalent Main Station and Trunk Demand: The number of main stations plus the number of equivalent trunks. To calculate, multiply the working trunks by 1.6, then add the working main stations. Each trunk will average 1.6 times the usage of an average main station. (Exclude trunks that are from a step-by-step office, immediate start or bylink.) Obtain these numbers from the current office main station and trunking report.

$$\text{Working MSs} + (\text{Working Trunks} \times 1.6) = \text{Equivalent MSs}$$

- (G) CCS Usage Data Today - CCS Demand: The CCS demand on the UTD circuits today. Read value from the current office engineering data.
- (H) CCS Usage Data Today - CCS per Equivalent Main Station: The UTD circuits, CCS usage per equivalent main station at which the office is running today. Obtain figure from the current office engineering data or calculate:

CCS Usage Data - Today CCS Demand <i>Column G</i>	=	CCS Usage Data - Today CCS per EMS <i>Column H</i>
EMS Demand <i>Column F</i>		

- (I) CCS Usage Data - EOP - EMS Demand: The number of main stations plus the number of equivalent trunks for EOP, or the highest demand during the engineering period. (Exclude trunks from a step-by-step office, immediate start or bylink.) Obtain these numbers from the main station forecast and the trunking forecast.
- $$\text{Forecasted MSs} + (\text{Forecasted Trunks} \times 1.6) = \text{Forecasted Equivalent MSs}$$

$$\text{Forecasted MSs} + (\text{Forecasted Trunks} \times 1.6) = \text{Forecasted Equivalent MSs}$$

- (J) CCS Usage Data - EOP - CCS per Equivalent Main Stations: This number represents the tone decoder CCS usage per equivalent main station at which the office is forecasted to be running at the EOP. Since main stations and CCS per main station may grow at different rates, projections of future demand for each must be made separately. The current CCS/EMS may need to be used if no forecast exists.
- (K) CCS Usage Data - EOP - CCS Demand: The forecasted CCS demand on the UTD circuits at the EOP. To calculate:

CCS Usage Data - EOP EMS Demand <i>Column I</i>	×	CCS Usage Data - EOP CCS/EMS <i>Column J</i>	=	CCS Usage Data - EOP CCS Demand <i>Column K</i>

- (L) Equivalent Main Station and Trunk Capacity - Today: The equivalent main station capacity that the UTD circuits are capable of handling today, based on the current CCS per equivalent main station. To calculate:

Total Office CCS Capacity <i>Column E</i> CCS/EMS <i>Column J</i>	=	Equivalent Main Station and Trunking Capacity EOP <i>Column M</i>

(M) **CCS Load Percent Utilization - Today:** The maximum CCS load being used today. To calculate:

CCS Usage - Today CCS Demand <i>Column G</i>			CCS Load Percent Utilization Today <i>Column N</i>
Total Office CCS Capacity <i>Column E</i>	× 100 =		

(N) **CCS Load Percent Utilization - EOP:** The maximum CCS load that will be used during the period. To calculate:

CCS Usage Data - EOP CCS Demand <i>Column K</i>			CCS Load Percent Utilization - EOP <i>Column O</i>
Total Office CCS Capacity <i>Column E</i>	× 100 =		

OFFICE _____
DATE _____

*SESS™ SWITCH EQUIPMENT UTILIZATION

EFFECTIVE PERIOD:

FROM _____ TO _____

LDSU DIGITAL SERVICE UNITS (LDSU) TONE DECODERS

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
DECODERS INSTALLED PER SM	ENGINEERED BLOCKING CRITERIA	OCS CAPACITY PER SM	NUMBER SMS INSTALLED	TOTAL EXCHANGE OCS CAPACITY	OCS USAGE DATA TODAY			OCS USAGE DATA EOP			EQUIVALENT MAIN STATION AND TRUNK CAPACITY	OCS LOAD PERCENT UTILIZATION		
NOTES 1,2	NOTE 3	NOTE 4 BASED ON COL A	NOTE 1	C X D = E	EMS DEMAND NOTE 5	OCS DEMAND NOTE 6	$\frac{G}{F} = H$	EMS DEMAND NOTE 7	OCS/EMS NOTE 8	DEMAND 1 X J = K	TODAY $\frac{E}{H} = L$	EOP $\frac{E}{J} = M$	TODAY $\frac{G}{E} \times 100 = N$	EOP $\frac{K}{E} \times 100 = O$
SM														
LAST SM														
TOTAL														

- Notes:
- Obtain information from the switch or TED.
 - Decoder per SM + Decoder in last SM = total figure for column A.
 - Select appropriate value: 0.05, 0.5, 1.0, 1.5, 2, 3, 4, 5, 6, 7, 8, 9, or 10.
 - Use appropriate Poisson Table based on the data in columns A and B.
 - Working SMS (main stations) + (WORKING TRUNKS" 1.0) = Equivalent SMS.
 - Value from current office engineering records.
 - Forecasted main stations + (Forecasted trunks" 1.0) = Forecasted Equivalent SMS.
 - Obtain from office forecasts.

Figure 10.13-1 Local Digital Service Units Tone Decoders Worksheet

10.14 DIGITAL SERVICE UNIT — MODEL 2

10.14.1 DESCRIPTION

Beginning with software release 5E2(2), the digital service unit — model 2 (DSU-2) was available as an upgraded replacement for the local digital service unit (LDSU). The term LDSU is synonymous with the term digital service unit model 1 (DSU1). The DSU-2 performs tone generation, cadencing, and decoding. In addition to performing the local LDSU functions (tone generation and tone decoding), the DSU-2 performs the following global functions:

- Recorded Announcement Function (RAF)
- Integrated Service Test Function (ISTF).

In older offices equipped with LDSUs, 5E5 software release local area signaling services (LASS) or common channel interoffice signaling (CCIS) functions can be performed by an LDSU conversion in some of the switching modules (SMs). This conversion will upgrade the LDSU to DSU-2/LDSUF capabilities, which include; voice path assurance (VPA), individual calling line identification (ICLID), and message waiting indicator (MWI). The converted LDSU (now a DSU-2/LDSUF) however, will still not be able to perform the RAF and ISTF functions of the standard DSU-2. The conversion also removes the reverive pulse (RP) functions. With this conversion option, an office could have all three types of digital service units; LDSU, DSU-2/LDSUF, and DSU-2.

The three types can be mixed in the same 5ESS® -2000 switch office. However, they cannot be mixed in the same SM. Since RP is not available in the DSU-2, an SM requiring RP must use an LDSU. The DSU-2 is a versatile unit that uses a digital service circuit (DSC) pack. The DSC board consists of a logical processor (Intel 80186) and seven digital signal processors (DSPs) as shown in Figure 10.14-1. One DSC pack can replace an entire service group of LDSUs having nine packs (one control pack, one UTG pack, and up to seven UTD packs), with substantial cabinet space savings. This is simply a hardware reduction whereby an entire shelf of 18 circuit packs which provide the 2 service groups of the LDSU can be replaced by 2 DSC circuit packs, 1 for each service group. The DSU-2 is much smaller than the previous LDSU and offers a substantial cost advantage. Additionally, the DSU-2 simplifies the introduction of new services, such as the following:

- VPA which is required with common channel signaling (CCS).
- Centralized automatic message accounting - transfer decoder (CAMA-TD)
- Analog incoming calling line identification (AICLID)
- Analog visual message waiting indicator (AVMWI).

Only one DSP is needed for tone generation, and the remainder of DSPs can be provided for TDs. (Each DSP can provide the same functions as 5 TDs used in prior software release programs.) The TDs do not require administration, and the TDs are administered in the same manner as those provided with previous software releases.

10.14.2 Digital Service Unit 2 - Recorded Announcement Function

The DSU-2/RAF can provide independent playback of prerecorded, variable length, and variable content OSPS and BRCS announcements. Each DSU-2/RAF service group provides the following features:

- Thirty-two simultaneous, independently phased, announcement channels
- A storage architecture where the prerecorded announcements are accessible by all the channels simultaneously

- The ability to grow the announcement storage capacity to 1250 seconds of speech
- The ability to play back stored variable length and variable content announcements.

For toll and assistance applications, the DSU-2/RAF-dial through announcement (DTA) configuration provides the same features except that only 20 simultaneous, independently phased, announcement channels can be provided.

Announcements provided through the DSU-2/RAF are predetermined for all applications and cannot be changed on site.

A community of DSU-2/RAF announcements is available for BRCS features. This community (DSU-2/RAF-BRCS) is maintained and engineered separately.

The SM configuration for dial through announcement (DTA) includes basic, standard, and loaded configurations, depending upon the application. Software release 5E6 served by the BRCS RAF community added LASS SLE. In addition, a community was added for the ASP feature. All features provide the capability to customize announcements and LASS SLE provides the capability to customize ISDN display messages in the field.

LASS SLE is compatible with Bellcore requirements. The compatibility is achieved with the introduction of circuit pack MC5D143A3. This pack contains the full complement of phrases needed to construct the required announcements.

10.14.3 DSU-2/RAF — BRCS

The ability is provided for the DSU-RAF-BRCS to interact with an analog dial pulse, touch-tone, or ISDN station set to provide interactive announcements and digit collection of DNs for all the LASS selective features (LSF). The DSU-RAF-BRCS is only used during the screen list editing and feature activation or deactivation. The DSU-RAF-BRCS is not used for the individual screening of incoming calls. The screening is performed by the LSF software. Digit collection is performed by UTD for intraswitch or obtained from CCS messages for interswitch. With the 5E5 software release, a new community of DSU-2/RAF announcements is available for BRCS features. This new community (DSU-2/RAF-BRCS) is maintained and engineered separately.

The features served by this RAF community are:

- Automatic customer station rearrangement (ACSR)
- Remote access to call forwarding (RACF).

10.14.3.1 Engineering Considerations

One DSU-2 circuit pack offers the equivalent service of 20 tone decoders. Therefore, an SM equipped with a DSU-2 (containing two circuit packs - one per service group) has an operations, administration, and management (OA&M) capacity of 1,043 CCS. This is the equivalent of 40 tone decoders. Each DSU-2/RAF service group can provide up to 32 (20 in the case of the dial-through application) variable length announcements. The total amount of time available for all announcements is 1250 seconds. Two or more service groups may be provided. The standard capacities for the DSC pack in the DSU-2 apply to DSU-2/LDSUF.

The DSU-RAF-BRCS are global resources. Up to eight units can be equipped in an SM (0-7). Each unit has four service groups. Each service group requires 20 DI time slots for DSU-RAF-BRCS and 32 DI time slots for ISTF. If only DSU-RAF-BRCS is equipped in an SM, only 6¼ units (or 25 service groups) can be provided. If ISTF is included, the number of units is reduced, depending upon the number of ISTF provided. The DSU2-ISTF requires the loaded software configuration. Any line in an office may be equipped with LASS-screen list editing (SLE). The capacity of DSU-RAF-BRCS is shown in Table 10.14-1 for from 1 to 24 service groups. The recommended blocking in Table 10.14-1 is P0.01. The CNI ring is limited to five link pairs, digital or analog or both.

Table 10.14-1 Poisson Capacity for DSU/RAF-BRCS for RACF, ASCR, and LSS-SLE

SERVICE GROUPS PROVIDED	EQUIVALENT CIRCUITS	CCS CAPACITY P0.01
1	20	399.0
2	40	963.6
3	60	1564.5
4	80	2184.1
5	100	2815.6
6	120	3455.7
7	140	4102.1
8	160	4753.7
9	180	5409.4
10	200	6068.6
11	220	6730.8
12	240	7395.5
13	260	8062.5
14	280	8731.5
15	300	9402.3
16	320	10074.7
17	340	10748.7
18	360	11423.8
19	380	12100.3
20	400	12777.9
21	420	13456.5
22	440	14136.1
23	460	14816.1
24	480	15497.9

10.14.3.2 Assignment Guidelines

The design of the local digital service unit function (LDSUF) provides a fixed number of resources (time slots and DSPs) that must be assigned to one of four possible functions. The four possible functions are tone generation, tone decoding, tone transceivers, and CAMA tone. The assignments required are dependent upon the features in the office or on a given SM.

Time slots on the LDSU bus (LDSUB) are allocated to the DSPs via translations on the office data administration system (ODA) record 5470. On this record, DSPs can be assigned the following functions:

- Tone Generation - a maximum of 31 transmit time slots
- Tone Decoding - a maximum of 5 receive time slots per DSP
- Tone Transceiver - a maximum of 5 transmit and receive time slots per DSP
- CAMA Transfer Decoder - a maximum of 10 receive time slots per DSP.

When assignments are made to the DSPs, a total of 31 transmit time slots and 30 receive time slots can be assigned.

For maintenance purposes, DSPs should always be assigned in pairs - equal number of time slots in each of two service groups.

Figure 10.14-2 shows two assignments of DSPs that can be done on an office basis. Figure 10.14-2 A is the case where there is no VPA, AVMWI, or AICLID. One DSP is always required for UTG while the remaining six DSPs are assigned to UTD. This would provide the equivalent of 62 UTG channels and 60 UTD channels (or the maximum allowed). Figure 10.14-2 B is the case where VPA, AVMWI, or AICLID is required in the office. In this case, one DSP is assigned to UTG; five are assigned to UTD, and one is assigned to VPA, AVMWI, and AICLID. This arrangement provides 52 UTG channels, 50 UTD channels, and 10 transceiver channels for VPA/AVMWI/AICLID.

Assignment rules for LDSUs converted to DSU-2/LDSUF are the same as for DSU-2.

The SLE and LSF features are supported on basic, standard, and loaded SM software configurations. Each LSF can have a different maximum size list defined on the 5945 record. The minimum value for each list is recommended as 6 and the maximum value is 31. The DNs are stored as multiples of 6; thus, sizes of 6, 12, 18, 24, and 30 are optimal. The LSF is available on an individual line basis or on a global office basis. The exception is multiline hunt groups (MLHGs) which requires individual assignments. The SLF lists for MLHG is located on the SM that contains the first member (member 0) of the group and on the SM that contains the routing information for the MLHG. Both flat-rate or usage-sensitive billing is available for SLE and LSF features.

10.14.3.3 Measurements and Primary Service Indicators

The measurement in Section 46 of the 30-minute traffic report includes a peg count of the DSU-2/RAF circuits as follows:

- Access
- Overflow
- Maintenance Usage
- Total Usage.

10.14.4 DSU-2/RAF — ASP

10.14.4.1 Engineering Considerations

There are no capacity considerations associated with this feature.

10.14.4.2 Assignment Guidelines

The DSU-2/RAF for ASP should be engineered using Poisson P.01 table. The traffic load depends upon the number of ASP calls requiring DSU-2/RAF and the average holding times for the announcement and/or digit collection. The following call types are examples of call types requiring DSU-2/RAF.

- IDDD access
- Authorization codes
- Remote access to PVN
- Call screening (originating).

A default holding time of 30 seconds should be used when measured holding times are unavailable.

Each DSU/RAF serving group provides 20 servers. The number of DSU/RAF-ASP groups required is calculated as follows:

$$\text{ASP\_Servers} \div 20 = \text{DSU/RAF-ASP Groups}$$

This calculation is the number of ASP servers divided by 20 and rounded up. Each group requires 20 time slots, and the number of TSS required is calculated as follows:

$$(\text{DSU/RAF-ASP groups per SM} \times 20) \div 32 = \text{ASP\_TSSs}$$

This engineering results in all of the DSU/RAF-ASP groups being equipped in the same SM. If the customer wants to distribute the groups in different SMs, the Time Slot Set calculation must be performed for each SM with DSU/RAF-ASP groups.

10.14.4.3 Measurements and Primary Service Indicators

The TRFC30 Section 118 provides measurements for the ASP feature and include.

- Call processing failure before initial query
- Call processing failure after initial query
- Resources unavailable before initial query
- Resources unavailable after initial query
- Network management control block
- Signal failure due to time-out
- Invalid command message
- Invalid sequence message
- Return error, reject message, or return query received
- Abandons before outpulsing
- Abandons after outpulsing
- Inter-Local access and transport area (LATA) carrier trunks busy
- Service provider trunks busy
- ASP calls originating in the SSP
- ASP calls originating in the network access point (NAP)
- ASP calls received from a NAP
- ASP queries sent to a service control point (SCP)
- Response messages received
- Play announcement messages.

10.14.5 FEATURE IMPACT

In offices employing VPA, AVMWI, and/or AICLID, the use of those features has an impact on the associated DSP. The feature impact for DSPs providing TD or UTG functions are the same as described for the LDSU.

The DSU-2 cannot provide RP signaling.

10.14.6 TRANSITION IMPACT

The DSU-2 is installed on a per SM basis. Data base changes and hardware assignments are required as previously described. Information concerning the conversion from LDSU to DSU-2 can be found in 235-105-231, *Hardware Change Procedures*. The LDSU can be converted to an equivalent DSU-2/LDSUF by removing the UTG and UTD packs and replacing the common board with a TN1637.

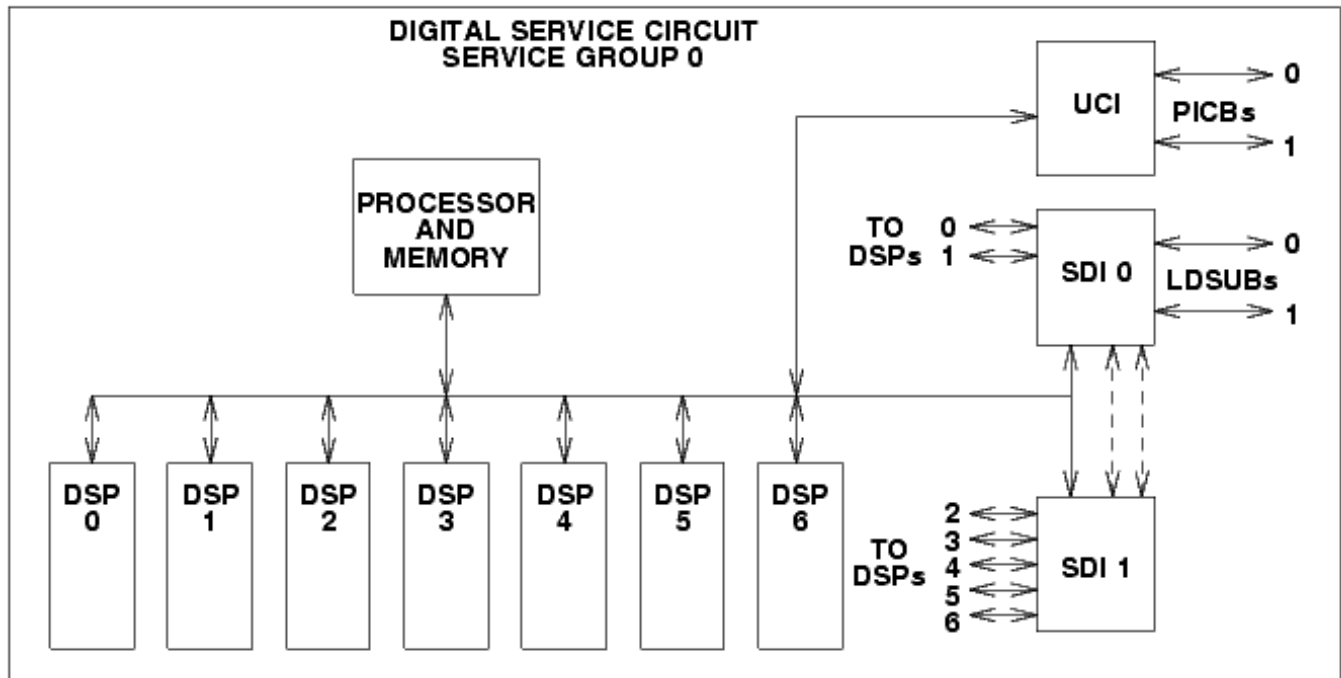
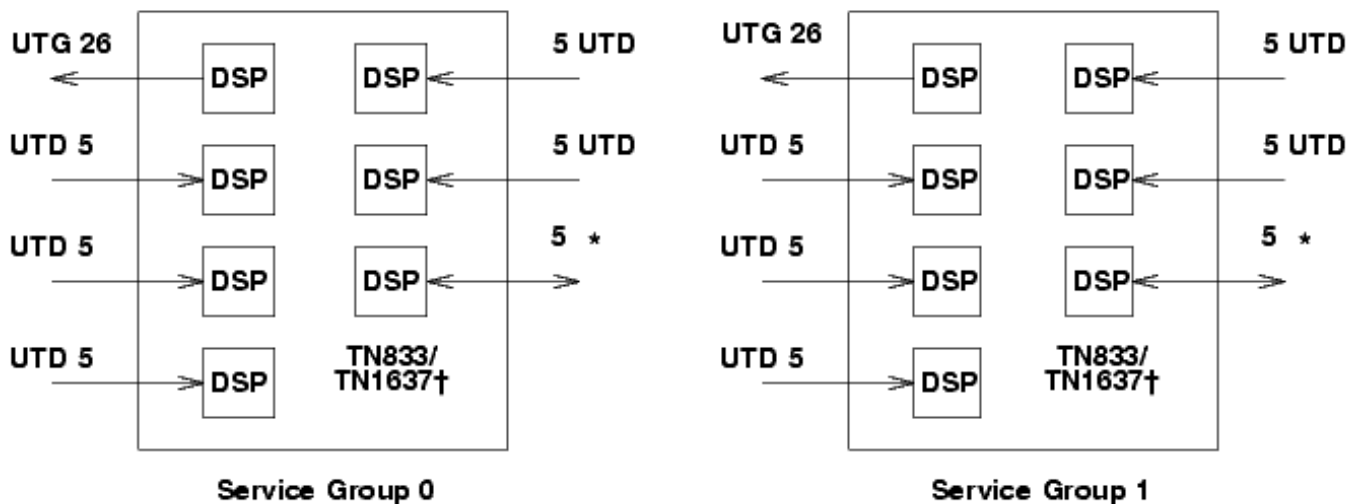
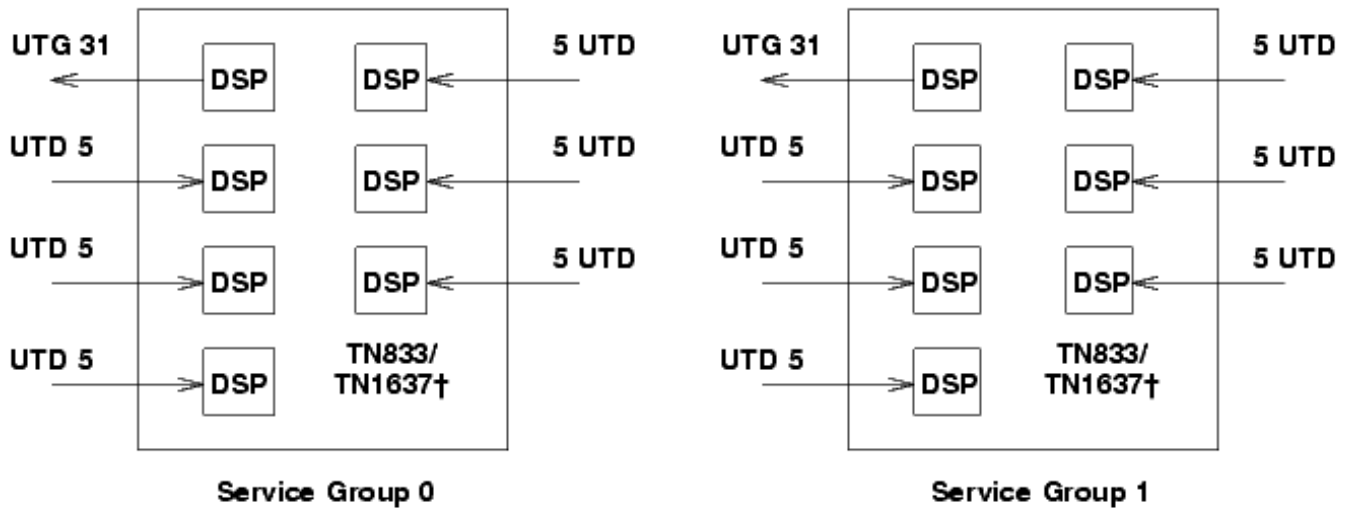


Figure 10.14-1 Digital Service Unit Model 2



* for VPA/AMWI/AICLID

† Applicable to 5E5 and later software releases.

Figure 10.14-2 Recommended Assignments Per Office

10.14.7 Service Announcement System

The Service Announcement System (SAS) is a high capacity announcement system for the 5ESS®-2000 switch. The SAS provides a significant increase in the number of announcements and announcement seconds supported. The SAS provides transparency with the existing RAF functionality, and can be used for Dial Through Announcement (DTA), Announcement Only Channel (AOC), Directory Assistance (DA), or COIN applications.

The SAS hardware is modified from the Digital Service Circuit 3 (DSC3) technology. Each SAS Physical Service Group (PSG) requires one SASDSC which interfaces with a single PIDB/PICB to provide full support for 32

announcement ports and/or MF/DTMF/Coin Detection. In addition to the SASDSC board (TN1841), a SAS PSG consists of 1 to 4 memory boards (TN1842), with each memory board containing up to 8 industry standard (PCMCIA/JEIDA) flash cards. The number of announcement seconds that can be provided depends on the flash card memory density. An individual flash card is given by:

$$\text{ANN (seconds)/CARD} = (\text{Flash Card Density (in MB)} - .5 \text{ MB}) \times (2^{20} \text{ bytes/MB}) \times (.096 \text{ sec} \div 774 \text{ bytes})$$

Therefore, a 20MB flash card can store 2,536 announcement seconds. The maximum announcement storage capacity per SAS PSG with 31 cards of 20MB density is 78,611 seconds (assuming one card is reserved). The SAS PSG is added to the DSU2 shelf space; no backplane changes are required.

10.14.7.1 Feature Overview

The following issues should be considered when deploying SAS:

- SAS/RAF PSGs can be mixed on the same DSU2 shelf in an SM (not SM-2000).
- A maximum of 8 PSGs can be on one DSU2 shelf
- SAS/RAF PSGs can be mixed within a given application (for example, Logical Service Group (LSG))
- Flash cards of varying density can be mixed in the same SAS PSG, and on the same memory board
- SAS PSGs should reside only on loaded SMs.

10.14.7.2 Service Provider Perspective

SAS hardware technology is based on the Digital Service Circuit 3 (DSC3), developed for SM-2000. Each SAS physical service group will have 1 to 4 memory boards, with each board having slots for 8 flash memory cards. SAS Service Groups will have 1 SAS-DSC control card; The SAS platform on SM-2000 effectively increases the announcement capacity on standard SMs while remaining compatible with existing RAF hardware and announcement administration.

The memory boards are designed to handle any PCMCIA compliant flash card. The design also allows the board to operate with flash cards of varying capacity, and with 1 or more empty flash card slots. To facilitate announcement updating and emergency restoration of announcements, each flash card will store information describing the phrase data stored on that card, and data for any given phrase will not be allowed to cross flash card boundaries.

Using 20 MB flash cards, a fully loaded SAS will be able to provide over 70,000 seconds of non-compressed announcement data, the equivalent of over 60 fully loaded RAFs.

Because of RAF transparency, SAS will have as many (if not more) Announcement Headers and Phrase IDs as is used for RAF. The number of announcement headers is 64,000. Thus, SAS will be able to play over 64,000 unique announcements.

It is possible to construct SAS announcements using 67 concatenated phrases (the current RAF limit).

SAS will support 32 ports, any number of which can be configured as Dial Through Announcement (DTA) ports. (A maximum of 20 of the RAF's 32 ports can be configured as DTA ports.)

10.14.7.3 Compatibility with Existing Hardware and Announcement Administration

SAS is upward compatible with existing RAF related application software and announcement administration procedures. SAS meets or exceeds the RAF's ability to provide multiple ports, interruptible and non-interruptible announcements, variable length announcements, variable content announcements, multiple playback modes, all

existing tone detection (including coin and DTMF), dial-through announcements, and other capabilities provided by the RAF. SAS will also meet or exceed RAF standards of responsiveness and reliability, and be able to work under the RAF principles of announcement indexing and phrase concatenation. Thus, while new office data will be introduced, it will not be necessary to modify existing application software and recent change procedures to accommodate the SAS -- which will be able to generate announcements based on the same data stream currently used to generate announcements in the RAF.

Service Announcement Systems will be able to co-exist with RAFs in the same DSU2 housing and in the same logical service group in the SM. When combining SASes and RAFs in the same logical service group, care must be exercised to ensure that all the physical service groups (each RAF and each SAS) contain the same announcement data. If they contain different data and a trunk-hunt method is used to route to an announcement port, a port might be reached that does not have the necessary data for the intended announcement. SAS will be designed to meet general switching maintenance requirements in the areas of diagnostics, REX, repair, and fault recovery. SAS will be able to detect 95% of all faults within 1 hour of failure. Unique unit types will be used to identify the various types of SAS and RAF PSGs.

The 30-Minute Traffic Report (TRFC30) is updated to include all relevant information for engineering SAS, similar to the DSU2-RAF. This information includes peg and overflow counts for circuits by announcement application type. The affected TRFC30 sections are 44, 46, 64, 100, 101, 102, and 146.

10.14.7.3.1 SAS Administration Workstation

The Service Announcement System (SAS) provides announcements for 5ESS®-2000 switch applications. In conjunction with the SAS, a workstation is needed to administer announcements. Customers have expressed a desire for a workstation in order to administer their own announcements.

A workstation is provided with an interface to a unit that allows individual flash cards to be written. This unit fits in the same space as a floppy disk drive on a PC. This requires flash memory cards to be written and then installed into the SAS unit on the 5ESS®-2000 switch. Using this procedure, the SAS unit must be removed from service for a short period. However, since the SAS is engineered to allow for outage of individual units, this should not cause call service disruption.

10.15 RECORDED ANNOUNCEMENTS

10.15.1 DESCRIPTION

The recorded announcement arrangements provided for the 5ESS®-2000 switch are provided by 13A, 14A, 15A Announcement Systems, Record Announcement Function (RAF) and Service Announce System (SAS), and software combinations for supplying information to customers through the use of recorded announcements. Announcements are used to inform customers and operators of certain conditions. Calls can be terminated to an announcement in one of two ways. First, a call can be directed to an announcement by the call originating process. Secondly, a call can be connected to an announcement if the routing and terminal allocation (RTA) program cannot complete the routing of the call. The following types of announcements may be provided:

- Dial-tone-first (DTF) coin
- Local coin overtime
- Partial dial
- Permanent signal
- No 1+ dialing error
- Invalid digit
- Extra 1+ dialing error
- Custom calling error
- Vacant code
- Emergency overload
- Coinless public telephone (Charge-a-Call).

Additionally, intercept announcements may be provided by way of trunks to the Automatic Intercept System (AIS).

Nine optional announcements are available for local area signaling services (LASS). Three announcements (13A type) are associated with customer-originated trace (COT), and six announcements (13A type) are associated with AR/AC (automatic recall and automatic callback).

The three announcements for COT are:

- Successful activation of COT request
- COT not available announcement
- COT buffer full announcement.

The six announcements for AR/AC are:

- AC confirmation announcement
- AR confirmation announcement
- AR/AC time-out without completion of AR/AC request announcement

- AC cancellation announcement
- AR cancellation announcement
- AR/AC party busy announcement.

Route index for these announcements are defined on 5945, LASS Office Parameters Form, and 5303, Route Index Form.

The call forwarding over private facilities (CFPF) feature is available to customers with the ability to use the call forwarding variable (CFV) feature to forward calls over private facilities or services. These private facilities selected by the customer may include; foreign exchange (FX), outward wide-area telecommunications (OUTWATS), common control switching arrangement (CCSA), senderized tie trunks, or automatic route selection (ARS). The CFPF announcement, which is optional for the CFPF feature, is a non-dial-through announcement using the 13A Announcement System.

Local announcements may be provided by a recorded announcement unit (RAU) which employs the 13A Announcement System. Announcements may also be provided by the 14A Announcement System. The DSU-2/RAF may be used to provide Operator Services Position System (OSPS) announcements. The feature control (FC) software subsystem within the 5ESS[®]-2000 switch establishes the connections between the customer line and the announcement facilities.

The DSU2-RAF service group offers custom announcements. The custom announcement capability allows the service provider to selectively customize specific phrases that are linked together into an announcement. Additional instructions or advertisements may be placed at the beginning or end of standard announcements. The term "phrase" refers to a tone, word, or group of words used for announcement construction. The term "announcement" refers to the linked together set of phrases that form the entire audible announcement.

Each RAF service group is equipped with a TN1053 announcement storage circuit. This circuit contains standard phrases for the particular feature that the RAF services. Standard phrases are encoded speech that has been digitized and edited. Each RAF service group also has two expansion ports for expanded phrase storage. The expansion ports are controlled by the TN1053 and may contain a TN1054 expansion announcement storage circuit. The TN1054 circuit contains standard phrases and is used for feature needing large memory.

The custom announcements are available both as audible announcements and as integrated service digital network (ISDN) display messages. Although the Bellcore TR222 only applies to audible announcements, the ISDN display messages have been changed to be consistent with the Bellcore requirement. These additions can be ordered as a list that will be delivered on the custom pack. An equivalent set of changes for the ISDN display also exists. A recent change/verify (RC/V) view 8.65 was added to manage the display messages.

A call can be connected to an announcement for up to 240 seconds before it is disconnected by the switch.

For more details on the DSU2-RAF custom announcements refer to 235-190-115 — *Local and Toll Feature Descriptions*.

SAS provides functions that are similar to the RAF. It is capable of providing a large increase in the number of announcements, as well as the length of announcements that are available.

10.15.1.1 13A Announcement System

The main component of the RAU is the 13A announcement machines which are located in the miscellaneous cabinet. This is a totally electronic storage device which uses semiconductor memory to store a recorded message in digital form. It has a capacity of 100 simultaneous calls. There are no moving parts in this announcement machine. A maximum of four 13A announcement machines may be installed in a miscellaneous cabinet.

Each 13A announcement machine has the capability to provide up to eight channels of recorded messages; each of which provides a single recorded announcement. The circuit packs which contain the circuitry to provide a recorded announcement are called message modules. There are two types of message modules that provide the following:

- (a) Variable message length (3 to 24 seconds)
- (b) Variable message length (3 to 12 seconds).

The recorded announcement interface uses 4-wire E&M trunk circuit packs. This interface converts each of the announcement channels from analog to pulse code modulation (PCM) and sends the data to the time slot interchanger (TSI) for distribution. When a call is to be routed to an announcement, a connection is made between the calling party and the trunk circuit by way of the TSI. The recorded announcement interface is a non-barge-in type of announcement. For any 5ESS®-2000 switch that provides the CFPF service, a 13A Announcement System is required.

10.15.1.2 13A+ Announcement System

Each 13A+ Announcement System supports up to 8 announcement channels. Each announcement channel can contain an announcement of 30 seconds, 1 minute, 2 minutes, or 4 minutes. The 13A+ has a remote recording interface allowing the service provider or customer to change the recorded announcement from a remote location.

NOTE: The 13A+ Announcement System replaced the 13A Announcement System.

10.15.1.3 14A Announcement System

The 14A Announcement System provides announcements in a manner similar to the 13A Announcement System. Additionally, the 14A Announcement System provides a line-side announcement capability which is particularly applicable to remote switching module (RSM) installations.

The 14A is a microcomputer-controlled electronic announcement system which uses a multipulse predictive coding (MPLPC) speech synthesis algorithm to generate high quality speech. The announcements may be preceded by special information tone (SIT) encodings. The digital data required to generate the speech and the SIT encodings is stored in erasable, programmable, read-only memory (EPROM) which is mounted on a plug-in module.

The 14A Announcement System has two plug-in modules, each having a dedicated announcement channel when the interface is on the line side (2-wire telephone line). Each of these channels can handle a single call. Therefore, only two calls may be connected to the announcement system at a time. When interfacing the trunk side, each channel can handle up to 32 calls.

The playback only announcement module provides a single announcement of up to 26 seconds in length depending on the type of EPROM (128 K-bit or 256 K-bit) installed. The system has a 2-channel capability with each channel providing a specific announcement. The announcements are changed by unplugging the installed module and plugging in another module containing the new announcement. The playback only announcement modules are preprogrammed to provide the specific message desired. The record/reproduce (R/R) announcement modules are programmed by the service provider to provide the specific message desired. The R/R modules provide a single announcement of 30 or 120 seconds.

Since the 14A system is completely electronic, no routine maintenance is required. An on-board microcomputer routinely performs diagnostics on both the plug-in module and the announcement channel circuitry.

In a stand-alone-RSM situation, originating calls destined to terminate to lines outside the RSM may be routed to the 14A Announcement System. Ten seconds after completion of the announcement, the call is disconnected and the caller receives dial tone.

10.15.1.4 15A Announcement System

The 15A Announcement Service is a circuit with 8 channels of announcement service. Two circuit packs can be mounted side-by-side to create a 16 channel system. The 15A Announcement Service uses CMOS EEPROM technology to provide effective, non-volatile recordings (without batteries). The 15A Announcement Service also has a remote recording interface allowing the service provider or customer to change the recorded announcement from a remote location.

The 15A Announcement Service has the following circuit packs giving the user flexibility in recorded announcement service:

- BLD1** A record/reproduce unit that can provide 8 unique announcements, each with a duration of up to 20 seconds.
- BLD2** A record/reproduce unit that can provide 8 unique announcements, each with a duration of up to 40 seconds.
- 400A** A module mounting on the BLD1 or BLD2 to provide remote record capability.

Table 10.15-1 shows the valid circuit pack configurations for the 15A Announcement Service.

Table 10.15-1 15A Announcement System Valid Configurations

CONFIGURATION (^a)					
	1	2	3	4	5
8 channel	BLD1	BLD1	BLD2	BLD2	BLD1
16 channel	NE	BLD1	NE	BLD2	BLD2
Notes:					
a. NE = not equipped					

10.15.2 ASSIGNMENT GUIDELINES

10.15.2.1 General

For each announcement that terminates on a trunk, the 5ESS[®]-2000 switch can fan out only 32 callers onto one announcement trunk or to reorder. If one announcement channel is repeatedly used in a high volume (greater than 32 simultaneous calls), try to spread the overflow to the same announcement in another trunk unit in a different SM. The announcements are assigned on a per-system basis. In some cases, the operating telephone company may have a choice to provide reorder tone instead of an announcement. This provides an equipment choice in terms of announcement facilities, but it provides more load on the tone generators.

All locally provided announcements can be provided on either a barge-in or non-barge-in basis. It is recommended that all announcements except the emergency overload announcement be provided on a non-barge-in basis. The software release selects the announcement circuits based on the type of announcement required. The telephone company must assign that announcement on a barge-in or non-barge-in basis, as desired.

In the case of the RAU, the assignment of announcements involves the use of trunk circuits in the trunk unit (TU) which is described elsewhere in this manual. Details concerning the assignment of trunk circuits can be found in Translation Guide TG-5 and 235-118-200 — *Recent Change Procedures Menu Mode* or 235-118-202 — *Recent Change Procedures Text Interface*.

In the case of the 14A Announcement System, the announcement may be provided by line-side or trunk-side connections. If a line-side application is employed, a directory number (DN) must be assigned to each of the announcement channels, and the ports must be defined in the office dependent data (ODD). Additionally, both lines should be in a uniform call distribution (UCD) hunt group. Refer to the descriptions of the line unit (LU) and the

RSM elsewhere in this manual in addition to the TG-5 and recent change documents for details concerning the assignment of line equipment.

The CFPF, ACSR, and RACF features will not affect the present load balance assignment rules for analog or digital lines.

Once the new phrases are added to either a new office or to a retrofitted office, the line assignments can be made for the feature that uses the new announcements. Customized announcement lengths that are appreciably longer than standard announcements have an effect on traffic engineering.

When the queuing feature is used as part of the MLHG call scenario, announcement circuits that occupy only one time slot on the peripheral side can occupy up to 20 time slots on the network side. These 20 time slots are occupied by the queued calls. Spread or provision each queuing trunk to occupy 20 time slots on the peripheral side if engineering did not provide adequate time slot sparing.

10.15.3 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

10.15.3.1 General

Measurements associated with the the DSU-2/RAF are contained in Section 46 of the 30-minute traffic report. These measurements are counts of total access, overflow, maintenance usage, and total usage. Refer to 235-070-100, *Traffic and Plant Measurements, Appendix 1* for further discussion of these measurements.

No additional measurements are provided with the CFPF feature. This data may be collected in TRFC30, Section 29, business residential customer feature, and Section 30, terminal group measurements. Measurements for each announcement is located in TRFC30 Section 12.

10.15.4 FEATURE IMPACT

The use of features or the implementation of new features generally have no impact on the recorded announcements. An exception to this is the implementation of the carrier interconnect (CI) feature. The implementation of the CI feature may involve additional announcements specifically developed to support calls involving the use of carrier facilities. These announcements are optional; and if provided, may require additional announcement frames and/or additional announcement machines.

10.15.5 TRANSITION IMPACT

Additional recorded announcements are implemented through the addition of new message modules, new announcement machines, or in some cases, the addition of new miscellaneous frames. Recent change procedures are required to make the new announcements available for use. The addition of new announcement facilities has no impact on existing announcement facilities. For further details concerning this growth procedure, refer to the following documents:

- 235-118-XXX — *Recent Change Procedures*
- 235-105-231 — *Hardware Change Procedures*
- 235-600-30X — *Equipment Configuration Data*
- 235-190-115 — *Local and Toll System Features.*

Custom announcements are provided on a TN1054 that resides in one of the expansion slots in the DSU2-RAF. To order custom announcements, fill out the order form obtained from DOPS engineering information and attach the form to the telephone equipment order. The J-drawing J5D003EA-1 lists 15A and MA-MK are available to order

standard announcements and messages as well as Bellcore and customized changes. SAS is provided on the TN1841 and TN1842 boards.

In a retrofit environment, standard packs and messages should be installed before the retrofit. This can be done by growing the standard announcement packs and assigning a telephone number to an ISDN SM before the retrofit. Lucent Technologies then maps the standard announcements and messages during the retrofit process. After the retrofit, the custom pack can be grown and the RC/V tape and script can be loaded. The custom pack can also be grown prior to the retrofit. The announcements may now be customized. As a general rule, the standard announcements and messages must be in the software before customization can proceed. Also, before the tape can be loaded, RC/V 8.64 must be completed. View 8.64 shows the applications(s) and the SM(s) that contain the RAF hardware.

11. RSM UNIQUE RESOURCE UTILIZATION

11.1 DESCRIPTION

The remote switching module (RSM) is a switching module (SM) located remotely from a host 5ESS®-2000 switch office and connected via T1 carrier, digital radio, and/or fiber optics. Figure 11-1 provides a simplified block diagram of typical RSM interconnections to the 5ESS®-2000 switch office. The RSM can terminate a maximum of 5,120 analog lines at a 10:1 concentration ratio (although this is not normally recommended). This number assumes no trunks and no optional equipment such as announcement machines which require trunk units (TUs). More realistic maximums when trunking and optional equipment are included are approximately 3,000 lines for the single-module RSM. The following conditions reduce the number of lines that the RSM can terminate:

- Lower concentration ratios such as 8:1 (4,096 lines), 6:1 (3,072 lines), or 4:1 (2,048 lines)
- Terminating pair gain systems
- Providing local announcements, remote testing capabilities at the RSM, or private branch exchange - direct inward dialing (PBX-DID) trunks
- Each TU provided reduces the line capacity.

The function of the RSM is to provide the switching capabilities of the 5ESS®-2000 switch to areas that cannot economically support an ESSTM switch. The RSM offers custom calling features to areas normally served by community dial offices (CDO) or small wire centers. In addition, the RSM performs switching functions for large pair-gain systems.

The RSM has additional software that enables the RSM to operate if control links to the host SM fail. The RSM can share the normalized office code designation of the host 5ESS®-2000 switch if the wire center is within the same rate area. If the wire center is not within the same rate area, a dedicated normalized office code that is separate from the host must be assigned.

The RSM has the following characteristics:

- Provides the same service as a host SM
- The ability to transmit traffic and other administrative data to the host office
- A zero resistance point for the loop plant
- Intraswitching of local RSM calls
- Stand-alone capability to provide autonomous local switching if facilities at or between the host office and the RSM fail
- Single-route access via the host office to the toll network as well as to other local offices
- A dedicated normalized office code, if required
- Access to all operating support systems available to the host office.

The RSM offers capabilities to terminate analog lines and pair gain systems such as the SLC® 96 carrier system and provides all the features available at the host SM.

The RSM consists of standard SM cabinets. However, the RSM uses a facilities interface unit (FIU) to convert data

received from the host office. The function of the FIU is to recover data, control, and timing information from the T1 line and to format this information into a pair of network control and timing (NCT) link signals.

All trunk types supported by the 5ESS[®]-2000 switch host office are also supported by the RSM.

The single-module RSM refers to a single-remoted SM connected to the host 5ESS[®]-2000 switch by T1 carrier or other transmission facilities.

11.2 HOST TO RSM/ORM/EXM-2000 DISTANCE

In order to meet transmission performance requirements, the RSM must be within 150 miles of its host 5ESS[®]-2000 switch. If a SLC[®] 96 carrier system is hosted by an RSM, the maximum combined distance from the host 5ESS[®]-2000 switch to the SLC[®] 96 carrier system is 120 miles (that is, host 5ESS[®]-2000 switch to RSM distance plus RSM to SLC[®] 96 carrier system distance). The distance limitations for the EXM-2000 are identical to the RSM/ORM. The Far Access Remote (FAR) feature enables Remote Switching Modules to be located at greater distances from the host Switching Module. With this feature, RSM and EXM-2000 can be placed up to 600 miles from the host.

11.2.1 TRANSMISSION CONSIDERATIONS

For further information about transmission considerations concerning the distance between host office and RSM/ORM/EXM-2000, see 235-900-1XX.

11.3 TRANSMISSION FACILITIES

Transmission facilities other than copper T1 cable (or T1 compatible) can be used for the umbilical links. The transmission facilities include:

- Fiber optic
- Digital radio.

11.3.1 OPTICALLY REMOTED MODULES (ORMs)

The term optically remoted module refers to standard SMs of the 5ESS[®]-2000 switch whose four NCT links are "stretched" via various optical and electrical transmission equipment beyond the constraints of the 5ESS[®]-2000 switch location. The ORM provides all customer services at the remote location as is provided by the host switch. In this case, the interface to the 5ESS[®]-2000 switch is made at the communications module (in the form of NCT links) instead of at a host SM (in the form of RSM umbilicals) as is required for an RSM.

AN ORM/2-mile ORM (ORM/TRM) feature enables sharing of the alarm status circuit (ASC), directly connected test unit (DCTU), and modular metallic service unit (MMSU) among ORM/TRMs that are located in the same building.

11.3.1.1 ORM Using Transmission Rate Converters

The lightwave termination and multiplex assembly (LTMA) equipment is available and can be used to multiplex up to 28 T1 facilities into a single DS3 rate (44.736 MB/s) channel for optical fiber transmission. This equipment can be used in lieu of the copper T1 cable for the RSM umbilical.

Transmission rate converters are required at the 5ESS[®]-2000 switch and the ORM to provide the conversion from the transmission rate of the communications module (32.768 MB/s) and the DS3 facilities (44.736 MB/s). This configuration is shown in Figure 11-2.

Fiber regenerator technology offers a wide variety of transmission systems allowing communication links up to hundreds of miles. Consequently, the distance limitation due to a fiber link is based on the listener echo requirements. The recommended maximum 5ESS®-2000 switch host to RSM distance using a fiber connection is 150 miles. Note that the fiber-optic repeaters must be located in a temperature controlled environment.

11.3.1.2 TRCU2

The transmission rate converter unit - model 2 (TRCU2), can be configured to support either clear channel DS3 electrical signals (TRCU2-E), or high rate (90 MB/s) optical signals (TRCU2-O). The TRCU2 allows ORM's three different versions of host/remote transmission interfaces:

- A 2-mile optical remote switching module (TRM) which is an SM using extended NCT links with more sensitive optical receivers.
- The 120 to 150-mile ORM utilizes a transmission rate converter unit (TRCU) or a TRCU2-E (DS3 connect option) at each end of the NCT links which allows it to interface to standard transmission facilities for the remote and host connection.
- The 44 mile version of the ORM uses a 90 MB/s multiplexed TRCU2-O (fiber connect option).

11.3.1.3 TRCU3

The TRCU3 feature provides the capability to remote an EXM-2000 or an Optically Remoted Switch Module (ORM). The TRCU3 incorporates circuit packs that support the conversion of NCT/NCT2 5ESS®-2000 switch signals into STS1. These circuit packs are used along with circuit packs derived from the DDM-2000 OC-3 multiplexer creating a new unit called TRCU3. The TRCU3 is capable of terminating an NCT or NCT2 link and capable of generating a SONET signal output. The TRCU3 is a replacement for the existing TRCU2 functionality, which is being manufacture discontinued, the TRCU3 provides additional capability. This capability is being implemented with a circuit pack (NCT or NCT2) which occupies a DS3 function slot in the DDM-2000 OC-3 Multiplexer. For this development, the TRCU3 created shall be equipped with either the NCT or NCT2 circuit packs and a base of DDM-2000 OC-3 packs (OLIU, OHCTL, SYSCTL, TGS). The following distinctions should be note

- The TRCU3 unit equipped with the NCT packs and the base of DDM-2000 OC-3 packs are used to remote ORM's. The NCT circuit packs terminate NCT links from the Communication module or from the ORM.
- The TRCU3 unit equipped with the NCT2 packs and the associated DDM-2000 OC-3 packs will be used to remote EXM's. The NCT2 circuit packs terminate NCT2 links from the Communication Module or the EXM.

11.3.1.4 2-Mile ORM

If the ORM can be positioned within 2 miles of the 5ESS®-2000 switch, fiber-optic links can be provided without the need for transmission rate converters or DS3 rate transmission facilities. In this case, the usual NCT links are simply extended up to 2 miles. The 2-mile ORM configuration is shown in Figure 11-3 .

11.3.1.5 44-Mile ORM

The 44-Mile ORM provides a transmission interface between the 5ESS®-2000 switch and an ORM, therefore achieving significant savings in transmission facilities over the standard DS3 interface. It provides a point-to-point connection of ORM's to the CM of the 5ESS®-2000 switch using the TRCU2-O configured to drive optical fiber. Configured this way, the TRCU2-O will convert the 32 MB/s NCT rate to the 45 MB/s DS3 rate and multiplex the two DS3 channels (odd and even time slots from one physical CM) onto a single 90 MB/s channel. The output of this channel can drive a single-mode fiber link (without repeaters) for a distance of 44 miles without any

transmission loss, depending on the specific driver pack used. The 44-mile ORM configuration is shown in Figure 11-4 .

11.3.1.6 Digital Radio

Digital radio (6 GHz) may also be used to provide the link between the host 5ESS[®]-2000 switch and the RSM. The maximum distance allowed between the host and the RSM with digital radio carrier is 150 miles. With digital radio, the distance limiting factor is not due to echo path delay requirements, but instead it is limited by the performance objectives. Performance impairments include multipath fading, obstruction fading, and equipment outages.

11.3.1.7 Extended Switch Module 2000

The Extended Switch Module 2000 (EXM-2000) is an optically remote SM-2000, somewhat analogous to the ORM in the SM configuration. The EXM-2000 supports optional stand alone capability and an optional Stratum 3 clock capability and is remoted from a CM2 using QLIs, NCT link formatted fiber optic, and TRCU2 equipment.

11.3.2 HSM Feature Requirements

The HSM-2000 feature provides the capability to remote an RSM from a host SM-2000 via standard 24 channel T1 lines. The HSM-2000 uses 24 channel T1 lines to subtend the RSM, and is an evolution of the HSM, intended to extend all the services provided by a HSM to a greater number (30) of RSMs, compared to the maximum of 5 RSMs that the existing HSMs can subtend. This development is only concerned with the operation of an SM-2000 as host to RSMs. Existing single module or multi-module RSMs must be supported by an HSM or an HSM-2000 with identical functionality, both in linked and stand-alone operation. As with HSM, the HSM-2000 is the interface between the subtending RSMs and the Communications module in the host office. The HSM-2000 must provide a conduit for timing and control links to the subtending RSMs, and also provide access to the network. In practice, the timing source for the RSM is done at the Facility Interface Unit, (FIU), and the role in this for the HSM-2000, as with the SMs, is to ensure that at the near end, the HDFIs are initialized/synchronized; the T1s umbilicals terminating on the HDFIs provide input to the RSM timing selection process.

For control, the HSM-2000 will, like its counterpart, route the Control Time Slots (CTS, two active or two active with two standby per RSM) to the RSMs. Since an HSM-2000 can subtend up to 30 RSMs, it must be capable of administering the Control Time Slots for the RSMs. (MM)RSM stand-alone operation must work in an HSM-2000 environment as it does in a HSM environment. This capability extends the current ability of HSMs to support a maximum of 5 RSMs each of which is subtended from 2 to 4 standard T1 lines. It must be recognized that any RSM may be subtended from the HSM or HSM-2000 by from two to twenty T1 lines, with 4 T1 lines being typical. To subtend 30 RSMs from an HSM-2000, the minimum of two T1 lines must be enforced. 4 T1 links used to subtend an RSM from an HSM is typical in the field. A few cases will be encountered in which an RSM requires up to the maximum of 20 T1 lines to the host. The HSM is capable of supporting a cluster of 4 RSMs, this capability must be maintained for the HSM-2000. HSM-2000 must be capable of reconfiguring (up to all) the control paths to the subtended RSMs without loss of call processing capability and without going into overload. The umbilical link interface between the single module or multi-module RSM and HSM-2000 will be the same as for the existing HSM.

- The basic transport rate to support the RSM must be T1 interface (US).
- The number of umbilical links per RSM (2 - 20 T1 links) must be the same for HSM or HSM-2000.
- All the umbilical link interface from a given RSM must terminate on the same HSM or HSM-2000. Different RSMs within an MMRS must be able to terminate their umbilicals on either the same HSM or HSM-2000.

MCC displays which contain HSM information will display similar information for HSM-2000. Currently identified MCC displays which are impacted include the DLTU page (112Y), this page displays all the RSMs (by RSM number and site number) remoted from the HDFI facilities also listed on this page. Information for up to 10 RSMs can be

displayed currently, this is increased to display up to 30 RSMs. HSM-2000 must be displayed on MCC pages as HSM. On a call involving an HSM-2000 and its subtending RSM(s), Utility Call Trace must be capable of displaying on the MCC all the hardware the call traverses. A Utility Call Trace involving an HSM-2000 and its subtending RSM should display on the MCC all the links the call traverses.

11.3.2.1 Limits and Restrictions

HSM-2000 hardware and software must support all the applicable functionalities supported by SM-2000 in 5E10. During normal operations the HSM-2000 must provide subtending RSM(s) access to host office-based features, control and timing. In 5E10, parity with HSM functionality must be achieved by HSM-2000. The number of RSMs containing Inter SM packet nailups under an HSM-2000 must be scaled up to a maximum of 30 RSMs. The HSM-2000 without ISDN must be capable of supporting from 0 to a maximum of 30 RSMs with ISDN. The number of RSMs containing Inter SM packet nailups under an HSM-2000 must be scaled up to a maximum of 30 RSMs. Recent Change will allow ISM nailups on all 30 RSMs under an HSM. Thus an HSM-2000 without ISDN must be capable of supporting from 0 to a maximum of 30 RSMs with ISDN.

ISM nailups in an RSM under an HSM-2000 will be provided on all SM configurations supported by the HSM. These configurations are:

RSM -> RSM over ICLs

RSM -> HSM-2000 -> LSM/ORM/HSM

RSM -> HSM-2000 -> HSM/HSM-2000 -> RSM

ISM nailups in an RSM under an HSM-2000 will be provided on all SM-2000 configurations which support ISDN. Those configurations are:

RSM -> HSM-2000 -> LSM-2000 (supporting ISDN)

RSM -> HSM-2000 -> EXM-2000 (supporting ISDN)

RSM -> HSM-2000 -> HSM-2000 (supporting ISDN)

RSM -> HSM-2000 -> HSM-2000 (supporting ISDN) -> RSM

Adding ISDN to an SM-2000 is planned in the 5E10 time frame. This requirement depends on the presence of the ISDN on SM-2000 feature.

Since the HSM-2000 can have up to 30 RSMs instead of the 5 RSMs (6 times the RSMs) but the HSM-2000 has 5 times the processor speed, the time needed to send the restoral requests to 30 RSMs will not significantly exceed the existing HSM time.

The scheduling of ISM nailup restores within the RSM is the same regardless of whether the RSM is under an HSM or an HSM-2000. The actual restoral times of the ISM nailups is dependent on the HSM-2000s ability to handle call processing requests from 30 RSMs. Therefore, any requirements on call processing completion rates for half calls routed through the HSM-2000 may also affect ISM nailup restore times.

An ISM nailup from an RSM through the HSM/HSM-2000 to another SM within the switch uses existing call processing code and primitives to establish an HTP (Host Terminal Process) for the half call routed through the HSM. This HTP is present as long as the ISM nailup is in-service. The HTP monitors the ISM nailup connection and handles the following events:

- MGINTERRUPT message - the HTP sends channel discontinuity across the umbilical to the RSM, sends E-bit discontinuity across the TMS to the other SM, releases all data and hardware associated with its half call, and performs an OSSUICIDE.
- E-Bit Discontinuity from TMS - the HTP is notified if E-bit discontinuity is detected by the TMS and responds by sending channel discontinuity across the umbilical to the RSM, releasing all hardware and data associated with its half-call, and performing an OSSUICIDE.
- Channel Discontinuity from Umbilical - the HTP is notified if channel discontinuity is detected on the umbilical (T1 channel connecting RSM to HSM) and responds by sending TMS E-bit discontinuity to the other SM and releasing all hardware and data associated with its half-call and performs an OSSUICIDE.

ISM nailups that are out-of-service in an RSM, due to NLI or NCT link hardware problems in its parent HSM-2000, must be triggered for restoral when the HSM-2000 hardware problems clear. The HSM-2000 will provide this trigger by monitoring the status of its NLI and NCT links and sending the hardware status of these units to its RSMs with ISM nailups whenever a change occurs.

The HSM-2000 must also send its NLI and NCT link status to its child RSMs with ISM nailups on a periodic basis as a refresh mechanism. If communication between the HSM-2000 and its child RSM(s) does not exist at the time the hardware change occurs, the hardware status of the HSM-2000 must be sent after communication is reestablished.

11.3.2.2 Measurements

There are no requirements unique to HSM for traffic and plant measurements. The capability of HSM-2000 to scale to 30 subtending RSMs has no impact on measurements. All the OA&M requirements for SM-2000 shall apply to HSM-2000. The SM-2000 hardware fault detection mechanisms implemented in hardware and software such as parity generation/detection, CRC checks, per call testing, sanity checks, audits, etc, need to work for HSM-2000. The HSM-2000 must be able to detect at least 98% of all hardware faults while using automatic testing, in-service continuous testing, and demand diagnostic testing capability available to the SM-2000.

11.3.2.3 Initialization

All RSM(s) subtending from an HSM-2000 are capable of being fully initialized (without pump) without disrupting stable calls on the HSM-2000. If an RSM(s) subtending from an HSM-2000 is fully initialized with pump, calls in the HSM-2000 which occupy the pump time slots will be affected (i.e., torn down) if the time slot is borrowed for pump. Stable calls from the initing RSM(s), passing through the HSM-2000 will also be dropped. This is the current applicable scheme for pump an RSM subtending from a HSM.

HSM-2000 must be capable of full-initialization without disrupting transient or stable calls in its subtending RSM(s), with the following exceptions:

- Calls passing through the HSM-2000 will be torn down during HSM initialization.
- Subtending RSM(s) may go into stand-alone during HSM-2000 initialization. When HSM-2000 initialization occurs, the stand-alone interval of the subtending RSM(s) must not exceed the HSM-2000 initialization interval.

11.3.2.4 Performance Monitoring

Performance monitoring is the systematic monitoring (or tracking) of a particular entity's health through the continuous collection and analysis of data derived by observing the entity's performance.

In order to provide end-to-end performance measurement of the umbilicals subtending RSM(s) from an HSM-2000,

performance data must be collected and analyzed in order to detect performance degradation and provide a basis for network maintenance. For HSM-2000, performance monitoring refers to the set of actions needed to collect, store, threshold, and report end-to-end performance of the umbilicals between it and the subtending RSM(s).

11.4 RSM UMBILICAL ORDER WIRE

The order wire in the single-module RSM is used to provide an independent voice grade circuit between the RSM and the host 5ESS®-2000 switch to extend the office beltline for teletypewriter (TTY) access from the remote site. With applications where the umbilical is routed by microwave radio, the TTY link can be treated the same as any other voice circuit multiplexed onto the carrier system as long as it remains independent of the RSM.

11.5 RSM UMBILICALS

Typically, T1 carrier facilities are used to connect the RSM to the host 5ESS®-2000 switch. The link is traffic-sensitive and simulates the NCT links of a local SM, carrying both network (call) and control data. The two control time slots are dedicated to channels in two separate T1 lines with the capability of automatically switching to dedicated channels on separate backup lines should the primary lines fail. This arrangement requires a minimum of two T1 lines and is limited by the requirement that all umbilical facilities from an RSM must terminate on the same host module.

The interface between the T1 facilities and the time slot interchanger (TSI) of the RSM is the FIU. The FIU converts T1 carrier format to NCT link format and vice versa. A single FIU can accommodate the maximum of 20 T1 lines for the umbilical. The T1 lines terminate at the RSM through digital facilities interface (DFI) circuit packs mounted in digital line trunk units (DLTUs). This use of the DLTU does not use any of the RSM time slots or call capacity. Standard cross-connections through a repeater bay or digital cross-connect (DSX) frame are required.

A separate metallic facility is required to provide remote maintenance terminal access to the host AM from the RSM. The order wire provided with T1 facilities may be used. To improve reliability, route diversity of the T1 facilities is strongly recommended.

The engineering of T1 lines for the umbilical follows methods developed for the remote switching system voice channels. The once-a-month (OAM) usage is estimated for outgoing and incoming traffic (including traffic to and from the host) and 3-way calling (3-port conference usage, multiplied by three, to reflect the usage of each port). The blocking probability 0.0005 (blocking probability 0.001, high day) table is then used to determine the number of channels required. Added to this total are four channels for control and control backup. This total is then divided by 23 to determine the number of T1 lines required (one channel per T1 line is required for signaling). A minimum of two T1 lines must be provided. At the host, umbilical T1 lines are included in DLTU engineering.

A subtending RSM affects the host beyond the additional T1 line terminations as follows:

- Additional usage on the host universal conference circuits.
- Additional load on central and host SM processors. The additional CDO load on the host is mitigated to the extent that the host processes interoffice calls to/from the RSM prior to cutover. The administrative processor is used only for calls that leave the RSM.

11.5.1 MULTIMODULE RSM (MMRSM)

The MMRSM enables the installation of a larger RSM facility or the expansion of an existing single-module RSM. With this arrangement, two to four RSMs may be configured and interconnected to provide additional switching capacity at the RSM location. Each RSM of the MMRSM can provide the same switching capacity as a single-module RSM. A block diagram illustrating the configuration of the MMRSM is shown in Figure 11-5 and 11-6.

Each RSM is connected to a host SM (HSM) at the 5ESS[®]-2000 switch office via standard T1 carrier umbilicals (a minimum of two). More than one HSM may be used to provide the umbilical interfaces; however, all umbilicals from a given RSM must terminate on the same HSM. Additionally, each of the RSMs in the cluster is connected to each of the other RSMs by inter-RSM communication links (ICL). These links provide the ability to complete calls between the remote modules of the MMRSMS without any services from the HSM. This is particularly important if standalone operation is required due to umbilical outages. The ICLs are provided by T1 facilities and the FIU in a manner similar to the umbilicals. A DFI circuit is required at both ends of the ICL to provide an interface with the FIU. The total number of umbilicals and ICLs per module in an MMRSMS cannot exceed 20 and is engineered based on traffic requirements.

A minimum of two ICLs connect the RSMs in an MMRSMS. No channels are dedicated for interprocessor message transmission on the ICLs, as there are on the umbilicals to the host; however, one channel on each ICL is dedicated to signaling. During normal operation, messages are passed between the modules in the MMRSMS using control time slots on the umbilical T1 links to the host SM, and ultimately, to the communications module (CM).

Voice and data are carried between the RSMs in the MMRSMS on the ICLs. A 4 Kbps data link is also provided on each ICL. This data link is used for inter-RSM message traffic when the control time slot is disrupted.

The MMRSMS uses standard SM hardware as does the single-module RSM, and it can serve lines, trunks and SLC[®] 96 carrier facilities. The environmental requirements are the same as the 5ESS[®]-2000 switch, and the connections to the host are via standard digital facilities. The MMRSMS can be remotd up to 150 miles from the 5ESS[®]-2000 switch office. This arrangement provides extensive options for area planning. Modernization needs and increased demands for service may be met through:

- Incremental growth of peripheral units (the addition of line units, trunk units, etc.)
- Adding or removing remote modules from existing RSMs
- Converting co-located single-module RSMs to MMRSMSs
- Growing an RSM from a 5ESS[®]-2000 switch base
- Homing a SLC[®] 96 carrier system on an RSM
- Adding or removing ICLs or umbilicals.

Further, a wide range of custom digital features and services are supported. These include:

- Complete 5ESS[®]-2000 switch feature set during normal linked operation
- Full trunking capability
- An optional RSM status display
- Optional 13A announcement machines
- Optional standalone operation
- Optional automatic billing during standalone
- Optional high-stability remote clock unit (used when data applications may be served from the RSM during standalone)
- Limited custom calling services during standalone.

Any feature the host provides is also available in the RSM during linked-mode operation. Calls originating and terminating within the MMRSMS can be routed without communicating with the administrative module (AM)/communication module (CM). The routing software first checks for the terminating port within the module in which the call originated. If not found, the other modules within the MMRSMS are checked for the terminating port. Finally, the AM/CMP is requested to route the call if the terminating port is not within the MMRSMS. Calls can also be routed by the AM/CMP through the CM in the event that an ICL talking path is unavailable (for example, during maintenance, out-of-service, or overflow).

Stand-alone call processing is an optional feature that allows the MMRSMS to continue processing calls in a standalone mode.

The implementation of this arrangement also provides a greater level of reliability. Since more than one set of umbilicals are provided, and since the remote modules are interconnected via ICLs, it may still be possible to process certain calls in the event of umbilical or ICL outages. Three levels of standalone operation are provided to assure the best possible service. These levels are defined as follows:

- **Partial Standalone:** Partial standalone exists when one or more, but not all, of the MMRSMS remote modules cannot communicate with the respective HSMs (due to umbilical outage). In this case, intra-MMRSMS calls originating or terminating to a remote module in standalone operation can be completed via the ICLs which interconnect all the remote modules. Limited custom calling services are still available in this instance. These services include call waiting, call hold, speed calling to lines terminating on the MMRSMS, limited hunt group calls, and access to private facilities. This is possible because the necessary translations and routing data for most lines and trunks served by the MMRSMS are duplicated in each of the remote modules. Calls requiring conference circuits cannot be completed in this instance because conference circuits are provided only at the HSM. Additionally, calls requiring AM/CMP routing (such as calls to global hunt groups which are routed by the AM/CMP and calls originating or terminating outside of the MMRSMS) cannot be completed. However, calls of this type involving lines served from remote modules which are not operating in standalone can still be completed normally.
- **Separation:** All modules in the MMRSMS are co-located; therefore, repeaters are not required for the ICLs. Separation exists when all the ICLs between the originating and terminating remote modules of an MMRSMS are severed, or if a call cannot be completed over the ICLs for any reason other than ICL overload. If an RSM is in separation, it does not go down, but rather attempts to complete calls to the separated RSM(s) through the host via the umbilicals (called back-hauling). This approach is also used when the ICLs are not severed but are completely busy. This call completion path is identical to the one that two single-module RSMs would use to communicate with each other. It is important that the ICLs are adequately engineered and administered so that back-hauling is not required.
- **Total Standalone:** Total standalone exists when all umbilicals between the MMRSMS and the 5ESS®-2000 switch office are inoperable. In this case, all intra-MMRSMS calls involving the limited custom calling features previously described (or involving no features) can be completed normally, except those that require conference circuits and those involving global hunt groups. During total standalone, calls originating outside the MMRSMS and attempting to terminate on hunt groups on the MMRSMS, and calls originating at the MMRSMS and attempting to terminate outside the MMRSMS cannot be completed. Calls between the modules of an MMRSMS are completed, and emergency calls are given special treatment. Alternate routing of emergency calls is provided through the use of foreign exchange lines. Up to ten foreign exchange lines can be assigned; and if a specified number is dialed, the call is routed to another host outside the MMRSMS where it can be handled appropriately. Additionally, carrier interconnect and many modular feature construction (MFC) features are functional during standalone.

Stand-alone billing may be used whether the MMRSMS is in total or partial standalone. Further details concerning the MMRSMS operation and implementation can be found in 235-900-101 - *Technical Specification*.

11.6 ENGINEERING CONSIDERATIONS

11.6.1 SM

The RSMs are limited by umbilical time slots. Two to 20 umbilical links may be provided between the DLTUs in the host SM and the DLTUs in the RSM. The T1 carrier facilities, which are usually used for RSM umbilicals, provide 24 channels per link. Each umbilical has either 2 or 4 control time slots and 1 signaling time slot. The remaining time slots are used to carry voice (customer calls). Table 11-1 provides umbilical time slot capacity information.

Table 11-1 RSM Umbilical Time Slot Capacities

UMBILICALS	TIME SLOTS				BLOCKING CRITERIA (CCS/HR)	
	VOICE	CONTROL	SIGNALING	TOTAL	P.0005 EVE	P.001 TCBH HD
2	44	2	2	48	914	947
3	67	2	3	72	1,588	1,603
4	88	4	4	96	2,173	2,226
5	111	4	5	120	2,865	2,926
6	134	4	6	144	3,569	3,638
7	157	4	7	168	4,285	4,360
8	180	4	8	192	5,008	5,089
9	203	4	9	216	5,737	5,825
10	226	4	10	240	6,504	6,599
11	249	4	11	264	7,212	7,312
12	272	4	12	288	7,955	8,062
13	295	4	13	312	8,703	8,814
14	318	4	14	336	9,453	9,561
15	341	4	15	360	10,206	10,306
16	364	4	16	384	10,961	11,052
17	387	4	17	408	11,719	11,797
18	410	4	18	432	12,479	12,542
19	433	4	19	456	13,240	13,287
20	456	4	20	480	13,954	14,032

Engineering of the MMRSM ICLs is based on the volume of traffic between each pair of RSMs within the MMRSM. Each ICL carries telephone traffic on 23 of its 24 channels. The remaining channel is used for signaling. (The ICLs require no control time slots.) A minimum of 2 ICLs are required between each pair of RSMs.)

A maximum of 20 T1 links can be provided per RSM within the MMRSM. This number includes the umbilicals back to the host SM as well as the ICLs to the remaining RSMs within the MMRSM. For example, an MMRSM with 4 RSMs could have 4 T1 umbilicals from each RSM to a host SM. Each RSM then has 16 T1 links remaining which can be used as ICLs to the other RSMs. If the minimum number of ICLs are equipped (2 to each of the other RSMs), a total of 10 of the 20 available links would be used. Table 11-2 provides ICL capacity information.

NOTE: The ISDN circuit-switched digital capability provides circuit-switched B-channel transport between ISDN terminals at a 56 kb/s or 64 kb/s clear channel data rate. The intra-switch data rate capability depends upon the data rate capability of the host-to-RSM transmission facilities. To provide 64 kb/s ISDN circuit switched data capability on an RSM, the umbilical to the RSM must support that data rate.

Table 11-2 RSM ICL Capacities

ICLs	TOTAL TIME SLOTS	SIGNALING TIME SLOTS	VOICE TIME SLOTS	BLOCKING CRITERIA (CCS/HR)	
				P.02 EVE	P.04TCBH HD
2	48	2	46	1,194	1,255
3	72	3	69	1,910	1,987
4	96	4	92	2,674	2,767
5	120	5	115	3,393	3,505
6	144	6	138	4,089	4,224
7	168	7	161	4,785	4,943
8	192	8	184	5,481	5,226
9	216	9	207	6,177	6,381
10	240	10	230	6,873	7,101
11	264	11	253	7,569	7,820

12	288	12	276	8,265	8,539
13	312	13	299	8,961	9,258
14	336	14	322	9,657	9,977
15	360	15	345	10,353	10,696
16	384	16	368	11,049	11,415
17	408	17	391	11,745	12,134
18	432	18	414	12,441	12,853

11.7 ASSIGNMENT GUIDELINES

Since the RSM is an SM which is remoted from the 5ESS®-2000 switch office, the assignment of RSM resources is no different than the assignment of SM resources. Those resources include:

- SM processor
- Memory
- Line units
- Digital carrier line units (DCLUs)
- DLTU (for RSM umbilicals, ICLs, and trunks from RSMs)
- Service circuits
- Recorded announcements.

For information concerning these resources, refer to the appropriate sections of this manual.

11.8 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

The RSM resources which are the same as SM resources have the same measurements as those taken in the SM. These measurements are found in the sections of this manual associated with those resources. However, there are some measurements which apply specifically to the RSM. These measurements are described here.

11.8.1 RSM MEASUREMENTS

Section 22 of the 30-minute traffic report provides measurements associated with the RSM. These measurements are discussed in 235-070-100 *Traffic and Plant Measurements* Appendix 1.

11.8.2 UMBILICAL TIME-SLOT MEASUREMENTS

Umbilical time slot measurements are found in Section 23 of the 30-minute traffic report and are discussed in 235-070-100 *Traffic and Plant Measurements* Appendix 1. These measurements are taken for each RSM and are associated with the RSM umbilical time slots.

11.8.3 MMRSR MEASUREMENTS

Measurements related to ICLs are found in section 37 of the 30-minute traffic report and are described in 235-070-100 *Traffic and Plant Measurements* Appendix 1. These measurements are made for each ICL.

Section 39 of the 30-minute traffic report provides standalone usage measurements. These measurements are made on a per-site basis.

11.9 FEATURE IMPACT

The impact of features on an RSM is the same as for an SM. The resources required to support features are the same as those provided in the SM and are discussed in the associated section of this manual. Additionally, 235-190-101 - *Business and Residence Modular Features* provides further information concerning the various features available and the impact on the switch resources.

11.10 TRANSITION IMPACT

Transitions involving the RSM are similar to those involving the SM. There are several types of growth operations which apply directly to RSMs. These may include:

- Growth of an RSM to an MMRS
- Growth of an RSM or MMRS to a 5ESS®-2000 switch office
- Degrowth of an MMRS to an RSM
- Degrowth of a 5ESS®-2000 switch office to an MMRS or RSM
- Growth of ICLs and umbilicals.

These procedures are installation, cutover, and turnover procedures that do not require administrative functions. Refer to the following documents for complete descriptions of growth procedures:

- 235-118-XXX - *Recent Change Procedures*
- 235-105-231 - *Hardware Change Procedures*
- 235-600-30X - *Equipment Configuration Data*.

11.11 REMOTE SWITCHING MODULE WORKSHEET

The worksheet (Figure 11-7) provides:

- RSM umbilicals MS (main station) capacity: Today and EOP (end of engineering period)
- Percent utilization of umbilicals: Today and EOP.

NOTE: The RSM umbilical is based on the number of main stations working in the RSM today, and the CCS (hundred call second) load generated by these main stations. Changes in the RSM calling rate (due to new toll billing, community of interest, area transfer, etc.) could affect the CCS load on the RSM umbilicals, thus changing the number of umbilicals.

- Three-port and 6-port conference circuits are provided at the host office. A push to sell more conference features could affect the number of umbilicals needed.
- Announcements are provided from the host. Announcement requirements could affect the number of RSM umbilicals needed.

The following paragraphs identify the columns of the RSM Umbilicals worksheet and describe the calculations required to complete the worksheet:

- (A) RSM Number: The number of the RSM module that this row on the worksheet represents.

- (B) HSM Number: The number of the HSM (host switching module) on which this RSM terminates.
- (C) RSM Umbilicals Channels Working: The number of umbilical channels working to this RSM. These channels are engineered in blocks of 23, except for the first two or four umbilicals which are engineered with 22 channels. Obtain this information from the switch or the telephone equipment order (TEO).
- (D) Engineered Blocking Criteria: The criteria used to engineer this component. Valid entries include the following blocking percentages: 0.05, 0.1, 0.5, 1.0, 1.5, 2, 3, 4, 5, 6, 7, 8, 9, and 10.
- (E) Umbilical CCS Capacity: The CCS capacity of the installed umbilicals for this RSM. Obtain number of working umbilicals from the appropriate Poisson table for the CCS capacity.
- (F) CCS Usage Today - Main Station Demand: The number of main stations working on the RSM today. Obtain information from the switch or a current main station report.
- (G) CCS Usage Today - CCS Demand: The current CCS usage on the RSM umbilicals. Obtain data from the current office engineering data.
- (H) CCS Usage Today - CCS per Main Station: The umbilical CCS load per RSM main station. Obtain number from the current office engineering data or calculate:

CCS Usage Today CCS Demand Column G					CCS Usage - Today CCS/MS Column H
	=				
CCS Usage Today RSM MS Demand Column F					

- (I) **CCS Usage EOP - Main Station Demand:** The total number of main stations forecasted for EOP. Obtain this information from the office forecast.
- (J) **CCS Usage EOP - CCS per Main Station:** The umbilical CCS load per RSM main station forecasted for EOP. Obtain this information from the office forecast.
- (K) **CCS Usage EOP - CCS Demand:** The forecasted CCS usage on the RSM umbilicals. To calculate:

CCS Usage - EOP MS Demand Column I	×	CCS Usage - EOP CCS/MS Column J	=	CCS Usage - EOP CCS Demand Column K

- (L) **Main Station Capacity of Umbilicals - Today:** The main station capacity of the RSM umbilicals today. To calculate:

Umbilical CCS Capacity Column E				Main Station Capacity or Umbilicals - Today Column L
	=			
CCS Usage/MS - Today Column H				

- (M) **Main Station Capacity of Umbilicals - EOP:** The forecasted main station capacity of the RSM umbilicals. To calculate:

Umbilical CCS Capacity Column E				Main Station Capacity of Umbilicals - EOP Column M
	=			
CCS Usage/MS - EOP Column J				

- (N) **Umbilical CCS Load Percent Utilization - Today:** The percent of the RSM umbilical channels that are being used today. To calculate:

CCS Usage - Today CCS Demand <i>Column G</i>		Umbilical CCS Load Percent Utilization Today <i>Column N</i>
$\frac{\text{Umbilical CCS Capacity}}{\text{Umbilical CCS Capacity}}$ <i>Column E</i>	$\times 100 =$	

- (O) ***Umbilical CCS Load Percent Utilization - EOP***: The percent of the RSM umbilical channels that will be used at the end of the engineering period.

CCS Usage - EOP CCS Demand <i>Column K</i>		Umbilical CCS Load Percent Utilization - EOP <i>Column O</i>
$\frac{\text{Umbilical CCS Capacity}}{\text{Umbilical CCS Capacity}}$ <i>Column E</i>	$\times 100 =$	

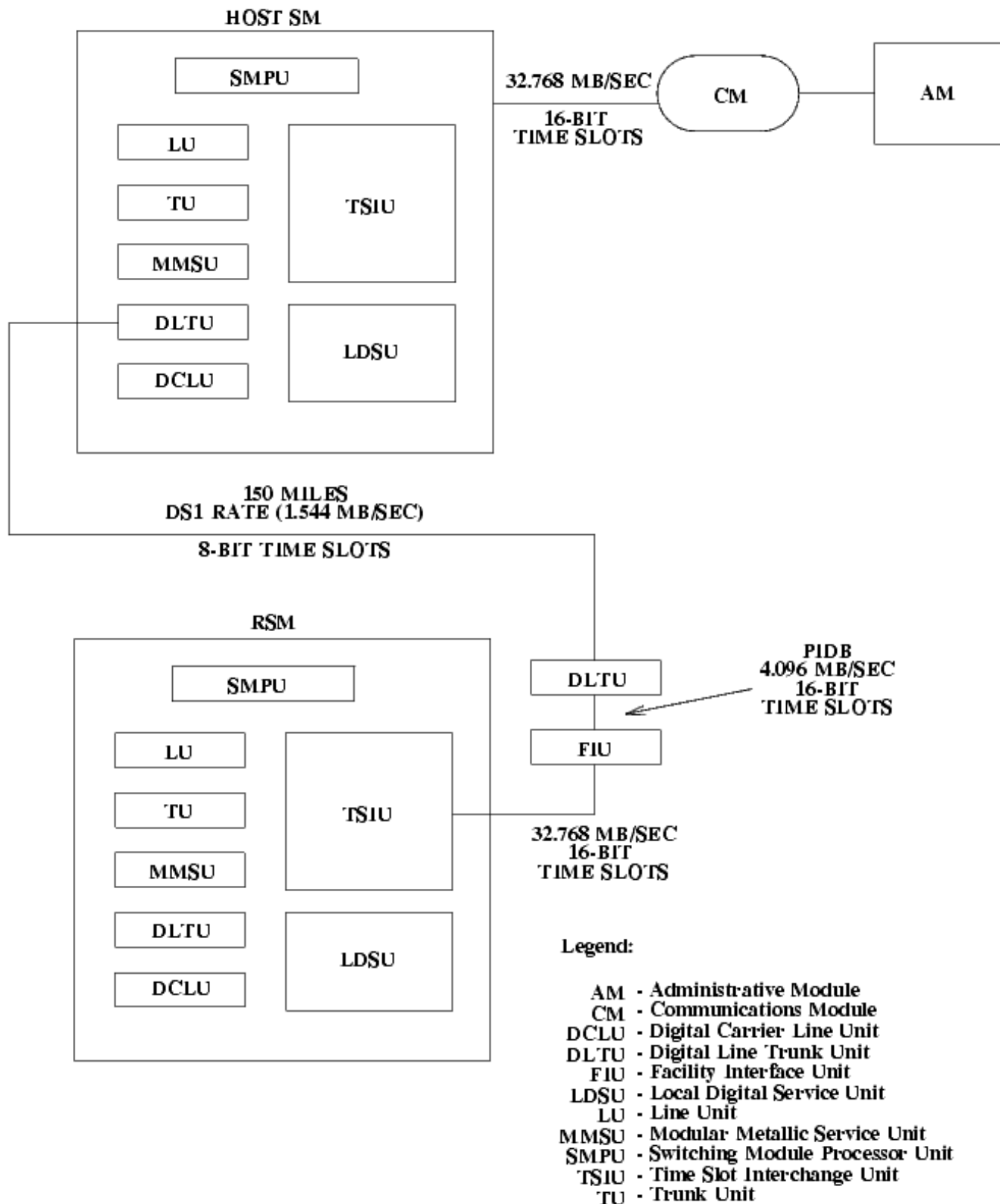
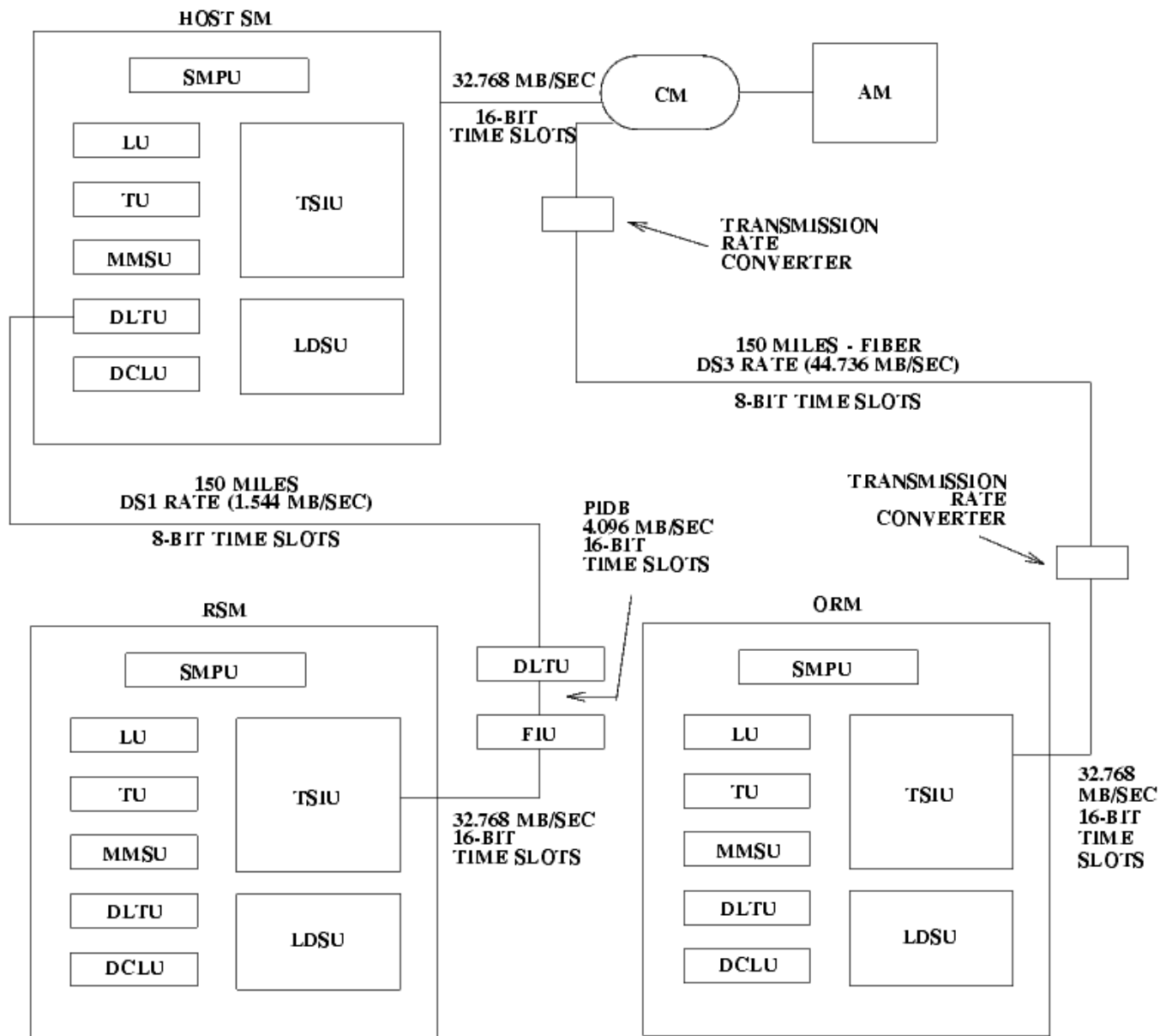


Figure 11-1 Simplified Block Diagram of RSM to 5ESS -2000 Switch Office Interconnections



Legend:

AM - Administrative Module
 CM - Communications Module
 DCLU - Digital Carrier Line Unit
 DLTU - Digital Line Trunk Unit
 FIU - Facility Interface Unit

LDSU - Local Digital Service Unit
 LU - Line Unit
 MMSU - Modular Metallic Service Unit
 SMPU - Switching Module Processor Unit
 TSIU - Time Slot Interchange Unit
 TU - Trunk Unit

Figure 11-2 Optically Remoted Module Using Transmission Rate Converters

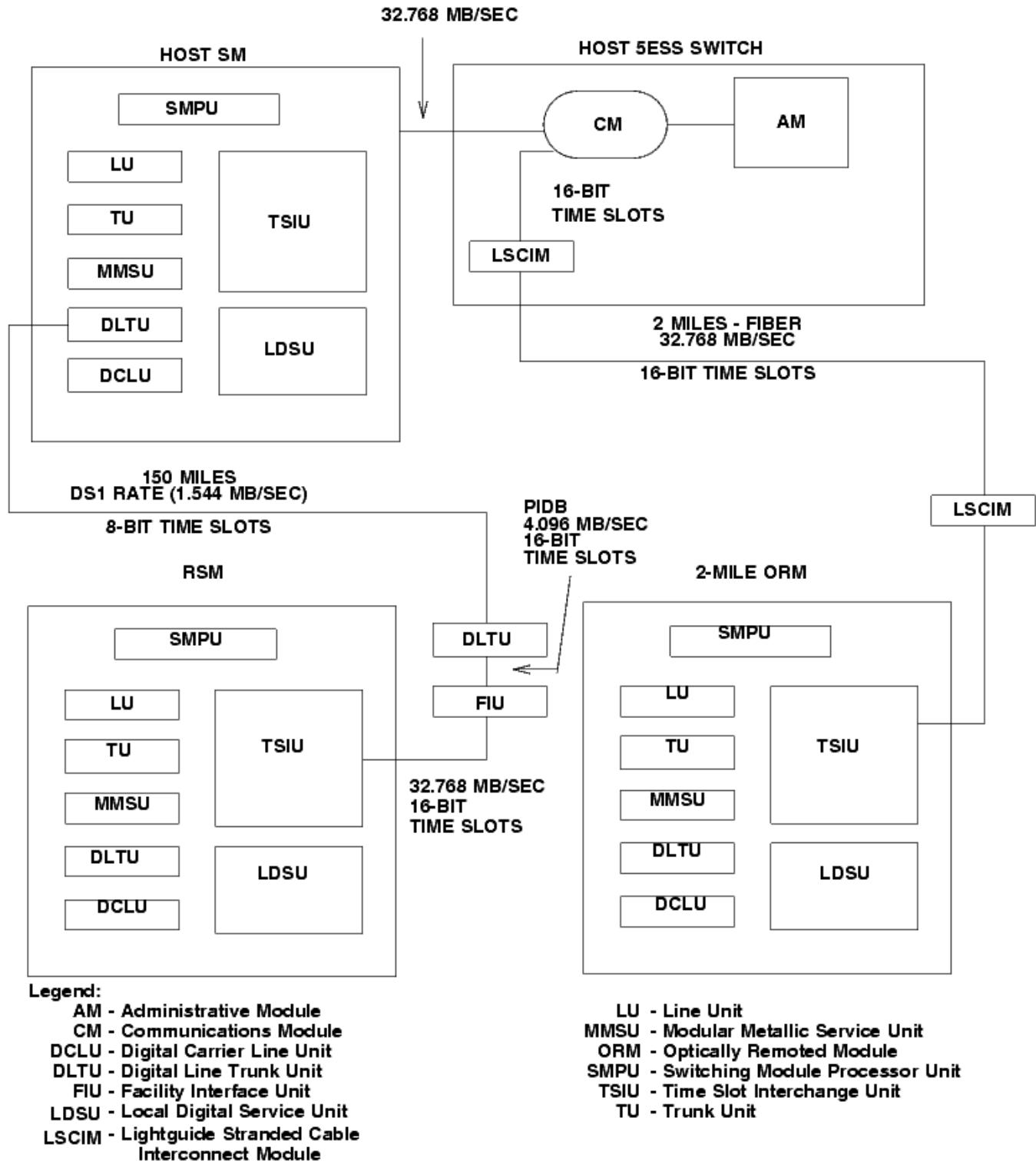


Figure 11-3 2-Mile Optically Remoted Module

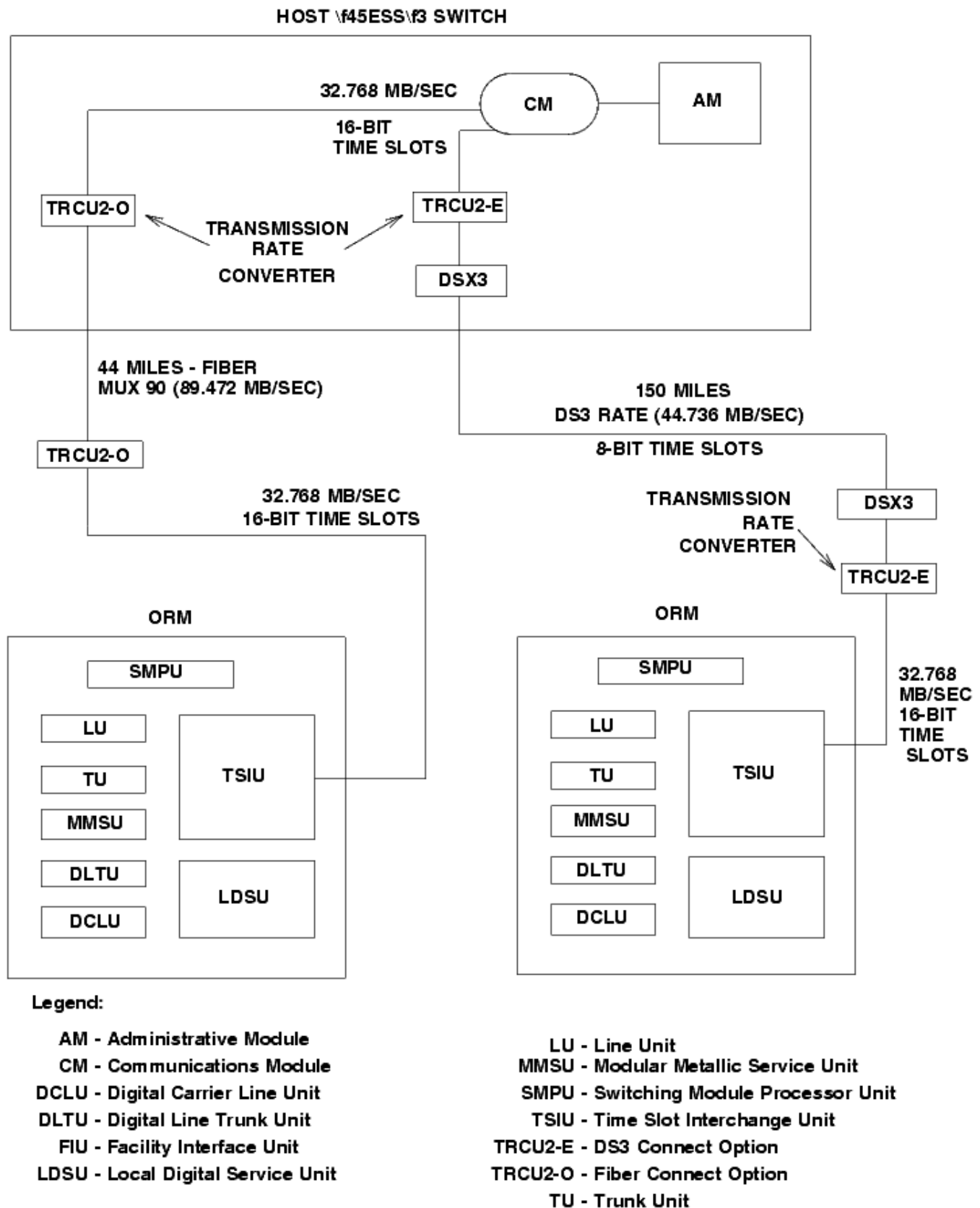


Figure 11-4 Optically Remoted Modules Using Transmission Rate Converter - Model 2 (TRCU2)

MMRSM SERVED FROM ONE SM

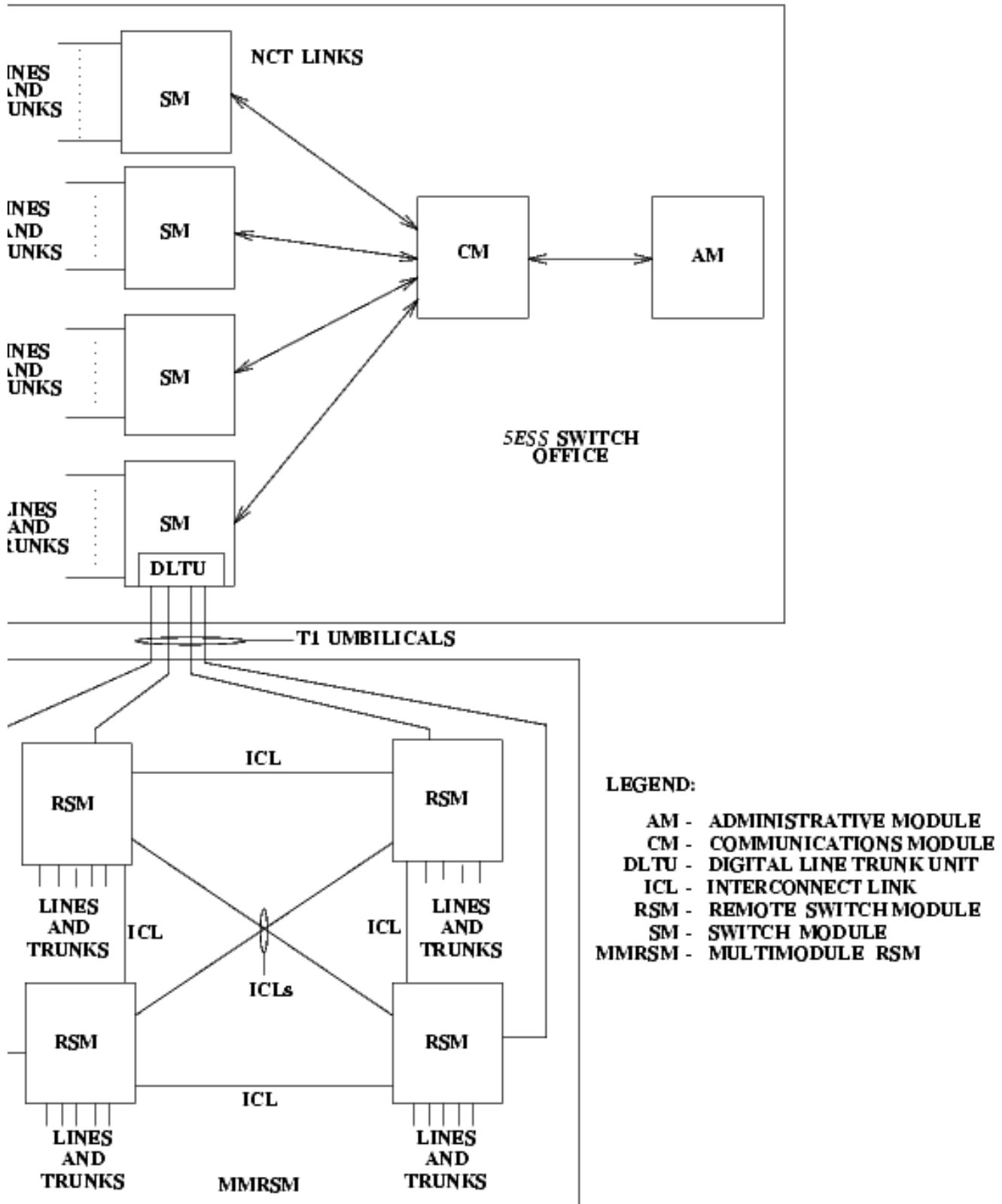


Figure 11-5 MMRSM Configuration

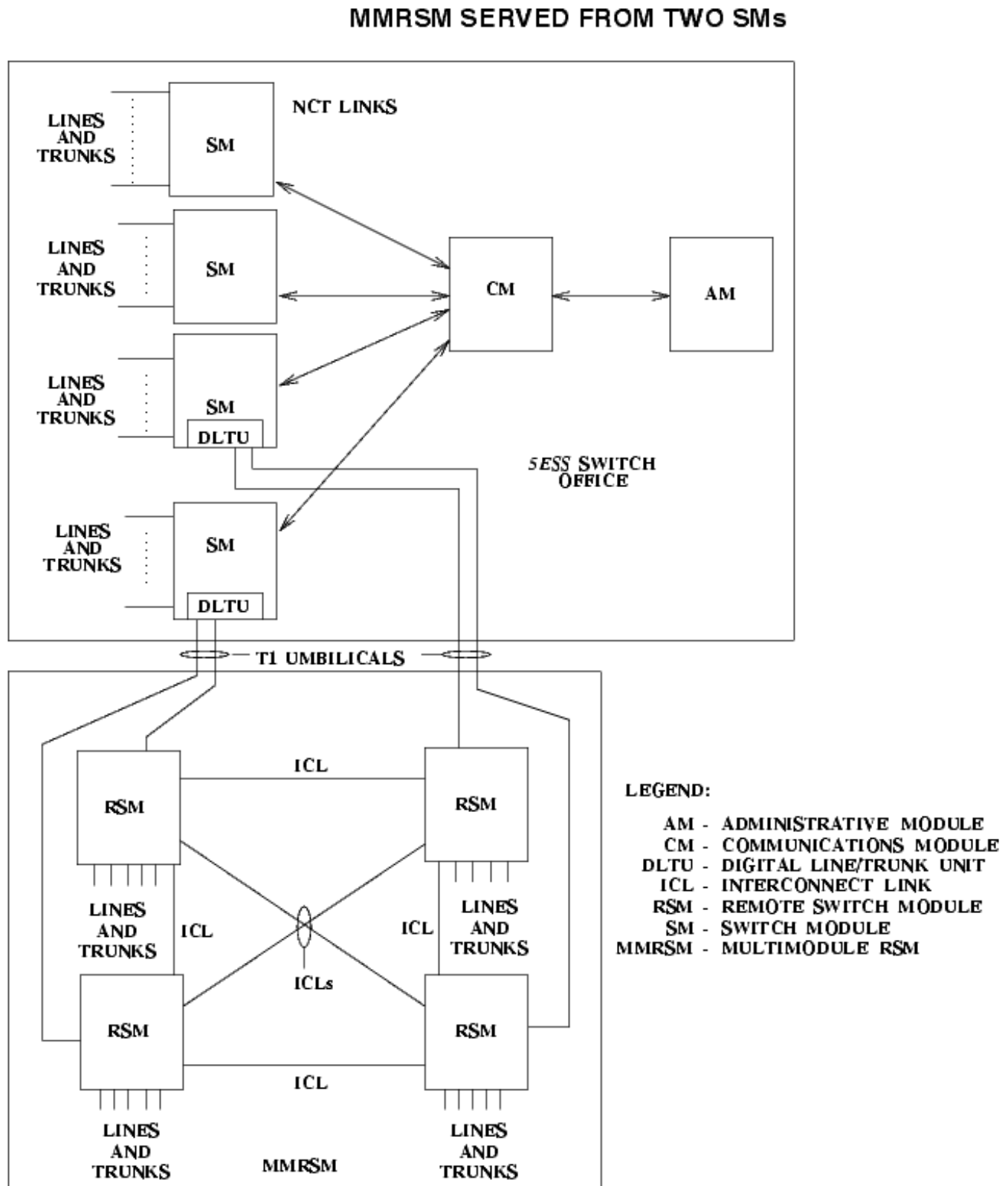


Figure 11-6 MMRSM Configuration

FROM _____ TO _____

[illegible]

Figure 11-7 Remote Switching Module Umbilicals Worksheet

12. SM-2000 UNIQUE RESOURCE UTILIZATION

12.1 INTRODUCTION

The SM-2000 is a new offering on the 5ESS[®]-2000 switch. The SM-2000 offers the capability to terminate Synchronous Optical Network (SONET) interfaces via the Digital Networking Unit - SONET (DNU-S), analog lines via the Line Unit Model 3 (LU3) or AIU/EAIU and digital trunks via the Digital Line and Trunk Unit Model 2 (DLTU-2). The SM-2000 also supports a Digital Service Unit - Model 3 (DSU-3) which provides tone decoder and tone generation capabilities to the SM-2000 via Digital Service Circuit Model 3 (DSC-3) units, ISLU, PSU, AIU/EAIU and IDCUC for ISDN capability.

The SM-2000 offers users the capability to engineer up to 30,720 time slots on a single SM-2000, compared to 512 peripheral plus 512 network time slots on SMs. The engineering capacity of the SM-2000 is now determined by the available number of Peripheral Interface Data Busses (PIDBs), Peripheral Interface Control Busses (PICBs), time slots, or by the total available SM-2000 real-time, and not on the fixed 512 time slot capacity of the SM.

On an SM-2000, a feature has been developed called "peripheral-to-peripheral." A line/trunk call to another line/trunk does not involve the network unless the call leaves the SM-2000. Engineers can configure the SM-2000 Time Slot Interchange (TSI) in a square or non-square configuration. Engineering the SM-2000 TSI with the square concept provides an equal number of peripheral and network side traffic bearing time slots. A non-square TSI provides more peripheral than network time slots. For example, if there is only one SM-2000 in the office and one conventional SM, there is no need to provide more than 512 network time slots.

The SM-2000 cannot be deployed as an Remote Switching Module-2000 (RSM), but may be used as a Host SM-2000 terminating umbilicals from an RSM. The SM-2000 can, however, be remotied via the EXM-2000 (Extended SM-2000) feature. The EXM-2000 provides the capability to deliver SM-2000 functionality at a remote location.

The SM-2000 can be grown into an existing 5ESS[®]-2000 switch or provided with a new 5ESS[®]-2000 switch. Both the SM-2000 and the EXM-2000 utilize a microprocessor complex, a Message Handler, a growable Time Slot Interchange Unit Model 4 (TSIU4) as its core, and new network and peripheral interfaces.

At present, the quantity of equipment needed for a CM2 is determined by the number of SMs in the office (each SM carries a fixed number of Network Time Slots). With the introduction of SM-2000 and EXM-2000, the number of Network Time Slots per SM-2000 and EXM-2000 are no longer fixed. A new set of engineering and ordering rules for CM2 offices with SM-2000 (using NCT2 links) and/or SMs/EXM-2000 (using NCT2 links) is used.

12.2 SM-2000 PROCESSOR

For an overview of the Switching Module-2000 (SM-2000) processor, refer to the discussion of the SM processor in the SM RESOURCE UTILIZATION

12.2.1 Real Time Call Detail Real Time Usage

WARNING: Any SM-2000 that is designated as a global billing SM must be engineered at only 75% of real-time capacity. It is necessary to reserve 25% of SM capacity for billing record activity. Failure to do this will result in an overload condition during peak hours and loss of billing records.

12.3 SM-2000 REAL TIME WORKSHEETS

The SM-2000 Real-Time Worksheet estimates the switching module (SM-2000) "real-time" call capacity either in half calls per busy hour or in full calls per busy hour at 90 percent occupancy, and the SM-2000 processor (SMP) occupancy at the offered load. Worksheets are found in the section of this document entitled "SM Resource Utilization". The worksheet enables switch administrators to make an appropriate assignment of lines, trunks,

attendants, and features to SM-2000s, considering the associated real-time use of the SMP. The term "SM-2000" used in this worksheet refers to an SM-2000 or Extended Switch Module 2000 (EXM-2000). As a general guideline, this worksheet is needed only when one of the following is true:

- (1) The following formula produces a result greater than 90,000:

sum

{(Number of analog nonshared DN centrex lines),
 $2 \times$ (Number of analog shared DN centrex lines),
 $80 \times$ (Number of analog attendant consoles),

multiplied by

(Average high day busy hour O + T calls/line)

plus

[Average high day (Incoming + Outgoing) calls/trunk]

multiplied by

$\sqrt[4]{m}$ (Number of digital attend consoles) $0.7 \times$ (Number of trunks)

- (2) An Intelligent Processor [as an Automated Response Unit or Service Circuit Node, causes call transfers to occur, and has more than 100 connected lines.

12.3.1

12.3.1.1 Using The Worksheet

The SM-2000 real-time worksheet provides spaces to enter the input data and the results of the arithmetic calculations. In many cases, a "skeleton equation" is provided below the basic line in the worksheets for your convenience in making intermediate calculations to determine "***YOUR INPUT.***"

The means for determining the data inputs may vary. As an example, input data for ***CALL WAITING*** can be determined as follows:

- Data can be collected for all terminal groups in the SM-2000.
- Data can be collected on a selected subset of terminal groups and the results extrapolated to represent the office totals.

Nominal or "common-sense" values may be used to supplant the need for a detailed analysis in many instances, particularly where low feature-penetration exists in the office.

Also, note that the ***MSEC PER CALL*** coefficient is a measure of the relative importance of the various inputs. For example, ***SPEED CALLING, 1 Digit*** is much less significant than ***CALL TRANSFER.***

"5ESS-2000" SWITCH

SWITCH MODULE REAL-TIME WORKSHEET

The minimum overhead occupancy of the SMP60 is 4% of the Switching Module Processor's time. Additional overhead occupancy is incurred from the analog line units in the SM-2000 , and depends on the number of line units and their concentration ratios. No additional overhead is incurred by ISLUs on the SM.

Please input the expected traffic partition & feature penetration during a 1-hour interval. The general format of this worksheet is:

		CORE60 OVERHEAD	CORE60
		OCCUPANCY PER UNIT	OVERHEAD OCCUPANCY
SM-2000 TRAFFIC PARTITION (NO. OF CALLS/HOUR)	NUMBER OF UNITS		
		(PERCENT)	(PERCENT)
_____	_____	x _____	= _____
_____	_____		

1. NUMBER OF 4:1 LINE UNITS x 0.15 =
ON THIS SM. _____

2. NUMBER OF 6:1 LINE UNITS x 0.19 =
ON THIS SM. _____

3. NUMBER OF 8:1 LINE UNITS x 0.24 =
ON THIS SM. _____

4. NUMBER OF 10:1 LINE UNITS x 0.28 =

ON THIS SM. _____

5. NO MMRSM CONFIGURATION x =

ON SM-2000. _____

Sum of the above 4 calculations (items 1 through 4) ==> | A: |
| |

Expected no-load occupancy (A + 4) ==> | B: |
| |

TRAFFIC PARTITION

(ORIGINATING AND TERMINATING CALL MIX)

Please input traffic partition during your high day busy hour
(number of (O+T) calls per hour). The number of originating and
terminating calls per partition can be estimated as follows:

average high-day busy hour calling rate of O+T calls per end-user
x number of end-users

or

average high dy busy CCS per end-user
_____ x number of end-users

average holding time in seconds per call

Where the "end-user" is defined as:

1. Customer premises equipment (CPE) such as an analog phone, shared or nonshared directory number (DN) of a digital phone, terminal, attendant console, printer, computer, FAX machine, applications processor (AP), etc.
2. Another switch (local, tandem, toll, PBX, etc.)
3. Conference circuit
4. Announcement circuit.

ANALOG LINES

TRAFFIC PARTITION

The general format of this worksheet is:

NUMBER OF CALLS	CORE60 REAL-TIME PER UNIT (MSEC)	CORE60 REAL-TIME CONSUMPTION (MSEC)
_____	x _____	= _____

If your SM-2000 has analog traffic, at least some of items 5

through 11 should be used. Each analog line should be classified in only one category.

6. NUMBER OF CALLS WHICH USE x 15 =
POTS LINES _____

Number of calls per hour which originate from or terminate on POTS lines in this SM-2000. No features are assigned to these lines.

7. NUMBER OF CALLS WHICH USE x 18 =
RURAL OR SUBURBAN ANALOG _____
LINES

Number of calls per hour which originate from or terminate on rural or suburban analog lines, that is, analog lines with at least one of the following features assigned: speed calling, call forwarding, call waiting, or 3-way calling, LASS, and LTSP. If lines have features in addition to any of the ones mentioned here, it should not be included in this classification.

8. NUMBER OF CALLS WHICH USE x 22 =
NONATTENDANT NON-ETN _____
(NONELECTRONIC TANDEM NETWORK)

ANALOG CENTREX LINES

Number of calls per hour which originate from or terminate on nonattendant, non-ETN, analog centrex lines, that is, analog lines with at least one of the following features assigned: call pickup, individualized dialing plan (IDP), call transfer, automatic route selection (ARS), private facility access (PFA), terminal groups, modular queuing for lines, intercom call restriction (ICR), carrier interconnect (CI), or multiline hunt group (MLHG). These lines may also have been assigned features as listed in item 6, but they cannot have other types of features assigned. In particular, this item does not include shared DN lines included in item 9a,b,c.

9. NUMBER OF CALLS WHICH USE x 25 =

NONATTENDANT ETN ANALOG _____

CENTREX LINES

Number of calls per hour which originate from or terminate on nonattendant ETN analog centrex lines; that is, analog lines with at least one of the following features assigned: ETN trunk queuing, deluxe ARS, authorization and account code, message detailed recording (MDR), or simulated facilities group (SFG) calls. These lines may also have been assigned features as listed in items 7 and 8. This item does not include shared DN lines included in item 10a,b,c.

10a. NUMBER OF NON-ATTENDANT, NON ETN x 44 =

SHARED DN ANALOG CENTREX _____

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 2 to 4 members.)

10b. NUMBER OF NON-ATTENDANT, NON ETN x 65 =

SHARED DN ANALOG CENTREX _____

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 5 to 8 members.)

10c. NUMBER OF NON-ATTENDANT, NON ETN x 86 =

SHARED DN ANALOG CENTREX _____

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 9 to 32 members.)

11a. NUMBER OF NON-ATTENDANT, ETN x 46 =

SHARED DN ANALOG CENTREX _____

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 2 to 4 members.)

11b. NUMBER OF NON-ATTENDANT, ETN x 68 =

SHARED DN ANALOG CENTREX _____

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 5 to 8 members.)

11c. NUMBER OF NON-ATTENDANT, ETN x 89 =

SHARED DN ANALOG CENTREX _____

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 9 to 32 members.)

12. NUMBER OF CALLS WHICH USE x 57 =

ANALOG ATTENDANT _____

Number of attendant or centralized attendant calls per hour.
This item is for SM-2000 with any analog attendant console.

NON-ISDN TRUNKS

Note: Each trunk should be classified in only one of the categories (items 12 through 15).

13. NUMBER OF CALLS WHICH USE x 11 =
 CCS7 POTS TRUNKS _____

Number of incoming and outgoing calls per hour on POTS CCS7 trunks that originate from or terminate on this SM-2000s.

14. NUMBER OF CALLS WHICH USE x 17 =
 TRUNK CENTREX _____

Number of incoming and outgoing calls per hour on trunks which have at least one of the following features assigned: Uniform Numbering Plan, Overlap Outpulsing, or Cut-Through calls.

15. NUMBER OF CALLS WHICH USE x (21+2.4xNDS0) =
 FRACTIONAL DS1 TRUNKS _____

Number of incoming and outgoing calls per hour on DS1 trunks on this SM-2000. "NDS0" is the average number of DS0 channels involved in the fractional DS1 trunk calls.

ISDN TRUNKS AND PRI

16. NUMBER OF CALLS WHICH USE x 4 =

TRUNK PACKET SWITCH DATA _____

Number of calls per hour over the incoming internal protocol (IP) trunk. This item is applicable if this SM-2000 is equipped with incoming IP trunks.

This item is applicable if this SM-2000 is equipped with incoming internal protocol (IP) trunks.

17. NUMBER OF CALLS WHICH USE _____ x 16 =

PRIMARY RATE INTERFACES (PRI) _____

PLAIN OLD DIGITAL SERVICE (PODS)

Number of voice-only calls per hour originating from or terminating on featureless primary rate interfaces (PRI) which go to PBXs. This item is applicable if this SM-2000 is connected to PBXs by PRIs.

18. NUMBER OF CALLS WHICH USE _____ x 21 =

PRI CENTREX _____

Number of voice-only calls per hour originating from or terminating on PRIs having INWATS or OUTWATS features going to a PBX. This item is applicable if this SM-2000 is connected to PBXs by PRI.

19. NUMBER OF CALLS WHICH USE x (38+2.4xNDS0) =

FRACTIONAL DS1 PRI _____

Number of incoming and outgoing calls per hour on DS1 PRIs on this SM-2000, multiplied by the average number of DS0 channels involved in the fractional DS1 trunk calls.

APPLICATION PROCESSOR

Items 20 through 24 are applicable only if an AP is attached via BRIs to the SM-2000. The real time for these items as indicated in the "SM-2000 REAL-TIME CONTRIBUTION" column is the SMP real time spent in processing messages between the AP and the SMP. The SMP real time spent on processing messages between the user's ISDN CPE and the SMP can be found in items 36 and 37.

20. NUMBER OF CALLS WHICH USE x 2 =

AP MESSAGE DETAILED _____

RECORDING (MDR)

Number of MDRs per hour that are generated by the switch and sent to the SM-2000 AP.

21. NUMBER OF CALLS WHICH USE x 5 =

AP MESSAGE SERVICE _____

SYSTEM (MSS) OR

ELECTRONIC DIRECTORY SERVICE (EDS)

Number of times per hour that an MSS or EDS system on the SM-2000 AP is initiated by the switch analog user.

22. NUMBER OF CALLS WHICH USE x 11 =

AP MSS OR EDS _____

Number of times per hour that an MSS or an EDS session on the SM-2000 AP is initiated by the switch ISDN users. This item is applicable if up to 40 percent of the AP MSS or EDS ISDN users have the 40-character display feature.

23. NUMBER OF CALLS WHICH USE x 12 =

AP MSS OR EDS _____

Number of times per hour that an MSS or an EDS session on the SM-2000 AP is initiated by the switch ISDN users. This item is applicable if 41 to 60 percent of the AP MSS/EDS ISDN users have the 40-character display feature.

24. NUMBER OF CALLS WHICH USE x 15 =

AP MSS OR EDS _____

Number of times per hour that an MSS or an EDS session on the SM-2000 AP is initiated by the switch ISDN users. This item is applicable if more than 60 percent of the AP MSS or EDS ISDN users have the 40-character display feature.

INTELLIGENT PROCESSOR

One example of an Intelligent Processor is a Service Circuit Node (SCN, an AIN implementation) linked to the SM-2000 via trunks. Another example is an Automated Response Unit (ARU) which is connected to the SM by an analog line.

25. NUMBER OF CALLS WHICH USE x 53 =

INTELLIGENT PROCESSOR _____

INITIATED TRANSFER

Number of calls terminating to a peripheral intelligent processor, with the intelligent processor then causing a call transfer to occur. The real times include only the intelligent processor termination and call transfer components and not any consumption by other features which may be involved in the call. The total effect on the SM-2000 real time consumption depends on how each vendor implements the feature on the intelligent processor.

CONFERENCE AND ANNOUNCEMENT CIRCUITS

26. NUMBER OF CALLS WHICH USE x 9 =

CONFERENCE CIRCUITS _____

Number of times per hour that conference circuits are used.

This item is applicable if conference circuits are on the SM-2000.

27. NUMBER OF CALLS WHICH USE x 11 =

ANNOUNCEMENT CIRCUITS _____

Number of times per hour that announcement circuits are used.

ISDN LINES

If the SM-2000 has ISDN traffic, at least some of items 28 through 42 should be used. One BRI can belong to more than one category.

28. NUMBER OF CALLS WHICH USE x 22 =

PLAIN OLD DIGITAL _____

SERVICE (PODS)

Number of calls per hour which originate from or terminate on featureless BRIs on the SM-2000.

29. NUMBER OF CALLS WHICH USE x 30 =

NONATTENDANT NON-ETN _____

NONSHARED DN DIGITAL CENTREX

Number of calls per hour which originate from or terminate on a

nonattendant, non-ETN, centrex, nonshared DN of a BRI. A nonattendant, non-ETN, centrex, nonshared DN is a nonshared DN with at least one of the following features assigned on the DN or BRI (and no other features assigned) speed calling, call forwarding, 3-way calling, call waiting, call pickup, call transfer, IDP, ARS, PFA, terminal group, modular queuing for lines, ICR, CI, MLHG, LASS, and ASP.

30. NUMBER OF CALLS WHICH USE x 32 =

NONATTENDANT ETN _____

NONSHARED DN DIGITAL CENTREX

Number of calls per hour which originate from or terminate on a nonattendant, ETN, centrex, nonshared DN of a BRI. A nonattendant, ETN, centrex, nonshared DN has at least one of the following features assigned to the DN or the BRI: queuing for trunks, deluxe ARS, authorization codes, account codes, and SFG. Features listed in item 29 may also be assigned to the DN or the BRI.

31a. NUMBER OF NON-ATTENDANT, NON ETN x 43 =

SHARED DN DIGITAL CENTREX _____

(SMALL GROUP)

Number of calls originated from, or terminated to, a shared DN of a BRI or a multipoint BRI. (From 2 to 4 members.)

31b. NUMBER OF NON-ATTENDANT, NON ETN x 65 =

SHARED DN DIGITAL CENTREX _____

(MEDIUM GROUP)

Number of calls originated from, or terminated to, a shared DN of a BRI or a multipoint BRI. (From 5 to 8 members.)

31c. NUMBER OF NON-ATTENDANT, NON ETN x 86 =

SHARED DN DIGITAL CENTREX _____

(LARGE GROUP)

Number of calls originated from, or terminated to, a shared DN of a BRI or a multipoint BRI. (From 9 to 32 members.)

Note: With respect to items 32a, 32b, and 32c, a non-attendant, ETN centrex shared DN is a shared DN with at least one of the features listed in item 30 assigned on the DN or the BRI or the multipoint BRI. Features listed in item 29 may also be assigned on the DN or the BRI.

32a. NUMBER OF NON-ATTENDANT, ETN x 46 =

SHARED DN DIGITAL CENTREX _____

(SMALL GROUP)

Number of calls originated from, or terminated to, a shared DN

of a BRI or a multipoint BRI. (From 2 to 4 members.)

32b. NUMBER OF NON-ATTENDANT, ETN x 68 =

SHARED DN DIGITAL CENTREX _____

(MEDIUM GROUP)

Number of calls originated from, or terminated to, a shared DN

of a BRI or a multipoint BRI. (From 5 to 8 members.)

32c. NUMBER OF NON-ATTENDANT, ETN x 89 =

SHARED DN DIGITAL CENTREX _____

(LARGE GROUP)

Number of calls originated from, or terminated to, a shared DN

of a BRI or a multipoint BRI. (From 9 to 32 members.)

33. NUMBER OF CALLS FROM x 5 =

PACKET SWITCH DATA _____

ORIGINATIONS

Number of packet switch data calls per hour (including on-demand

B-channel packet switch data calls) originating from, but not

terminated to, the SM-2000.

34. NUMBER OF CALLS WHICH USE x 24 =

CIRCUIT SWITCH DATA _____

Number of featureless circuit-switched data calls per hour
originating from or terminating at the SM-2000.

35. NUMBER OF CIRCUIT-SWITCHED DATA x 28 =

CENTREX CALLS _____

Number of times per hour that circuit switched data calls
originated from or terminated to this SM-2000 with at least one
of the following features assigned: hunt group/transfer, MLHG
queuing, ARS, PFA, authorization code, account code, ICLID, or MDR.

APPLICATION PROCESSOR

Items 36 and 37 are applicable only if the AP is attached to the
switch by BRIs. (The AP may be attached to any SM-2000 on the
switch.) The real-time consumption for these items is the SMP
real time spent on processing messages between the user's ISDN
CPE and the SMP. If the AP is connected to the SM-2000, the SMP
real time spent on processing messages between the AP and the AP
associated system process can be found in items 20 through 24.

36. NUMBER OF CALLS FROM x 25 =

AP USERS (WITHOUT _____

40-CHARACTER DISPLAY TERMINALS)

Number of times per hour that ISDN users without 40-character

display terminals initiate an EDS or MSS session at the SM-2000.

37. NUMBER OF CALLS FROM x 33 =

AP USERS (WITH _____
40-CHARACTER DISPLAY TERMINALS)

Number of times per hour that ISDN users with 40-character display terminals initiate an EDS or MSS session at the SM-2000.

DIGITAL ATTENDANTS

38. NUMBER OF CALLS WHICH USE x 81 =

DIGITAL ATTENDANT _____

Number of times per hour that attendant 1- and 2-way calls split with bridge are made. This item is applicable if attendants using ISDN consoles are located on the SM-2000.

39. NUMBER OF CALLS WHICH USE x 18 =

DIGITAL MESSAGE SERVICE _____

SYSTEM (MSS) ATTENDANT

Number of times per hour that attendant MSS call coverage calls are made on this SM-2000. The assumption is that the digital MSS attendant is always logged onto the AP by way of a packet or circuit switch data call to monitor or insert messages. This item is applicable if attendants using ISDN consoles are located

on the SM-2000.

40. NUMBER OF CALLS WHICH USE x 28 =

ACD/BRCS AGENT _____

Number of calls per hour terminating to, or originating from,
ACD/BRCS agents on this SM-2000.

Note: If the SM-2000 has OSPS/CACD traffic as well as
ACD/BRCS traffic, the call counts for both types of
ACD traffic can be combined in this item. However,
this worksheet does not account for any other OSPS
traffic, and therefore, if other OSPS traffic
exists on this SM-2000, the worksheet will not
provide an accurate result for the call capacity of
this SM-2000.

A and B should be entered in these formulas
in decimal fractions.

Sum of YOUR INPUT (items 5 through 40) ==> | C: |
| |

Sum of SM-2000 REAL-TIME CONTRIBUTION

(items 5 through 40) ==> | D: |
| |

**CALL CAPACITY CALCULATIONS
AT 90 PERCENT OCCUPANCY**

A+B Should be entered as decimal fractions in the following formulas.

CORE40

$$\begin{array}{l}
 3,600,000 \times (0.9 - (0.06 + 1.2 \times A \text{_____})) \\
 \text{-----} = \text{_____ calls per hour} \\
 \qquad \qquad \qquad D \text{_____} \\
 1.45 \times 2 \times \text{-----} \\
 \qquad \qquad \qquad C \text{_____}
 \end{array}$$

CORE60

$$\begin{array}{l}
 3,600,000 \times (0.9 - B \text{_____}) \\
 \text{-----} = \text{_____ calls per hour} \\
 \qquad \qquad \qquad D \text{_____} \\
 2 \times \text{-----} \\
 \qquad \qquad \qquad C \text{_____}
 \end{array}$$

Note: A = Overhead from line units

B = No load occupancy in decimal fraction form

C = Total number of (O+T) calls per hour

D = Total real time used by the offered load

PERCENT OF CALL CAPACITY

USED BY THE OFFERED LOAD

CORE40

$$1.45 \times D \underline{\hspace{2cm}}$$

$$\text{-----} \times 100 = \text{-----} \%$$

$$3,600,000 \times (0.9 - (0.06 + 1.2 \times A \underline{\hspace{2cm}}))$$

CORE60

$$D \underline{\hspace{2cm}}$$

$$\text{-----} \times 100 = \text{-----} \%$$

$$3,600,000 \times (0.9 - (B \underline{\hspace{2cm}}))$$

If these calculations indicate a call capacity occupancy greater than 90%,
it is recommended that you deload your SM-2000.

12.4 SM-2000 MEMORY

Information regarding SM—2000 memory parameters for the latest software release can be found in Section 10.4

12.5 DIGITAL NETWORK UNIT - SONET

The Digital Network Unit - SONET (DNU-S) is a peripheral interface unit for trunks replacing the DLTU in the SM-2000, and Remote TR303 lines. The primary function of this unit is to terminate SONET facilities and to convert data and signaling to the Peripheral Control and Timing (PCT) link format for the SM-2000. All information is passed between the DNU-S and the SM-2000 over these PCT links.

The following Digital Networking Unit-SONET (DNU-S) items are engineerable:

- **STSX-1 Link Interface (SLI)** STSX-1 Link Interface (SLI)-Each SLI terminates one STSX-1 link. A minimum of 1 and a maximum of 12 may be equipped per unit. 5E11 and then 5E13 software releases permitted the use of two and then three DNU-S units in the SM-2000, expanding the usable number of STX-1 links to 24 and then to 36. Usable trunks have been increased to 16,128 with 5E11 and then again to 24,192 with 5E13.
- **STSX-1 Link Interface (SFI)** Two SFIs are provided in each data group of TMUXs. A minimum of 2 OR a

maximum of 4 are provided per unit.

- **Transmission Multiplexer (TMUX)** TMUXs are provided one per PCT link plus one spare for each group of 6 TMUXs. A minimum of 2 OR a maximum of 14 are provided per unit.
- **Common Control (CC)** Each DNUS comes equipped with two Common Control (CC) boards
- **Common Data (CD)** A minimum of two OR a maximum of 4 CD boards may be provided per DNUS unit.
- **Common Optical Termination (COT)** A maximum of 24 COT boards may be provided per DNUS unit. Each COT terminates the optical fibers for 1 PCT link and performs the optical-to-electrical (and vice versa) conversion of data and control received and transmitted over the PCT link interfaces
- **Peripheral Link Interface (PLI)** Each side of a duplex PCT link terminates on a Peripheral Link Interface (PLI) paddle board at the SM-2000.

Table 12-1 describes the pack count for a single DNU-S at varying quantities of STSX-1s. Each STSX-1 is terminated by an SLI. The table assumes the most economical equipage of TMUXs, and buys the second spare only after the first data group is fully equipped.

Table 12-1 Pack Count for Single DNU-S

SLI (STSX-1)	SFI	TMUX	CC	CD	COT	PLI
1	2	1	2	2	2	2
2	2	2	2	2	4	4
3	2	3	2	2	6	6
4	2	4	2	2	8	8
5	2	5	2	2	10	10
6	2	6	2	2	12	12
7	4	7	2	4	14	14
8	4	8	2	4	16	16
9	4	9	2	4	18	18
10	4	10	2	4	20	20
11	4	11	2	4	22	22
12	4	12	2	4	24	24

Table 12-2 shows the SM-2000 engineering for the DNU-S.

Table 12-2 DNU-S Engineering for 100 Percent Inter SM Traffic

PCT PER SM	TRUNKS PER DNU-S ^a	DNU-S PER SM-2000 ^a	NCT2 PAIRS PER SM-2000 ^a	TSIS PER SM-2000 ^a
1	672	1	1	2
2	1,344	1	2	2
3	2,016	1	2	3
4	2,688	1	3	3
5	3,360	1	4	4
6	4,032	1	4	5
7	4,704	1	5	5
8	5,376	1	6	6
9	6,048	1	6	7
10	6,720	1	7	7
11	7,392	1	8	8
12	8,064	1	8	8
13	8,064+672	2	9	9
14	8,064+1,344	2	10	9
15	8,064+2,016	2	10	10
16	8,064+2,688	2	11	10
Notes:				
a. Equal time slots on the peripheral and network sides. (square)				

The SM-2000 is offered with a non-square TSI. The peripheral-to-peripheral feature enables a trunk (or line) to talk

to another trunk (or line) without using any network side time slots, as long as the calls originate and terminate on the same SM-2000. Square engineering on an SM requires 2 peripheral time slots and 2 network time slots even if the calls originate and terminate on the same SM.

Tables 12-3 and 12-4 show the equipment required for 50 and 100 percent tandem trunk traffic within the same SM-2000 respectively. Note the number of TSISs decreases as the tandem traffic increases.

Table 12-3 50 Percent Intra SM Tandem Trunk Traffic

PCT PER SM	TRUNKS PER DNU-S	DNU-S PER SM-2000	NCT2 PER SM-2000	TRUNKS PER SM-2000	TSIS PER SM-2000
1	672	1	0.6563	672	2
2	1,344	1	1.3125	1,344	2
3	2,016	1	1.9688	2,016	3
4	2,688	1	2.6250	2,688	3
5	3,360	1	3.2813	3,360	3
6	4,032	1	3.9375	4,032	4
7	4,704	1	4.5938	4,704	4
8	5,376	1	5.2500	5,376	4
9	6,048	1	5.9063	6,048	5
10	6,720	1	6.5625	6,720	5
11	7,392	1	7.2188	7,392	6
12	8,064	1	7.8750	8,064	6
13	8,064+672	2	8.5313	8,736	7
14	8,064+1,344	2	9.1875	9,408	7
15	8,064+2,016	2	9.8438	10,080	8
16	8,064+2,688	2	10.5000	10,752	8
17	8,064+3,360	2	11.1563	11,424	8
18	8,064+4,032	2	11.8125	12,096	9

Table 12-4 100 Percent Intra SM Tandem Trunk Traffic

PCT PER SM	TRUNKS PER DNU-S	DNU-S PER SM-2000	NCT2 PER SM-2000	TRUNKS PER SM-2000	TSIS PER SM-2000
1	672	1	0	672	2
2	1,344	1	0	1,344	2
3	2,016	1	0	2,016	2
4	2,688	1	0	2,688	2
5	3,360	1	0	3,360	3
6	4,032	1	0	4,032	3
7	4,704	1	0	4,704	3
8	5,376	1	0	5,376	3
9	6,048	1	0	6,048	4
10	6,720	1	0	6,720	4
11	7,392	1	0	7,392	4
12	8,064	1	0	8,064	4
13	8,064+672	2	0	8,736	5
14	8,064+1,344	2	0	9,408	5
15	8,064+2,016	2	0	10,080	5
16	8,064+2,688	2	0	10,752	5
17	8,064+3,360	2	0	11,424	6
18	8,064+4,032	2	0	12,096	6

12.5.1 TR-303 Interface on DNU-S

12.5.1.1 Feature Overview

Currently IDCU is used to terminate the TR303 RT lines. TR303 is industry standard and RTs may not always be a Lucent product. The DNU-S is used to terminate the SONET high speed trunks in the 5E software releases. With the introduction of this feature, the Remote lines can terminate on DNU-S which provides Peripheral Controller and Timing (PCT) links with multiple functionalities. TR303 connections from RTs terminate on Digital Access and Cross Connect System (DACS). From the DACS, STSX-1(s) connect to the DNU-S. The DNU-S is connected to the TSIU via PCT links. TR303 Embedded Operations Channel (EOC), Timeslot Management Channel (TMC), Basic Rate Interface (BRI) D-channel(s) and Permanent Packet B channel(s) are nailed up to the Packet Switch Unit (PSU) via

Data fanout Multiple Peripheral Interface Data Bus (DFMP), or Data Fanout PCT known as DF2. No Directly Peripheral Interface Data Bus (DPIDB) connections are used.

This feature represents a conjoining of two evolution paths. The DNU-S evolution path started with the development of the hardware platform for digital trunks. The long term view of the DNU-S is that it will become the single interface unit for DS1 or higher rate based services. This includes digital trunks and IDLC lines. The NGDLC evolution path started with the development of the line TR-303 interface followed by the introduction of the 2048 line TR-303 interface. Given that most NGDLC systems are SONET based, it is a natural step to provide a SONET interface on the switch to match.

Currently the DNU-S on the SM-2000 has a limitation of 28,800 analog line terminations. As touched on in previous sections, the TR-303 interface on DNU-S feature has the potential to easily surpass this limitation. As a result of the need to present a complete SM-2000 solution for line terminations, a new feature focussed on scaling the analog line terminations to the relation size maximum capacity of 64K. TR-303 on DNU-S feature provides the capability to assign a TR-303 Remote Digital Terminal (RDT) to DS1 facilities terminating on a DNU-S (contained with an EC-1). The 5ESS[®]-2000 switch will provide the equivalent capabilities and services for TR-303 RDTs on a DNU-S as for those on an IDCU with the exception of DS1 maintenance capabilities, PLS, and Hairpins.

The DNU-S is designed to connect to transmission equipment via EC-1 interfaces. DDM-2000, SLC[®] 2000, and DACS IV-2000 support the EC-1 interface. In addition, DDM-2000, SLC[®] 2000 and DACS-IV-2000 currently support the OC-3 interface. This feature allows the 5ESS[®]-2000 switch to terminate DS1 based TR-303 RDTs that interface to the DNU-S by mapping the DS1s asynchronously into SONET VT1.5s, multiplexed up to an EC-1.

12.5.1.2 Transparency Issues

The DNU-S TR-303 interface to the RDT is transparent with the IDCU TR-303 interface with the following exceptions:

- (1) DS1 Protection Line Switching (PLS). Since there are no physical DS1s present in the configuration, PLS is not needed. For applications where PLS is needed, the customer may choose to deploy RDT on an IDCU, instead of the DNU-S. As a consequence of not supporting PLS, DS1 Bit Error Rate (BER) is not be supported.
- (2) DS1 Loopbacks are not required to be supported for the same reason as PLS.
- (3) Hairpins are not supported for the DNU-S Interface. The ability to provide this feature requires a TSI that the DNU-S does not support.

Although TR-303 interface on DNU-S uses a different external name, DS1SFAC, for TR-303 DS1s interface on the DNU-S, the user will observe equivalent TR-303 interface functionality on the DNU-S as is currently found on the IDCU. The internal operations for the DNU-S differ from that of the TR-303 operation on the IDCU. Differences here are characterized as providing equivalent functionality without redesigning the current DNU-S OAM&P design.

For clarity, the TR-303 interface on DNU-S feature does not provide the TR-008 functionality found on the IDCU. Since DNU-S does not support TR-008, the ability to perform "RT Conversions" on the DNU-S is not supported. TR-008 RDTs are required to follow the Degrowth procedure for TR-008 RDTs then add the equipment to DNU-S following DNU-S Growth procedures for TR-303 RDTs. In addition, the external craft interface will see some differences e.g. the I/O commands make use of unit identifiers. IDCU and DNU-S are part of the the command string to specify which type of unit the TR-303 line is being served from.

12.5.1.3 Feature Penetration And Usage Data Projections

Between 40 and 50 percent of all 5ESS[®]-2000 switch lines to be shipped after 1996 are estimated to be IDLC lines. This number could go even higher if PCS or cable TV TR-303 applications increase. Today, TR-303 lines represent

a small percentage of these lines as the transition from TR-008 systems takes place. Within a short period of time, TR-303 should account for 100 percent of all new IDLC systems deployed. For new starts, these could all be deployed on the DNU-S platform. Growth is limited by the availability of the SM-2000 hardware platform, required for the DNU-S. Service activation is done exactly the same as for TR-303 lines on an IDC. The only difference is that the Office Equipment (OE) number has a different type and associated semantics.

12.5.2 Administration

Traffic usage, maintenance usage, call attempts, and Blocked Call Indication (BCI) reports are collected for each RDT. This involves creation of new reports to provide equivalent reporting capability. Since there is no blocking between the DNU-S and the SM-2000, this data is not required for the DNU-S itself.

- Print 30 minute traffic reports of attempts, usage, and time slot quantities per RDT.
- Initiate Subscriber Line Busy (SLB) studies for DNU-S lines.
- Initiate Blocked Call Indication (BCI) reports for DNU-S lines
- Collect measurements of usage and attempts for lines on a DNU-S

12.6 DIGITAL LINE TRUNK UNIT 2 (DLTU 2)

A Digital Line Trunk Unit 2 (DLTU2) consists of 10 DFI2 circuits. Each DFI2 terminates either a single or two T1 (24 channel) facilities per circuit pack. A maximum of 6 DLTU2s would be possible on an SM-2000 switch module. This allows 120 T1s (24 X 120) or 2880 trunks per SM-2000. This is increased from the SM limitation of 1 DLTU2 and 480 trunks per SM. The number of trunk T1s is reduced by the number of facilities that are used for RSMS. For an overview of DLTU, refer to the discussion in DIGITAL LINE AND TRUNK UNIT, Section 10.11.

12.7 DIGITAL SERVICE UNIT 3 (DSU3)

More decoders per SM are required with the SM-2000 than with an SM. The DSC3 provides roughly four times the capacity of the classic DSC. The DSU3 provides the Local Digital Service Unit Function (LDSUF). Each DSC3 board contains 10 Digital Signal Processors (DSPs). Each DSC3 circuit pack is a service group (SG) containing 4 duplex PIDBs, providing 128 time slots terminating to a DX board. Two DSC3s are required. These terminate on the first DX board. Up to 6 additional DSC3s may terminate on any DX board having ports available. All PIDBs from one DSC3 must be on the same DX board. Functional usage of the DSP types depends upon the market although there is some common usage. Table 12-5 shows DSP functions versus DSP types.

Table 12-5 Local DSU Functions

DSP TYPE	FUNCTIONS
Digit Receptor	Touch Tone Dial Pulse Multi-Frequency CAMA
Tone Outputter	Generalized Tone Outputter Inband Multiwink Signaling Incoming Calling Line Identification Message Waiting Indicator
Tone Transceiver	Voice Path Assurance
Voice Band Data Service	Analog Incoming Calling Line Identification Analog Visual Message Waiting Indicator

12.7.1 DSC3 Limits per DSC3

- 10 DSPs

- 128 incoming and 128 outgoing time slots
- 4 duplex PIDBs
- 1 duplex PICB.

12.7.2 Digit Receptors (DRs) per DSC3

- Each DR type DSP uses 16 incoming time slots.
- A maximum of 8 DSPs may be DR type DSP per DSC3 board.

The usage for Touch-Tone, Multi-Frequency, dial pulse and ASI- PROXY is determined by:

$\text{Calls} \times \text{holding time} / 100 = \text{CCS for decoders}$

This usage is then read into a Poison table (P.01) and the number of servers required is determined. These servers divided by 16 determine the DSPs that should be DR type. Two additional DSPs should be provided if CAMA trunks are in the SM-2000.

12.7.3 Tone Outputser (TO) per DSC3

Two DSPs per DSC3 can be TO type DSPs for 128 outgoing time slots. These 128 time slots are decremented by the outgoing time slots required by the tone transceiver (TTR) type DSPs. A minimum of 18 TO type time slots must remain for the tone outpulsing feature alone in the DSU3 (18 on each of the first 2 DSCs).

12.7.4 Tone Transceiver Per DSC3

A maximum of 8 DSPs may be TTR type per DSC3, but at least 2 DSC boards per SM-2000 are limited at 7 DSPs per DSC3 because of the time slots for tone generation. Tone transceivers are located in both the DSU-2 and DSU-3 units.

12.7.5 Voice Band Data Services (VBS) per DSC3

- A maximum of 8 DSPs per DSC3 board may be VBS
- Each VBS DSP can support up to 8 outgoing channels
- VBS does not require incoming time slots
- Traffic counts are provided for this DSP type.

12.7.6 Combinations per DSC3

- The sum of the TTR plus the DR plus DSPs must not exceed 8 on any one DSC3 board
- If a TTR type is required by VPA, two DSPs should be sufficient inasmuch as they provide 732 CCS.
- A minimum of 2 and a maximum of 6 DSC3 boards can be provided per SM-2000. The DSC3s operate in a service group load sharing active-active mode.
- A minimum of 18 TO type time slots must be available on 2 DSC3s.

12.7.7 Local Digital Service Unit Function (LDSUF)

Eight or 24 PIDBs are reserved for DSC3s when the first or sixth DX circuit packs, respectively, are equipped.

12.7.8 Technology Upgraded LDSF

The Technology Upgraded Local Digital Service Function provides a single hardware platform and resident software image for the Local Digital Service Function (LDSF) of tone generation, tone decoding and signaling on both the SM and SM-2000. The new version of the LDSF uses smarter Digital Signal Processors (DSPs) to perform the required functions. This pack is designated as a TN1890 and replaces the TN 833C in the SM. For the SM-2000, the new version of the LDSF is designated as a UN590, and replaces the UN363. The TN1890 pack is compatible with all DSU-2 and the UN590 with DSU-3 hardware. Its use is designed to be **totally transparent** to Call Processing, Recent Change, and Office Data Base information.

12.8 HOST SWITCHING MODULE ON SM-2000

The Host Switching Module (HSM) on SM-2000 feature extends the capability of the SM-2000 to support RSMs. The HSM-2000 is an evolution of the HSM which supports 30 RSMs compared to a maximum of 5 RSMs supported on existing HSMs. The HSM-2000 feature provides the capability to remote an RSM from a host SM-2000 via standard 24 channel T1 lines.

The HSM-2000 feature provides the functionality of an SM-2000 as a host to RSMs. Figure 12-1 presents a high level view of the HSM-2000 switch.

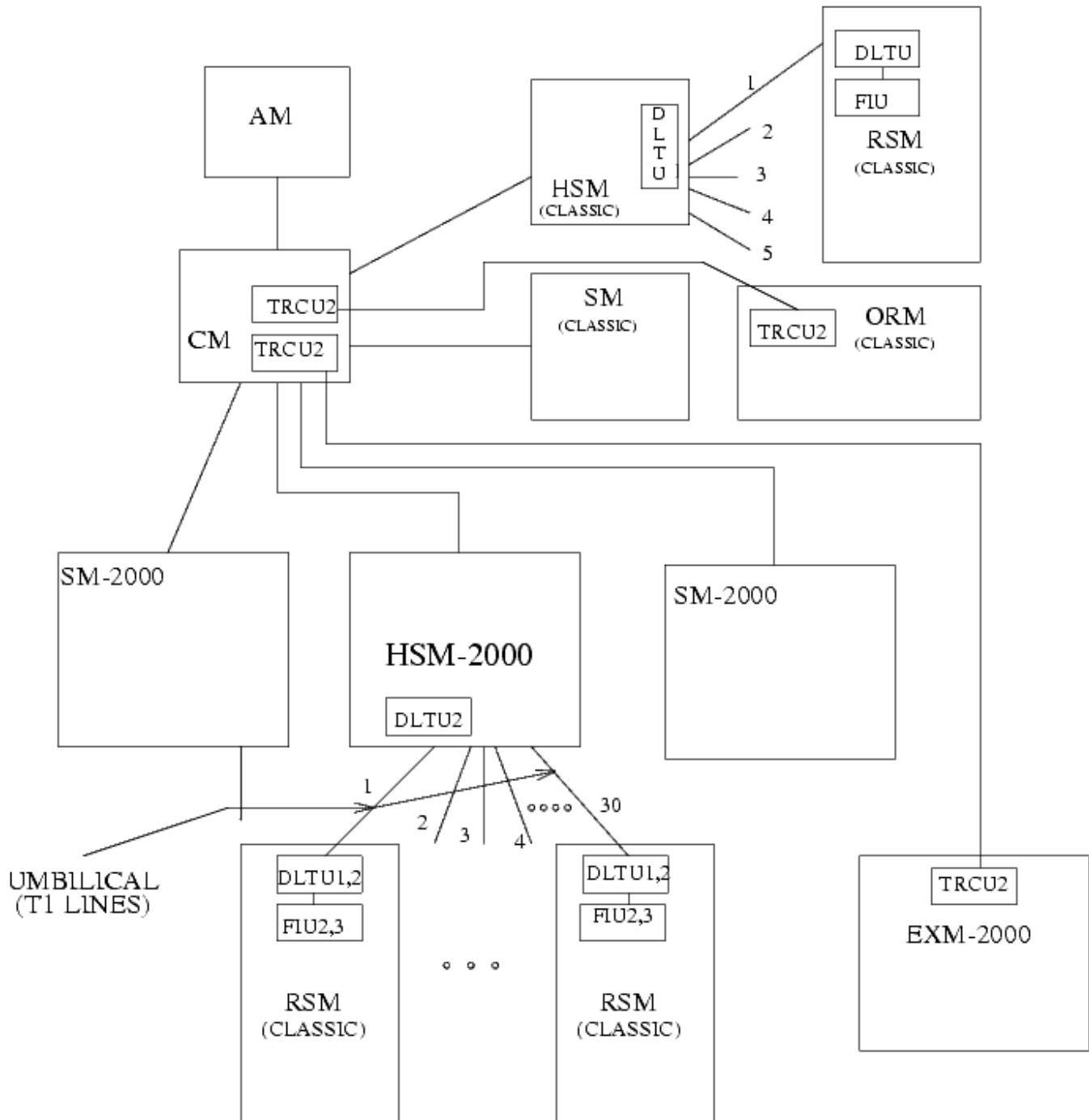


Figure 12-1 Host Switching Module 2000 (HSM-2000)

12.8.1 Host Switching Module Requirements

The HSM-2000 feature provides the capability to remote an RSM from a host SM-2000 via standard 24 channel T1 lines. The HSM-2000 uses 24 channel T1 lines to subtend the RSM, and is an evolution of the HSM, intended to extend all the services provided by a HSM to a greater number (30) of RSMs, compared to the maximum of 5 RSMs that the existing HSMs can subtend.

This feature is concerned with the operation of an SM-2000 as host to RSMs. As with HSM, the HSM-2000 is the

interface between the subtending RSMs and the Communication module in the host office. The HSM-2000 must provide a conduit for timing and control links to the subtending RSMs, and also provide access to the network. In practice, the timing source for the RSM is done at the Facility Interface Unit, (FIU), and the role in this for the HSM-2000, as with the SMS, is to ensure that at the near end, the HDFIs are initialized/synchronized; the T1s umbilicals terminating on the HDFIs provide input to the RSM timing selection process.

For control, the HSM-2000 must, like its counterpart, route the Control Time Slots (CTS), (two active or two active with two standby p per RSM) to the RSMs. Since an HSM-2000 can subtend up to 30 RSMs, it must be capable of administering the Control Time Slots for the RSMs.

This capability extends the current ability of HSMs to support a maximum of 5 RSMs, each of which is subtended from 2 to 4 standard T1 lines. It must be recognized that any RSM may be subtended from the HSM or HSM-2000 by from two to twenty T1 lines, with 4 T1 lines being typical. To subtend 30 RSMs from an HSM-2000, the minimum of two T1 lines must be enforced. No design decision must be made which would foreclose the ability of HSM-2000 to subtend more than 30 RSMs. The current thinking is that the ability to subtend up to 30 RSMs represents the bulk of the known market. The HSM-2000 is able to subtend a single RSM with 2 to 20 T1 links.

12.8.1.1 Initialization Requirements

All RSM(s) subtending from an HSM-2000 must be capable of being fully initialized (without pump) without disrupting stable calls on the HSM-2000. If RSM(s) subtending from an HSM-2000 is fully initialized with pump, calls in the HSM-2000, which occupy the pump time slots, is affected (for example, torn down) if the time slot is borrowed for pump. Stable calls from the initializing RSM(s), passing through the HSM-2000 are also be dropped. This is the current applicable scheme for pump an RSM subtending from an HSM.

HSM-2000 must be capable of full initialization without disrupting transient or stable calls in its subtending RSM(s), with the following exceptions:

- Calls passing through the HSM-2000 are torn down during HSM initialization.
- Subtending RSM(s) may go into stand-alone during HSM-2000 initialization. When HSM-2000 initialization occurs, the stand-alone interval of the subtending RSM(s) must not exceed the HSM-2000 initialization interval.

HSM-2000 must be capable of full-initialization without disrupting transient calls in its subtending RSM(s). An HSM-2000 full initialization with pump shall not take longer than 5 minutes.

Umbilical connectivity exercises must pass ATP, if both host and remote ends are active and the umbilical is connected correctly. Umbilical connectivity exercises fail if the umbilical is connected incorrectly or looped at either end.

If redundant CTS channels are provided, craft or fault recovery requests to take a CTS umbilical out of service must cause a switch of the CTS to the designated mate umbilical. Performance monitoring is the systematic monitoring (or tracking) of a particular entity's health through the continuous collection and analysis of data derived by observing the entity's performance.

In order to provide end-to-end performance measurement of the umbilicals subtending RSM(s) from an HSM-2000, performance data must be collected and analyzed in order to detect performance degradation and provide a basis for network maintenance. For HSM-2000, performance monitoring refers to the set of actions needed to collect, store, threshold, and report end-to-end performance of the umbilicals between it and the subtending RSM(s). The HSM-2000 must provide continuous performance monitoring of all HDFI facilities to subtending RSMs.

13. EXM-2000 UNIQUE RESOURCE UTILIZATION

13.1 DESCRIPTION

13.1.1 EXTENDED SWITCHING MODULE-2000

The Extended Switching Module-2000 (EXM-2000) is an optically remote SM-2000, somewhat analogous to the ORM in the SM configuration. The EXM-2000 supports optional stand alone capability and an optional Stratum 3 clock capability and is remoted from a CM2 using QLIs, NCT link formatted fiber optic, and TRCU2 equipment.

The EXM-2000 supports analog lines (LU3), digital trunks (DLTU2) for low speed interfaces, DNU-S for SONET high speed interface, and DSC3.

Examples of EXM-2000 applications include the following:

- Small analog switch replacements (4000 - 20,000 lines)
- New remote sites where large growth is expected, and using RSMs/ORMs will reach exhaust capacity
- Replacing Multi-Mode Remote Switching Module (MMRSM) configurations that are approaching exhaust (Approximately 10,000 lines)

13.2 ENGINEERING CONSIDERATIONS

See Section 12, SM-2000 UNIQUE RESOURCE UTILIZATION, for a discussion of engineering considerations for the EXM-2000.

13.3 ASSIGNMENT GUIDELINES

See Section 12, SM-2000 UNIQUE RESOURCE UTILIZATION, for a discussion of assignment guidelines for the EXM-2000.

13.4 FEATURE IMPACT

The impact of features on an EXM-2000 is similar as for an SM. The resources required to support features are similar to those provided in the SM and are discussed in the associated section of this manual.

13.5 TRANSITION IMPACT

The impact of features on an EXM-2000 is similar as for an SM. The resources required to support features are similar to those provided in the SM and are discussed in the associated section of this manual.

13.5.1 ABSTRACT

The SM-2000 is an evolution of the SM that provides a significant per time slot cost reduction, enhanced architecture, and platforms for new features/services. The cost reduction is achieved through the sharing of centralized resources over a significantly increased number of line and trunk terminations.

The EXM-2000, an optically remoted SM-2000, provides the capability to deliver SM-2000 functionality at a remote location. The functionality of EXM-2000 in the initial offering is circumscribed by the current planned capability of the SM-2000. The SM-2000 release supports analog lines, (LU3), and digital trunks (DLTU2 for low speed interfaces, and DNU-S for SONET high speed interface), and DSC3. The EXM-2000 supports these interfaces also. The SM-2000, does not currently support all functions found in the SM. These functions not supported directly by the SM-2000 are provided by one or more SMs coexisting in the same office. The EXM-2000 accesses the

functions provided by local SMs during normal operations. When an EXM-2000 is isolated from the host switch, only optional Stand Alone functionality is available if the customer pays for it.

Stand alone call processing capability must be developed for the local SM-2000 for stand alone capability to be an option for the EXM-2000. Without the stand alone call processing feature, an isolated EXM-2000 is out of service until it is restored.

Metallic testing, scanning and distribution functions provided by the MMSU/DCTU systems are needed for the normal operation of the EXM-2000. These functions not currently planned for the local SM-2000 must also be developed.

The Alarm Status Unit (ASU) provides visual indications of any alarms in a solitary ORM or ORM complex, displays the degree of the alarm (major, minor, critical), and shows the status of the Switch Module Control Unit (SMCU) (normal, stand alone, trouble, or power alarms). The ASU is needed in the EXM-2000.

Table 13-1 summarize features and hardware supported by SM-2000, EXM-2000, and ORM.

Table 13-1 Hardware Supported in Local and Remoted Modules

HARDWARE SUPPORTED	SM2K	EXM2K	ORM
MCTU4	X	X	MCTU2
Line Units	LU3	LU3	LU1/LU2/LU3
ATU	X	X	X
DLTU2	X	X	X
DNU-S	X	X	
DSC3/LDSF	X	X	DSC2
GDSU			X
MMSU	X	X	X
DCTU	X	X	X
PGTC	X	X	X
Universal SLC®	X	X	X
ISLU			
ISLU2	X	X	X
PSU2	X	X	
IDCU	X	X	X
GDSF	X	X	
Remoting HW Interface		X	X
TRCU2		(multiple)	(one)
ENLI		X	

EXM-2000 will not be available in cluster configuration. Those applications that require a cluster of 5ESS®-2000 switching modules are served using existing MMRSMs (Multi-Module Remote Switching Modules) based on the conventional SMs.

14. ISDN RESOURCE UTILIZATION

The architecture, design, and implementation of integrated services digital network (ISDN) in the 5ESS®-2000 switch impose unique requirements on and demand complicated procedures in the daily administration of the switch. This is especially true for the task of line assignment. The requirements and resulting procedures accommodating them are derived by combining two different types of switching, packet and circuit, in a single BRI. The two switching types each use different switch resources, the utilization of which is driven by the assignment of the single interface.

This document provides a description of the duality of ISDN in the 5ESS®-2000 switch and itemizes the resulting requirements imposed by ISDN on the line assignment process. It also presents an assignment methodology that addresses those requirements.

A brief description of the line assignment task is provided to give the reader a conceptual understanding of its objectives and parameters. The architecture of ISDN in the 5ESS®-2000 switch is then reviewed, but with emphasis placed on the limited switch resources that are the source of assignment constraints. Finally, a description is provided of the BRI assignment methodology that supports the assignment objectives and addresses the switch constraints previously described.

This section describes the ISDN components and how they are administered. Background information is provided to assist in the understanding of the administrative tasks associated with ISDN. This section also describes some of the functions provided by the ILAS tool to assist in the ISDN administration.

14.1 ISDN SWITCHING MODULE

14.1.1 ISDN SWITCHING MODULE

The basic unit of ISDN in the 5ESS[®]-2000 switch is the switching module (SM). An illustration is provided as Figure 14.1-1. An integrated services digital network (ISDN) SM has three unique components that distinguish it from a standard SM: a single PSU, up to five ISLUs (although it is physically possible to install five ISLUs, it is not normally recommended due to memory and real-time constraints), and the optionally loadable software for PSU and ISLU control and maintenance and ISDN call processing.

NOTE: The commercial centrex automatic call distribution, *PINNACLE*[®] ACD, application on the 5ESS[®]-2000 switch does not require a dedicated SM. The *PINNACLE*[®] ACD service and other ISDN applications can be served from the same ISDN SM. The *PINNACLE*[®] ACD should always be considered as an ISDN centrex business services application rather than a unique application.

The ISLU, ISLU2, PSU and PSU2 are 5ESS[®]-2000 switch peripheral units connected to the time slot interchange unit (TSIU) via peripheral interface data buses (PIDBs). In addition to these typical bus connections, directly connected PIDBs (DPIDBs) are provided between ISLUs and the PSU of the same SM; these interunit buses are unique to ISDN SMs.

In the remaining discussion, several terms are used that may be unfamiliar to the reader. These terms are defined as follows:

- **Basic Rate Interface (BRI):** The BRI provides the digital subscriber line interface to 3 digital channels. This interface provides 2 B-channels that communicate digitized voice or data. Also, a single D-channel that is used for controlling signaling and packet-switched data.
- **2B+D:** The term 2B+D is often used to define the BRI. Each B-channel on the BRI has a transmission rate of 64 Kbps and the single D-channel has a transmission rate of 16 Kbps.
- **Z-card:** The Z-card provides an interface for standard analog lines into the ISLU. This allows a mixture of digital and analog lines to be served from the ISLU. The use of the Z-card reduces the number of digital lines that may be served from the ISLU.
- **T-card:** The T-card provides a 4-wire BRI connection into the ISLU. The distance between the customer terminal and the ISLU is limited, in terms of loss, to 6 dB at 96 kHz.
- **U-card:** The U-card provides a 2-wire BRI connection into the ISLU. The distance between the customer terminal and the ISLU is limited in terms of dB loss.
 - AMI U-card — The loss for the AMI U-card is 32 dB at 80 kHz. This allows a longer loop than possible with the T-card. A network termination 1 (NT1) adapter may be used to convert from a 4-wire customer terminal to a U-card interface. Some terminals have built-in NT1s, therefore U-cards are required for those.
 - ANS[®] U-card — Performs similar functions to the current Lucent Technologies AMI U-card but with a transmission format compatible with T1D1 U-interface standard. The ANS[®] U-card requires an NT1 compatible with the T1D1 standard interface.
- **Q.931 Protocol:** The Q.931 protocol is used on the D-channel to provide signaling information for communications on the B-channels.
- **X.25 Protocol:** The X.25 protocol is a layered protocol used in the ISDN environment to transmit data calls on B- or D-channels in the form of data packets. The protocol layers include the electrical (hardware) level, a link

access level, and a packet transfer level.

- **Virtual Circuit:** A virtual circuit is a logical connection across the ISDN packet network that emulates a point-to-point physical circuit. The virtual circuit ensures data integrity, transparency, and sequencing.

The ISLU contains the 5ESS®-2000 switch BRI circuits (U or T BRI cards). The ISLU also provides a segregating function, sending B-channel, circuit-switched voice and data calls toward the time slot interchanger (TSI) and D-channel and (X.25) packet-switched B-channel calls toward the PSU, the PSU forms a packet switch network within the 5ESS®-2000 switch. The DPIDBs (between the ISLUs and the PSU) thus perform a function similar to the PIDBs, providing access to an internal network from the periphery.

This is a key element of ISDN architecture: the creation of a separate packet-switched network paralleling the already existing circuit-switched time division network. This architecture confines the two types of calling, circuit and packet, with their differing call characteristics, to separate switch resources to meet the differing call requirements.

It is the same concept, however, of differing call types using unique resources in the switch and gaining access to the switch through a single interface (the BRI) that has profound impact on the assignment process.

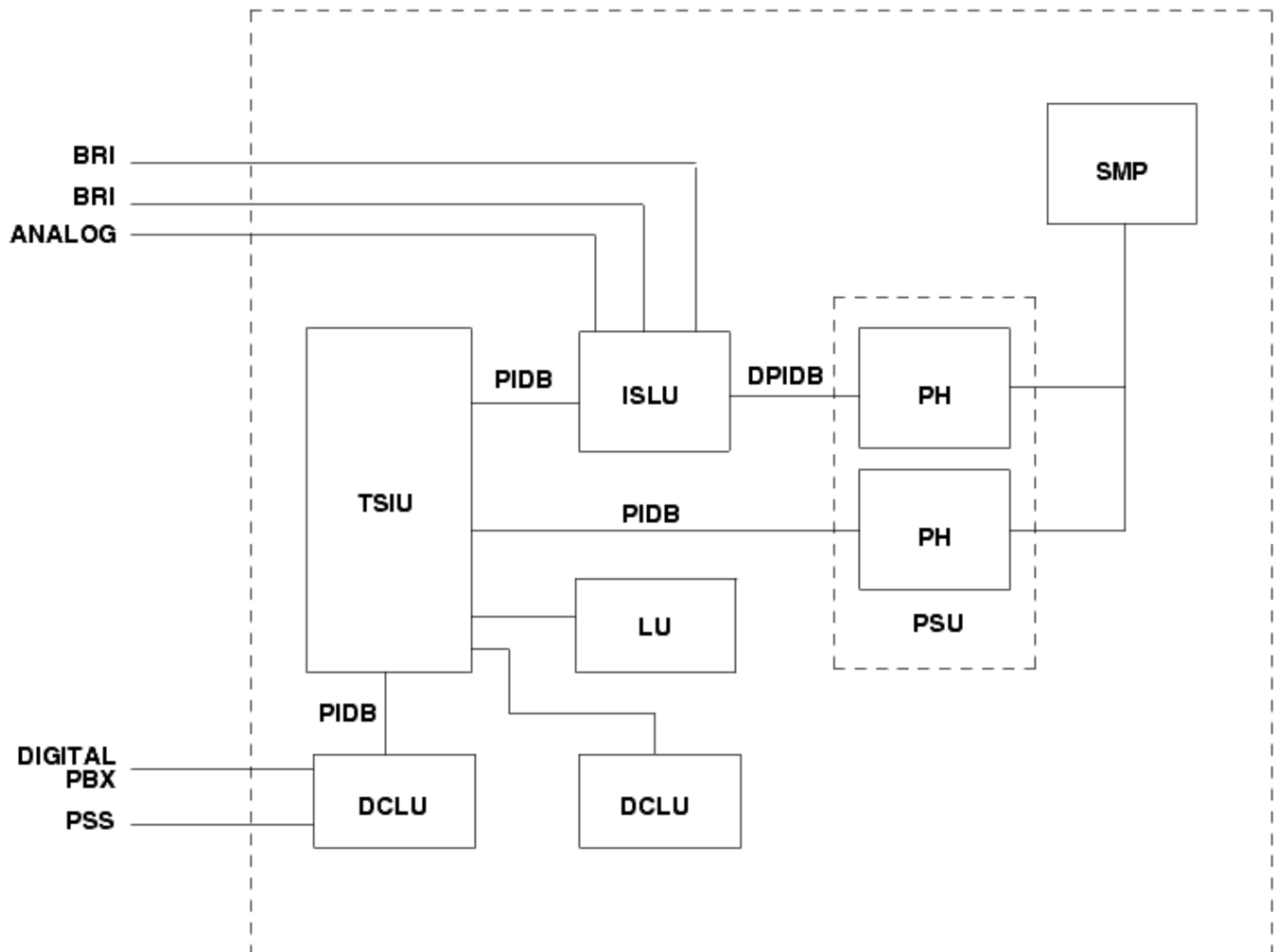


Figure 14.1-1 ISDN SM Architecture ISDN SM architecture

14.1.2 ISDN ON SM-2000

The Fractional DS1 Switching in the 5E10 software release is part of the ISDN on the SM-2000 feature. This expanded capability of the NxDS0 feature provides the capability to establish calls at rates between 128 Kbps and 1536 Kbps (2 to 24 DSOs) through the 5ESS[®]-2000 Switch Module by switching multiple rates of 64 Kbps (NxDS0). Fractional DS1 Switching will expand the environments for calls between the following:

- SM-2000 to SM
- SM-2000 to SM-2000
- ORM to SM-2000
- SM to EXM
- EXM to SM-2000
- ORM to EXM

14.2 ISLU/PSU

14.2.1 ISLU

The integrated services line unit (ISLU) supports the U- and the T-basic rate interfaces (BRIs) used for digital services between the end customer and the network. (Figure 14.2-1.) The ISLU is also capable of supporting an analog line interface, the Z interface card, or Z-card. The Z-card is a per line coder/decoder (CODEC) and is not an ISDN interface; however, it can be mixed in ISLUs with BRI cards installed and must, therefore, be accommodated in the BRI assignment process. In terms of resource use, Z-cards create circuit-switched demand and must share common resources with ISDN circuit-switched calls.

Automated facilities are available to assist in the assignment and administration of ISDN equipment and lines.

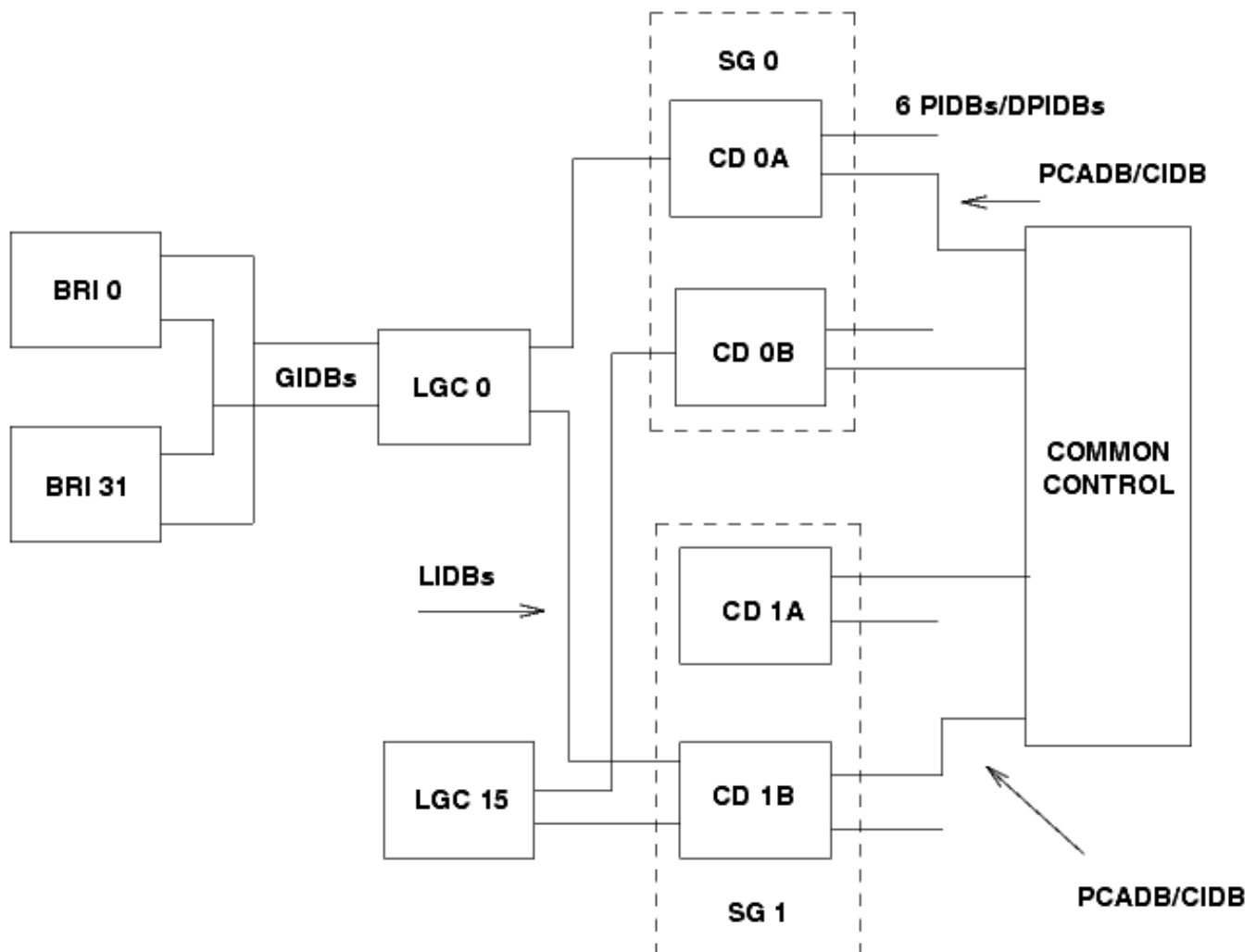


Figure 14.2-1 Integrated Services Line Unit Basic Diagram

The ability to mix the three types of cards in a single ISLU requires attention to the card type available/installed as an assignment parameter. The wiring of the circuit pack drawers in the ISLU is also a consideration. The T-card requires a 4-wire drawer, while the U- and Z-cards can be used in 2-wire or 4-wire drawers, but require the installation of high-level service circuit (HLSC) cards.

The ISLU has a capacity of 512 BRI cards arranged in line groups of 32 cards each. Each line group has its own

controller or line group controller (LGC). The quantity of LGCs are engineered based on physical card quantities, circuit-switched traffic, or packet-switched traffic, whichever is determined to be limiting.

The output of the ISLU toward the 5ESS®-2000 switch networks (packet and circuit) is a maximum of 24 data buses. Two separate quantities are engineered: PIDBs carrying circuit-switched voice and data calls to the time slot interchange and the time division circuit network, and DPIDBs carrying packet-switched calls to the packet switch unit (PSU) and its packet network.

Engineering of (circuit-switched) PIDBs follows existing methodologies that are based on expected traffic (CCS) on the BRI and Z-cards. For a fully equipped circuit-switched ISLU (512 cards installed), card concentration ratios varying from 2:1 to 16:1 are configured as shown in Table 14.2-1.

Table 14.2-1 Fully Equipped ISLU Card Concentration Ratios

PIDBs	TS	LU EQUIV. CONCENTRATION	CCS HIGH DAY (30 min) CAPACITY
1	32	16:1	518
2	64	8:1	1,036
3	96	5.3:1	1,555
4	128	4:1	2,073
5	160	3.2:1	2,592
6	192	2.6:1	3,110
7	224	2.3:1	3,628
8	256	2:1	4,147

Quantities of (packet-switched) DPIDBs are based on the number of BRI cards installed and the number of packet-switched B-channels configured on those cards. A fully equipped ISLU (512/496 BRI cards if spare cards are equipped) requires a minimum of 8 DPIDBs, leaving a maximum of 16 PIDBs for circuit-switched cards calling that supports the minimum concentration ratio noted previously.

The interfaces between the PIDBs/DPIDBs and the internal ISLU network are common data (CD) boards. Four are equipped and grouped into two service groups: each pair of CD boards functions as one entity from call processing and failure points of view.

The ISLU CD service groups can be configured as active/standby or active/active modes (RISLU supports only the active/standby mode.)

Active/standby mode provides duplex CD operation and therefore guarantees the preservation of stable calls if the active CD fails while the other CD is standby.

NOTE: The on-demand B-channel (ODB) call feature is supported only on the active/active configuration. This feature is not supported on RISLU.

Active/active (load sharing - ACTIVE MAJOR/ACTIVE MINOR) CD configuration, where both CDs are involved in call processing, provides greater call processing throughput and can be configured to carry the full traffic load of the ISLU without service degradation. The active/active configuration is not duplicable. This means that system reliability for the ISLU may be sacrificed when one of the CDs is taken out of service due to fault(s). Stable calls being served by the faulty CD are dropped but can be reestablished immediately.

The internal network of the ISLU is composed of data buses of the same structure (32 time slots each 16 bits wide) as the PIDB/DPIDB outputs. The time slot paths of the internal network is used for either circuit-switched or packet-switched calls.

Circuit-switched time slot paths are hunted at the initiation of a call. Packet-switched paths, however, are established whenever a BRI card is initialized (at unit installation or service order input). At that time, parallel paths are secured on each data bus (see Figure 14.2-1) to the PSU. Thus, there is a permanent, fully duplicated connection established from each BRI to the 5ESS®-2000 switch packet network.

The impact of the differing mechanisms of path hunt and initialization requires detail discussion of the internal ISLU network, specifically the line interface data bus (LIDB) output paths (time slots) from the LGCs. Of the 64 time slots leaving each LGC on the 2 LIDBs, 2 (duplicated, for a total of 4) are dedicated to LGC and line card control. From a line group fully equipped with 32 BRI cards, an additional 16 time slots are needed for D-channels: four D-channels per time slot, duplicated. There are 44 time slots remaining to carry B-channel traffic. Each LIDB has a potential 1,584 CCS on the 44 TS (36×44) = 1,584. Since the LIDBs are engineered at 40.9 percent occupancy, the engineered CCS capacity of the LIDB pair is $1,584 \times 0.409 = 648$ CCS/LIDB pair. The importance of this use of time slots from the LGC requires consideration of the permitted B-channel configurations supported (see Table 14.2-2). Traffic sensitivity at the LGC (that is, concentration) may be present if the cards configured in an LGC offer more than 44 circuit-switched channels to the LIDB, as well as the number of PPBs assigned.

Table 14.2-2 2B+D Configurations

SOFTWARE 2B+D CONFIGURATIONS (NOTES 1 THROUGH 4)			
D SERV	B1 SERV	B2 SERV	NOTES
SX	DMD	DMD	PD, CKT AND PKT ON B-CHANNELS
SX	X.25	DMD	PD AND PPB, CKT AND PKT ON B2
SX	DMD	X.25	PD AND PPB2, CKT AND PKT ON B1
SX	X.25	X.25	PD PPB1 AND PPB2, NO CKT
ADMIN	X.25	X.25	PPB1 AND PPB2, NO CKT, NO PD
ADMIN		X.25	PPB2, NO CKT, NO PD
ADMIN	X.25	—	PPB1, NO CKT, NO PD
XMP	—	—	MODEM POOL, PD ONLY, NO CKT
SONLY	DMD	—	ISDN ATTENDANT ONLY

Notes:

- PD Packet-switch data on D-channel
- CKT Voice and circuit-switch data
- PKT Packet-switch data not nailed up
- PPB[1,2] Packet-switch data nailed up on B1 or B2 channels

Even in the presence of concentration, recommended engineering methods (which limit average LIDB occupancy to around 40 percent) greatly lessen the traffic impact. (For comparison, it takes almost 70 percent occupancy to cause 1 percent blocking on a group of 44 servers.) Even though the impact is lessened, however, the necessity remains to distribute evenly BRI card configurations across line groups to match the average occupancy assumptions used in engineering.

A complicating factor in assessing the traffic impact at the LGC is the B-channel (X.25) packet switching configurations. Such channels are also provided with duplicated paths to the PSU at card initialization. Time slots for circuit-switching may, thus, be further reduced at the rate of two per packet-switched B-channel. (As the pool of time slots available for circuit-switching is reduced, the occupancy level at which a given level of blocking occurs also falls.) See Table 14.2-3 for PPB assignment vs. LIDB CCS.

Table 14.2-3 PPB Assignment Vs. LIDB CCS

NUMBER OF CIRCUITS	TSS REQUIRED	TSS USABLE	LIDB (60 min) CCS CAPACITY
0	0	44	648
1	2	42	576
2	4	40	504
3	6	38	432
4	8	36	360
5	10	34	288
6	12	32	216
7	14	30	144
8	16	28	72
9	18	26	0

The Z-cards compete for the remaining time slots for circuit-switching. Configuration distribution should include

Z-cards also. (Z-cards do not require paths to the PSU.)

14.2.1.1 ISLU2

The ISLU2, which is initially available in the 5E10 software release, is a replacement for the ISLU. This unit incorporates physical design changes and an increase in the number of DSLs supported on one unit.

The ISLU2 can support a current maximum of 768 lines. In the ISLU2, the line circuits are partitioned into 16 line groups with up to 64 lines in each group, as compared to the 32 lines per line group maximum on the ISLU. In the ISLU2, all line group circuitry is contained on circuit packs that are equipped in shelves. The ISLU2 can be configured as either a three-shelf, four-shelf, or five-shelf unit. As a three-shelf unit, ISLU2 consists of a common shelf, and either one line shelf and a plenum, or two line shelves. As a four shelf unit, ISLU2 consists of a common shelf and three line shelves. As a five-shelf unit, ISLU2 consists of a common shelf and four line shelves. These shelves eliminate the drawer hardware, and smaller KCB, and KCD packs used in the ISLU. In the present design, eight line circuits are contained on each pack. Line Group Control (LGC), and Line Group Power (LGP) functionality are distributed across the associated Line Packs (LP). There are no separate LGC and LGP packs.

In the ISLU2, the line circuits are partitioned into 16 line groups, with up to 64 lines in each group. Each line circuit is identified by a unique line-group, line-pack, and line-circuit designation. All eight line circuits equipped on a line pack are of the same type such as U, or T. Up to eight line packs of any type may be equipped in a line group in any combination. Since lines are equipped eight lines per pack, hardware growth and conversion must be done in groups of eight.

The ISLU2 data handling architecture is generally equivalent to that of the ISLU. The only difference is the electrical configuration of the LIDB interface used in the ISLU2 as compared to the LIDB interface in the ISLU. (See Figures 14.2-2 and 14.2-3.)

LG8				LG9		LG10		LG11		LG12		LG13		LG14		LG15		LINE SHELF 4				
P A C K 4	P A C K 5	P A C K 6	P A C K 7	LG1		LG2		LG3		LG4		LG5		LG6		LG7		LINE SHELF 3				
LG0																						
FAN UNIT																						
R G 0	H L S C 2	H L S C 1	H L S C 0	M A N 0	M A N 0	P O W E R	C D 0 1	C D 0 0	C C I P	C C C P	C C C I	C D 1 0	C D 1 1	P O W E R	M A N 1 0	M A N 1 1	H L S C 3	H L S C 4	H L S C 5	R G 1	COMMON SHELF	
LG8				LG9		LG10		LG11		LG12		LG13		LG14		LG15		LINE SHELF 2				
P A C K 0	P A C K 1	P A C K 2	P A C K 3	LG1		LG2		LG3		LG4		LG5		LG6		LG7		LINE SHELF 1				
LG0																						

Figure 14.2-2 ISLU2 Pack Configuration

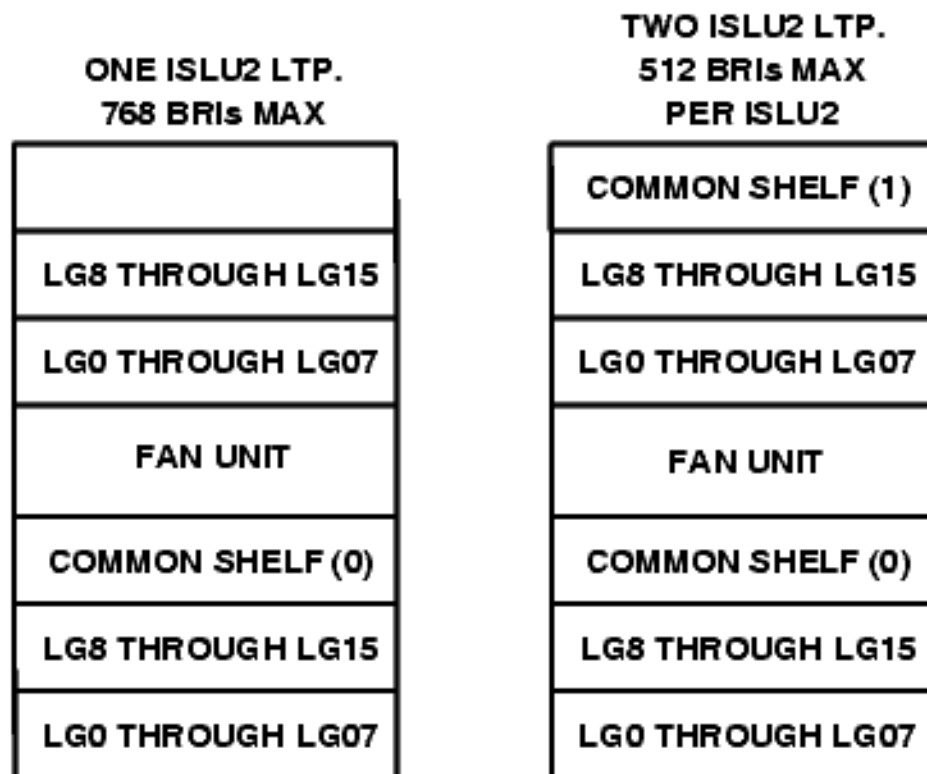


Figure 14.2-3 ISLU2 Shelf Configuration

14.2.1.1.1 Feature Descriptions

The ISLU2 is a unit available with, and requiring, the 5E10 software release. It is provisioned on either an SM, or an SM-2000. To understand the impact of ISLU2, the following describes what engineering changes are made by ISLU2, as well as what major engineering components have remained the same. Note that even though the ISLU2 is physically capable of supporting 1024 BRIs, The 5E10 software release currently only supports an engineering limit of 768 BRIs per unit.

The major engineering change with the ISLU2 is the capability to provide up to 768 BRIs per ISLU2 (when equipped with four line shelves) vs. the ISLU's maximum capacity of 512 BRIs. Because of the larger number of BRIs, an SM-2000 can support up to 3840 BRIs (5 ISLU2s x 768 BRIs per ISLU2). The limit of the SM remains at five ISLU2s equipped with 512 BRIs each, or 5 ISLU2s equipped with only 512 BRIs each (real time limit), or three ISLU2s at 768 BRIs each (LTP physical limit). Due to the limitation of 768 BRIs, ISLU2 equipped boards are numbered zero through five. However, it is possible that other items could limit the SM before the above ISLU/ISLU2 limits are reached. Therefore, CCS and real time engineering must be performed for ISDN configurations. Equip boards zero through five for the U.S. market due to this limitation.

To accomplish the increased number of BRIs, new ISLU2 BRI cards are used which provide eight BRIs per card. These cards are available for the "U" and "T" interface. Analog "Z" cards are not supported in the ISLU2 for the 5E10 software release. As a result of the increase to 768 BRIs per ISLU2, and the fact that the maximum quantity of Line Group Controllers (LGC) per ISLU2 remain at 16, an ISLU2 LGC can support up to 48 BRIs. (In the ISLU2, the LGC is built into the Line Card and Line shelf, and the LGC functionality can be referred to as a "virtual LGC"). As a result, the Line Interface Data Bus (LIDB) CCS capacity is reduced to 506 CCS per LIDB pair (for a fully loaded ISLU2), or approximately 10.5 CCS per BRI.

14.2.1.1.2 LIDB TIMESLOTS

The method for calculating available LIDB time slots for a 768 BRI ISLU2 is as follows:

- 64 LIDB TSs per LGC - 24 TSs for D channels - 4 TSs for control = 36 TSs
- Subtract 2 time slots for each Permanent Packet B user provisioned in the Line Group to determine the remaining LIDB time slots available for circuit switched and On- Demand B (ODB) services.

This method is also valid for calculating ISLU timeslots as well. Use Table 14.2-4 to determine the available LIDB CCS capacity for circuit switched and ODB services:

Table 14.2-4 LIDB CCS Capacity

REMAINING TS	CCS CAPACITY
10	45
12	80
14	116
16	151
18	187
20	222
22	258
24	293
26	329
28	364
30	400
32	435
34	471
36	506
38	542
40	577
42	613
44	648

If the ISLU2 is deloaded to accommodate higher CCS rates, the above LIDB capacity formula is adjusted as follows:

- $64 \text{ LIDB TSs per LGC} - ((\# \text{ of BRIs per LGC} * .25) * 2) - 4 \text{ TSs for control} - (2 * \text{PPB users per LGC}) = X \text{ TSs}$
- Table look-up for X TSs = Available LIDB CCS Capacity

Note that the LIDB capacity reduction (due to provisioning of PPB) is changed from the previous value of 72 CCS. The change is caused by the results of simulations done to measure the actual impact of PPB on LIDB capacity).

As with the ISLU, there are 24 ports available on the Common Data Boards. An ISLU2 fully equipped with 1024 BRIs requires 6 active DPIDBs and 6 standby DPIDBs (1024 BRIs 25 TSs per BRI / 32 TSs per DPIDB). Therefore, 12 CD ports are required for DPIDBs, leaving 12 CD ports available for PIDBs. A fully equipped ISLU2, therefore, supports an average BRI CCS of 8.1 CCS. (6 active PIDBs * 1036.8 CCS per PIDB / 1024 BRIs = 8.1 CCS per BRI).

Table 14.2-5 X.25 B Channels Including ODB

NO. OF X.25 ASSIGNMENTS	LIDB TSs REQUIRED FOR X.25	LIDB TSs LEFT AVAIL. FOR CS	CS CCS AVAIL. (30 MIN.)
0	0	44	324.0
1	2	42	309.0
2	4	40	294.5
3	6	38	280.0
4	8	36	265.0
5	10	34	250.5
6	12	32	235.5
7	14	30	221.0
8	16	28	206.0

9	18	26	191.5
10	20	24	176.5
11	22	22	162.0
12	24	20	147.5
13	26	18	132.5
14	28	16	117.5
15	30	14	103.0
16	32	12	88.5
17	34	10	73.5
18	36	8	59.0
19	38	6	44.0
20	40	4	29.5

The major ISLU2 engineering rules which have not changed are as follows:

- Common Data Boards ports = 24
- PIDB range per ISLU2 = 4 to 16 PIDBs
- DPIDB range = 2 to 20 DPIDBs
- PIDBs + DPIDBs <= 24
- There are 16 (virtual) LGCs per ISLU2
- PIDBs are engineered at 90% occupancy, then duplicated.
- An SM-2000 can support 5 ISLU2s with 768 BRIs each
- An SM can support 5 ISLU2s with 512 BRIs each (real time limit). Actual configurations may support fewer BRIs based upon actual real time and CCS engineering.
- An SM can only support 3 ISLU2s with more than 512 BRIs each (i.e. 768 BRIs) due to LTP cabinet limitations.
- MAN packs (without Line Circuit Sparing) = 2 if U-BRIs are present, else 0 if all T-BRIs
- MAN packs (with Line Circuit Sparing) = 2 - 4 if U-BRIs are present. Spare line equipment in LG00-LP00-LC00 and LG08-LP00-LC00, are supported by MAN Packs 00, and 01. If spare line equipment is assigned to LG07-LP03-LC00, MAN10 is required. If a spare assignment is made to position LG15-LP03-LC00, MAN11 is required (Where LG = Line Group, LP = Line Pack, and LC = Line Circuit). However, MAN Service Group 0 packs must be equipped prior to the MAN Service Group 1 packs. (for example, MAN00 must be equipped before MAN10, and MAN01 must be equipped before MAN11). T-BRIs cannot be spared.
- HLSC packs = 2 if U-BRIs are present, else 0 if all T- BRIs

14.2.1.1.3 Hardware

14.2.1.1.3.1 ISLU2 High Level Summary of Hardware Capabilities

- Available on both the SM and SM-2000 operating on the 5E10 software release.
- Uses new BRI packs which support 8 BRIs per pack. The new pack is available for U-BRIs and T-BRIs. The Z interface will not be supported with the 5E10 software release.
- Has 768 BRIs per ISLU2 terminal capacity in software release 5E10.
- 48 BRIs can be assigned to each virtual Line Group Controller

- Equipping an ISLU2 with 1024 BRIs requires 5 LTP equipment shelves.
- Equipping an ISLU or ISLU2 with 512 BRIs requires 3 LTP shelves.
- Same PICB and PIDB layout as ISLU.
- Provides 16 virtual Line Group Controllers per ISLU2. The Line Group Controller function (in the ISLU2) is incorporated in the Line Shelf and Line Card. Therefore, no LGC hardware engineering is required.
- Common Data boards have a 24 port capacity. Therefore, the PIDBs + DPIDBs <= 24.
- Mapping of LIDB D-channel time slots onto DPIDBs is the same as the ISLU mapping. Only four time slots on a particular DPIDB can be mapped to a particular LGC. Line Groups 0-7 can access DPIDBs A,C,E,G,I. Line groups 8-15 can access DPIDBs B,D,F,H,J.

14.2.1.1.4 Software

14.2.1.1.4.1 Line Circuit Naming

A new line circuit naming convention is required for the ISLU2. With the ISLU, each BRI is associated with a particular line card. For port naming, the Line Card Equipment Number (LCEN) is used. With the ISLU2, 8 BRIs are provided with each line card. Therefore, to identify the single line termination on the 8 BRI pack, Line Circuit Equipment Number (LCKEN) was created. The arguments for the LCEN (for ISLU) and the LCKEN (for ISLU2) are shown below:

LCEN = AAAHDDJJ

Where:

AAA = (1-192) Range for SM Number

H = (0-7) Range for ISLU Unit Number

DD = (00-15) Range for Line Group Controller Number

JJ = (00-31) Range for Line Card Number

LCKEN = AAABBDDEGG

Where:

AAA = (1-192) Range for SM or SM-2000 Number

BB = (00-42) Range for ISLU Unit Number

DD = (00-15) Range for Line Group Controller Number

E = (0-7) Range for Line Pack Number

GG = (00-07) Range for Line Circuit Number

Operations Systems will need to evaluate the impact of LCKEN on the systems, and modify them accordingly.

14.2.1.1.4.2 Real Time

The ISLU2 in itself will not impact SM2000 real time. However, ISDN real time must be included when calculating total SM2000 real time usage.

14.2.1.1.4.3 Administration

Two new administration considerations required are new LC naming conventions for the ISLU2, and the LIDB CCS capacity determination.

14.2.1.2 Multipoint Basic Rate Interface

This feature provides support for connecting a maximum of eight users, belonging to the same customer, to a single BRI. The feature makes it possible to alert one or more of the users connected to the same BRI. (Except for key system users, only one user will be alerted per call.)

There can be a maximum of eight terminal endpoint identifiers (TEIs) on a single BRI. The users share the two B-channels for circuit or packet mode services and the D-channel for signaling and additional packet data services. (A maximum of eight permanent D-channel links may be used for X.25 packet mode services.)

14.2.1.2.1 User Service Order Profile

The multipoint BRI service allows up to eight users per "U-interface" BRI or "T-interface" BRI. In either case, all users vie for the two B-channels of the 2B+D interface and share the D-channel for signaling and X.25 packet switching. Each user is allowed circuit-switched voice, circuit-switched data and X.25 packet-switched calls on either or both B-channels (B1 and B2). One user "owns" the B-channel during a call and the other users are excluded. The other users (or any other party) can be added to the call by invoking the multiway calling feature such as 3-way or 6-way conferencing. No special dialing is required between users on the same BRI.

In addition to each user call being private, its service configurations and feature subscriptions are independent. A separate user service order profile (USOP) containing the directory number, service configuration, billing directory number, and feature information, is stored for each user. This independence of user information from BRI data aids the implementation of the automatic customer station rearrangement feature, allowing the subscriber to make station moves without accessing a recent change terminal.

The service profile identifier (SPID) is the access key for all of the user service order information stored in a collection of data relations referred to as a USOP. Because BRI parameters are stored separately from the USOP, the user's service is activated when the USOP is bound to the BRI. After the binding process is completed the SPID becomes the key to all customer information. The 5ESS®-2000 switch maps the information elements of the Q.931 and the LAPD protocols into the SPID to access the data required to service all of the user's calling requests.

A separate service order is required for each user subscription. From the user service order data, the 5ESS®-2000 switch calculates and stores a customer identification called a Service Profile ID having three attributes:

- (1) **Extended Primary Directory Number (EPDN)** — The DN or MLHG terminal number associated with the user service subscription.
- (2) **Network Access Type (NATYPE)** — Attribute identifying whether the EPDN is a DN or MLHG
- (3) **Numbering Plan ID (NPID)** — Identifies whether the EPDN is a circuit or packet numbering plan DN is a circuit or a packet MLHG.

The SPID for a standard line consists of two parts: (1) a 1 to 18-digit user service order profile identifier (USPID), and (2) a 2-digit terminal identifier (TID). The custom line consists of a 1 to 10-digit USPID only.

14.2.1.2.2 Signaling Interface

The multipoint service requires that the switch support independent signaling interfaces for up to 8 users per D-channel. The frame addressing the LAPD implements multiple logical links for each user on the D-channel. The individual users are identified by the terminal endpoint identifier (TEI). Each user is assigned a separate TEI, with TEI 127 used for broadcast to all users. Three service access point identifiers (SAPI) are reserved. The SAPI 0 is used for Q.931 signaling, and SAPI 16 is used for X.25 frames. The SAPI 63 is reserved for maintenance functions. A particular customer premises equipment (CPE) terminal can determine if a frame is intended for that CPE by examining the TEI and can tell if the frame is a call processing frame by the SAPI. Broadcast frames require the CPE to further examine the embedded information (Q.931 packet) to determine the appropriate response, if any.

The number of call processing logical links per PH has been increased from 256 to 384 to support MPT. Each user can have one logical link for circuit switching and another for packet switching, with users subscribing to D-channel packet switching only being required to have both a packet and a signaling link.

14.2.1.2.3 Call Processing Impacts

The Multipoint BRI service requires that the CPE be able to identify itself to the switch. This is accomplished through the end point identification (EPID) procedures. The EPID procedures are implemented in new information elements of the set up message and new parameters in the management information message. The MPT compatible CPE is required to perform additional packet processing to determine the SPID or DN contained in the Q.931 packet. Individual Multipoint CPE only acknowledges packets containing its own SPID or DN.

14.2.1.2.4 Operations

There are no new TRFC30 counts for Multipoint service. Engineering and daily administration use existing ISDN usage and peg count measurements.

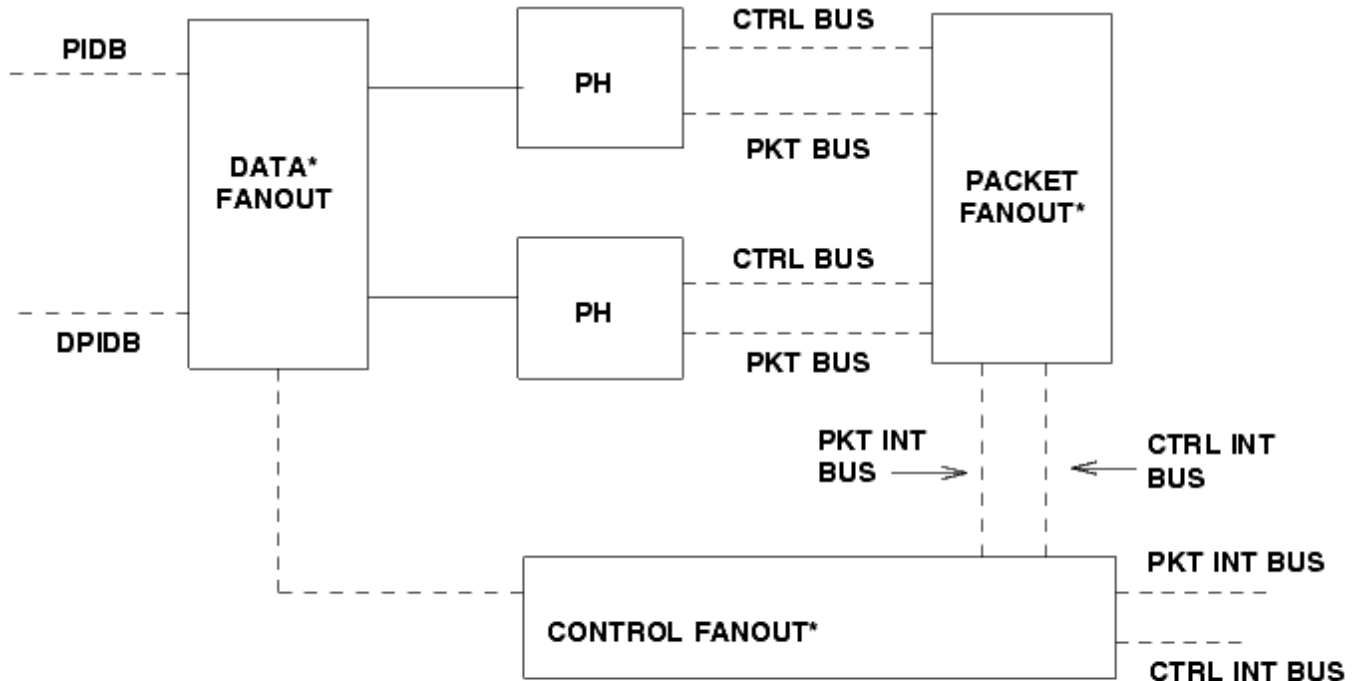
Several maintenance enhancements have been added for Multipoint service. The craftsperson must have the ability to remove and restore, perform digital tests, and receive protocol error notification for individual CPE. Craftsperson must also be able to obtain CPE status including the SPID, terminal initialization type, and TEI.

14.2.1.3 Automatic Customer Station Rearrangement

The ISDN Automatic Customer Station Rearrangement enables end-users to relocate their terminal equipment and associated directory number, without a service order. The customer dials an access code and the recent change is completed by the switch.

14.2.1.4 Customer Perspective

The internal packet network of the 5ESS®-2000 switch is provided by the PSU (shown in Figure 14.2-4).



***DUPLICATED**

Figure 14.2-4 Packet Switch Unit

Data frames containing X.25 protocol packets or Q.931 protocol packets arrive at the unit over DPIDBs from BRIs in the ISLUs; Lucent Technologies proprietary internal protocol (IP) frames arrive over PIDBs from the TSI for ISM and interswitch packet calls. All are switched to PH data buses (PHDBs) by a data fanout (DF). A DF functions as a full time slot interchanger, switching between any two PIDB/DPIDB and PHDB time slots. A duplicated DF is provided for each PSU shelf. It is important to note that the time slot switching is done with whole time slots.

The primary component in the 5ESS®-2000 switch packet network is the protocol handler (PH), which performs all layer 2 and X.25 layer 3 protocol processing. A maximum of 16 PHs can be equipped on a single PSU shelf. The quantity of PHs required is a function of BRI cards installed or data throughput requirements, whichever is limiting. The PHs are not duplicated, but are provisioned using an 'n + k' sparing scheme, where 'k', the number of spare PHs, is established by the service provider and 'n' is the number of PHs not including spares. The range of spares per shelf is from zero to eight, for an effective duplication of PHs if desired (Lucent recommends 1 spare per shelf). Table 14.2-6 illustrates the relative throughput of the PHs versus the various software releases.

The PHs are functionally distinguished as five types. (These distinctions are to facilitate PH engineering and administration. In terms of software and firmware, all PHs are identical and interchangeable.)

- **Access PH** — Serves B, ODB, D X.25 and D-channel signaling
- **ISM** — The inter-SM (ISM) PHs process IP frames for packet calls between SMs.
- **ISPT** — The inter-SM packet trunk (ISPT) PHs handle packet data to other switches or networks via an

external (to the 5ESS[®]-2000 switch) packet tandem switch [the Lucent Technologies *Western Electric*[®] Packet Switching System (1PSS)].

- **IP** — Internal Protocol 5ESS[®]-2000 switch to 5ESS[®]-2000 switch)
- **PRI** — Primary Rate Interface.

Table 14.2-6 Protocol Handler Throughput

ACCESS		INTER-SM (ISM)				INTER-SW (ISPT)			X.75/x.75 [*] INTER-SW		
PH	PPS	PH	PPS	TSs	ACK MODE	PH	PPS	TSs	PH	PPS	TKs
PH3	160	PH3	320	10	NON-ACK	PH3	240	6	PH3	160	4
		PH3	192	6	ACK						
PH3	200	PH3	320	10	NON-ACK	PH3	240	6	PH3	200	4
		PH3	192	6	ACK						
PH4	200	PH4	320	10	NON-ACK	PH4	240	6	PH4	200	4
			192	2	ACK						

Packets are transmitted between PHs through the (duplicated) packet fanout (PF) provided, per PSU shelf, and over the packet bus using the IP.

Data communication between the shelves of the PSU, as well as the distribution of control messages to the fanouts and PHs, is performed by the duplicated control fanout (CF), provided one per unit. The CF also transmits and receives data frames and control messages between the PSU and the switching module processor (SMP) over the packet bus (PB) and peripheral interface control bus (PICB), respectively. The CF acts as the arbiter for the broadcast of data and control information over the internal PF data network between PHs (and the SMP).

The PSU provides full local area network (LAN) functionality for BRIs existing in a single SM or in an ISM network. Layer 2 protocol processing [link access protocol, type B for packet-switched B-channels (LAPB) and type D for D-channels (LAPD)] and X.25 layer 3 protocol processing is performed autonomously by the access PHs for packet-switched calls. The SMP is used for routing information at virtual call set up time.

The PH terminates only layer 2 protocol (LAPD) for the Q.931 packets associated with circuit-switched calls. These packets are forwarded to the SMP for layer 3 termination.

From an assignment point of view, it is significant that the architecture assigns functions to discrete resources (PHs). To achieve the engineered capacity of the ISLU, it is necessary to administer the load on the packet network in the 5ESS[®]-2000 switch in a manner analogous to the circuit-switched load. A difference exists between the packet- and circuit-switched networks in that the packet network is nonblocking. Instead, the end-user experiences poorer performance during overload conditions. These performance degradations are usually manifested in longer file transfer times and 'real-time breaks' during display functions. In short, a congested packet network performs similarly to an overloaded processor in a time-shared computer system.

To ensure good packet switching service, it is necessary to evenly distribute the packet load across the PHs in the PSU. This requires that the lines be categorized according to anticipated packet load. This load may be based on traffic measurements, but is initially derived from service attributes or knowledge of specific customer applications.

Note, however, that packet load analysis depends less on BRI configurations, as in the ISLU case, and more on applications, which may vary widely. There are several factors germane to this analysis.

A common application is terminal to host computer communications. These tend to be low usage, in terms of packet throughput, with response time limited by the host computer and not the network. Typical examples are electronic mail and text processing.

Applications that involve LANs and data entry/data collection networks experience higher packet loads. These are high-speed transmission networks, and often involve some sort of distributed processing. These applications could

involve order entry, record updates, and point-of-sale terminals.

The highest usage applications involve host-computer to host-computer communications. Typical applications could include program downloading and remote job entry functions.

Packet load and, hence, resource demand is affected by packet size, also. Packet size refers to the amount of data (in bytes) that is transmitted in a single packet. This parameter in the construction of the individual packets is controlled by the customer premises equipment (CPE). The impact can be summarized in saying that, for a given bit rate and channel occupancy, the smaller the packet, the greater the packets per second transmitted.

For example, a 9.6 kilobit per second (Kbps) line operating at 85 percent occupancy transmits 8,160 bits of data in 1 second. With a packet size of 128-bytes, roughly eight data packets per second (dpps) is transmitted. If the packet size is halved, to 64 bytes, the data rate, in dpps, doubles to 16. Considering that an access PH has a packet load capacity of 50 dpps, the effect on BRI assignment is obvious.

The full impact of the data rate/packet size relationship is expected only during large file transfer operations where a link carries sustained transmission. If an individual link does exceed the PH overload control threshold, the PH returns a 'receiver not ready' message, resulting in the CPE experiencing a longer time to complete the file transfer. There is no data corrupted or lost, and the switch does not peg any error registers due to this type of packet overload.

In the analysis of packet switching loads, the influence of BRI configuration is not totally absent, however. The major difference between packet switching on the B- and D-channels is the bandwidth of the transmission: the B-channel is a 64 Kbps channel and the D-channel is a 16 Kbps channel. (A second difference is the maximum number of virtual calls per channel: 15 for the B-channel and 127 for the D-channel.

The impact of this is found in the number of time slots required to carry packet calls from the line group controller in the ISLU to the PH. Because a time slot and a B-channel both have a 64 Kbps bandwidth, a B-channel requires a whole time slot. The D-channels, however, can be multiplexed (up to four per time slot).

The number of time slots between ISLUs and the PSU dedicated for packet traffic is an engineered quantity. The switch assigns them at initialization or service order entry based on assignment input (BRI card and PH). The impact on the assignment process is that unless the engineered utilization is achieved, either line card terminations or PH capacity is lost.

14.2.2 PSU2

The PSU2 is initially available in the 5E10 software release. This unit is a replacement for the PSU. It provides a centralized high bandwidth interface that supports packet switching of data and signaling messages on both the SM-2000 and SM platforms. The PSU2 provides the ability to support the D-Channel Signaling associated with the 5ESS®-2000 switch ISDN services, in addition to the ability to switch customer packet data on the B- or D-Channels.

14.2.2.1 Hardware

The PSU2 hardware platform consists of a new 5 shelf, 100 Mb/s backplane PSU2 unit equipped with new Control Fanout 2 (CF2), Packet Fanout 2 (PF2), and Protocol Handler 4 (PH4) circuit packs. The PSU2 also supports the Data Fanout (DF) interface which supports a maximum of 6 DPIDBs and 1 PIDB per shelf, or the Data Fanout Multiple PIDB (DFMP) interface which supports up to 4 PIDBs per shelf. The PSU2 will interface with the SM-2000's or SM's Module Controller and Time Slot Interchange Unit (MCTU) through the new Packet Interface 2 (PI2). The PI2 provides significantly higher packet throughput [800 packets per second (pkts/sec) versus 210 (pkts/sec)].

The PSU2's packet switching interfaces are provided by the peripheral interface data buses (PIDBs) to the TSIU, and the directly connected peripheral interface data buses (DPIDBs) to the various peripheral units such as the ISLU2. The PSU2's communication with the SMP is via the peripheral interface control buses (PICBs) which

provide a low level control interface, and via the packet bus (PB) which provides a high level control and signaling interface. The PSU2 also supports the Data Fanout (DF) interface which supports a maximum of 6 DPIDBs and 1 PIDB per shelf, or the Data Fanout Multiple PIDB (DFMP) interface which supports up to 4 PIDBs per shelf. The PSU2 will interface with the SM-2000's or SM's Module Controller and Time Slot Interchange Unit (MCTU) through the new Packet Interface 2 (PI2).

The Data Fanout terminates six DPIDBs and one PIDB to the active side (and the same on the standby side). The Data Fanout is required if any BRIs will be terminated to a particular PSU2 shelf. This unit is engineered the same as the current PSU.

14.2.2.2 Data Fanout Multiple PIDB Unit

The Data Fanout Multiple PIDB (DFMP) is a unit which provides 1-4 active PIDBs and 1-4 standby PIDBs to the active DI. No DPIDBs are supported. Therefore, at a minimum, each DFMP requires 2 PIDB ports to the active side and 2 PIDB ports to the standby side of the time slot interchange. At a maximum, each DFMP requires 8 PIDB ports to the active, and 8 PIDB ports to the standby side of the time slot interchange. In an SM-2000 application, a 5 shelf PSU2 fully equipped with DFMPs would require 40 PIDB terminations on the active DX and the same on the standby DX (SM-2000 has a 136 active side PIDBs available for optional peripherals). This configuration would not fit on an SM, since only 31 DI ports are available. The DFMP can be used for applications where there are concentrations of nail-up trunks (for example, IP, X.75, X.75', XAT, PRI) in one SM/SM-2000, and the use of the Data Fanout would limit the PSU2 shelf on PIDB time slots to the time slot interchange.

In 5E10 software release, both the SM, and SM-2000 will support the following peripherals: ISLU2, IDCU, DLTU2, and DLTU-RH. DNU-S is only supported on the SM-2000. The DLTU and ISLU are only supported on the SM.

The PSU2 occupies from one to five equipment shelves in a single cabinet and consists of the following circuitry (see Figure 14.2-5):

1. Data Fanout (DF)

- Terminates up to six DPIDBs and one PIDB
- Performs the time slot assignment of the DPIDBs and PIDB to the PH4s via the protocol handler data bus (PHDB)

2. Data Fanout with Multiple PIDBs (DFMP)

- Terminates up to four PIDBs
- Performs the time slot assignment of the PIDBs to the PH4s via the protocol handler data bus (PHDB)

3. Packet Fanout 2 (PF2)

- Distributes packet bus arbitration control signals to the PH4s
- Concentrates packet bus requests from the PH4s to the CF2
- Distributes packet bus data to the PH4s

4. Control Fanout 2 (CF2)

- Communicates with the SMP via a PICB
- Distributes configuration and control information to the PF2 and the DF or DFMP

- Distributes time slot assignment information to the DF or DFMP
- Performs packet bus arbitration

5. Protocol Handler 4 (PH4)

- Communicates D-Channel information via time slots from the DF or DFMP
- Supports a maximum of 128 sixteen kb/s Channels or 32 sixty-four kb/s Channels
- Communicates over the packet bus to the SMP and to other PH4s
- Provides a localized environment to support distributed processing

5 SHELF PSU2 UNIT

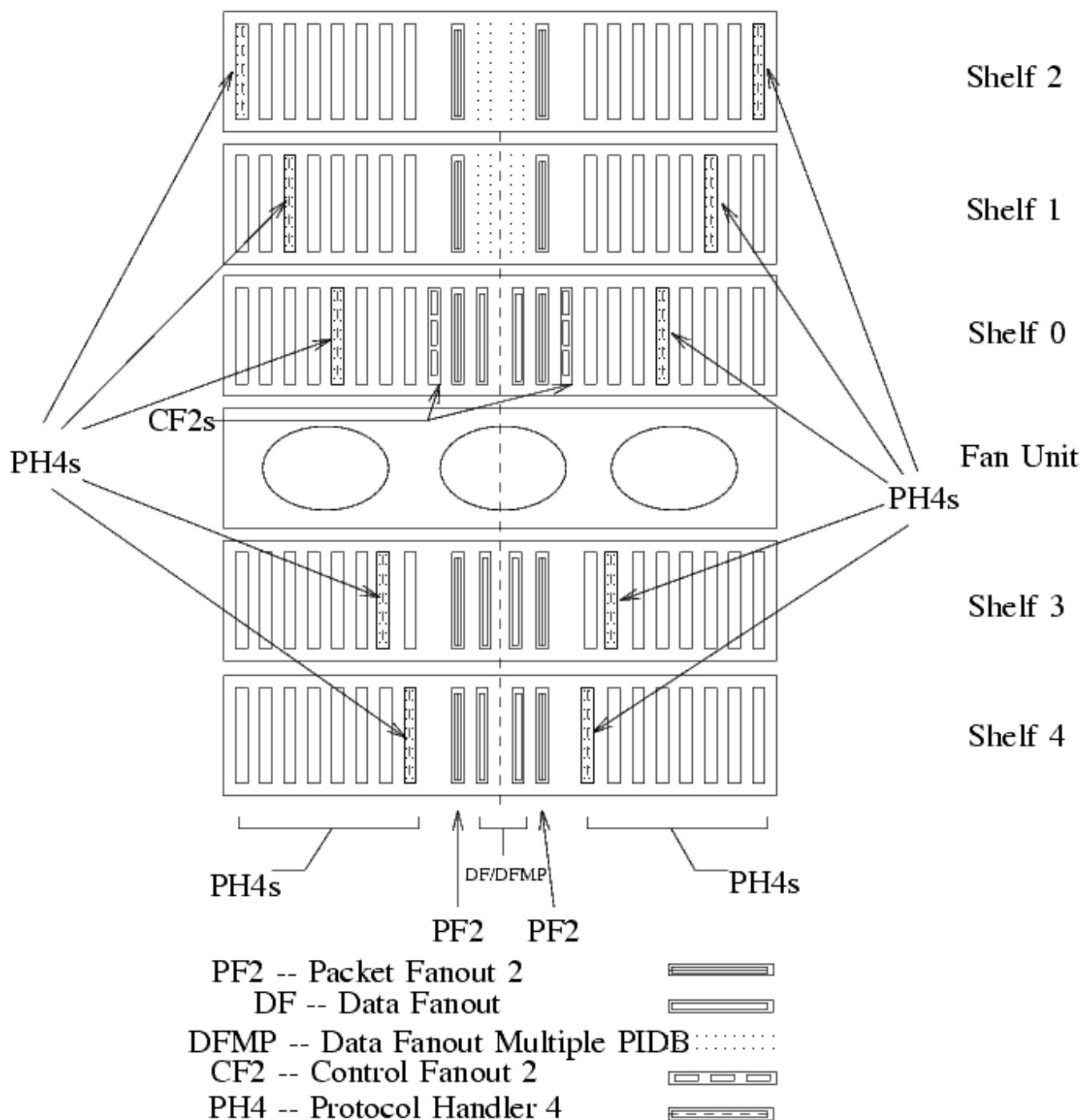


Figure 14.2-5 5 Shelf PSU2 Unit

14.2.2.3 Engineering

Engineering of PSU2 differs slightly from the current PSU. The differences are:

- Within the same PSU2, the Data Fanout, and the DFMP can be provisioned on different PSU2 shelves.

- DFMP PIDBs are engineerable. 1 to 4 active PIDBs can be connected to the time slot interchange.
- The PSU2 only supports PH4s.
- 160 Nail-up time slots can be provided to the time slot interchange using the Data Fanout (5 PSU2 shelves X 32 time slots per shelf).
- The DFMP can provide 640 time slots to the time slot interchange (5 PSU2 shelves X 128 time slots per shelf).
- The SM has a 190 time slot nail-up limit.
- The SM-2000 is expected to have a 2000 time slot nail-up limit (software limit).

The packet switching features to be provided by the PSU2, PH4, and PI2 platform, are transparent to the features which were provided by the PSU, PH3, and PI platform with only three exceptions:

- The PSU2, PH4, and PI2 platform do not support the OSPS, ACD/BRCS, and DSN features which are supported on the PSU, PH3, and PI platform.
- The "Operation" of the packet switching features (with the exception of the OSPS, ACD/BRCS, and DSN features), which are provided by the PSU2, PH4, and PI2 platform, will be transparent to the "Operation" being provided by the PSU, PH3, and PI platform; therefore, no impact is expected.
- Since the "End-User Features" (with the exception of the OSPS, ACD/BRCS, and DSN) which are provided by the PSU2, PH4, and PI2 platform will be transparent to the "End User Features" provided by the 5E9(2) PSU, PH3, and PI platform, no impact is expected for the "End-User Scenarios" associated with the PSU2, PH4, and PI2 platform.

14.2.2.3.1 Operational User

The operation and maintenance of the PSU2, PH4, and PI2 feature capabilities will primarily be conducted by the telephone company's Recent Change Technician. The Recent Change Technician will be able to operate and maintain the PSU2, PH4, and PI2 platform with almost identical procedures to the existing PSU, PH3, and PI platform. This "transparent" OA&M design objective minimizes the impact on the Technicians' productivity.

In the 5E10 software release, the PSU2, PH4, and PI2 on the SM-2000 and SM will not be supporting the features and capabilities shown in table 14.2-7.

Table 14.2-7 PSU2 Features and Capabilities Not Supported

SM-2000	SM
CDMA	CDMA
OSPS	OSPS
DSN	DSN
ACD/BRCS	ACD/BRCS
ISLU	-
PH1	PH1
PH2	PH2
PH3	PH3

NOTE: It must be noted that the PSU2, CF2, PF2, PH4, and PI2 hardware is currently being ported to the SM-2000 and SM to support the 5E10 CDMA (Code Division Multiple Access) feature. Since the majority of the PSU2, PH4, and PI2 hardware and software platforms are provided by the CDMA feature, minimal additional hardware and software development is required.

Detailed information covering the engineering and operation of the PSU2 and PH4 can be found in 235-200-100,

5ESS®-2000 Switch AUTOPLEX® System 1000 Wireless Applications.

14.2.2.3.2 Call Processing

The PSU2, PH4, and PI2 feature will not affect the following high-level call processing functions:

- Originating/Incoming
- Terminating/Outgoing
- Release
- Interrupt
- Operations on Remotes
- Connections
- Class of service
- Code Interpretation
- Screening
- Routing
- Overload

14.2.2.3.3 Signaling and Protocol

The PSU2, PH4, and PI2 hardware units do not impact the following:

- Subscriber/Exchange Interfaces
- Exchange/Exchange Interfaces
- Other Intra-Network Interfaces

14.2.2.3.4 Hardware Interfaces

The Packet Switch Unit Unit 2 (PSU2) supports the following:

- 5 shelf 100 Mb/s backplane.
- Control Fanout 2 (CF2) circuit packs
- Packet Fanout 2 (PF2) circuit packs
- Data Fanout (DF) circuit packs
- Data Fanout Multiple PIDB (DFMP) circuit packs

The PSU2 unit needs to support a mix of shelves which contain either the Data Fanout (DF) circuit packs or Data Fanout Multiple PIDBs (DFMPs) circuit packs. Each PSU2 shelf can support up to 16 Protocol Handler 4s (PH4s).

PSU2 and PSU shelves support up to 16 Protocol Handler 4s (PH4s) beginning with the 5E10 software release.

14.2.2.3.5 Interactions and Transparencies with Other Features

The PSU2 supports interfacing with the ISLU2, IDCU, DLTU2, DLTU-RH, DNU-S, and PI2 on both SM-2000 and SMs. The packet switching services which are provided by the PSU2 on the SM-2000 or SM, must not experience any degradation in service to the end-user when compared to its associated packet switching service which is provided by the PSU on the SM.

14.2.2.3.6 Operations, Administration and Provisioning

The PSU2 and PI2 hardware does not affect the existing input/output messages and measurements. The input/output messages and measurements which currently reference the "PSU" will, therefore, be performed on either the "PSU2" or "PSU", whichever is present. This transparent input/output message and measurements approach will also be utilized for the PI2 and the PI.

14.2.2.3.7 Service Changes

RC/V must provide the ability to insert, update, and delete the PSU2 and PI2 hardware in support of the PSU2 feature on both the SM-2000 and SM. The PSU2 and PI2 hardware which must be supported includes the PSU2, CF2, PF2, DF or DFMP, PH4, and PI2. The Recent Change Views which may be impacted are as follows:

- RC_PSUPI 22V1
- RC_PSU 22V2
- VER_PSU 22V2
- RC_PSUSH 22V3
- RC_PSUPH 22V4

RC/V blocks the ability to provide the OSPS, ACD/BRCS, and DSN feature applications on the PSU2 and PI2 hardware platform on both the SM-2000 and SM. (The PSU2 and PI2 hardware platform includes the following hardware: PSU2, CF2, PF2, DF or DFMP, PH4, and PI2.) RC/V must support the following PH Conversion Procedures for the PHs in PSUs on SMs:

- PH3 to PH4
- PH2 to PH4
- PH4 to PH3
- PH4 to PH2

RC/V must support the ability to add or delete a PIDB on a DFMP. When a PIDB is added to the DFMP, the PIDB circuit is placed in a out-of-service state, and must be restored by the craft. A PIDB may only be deleted under the following conditions:

- (1) The PIDB circuit status is out-of-service.
- (2) Deleting the PIDB will not decrease the number of available PIDB time slots below the number of ISDN and CDMA applications assigned to the PSU2 shelf containing the PIDB.

14.2.2.3.7.1 Software Update

The software program update capabilities PI2 and PH4 respectively. The capabilities [for example: apply, back out, or back out last official (BOLO)] to update a PI2 and PH4 are provided as part of this feature.

14.2.2.3.8 Protocol Handler 2

The Protocol Handler 2 (PH2) is limited to 1 MB of memory. The PH2 is provisioned as shown in Table 14.2-8.

Table 14.2-8 PH2 Usage

5E6 - 5E8	5E9(1)	FUNCTION
Q931	Q931	Signaling
X.25	—	Packet on BRI
X.75	X.75	
X.75'	X.75'	Packet trunk
IP	IP	
XAT	—	Packet on T1
ISM	ISM	Inter SM packet

14.2.2.3.9 Protocol Handler 3

The protocol handler 3 (PH3), has greater throughput and reduced time delay as compared to earlier PHs. See Table 14.2-6 for a direct comparison of PH throughput. The PH3, like its predecessors, is equipped on the PSU, and there can be up to 16 PH3s per shelf. The PH3 can have a maximum of 128 D-channels assigned, real time permitting. The PH3 processes approximately 3 times as much data as the PH2.

14.2.2.3.10 Protocol Handler 4

The PH4 hardware unit contains software that performs the frame relay protocol handler (FRPH) function. The PH4 is a TN1846 circuit pack located in the PSU2. It terminates CDMA packet pipes from the cell sites. The PH4 and the FRPH demultiplex voice packets from the cell sites and routes them over the packet bus to the correct speech handler channel (SHC). A single PH4 can support multiple packet pipes. The PH4, introduced with the 5E10 software release, is designed to increase static memory to 3MB. It is the only PH provisionable on the PSU2. When mixing PH3s, and/or PH2s on the PSU, each shelf must have at least one spare of each PH type resident on the shelf.

14.2.2.4 Directly Connected Peripheral Interface Data Buses

The ISLU is logically divided in half with each half having a unique set of DPIDBs that are designated, for purposes of discussion, alphabetically. The half ISLU relationship is established by an initialization algorithm implemented in the 5ESS®-2000 switch software that nails up connections between LGCs and PHs using predetermined time slots. This algorithm guarantees that LGCs do not experience time-slot contention problems and results in a particular pattern of time slots on the DPIDBs.

The DPIDB time slot output of the ISLU is shown pictorially in Figure 14.2-6. Note that ISLU half 0-7 (LGCs 0-7) can only be equipped with DPIDBs A, C, E, G, and I, and the other ISLU half 8-15 (LGCs 8-15) can only be equipped with DPIDBs B, D, F, H, and J. As a result of the initialization algorithm mentioned earlier, each LGC in the ISLU has access to four unique time slots on each DPIDB. Because an LGC has access to a total of 5 DPIDBs (that is, A, C, E, G, and I for LGCs 0-7), there is a maximum of 20 time slots per LGC to the PSU. The exact number of time slots available to a given LGC depends on the number of DPIDBs engineered from that ISLU half. These time slots are used for connecting both B-channels with X.25 packet switching and D-channels to the PSU.

NOTE: Recall that a time slot can carry up to four D-channels but only one B-channel.

DPIDB TIME SLOTS

		L G C																																						
GRP 0	0	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I				
	1	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I				
	2	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I				
	3	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I			
	4	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I		
	5	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	
	6	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I
GRP 1	7	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I	A	C	E	G	I				
	8	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J				
	9	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J				
	10	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J				
	11	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J			
	12	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J		
	13	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	
	14	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J
	15	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J	B	D	F	H	J				

Where A = TS to DPIDB A, J = TS to DPIDB J, etc.
Max. 4 TS From Any 1 LGC to Any 1 DPIDB

Figure 14.2-6 LGC LIDB Time Slots DPIDB Stuffing Pattern

The assignment implications of the DPIDB arrangement described previously are not immediately obvious. They are as follows:

- The BRI D-channels that share a DPIDB time slot must all terminate to the same PH.
- A BRI channel carried to the PSU in a DPIDB time slot may only be assigned to a PH on the PSU shelf where that DPIDB terminates.
- Depending on the ISLU to PSU cabling arrangement, BRI in an ISLU half may not have access to all PHs (that is, PSU shelves).
- As DPIDB time slots are assigned, access to assignable PHs is reduced.
- Because a whole time slot is switched to a PH, and an LGC has only 4 time slots per DPIDB, an LGC can communicate with a maximum of 4 PHs per DPIDB.

Consider two examples: In Figure 14.2-7, the ISLU half corresponding to LGCs 0-7 has no connection to PSU shelf 3. Therefore, no lines in that ISLU half can be assigned to PHs on PSU shelf 3. In Figure 14.2-8, all BRI cards have access to all PHs, but only four 'time slots worth' can be assigned to each shelf, that is, the first 16 BRI D-channels from any ISLU half assigned to PHs on shelf 0 require that the 17th BRI card be assigned to shelf 1.

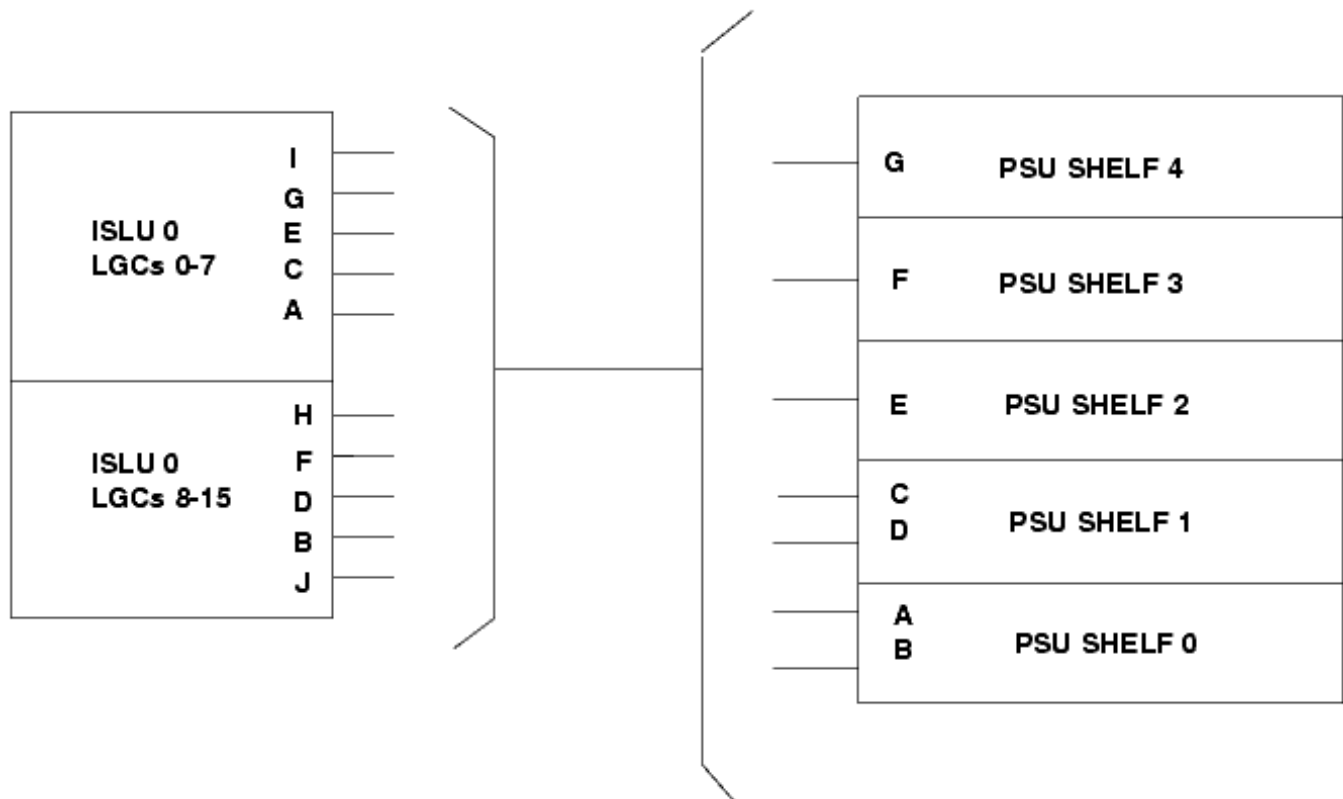


Figure 14.2-7 PIDB Layout Example 1

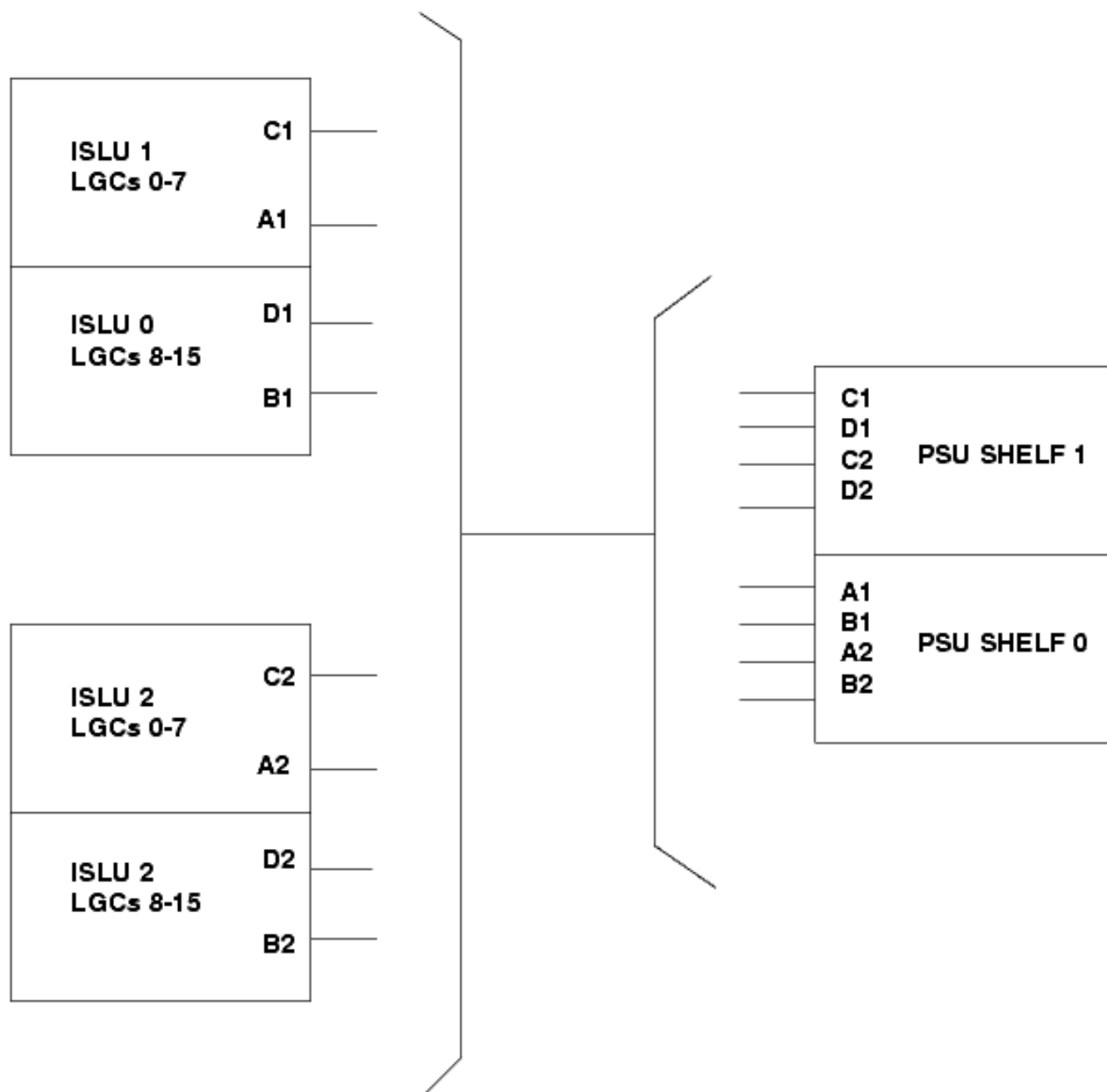


Figure 14.2-8 PIDB Layout Example 2

The key element to understand in the above DPIDB time slot analysis is that the universe of potential PH assignments, given a BRI card location, may well be limited. Depending on the DPIDB cabling and time slot fill, this limit may be to a single PH.

As can be seen, because administrators may be responsible for BRI card and PH assignments, it is essential to be aware of the cabling pattern between ISLUs and the PSU. There are three mechanisms for doing so:

- (1) **384 Specification, Table D:** The record of data port assignments found in the engineering specifications generated by the Lucent Technologies Network Systems line engineer.

- (2) **Office Records:** The ISLU equipage record (Office Record form 5731), (R)ISLU (remote ISLU) LGC equipage record (form 5733), and the packet switching unit PH equipage record (form 5742).
- (3) **ISA reports:** (ISDN SM assignments) generated from DOPS.

The 384 Specification has a Table D for each SM, and there are 4 entries in the table for each DPIDB. (There are physically four cables used in the DPIDB connection, even though the discussion previously has been in terms of a single bus. One is the 'mirror' DPIDB from the other common data service group; two reflect the duplication of buses to the duplicated PSU DF. The PSU shelf is designated in the 'PORT' column of the table, that is, PSIU0 indicates PSU shelf 0. The ISLU number is designated in the 'UNIT TYPE' and 'UNIT NO.' columns, that is, UNIT = ISLU and UNIT NO. = 0 indicate ISLU number 0. The common data port number is given in the 'SRV GRP' column, with each DPIDB having a unique port number. The alphabetical designation used in the DPIDB stuffing pattern is determined as shown in Table 14.2-9.

Table 14.2-9 Alphabetical Designation for PIDB Stuffing Pattern

PORT	ALPHA	ISLU HALF
11	A	0
10	B	8
09	C	0
08	D	8
07	E	0
06	F	8
05	G	0
04	H	8
03	I	0
02	J	8

The Office Record form 5731 has an entry for each common data port on the ISLU. The DPIDBs are designated in the section to the far right of the form under the title 'PIDB DATA'. If a DPIDB is equipped, the value 'PSIU' appears in the 'TYPE' column. The common data port is designated in the 'NO.' column to the left of the 'TYPE' column. The SM number is in the 'SM' column, and the ISLU number appears in the 'ISLU' column. The PSU shelf is designated in the 'PSIU SHELF' column. The ISLU HALF is determined from the DPIDB alphabetic designation (derived from Table 14.2-9).

The particular ISLU to PSU cabling pattern may be optionally indicated by the telephone company traffic engineer using the 'Notes' capability of the 5 Digital Ordering and Planning System (DOPS) or in a separate document. It is essential for the telephone company to specify the pattern if, because of PH engineering or allocation, a nonsymmetrical pattern is required (as was the case in Figure 14.2-7). If not indicated by the telephone company, cabling assignments are performed by the Video Interactive Regional Generation of Specifications (VIRGOS) system. (VIRGOS is a Lucent Technologies program used by Lucent engineering personnel.)

While availability of time slot paths between BRI card positions and the PSU is directly dependent on the pattern and availability of time slots on the DPIDBs, the impact on the assignment process does not extend to the assignment of specific time slots. That function is performed by the switch. It is necessary, however, for the assigner to ensure that a path does, in fact, exist.

14.2.2.5 SS7 PSU in SM/EXM-2000

14.2.2.5.1 Feature Overview

Prior to the 5E12 software release, switching modules would communicate with the SS7 network through the CNI signaling platform. At a high level, normal operation of an SS7 interswitch call would generally proceed like this:

- (1) Digit analysis in the originating switching module would determine an outgoing SS7 trunk group.
- (2) A request would be sent to the Communication Module Processor (CMP) to globally hunt an outgoing trunk

within the selected SS7 trunk group.

- (3) The CMP would check appropriate overload controls and destination point code (DPC) routing status before hunting the trunk group. If successful, the CMP would hunt an SS7 trunk and send a message to the terminating switching module.
- (4) A terminating terminal process (TTP) would be created in the terminating SM.
- (5) The TTP would assemble corresponding SS7 signaling message(s) and forward it (them) to the CNI signaling platform (through the CM and AM) for transmission to the SS7 network.

In the unlikely event that a switching module loses communication with the communication module, the isolated SM can not communicate with the CM/AM/CNI and all of its SS7 call processing will fail. From a reliability standpoint, SS7 stand-alone capability can not be supported by this architecture. The introduction of SM-based SS7 signaling allows basic SS7 subscriber features and services to communicate under normal conditions with other SS7 network elements via an SS7 packet switch unit (PSU) platform instead of through CNI. Those switching modules that have SS7 signaling links terminating are designated as Global Switching Modules (GSMs). In the unlikely event that a GSM loses communication with the AM, basic SS7 subscriber features and services will continue to function locally if the customer has provisioned the switching module for stand-alone call processing operation. The SM-based SS7 signaling platform is provided by the addition of signalling functionality on PH3s on a new or existing PSU/PSU2 on the switching module. This feature consists of the following elements:

On a PSU, it allows both the (AM-based) CNI and (SM-based) SS7 PSU signaling platforms to co-exist in the same host office. This feature allows the customer to provision up to sixteen GSMs in a 5ESS[®]-2000 switch, regardless of whether CNI is equipped or not.

For those switching modules not equipped as GSMs, ISUP trunks and TCAP service applications will continue to signal through the CNI signaling platform as is done today.

On a switching module equipped as a GSM, an ISUP trunk group can be provisioned by the customer to use either CNI (if equipped) or a PSU platform for SS7 signaling message transport. This will provide a means for the service provider to transition ISUP signaling from CNI to the SS7 PSU for normal and standalone operation over time rather than being flash cut. Currently, an SS7 PSU platform will support only trunk groups terminated on the GSM. The GSM possesses a unique point code in the SS7 network.

Individual TCAP application services can be provisioned by the service provider, on a per SM basis, to use either CNI or a PSU platform for SS7 signaling. For switching modules without an SS7 PSU, CNI must be used for the TCAP message transport. For GSMs, the customer can select either CNI (default) or the GSM's SS7 PSU platform for TCAP message transport for certain service applications.

One of two SS7 PSU deployment scenarios are envisioned: (1) the SS7 PSU platform is installed as part of a new switching module and (2) the SS7 PSU platform is grown into an existing switching module of any type.

14.2.2.5.2 System Architectural Constraints and Impacts

This feature introduces an SS7 signaling platform resident on any 5ESS[®]-2000 switching module (SM). A signaling link arrives as a timeslot either on a 24-channel T1 facility terminating on a DFI/DFI2 in a DLTU or on a DNU-S. A nailed-up, semi-permanent path through the TSIU connects the timeslot on the DFI/DNU-S to a Signaling Terminal Protocol Handler (STPH) in the PSU. The STPH manages individual signaling links and routes SS7 signaling messages. The STPH sends an incoming application signaling message across the Packet Bus to the Packet Interface (PI/PI2) which resides in the TSIU. The PI/PI2 hands off the signaling message to call processing software in the SMP. Call processing software in the SMP sends an outgoing signaling message to the PI/PI2 which passes the message across the Packet Bus to the Message Delivery PH (MDPH). The MDPH determines the outgoing signaling link and forwards the message to the corresponding STPH terminating the selected link. The

STPH routes the message to the link-level manager of an signaling link. The link-level manager sends the message across the nailed-up connection to the timeslot on the DFI. The DFI/DNU-S transmits the message in serial form on a T1 PCM bit stream. *MDPH and STPH must be PH3s.*

This feature needs the following hardware units:

- Either (1) DFI/DFI2 in a DLTU or (2) DNU-S
- Time Slot Interchange Unit (TSIU)
- Data Fanout (DF)
- Protocol Handlers (PH) serving the STPH and MDPH roles (PH3 required)
- Packet Fanout (PF)
- Control Fanout (CF)
- Peripheral Interface (PI/PI2) in the TSIU.

14.2.2.5.3 PH Images

SS7 signaling is supported by the PH3 (TN1367) only. The SS7 signaling software is packaged in a pair of PH3S images, one for the PH3's application processor and the I/O processor.

14.2.2.5.3.1 Features Supported

The following US functionality is supported by this feature to ensure SS7 operational transparency provided by the SS7 PSU on all 5ESS[®]-2000 switch CDX and VCDX switching modules:

- Integrated Services Digital Network User Part (ISUP)
- Local Area Signaling Services (LASS) features
- Number Services 800 (NS800) Application
- Inter-Switch Voice Messaging (ISVM)
- Analog Calling Name Display (CNAM) Application
- Advanced Services Platform (ASP) Release 0 and 0.1B
- Network Element Services Signaling (NESS)
- SS7 PSU MTP and SCCP Measurements
- Protocol Monitoring for SS7 (in 5E12 Software Update)

14.2.2.5.3.2 Features Not Supported

The following existing US functionality, available on the CNI platform, will NOT be supported by the SS7 PSU in the 5E12 software release:

- Leased Networks (including FTS2000)

- MTP Cluster Routing
- MTP Routing Verification Test (MRVT)
- SCCP Routing Verification Test (SRVT)
- Message trapping
- Inter-Module Trunking (IMT)
- Software Defined Network (SDN)
- OSPS Line Information Data Base (LIDB)
- OSPS Billing Validation Application (BVA)
- OSPS ANSI TCAP Type I
- OSPS Customer Account Services (CAS) CCS7 Application
- OSPS LIDB Alternate Destination Application
- Inward Wide Area Telephone Service (INWATS)
- Network Access Interruption (NAI) for OSPS and 5ESS®-2000 Toll [FDAF 98-5E-2604]
- Network Call Denial (NCD)
- Pseudo Point Code (PPC) Capability
- MTP Node Restart [FDAF 99-5E-2314]
- Signaling Link Selection (SLS) Code Expansion [FDAF 99-CP-2316]
- Improved Signaling Link Test (SLT) Procedures [FDAF 99-CP-3072]
- Network Management Support for Local Trunk Groups

This feature does not support any of the following software release 5E11 functionality:

- Multiple Point Codes (as defined in Bellcore's GR-606-CORE)
- SFG and NM for VCDX [FDAF 97-5E-2962]

14.2.2.5.4 Operations, Administration and Provisioning Requirements

14.2.2.5.4.1 Recent Change and Verify

14.2.2.5.4.1.1 Data Administration via Recent Change

The 5ESS®-2000 Switch ODA provides SS7 PSU platform office data. Examples of items for which the SS7 PSU platform requires data are signaling links, linksets, combined linksets, point codes, signaling routes, and guard timer values. The factory can build and ship SS7 PSU data in the ODD and provide corresponding Office Records. Recent Change technicians can insert, delete, and modify SS7 PSU platform data.

14.2.2.5.5 Administrative I/O Messages

MML commands allow craft personnel to determine the status of signaling links, linksets, combined linksets, and destination point codes. Link reports show detailed status including congestion, inhibited and blocked qualifications. Linkset and combined linkset reports show whether the linkset has available links for traffic and the current distribution of SLS codes over those available links. Point code reports should show whether the DPC is accessible and, if accessible, what the current route is and whether the route is congested.

As events occur, automatic reports show the change in status for links and DPCs. MTP reports when links become available or unavailable and when DPCs become accessible or inaccessible. When a link fails, MTP reports the cause as known at the near end. MTP also reports when congestion status changes for links and DPCs.

MML commands exist to activate, deactivate, block, unblock, inhibit, and uninhibit signaling links.

MCC screens are provided to display the summary status of linksets as well as screens to provide detailed status of individual signaling links. In addition, MCC screens have menu selections that translate to the MML commands that change the state of links.

Commands to display the status of SCCP SSN access on remote DPCs exist.

14.2.2.5.6 Traffic Measurements

Measurement collection selectivity provides administration personnel with the capability to tailor which traffic measurements are collected on a per office basis. The administration personnel controls the decision as to which traffic measurements are collected in a fixed amount of AM (administrative module) buffer space. Measurements collection selectivity was introduced by the Access Interface Unit (AIU) feature and is being modified to accommodate selectivity of the new SS7 traffic reports. Traffic reports available are:

- Existing RC view 13.7 for Traffic Measurement Collection Selectivity is used to control which components have measurements collected for selected 30 minute traffic report (TRFC30) sections. because of the need to limit the number of sections being reported to the ROP, this feature provides an additional capability to specify which components will have measurements reported to the ROP.
- RC view 13.7 for Traffic Measurement Collection Selectivity is available for Review of the new TRFC30 section 230 for SIGNALING LINK (SL)
- RC view 13.7 for Traffic Measurement Collection Selectivity is available for Review of the new TRFC30 section 233 for SIGNALING CONNECTION CONTROL PART (SCCP) with the following fields:
- RC view 13.7 for Traffic Measurement Collection Selectivity is available for Review of the new TRFC30 section 234 for MTP POINT CODE (PC)
- The existing Traffic Measurement Range Selectivity RC view 13.8 is used to control which range of components is selected for measurements in each section of the 30 minute traffic report (TRFC30).
- View 13.8 for Traffic Measurement Range Selectivity is available for Review of the new TRFC30 section 230 for SIGNALING LINK (SL)
- View 13.8 for Traffic Measurement Range Selectivity is available for Review of the new TRFC30 section 233 for SIGNALING CONNECTION CONTROL PART (SCCP).
- ORC View 13.8 for Traffic Measurement Range Selectivity is available for Review of the new TRFC30 section 234 for MTP POINT CODE (PC).
- View 13.9 for Traffic Measurement Collection Summary is available for Review of the new TRFC30 section 230 for SIGNALING LINK (SL)

- ORC view 13.9 for Traffic Measurement Collection Summary is available for Review of the new TRFC30 section 233 for SIGNALING CONNECTION CONTROL PART (SCCP).
- RC view 13.9 for Traffic Measurement Collection Summary is available for Review of the new TRFC30 section 234 for MTP POINT CODE (PC).

14.2.2.6 PRI PH

The PRI is used between a 5ESS®-2000 switch and a digital PBX or for OSPS interflow between two 5ESS®-2000 switches. The B-channels provide circuit switch voice and circuit switch data services. The D-channel provides out-of-band signaling for the B-channels. ITU-T Recommendation Q.931 is the signaling protocol used on the D-channel. The path between the PH and the DFI is provided by the way of a nailed-up connection in the TSI. This connection involves two nailups, one from the DFI to the TSI, and the other from the TSI to the PH in the PSU.

The 5ESS®-2000 switch supports the assignment of more than one 64 Kbps PRI D-channel per PH and up to 20 PRI D-channels can be equipped per PH. Each D-channel connection requires two nailed-up time slots; therefore, a fully equipped PRI D-channel PH requires 40 of the allowed 190 TSI nail ups.

A fully equipped PRI requires a DFI, 25 time slots, one data interface port and a dedicated PH port. The DFI requires 24 time slots for connection to the TSI, and one additional time slot for the D-channel connection between the TSI and the PSU. A PH supports up to 128 logical ports, four of which are required for the PRI D-channel. Because the B-channels do not support packet switching, no equipment is required for this capability. The loaded software configuration is required to support PRI.

An SM can have up to 20 PRIs, limited by the maximum number of DFIs per SM. Up to 19 PRIs may be assigned to a single PH2 or PH3. The DOPS assigns a maximum of 19 PRIs to a DLTU equipped ISDN SM, provided that there are 19 or 20 DFI circuits in the ISDN SM. If 20 PRIs are desired, the 20th must be edited with a second PSU shelf and another PH. The PRI D-channels may be mixed on the same PH with BRI, permanent packet B-channel (PPB), and BRI D-channel assignments. Mixing PRI channels with BRI channels on the same PH creates more difficult PSU arrangements and may impact time slot use in the ISLU, resulting in fewer BRIs per SM. It is for these reasons that mixing is not recommended and no engineering is provided for mixing.

The PRI D-channel traffic is limited to Q.931 call processing packets, which can include up to 512 bytes of ISDN user part (ISUP) information. One possible model for this traffic assumes an average of seven Q.931 packets and four data packets per call. Because the D-channel carries signals for 479 (with a theoretical maximum of 36 CCS) a D-channel should handle a maximum of about 20 calls per hour (assuming a 180-second holding time per call). This translates to a rate of 0.04 dpps.

A PH supports up to thirty-two 64 Kbps channels, equipped on every fourth port beginning with port 0. Because a maximum of 20 PRIs may be equipped per ISDN/SM, a maximum of twenty 64 Kbps PRI D-channels can be equipped per PH. This is increased to 31 on the SM-2000. The DFI and the PH must be equipped on the same SM. This feature allows individual digital signal level (DS0) channels on a T1 facility to be configured on a subscription basis for X.25 packet-switched data access. Up to 24 channels of a T1 facility can be configured for packet-switching. Any remaining channels on the T1 facility can be used for other digital services available on the switch; for example, PRI or circuit-switched connections to a digital PBX. The number of channels chosen to carry the X.25 traffic can also be changed by subscription. The packet-switched DS0 channels on the T1 facility are not aggregated but remain channelized. For Engineering and Administration information see the ISDN SOFTWARE UPDATES section.

14.2.2.7 X.75'-Phase 1 Gateway to Public Packet-Switched Network

The X.75'-Phase 1 Gateway to a public packet switched network (PPSN) feature specifies the protocol used and the capabilities provided to allow a 5ESS®-2000 switch (ISDN) owned by a telephone company to connect with a

PPSN owned by the same telephone company. Both switches must reside in the same local access and transport area (LATA). With this feature, end-users of X.25 packet switching on the 5ESS®-2000 switch are allowed to reach any end point accessible from the PPSN. Each 5ESS®-2000 switch can access the PPSN either by directly supporting an X.75' interface to it or via a Lucent Technologies internal protocol trunk group to another 5ESS®-2000 switch that has an X.75' interface.

This feature also enables the 5ESS®-2000 switch to number the X.25 DTE consistent with the ITU-T Recommendation E.164. It provides the 5ESS®-2000 switch with the capability to interwork the ITU-T Recommendation E.164 numbers in the ISDN with the ITU-T Recommendation X.121 numbers of public data networks (PDNs), in accordance with the ITU-T recommended escape code solution.

Time slots from the TSIU to the PSU are allocated via recent change view 22.2. These TSs are used for; X.75' trunks, IP trunks, PRI D-channels, and Inter-SM links.

14.2.2.8 Multiple Internal Protocol Trunk Groups

This feature will support multiple packet switching trunk groups on a 5ESS®-2000 switch using the Lucent proprietary IP. Each trunk group will connect a 5ESS®-2000 switch to a unique Lucent Technologies switch in an IP subnetwork in a LATA. This development will make it possible to have an exclusive network of 5ESS®-2000 switches in a LATA thereby eliminating the need for 1PSS switches from the IP subnetwork.

This feature allows availability of a maximum of 16 trunk groups, one destination per trunk group, and 32 trunks per group on a single 5ESS®-2000 switch. In addition to providing the capability to tandem IP packets, this feature also allows alternate routing and reconnect recovery procedures.

14.2.2.9 On-Demand B-Channel Packet Switching

On-demand B-channel packet switching on the BRI allows the B-channels on a BRI to be used to support voice, circuit switching, or packet switching on a dynamic basis. One possible application of this feature is for users that occasionally require higher performance X.25 packet switching service (that is, lower transmission delays, or higher throughput) than achievable on a D-channel. Another possible application of this feature is an office where each BRI is likely to have both voice and data (X.25 packet switching terminal) station sets. The requirements of each X.25 packet terminal will be such that D-channel packet switching will not be adequate to serve the needs of some of the users. For ease of administration, the service provider may elect to provision all BRIs with on-demand X.25 packet switching service on the same PH.

14.2.2.10 ODB Assignment Guidelines

On-demand B-channel lines can be assigned anywhere within the ISLU (either ISLU half). They are not restricted to the same assignment rules as the PPB or D-Packet DSLs. ODB channels have full connectivity from the ISLU to the PSU shelf. Prior to assigning ODB lines, translations have to be completed in the switch (Recent Change View 23.13 ODB TS Allocation and View 23.14 ODB ISCN Reservation) specifying the ISCNS and the number of time slots to allocate for ODB. The ODB DSLs automatically path hunt for an available DPIDB time slot within the switch. ODB lines use available time slots on any DPIDB from either ISLU half to reach the appropriate PSU shelf and ODB PH. Based on the number of time slots allocated and the number of DSLs assigned, the user may encounter blockage. The switch administrator must be careful not to assign more ODB lines with the ISLU than was traffic engineered.

14.2.3 ASSIGNMENT METHODOLOGY

14.2.3.1 Objectives

At this point, the reader should have a firm understanding of the task faced by the ISDN BRI line assigner and the

constraints placed on that task. The parameters of this process are summarized in Table 14.2-10 .

Table 14.2-10 BRI Assignment Considerations

PARAMETER	RESOURCE
Termination & Type	ISLU, Cards
Circuit Usage (CCS)	ISLU
Active B-Channels	LIDB, DPIDB
Packet Channels	PH
Packet Usage (PPS)	PH
Virtual Circuit	PH
DPIDB Time Slots	ISLU, LGC, PH

The description has highlighted four main points:

- The assigner **must** direct assignments in a way envisioned by the traffic engineer in terms of equipment quantities provided and assumptions made regarding the characteristics of the user demand offered to the switch. This is to fully utilize the limited resources engineered. Assignment directions are stated in terms of the parameters of resource use (cards, CCS, dpps, etc.).
- In the ISLU, assignments are directed by the equal distribution of line card quantities and card configurations assigned to each ISLU and, within ISLUs, each line group. After cutover, usage statistics replace card quantities in terms of ISLU assignments, but configuration distribution must be maintained over LGCs.
- In the PSU, specific packet switching applications are needed to estimate resource demand with assignment direction being determined by a numerical distribution in a precutover environment, or traffic data after cutover.
- Optimal line card and PH assignments address different architectural constraints and are driven by (quite probably) independent parameters of demand. The assignments thus directed are not independent, however, since the architecture restricts the association of PHs and line card positions.

A figurative description of the BRI assignment dilemma is the requirement to choose two 'ends' and make sure that they meet in the 'middle.'

14.2.3.2 Methodology Overview

An ISDN assignment methodology must allow the BRI line assigner to track the use of resources in a proper manner (as designed by the traffic engineer) considering the constraints placed on that use. In perhaps simplistic terms, the assigner must be able to see where space exists.

14.2.3.3 Equipment Configuration

The next step for the administrator is to know the configuration of the equipment that was engineered. This section identifies the information required to understand how the office is configured for ISDN. The office configuration may be obtained from the ISA report, ODA forms, Office Records, or Recent Change/Verify Views.

14.2.3.3.1 ISA Report

The ISA report is created in DOPS when ISDN is engineered in the 5ESS®-2000 switch. The ISA report shows the equipment configuration of the ISDN hardware in the SM. In DOPS, the ISA report can be assessed from four levels; ISDN, ISLU, IDCU, or PSU.

NOTE: *In Software releases where both DOPS and DOPSMOD are the engineering tools, you will need to be sure to check the ISA reports from both tools for complete information.*

The traffic engineer can access two versions of the ISA report in DOPS: SUMMARY and EXTRACT. The

SUMMARY version provides the entire layout of ISDN SMs via the ALL option, including the number and type of BRI (Basic Rate Interface) cards, ISLU and PSU layout (including Line Group Controllers, DPIDBs, PIDBs, PSU Shelves, and Protocol Handlers), MAN, HLSC, and RG circuit packs, and type of wiring (2 or 4) for each ISLU.

The EXTRACT version of the ISA report enables the DOPS user to determine if the ISDN configuration generated in DOPS is consistent with the traffic engineers' assumptions. The EXTRACT Version contains the ISDN community parameters common to the ISDN SM, the SM PIDB, LG breakdown, and resources (time slot demands). The ISLU layout and the PSU layout are not included in this version.

The ISA report is part of the Traffic Engineering Order (TEO). The traffic engineer has the responsibility to maintain the DOPS data base for each 5ESS®-2000 office, including ISDN. It is imperative that DOPS be updated to reflect any additions or changes of the engineered equipment; whether the change is the number of BRI cards or an additional ISDN SM. Changes can be made to the original order of the ISDN equipment layout if the traffic engineer has not specified a proposed equipment layout or if the Lucent Technologies Regional Engineer identifies potential equipment savings or problems. When there is a need for Lucent Technologies to modify the original request for equipment on the TEO, the service provider equipment engineer must be notified and must give Lucent Technologies permission to change the order.

NOTE: In the current DOPS, users may assign any number they wish to an ISDN SM, PSU, or ISLU by using the external number command. The *DOPS User's Guide* 235-060-100 has detailed information for editing the ISDN SM number using the **extnbr** command.

14.2.3.3.1.1 Using the ISA Report

The ISA report is used by traffic engineers and switch administrators. The traffic engineer uses the ISA report for capacity determination and future growth of the ISDN equipment.

The switch administrator also uses the ISA report for capacity determination, but also can use the report to determine the equipment layout of the ISDN equipment; including the ISLU, LGC, BRI cards, PIDBs, DPIDBs, PSU shelves, and PHs (PPB, ODB, D, ISM, etc).

NOTE: The ISA report can be changed. It is important that the ISA report used is the most current version available for a specific project. The DOPS data base must be updated by the traffic engineer to reflect any changes. Administrators should contact their respective traffic engineer to verify the ISA report is the most current issue.

Since changes can be made to the original ISA report, once the ISDN equipment is in the 5ESS®-2000 switch the switch administrator or the traffic engineer should verify the equipment layout on the ISA report with the actual switch configuration. Request that your Switching Control Center (SCC) or technicians obtain the Office Records or recent change views (RC/V) used to verify the ISDN equipment layout. Detailed information for the Recent Change/Verify Views, Office Data Assembler (ODA) Forms, and Office Records can be found in Sections 14.2.3.3.2, 14.2.3.3.3, and 14.2.3.3.4.

When discrepancies exist between the switch and the ISA report, the traffic engineer must be notified so that they can be resolved and the ISA report updated.

14.2.3.3.1.2 DOPS User Inputs and Sample TEO Version of ISA Report

This section illustrates engineering a sample ISDN office. The first step is to determine the number of BRIs and the type of service they will provide. In our sample office we have assumed demand for service as listed in the following paragraphs. This section includes the DOPS ISDN inputs and the TEO version of the ISA report.

The assumptions shown in Figure 14.2-9 are made in the sample ISDN office:

CSD/CSV Users

BRCS Users	200

Non-BRCS Users	100

XCSDUSR =	300

PSD Users

BRCS Users	200

Modem Pool Members	200

XPSDUSR =	400

ODB Users

BRCS Users	20

Computer Ports	10

XODB =	30

	BRI Cards	Total Users

2 Parties per BRI	533	1066

1 Party per BRI	400	400

933

1466

XAVUSCD = Average users per card = $1466/933 = 1.57$

Note: A User is a BRI customer assigned to a multipoint DSL.

Figure 14.2-9 Sample ISDN Office Assumptions

The traffic engineer determines the number of BRIs required for the office by using marketing forecasts or customer requests for service. In addition to the number of lines, the traffic engineer accumulates additional data to input into DOPS, such as the type of service(s) per BRI, anticipated CCS and dpps, ISM Link requirements, and trunking needs (X.75, X.75' and IP).

The ISDN inputs for the example are listed in Table 14.2-11 .

Table 14.2-11 Complete ISDN Inputs

I= list			
x2blqu	768	xbritcd	165
xzcrd	27	xpsdusr	400
xcsdusr	300	xavuscd	1.57
xccsbri	8.47	xzccs	12.00
xislulf	100.00	xilsuhd	1.19
xdpps	1.60	xodbpps	1.00
xodb	30	xistf	yes
xodbccs	5.00	xph3pri	yes
xppb	20	xph3xat	yes
xppbpps	32.00	xtlip	2
xtlpri	1	xtl75P	2
xtlxat	6	xph3ism	yes
xatpps	16.00	xph3ip	yes
xph3x75	yes	x2dtulh	1

Three inputs are input by the STARTUP mode in DOPS, they are as follows:

xph3ppd = yes

xph3odb = yes

xph3ppb = yes

Refer to the *DOPS Engineering Procedures* 235-060-110 for a complete list of all DOPS Symbols used to engineer the 5ESS®-2000 switch.

The TEO version of the ISA report shown in Table 14.2-12 :

Table 14.2-12 Office Totals

		ISLU	IDCU
CCSPTSM	HD WEIGHTED AVG CCS/BRI CARD	10.20	
BRITCRD	BRI T LINE CARDS	165	
U2B1QCD	BRI 2B1Q U LINE CARDS	768	
UAMICD	BRI AMI U LINE CARDS	0	
ZCRD	Z LINE CARDS	27	
TUZCRD	TOTAL LINE CARDS	960	0
TR303	NO. OF TR303 RTS IN IDCUs		0
TR008	NO. OF TR008 RTS IN IDCUs		0
NRT	NO. OF PUB43801 DS1s IN IDCUs		0

DPPS	WEIGHTED AVG PPS / D-CHANNEL	1.60	
PPB	NO. OF PERM. PKT B-CHANNELS	20	0
PPBPPS	PERM. PKT B PEAK PPS PER PPB	32.00	0.00
ODB	NO. OF ON-DEMAND B USERS	30	0
ODBCCS	DPIDB OCCUPANCY CCS PER ODB	5.00	0.00
ODBPPS	ON-DEMAND B PEAK PPS PER ODB	1.00	0.00
PH2SPR	NO. SPARE PH2 / PSU SHELF	1	
PH3SPR	NO. SPARE PH3 / PSU SHELF	1	
XISTF	ISTF OPTION (YES / NO)	Y	
IDCU	NO. OF IDCU UNITS		0
XSPLFCT	UNIFORM INTER-SM CONN. FACTOR	1.20	
BRIPLGC	BRI CARDS / LINE GRP CNTRLR	32	
MAXPIDB	MAXIMUM PIDBS AT THIS CCS-ISLU	12	
BRILGC	NO. LGC REQD FOR BRI - ISLU	30	
ISDNSM	NUMBER OF ISDN SMs REQUIRED	1	
DLTUSM	NUMBER OF ISDN SMs WITH DLTU	1	
PRI	NO. OF PRI D CHANNELS	1	
XAT	NO. OF XAT CHANNELS	6	
XATPPS	WEIGHTED AVG PPS/XAT-CHAN	16.00	
IP	NO. OF IP TRUNKS	2	
X75	NO. OF X.75 TRUNKS	0	
X75P	NO. OF X.75' TRUNKS	2	

Table 14.2-13 shows the ISDN SM No. 1 version:

Table 14.2-13 ISDN SM No. 1

SUMMARY		ISLU		IDCU	
		QTY	PH	QTY	PH
CCSPTSM	HD WEIGHTED AVG CCS/BRI CARD	10.20			
BRITCRD	BRI T LINE CARDS	165			
U2B1QCD	BRI 2B1Q U LINE CARDS	768			
UAMICD	BRI AMI U LINE CARDS	0			
ZCRD	Z LINE CARDS	27			
TUZCRD	TOTAL LINE CARDS	960	PH3	0	
TR303	NO. OF TR303 RTs IN IDCUs			0	
TR008	NO. OF TR008 RTs IN IDCUs			0	
NRT	NO. OF PUB43801 DS1s IN IDCUs			0	
PPB	NO. OF PERM. PKT B-CHANNELS	20	PH3	0	
PPBPPS	PERM. PKT B PEAK PPS PER PPB	32.00			
DPPS	WEIGHTED AVG PPS/D-CHANNEL	1.60			
ODB	NO. OF ON-DEMAND B USERS	30	PH3	0	
ODBCCS	DPIDB OCCUPANCY CCS PER ODB	5.00			
ODBPPS	ON-DEMAND B PEAK PPS PER ODB	1.00			
X2DTU1H	NO. DFI CIRCUITS	4			
PRI	NO. OF PRI D CHANNELS	1	PH3		
XAT	NO. OF XAT CHANNELS	6	PH3		
XATPPS	WEIGHTED AVG PPS/XAT-CHAN	16.00			
IP	NO. OF IP TRUNKS	2	PH3		
X75P	NO. OF X.75' TRUNKS	2	PH3		
PH2RAT	PH2 PER DPIDB (1/4 ISLU BASIS)	4.58			
PH3RAT	PH3 PER DPIDB (1/4 ISLU BASIS)	1.34			
ISMPH	AVG INTER-SM PROTOCOL HANDLERS	a	PH3	b	
PSUSHVS	NO. PSU SHELVES IN THE ISDN SM	2			
DSU2IF	QTY OF ISTF PACKS ON DSU-2	1			
IDCU	NO. OF IDCU UNITS			0	
RPATS	RESERVED RPA/RPM T.S. PER SHF	0			
INSMPPS	EST. PPS FOR INTER-SM PKT TPT	0			
Notes:					
a. 0 Estimated					
b. 0 Assigned					

SM PIDB and LG breakdown	PIDBs	LGs
ISLU# 1	10	15
ISLU# 2	10	15
SUM PIDBs	20	
SUM LGs		30

Figures 14.2-10 and 14.2-11 show the ISLU 1 and ISLU 2 protocol handler assignments.

		5B			PSU				
HALF	LG	PIDB	DPIDB	PPB	ODB	PH2	PH3	SHELF	PORT
1	8	10	A (11)	0	0	0.00	1.34	0	a
			C (9)	0	0	0.00	1.34	1	a
			E (7)	10	0	0.00	2.00	0	e
			G (5)	0	0	0.00	0.00		
			I (3)	0	0	0.00	0.00		
2	7		B (10)	0	0	0.00	1.18	0	c
			D (8)	0	0	0.00	1.18	1	c
			F (6)	0	30	0.00	1.00	0	f
			H (4)	0	0	0.00	0.00		
			J (2)	0	0	0.00	0.00		
BRITCRD		BRI T LINE CARDS					83		
U2B1QCD		BRI 2B1Q U LINE CARDS					384		
UAMICD		BRI AMI U LINE CARDS					0		
ZCRD		Z LINE CARDS					13		
HLSCDS		HIGH LEVEL SERV. CKTS/ISLU					2		
DF4WIRE		ISLU 4WR CABLE TO DIST. FRAME					1		
BRIMAN		NO. MAN PACK PAIRS - ISLU					1		
RG		NO. RG PACK PAIRS - ISLU					1		

Figure 14.2-10 ISLU 1 Protocol Handler Assignments

		X.25B			PSU				
HALF	LG	PIDB	DPIDB	PPB	ODB	PH2	PH3	SHELF	PORT
1	8	10	A (11)	0	0	0.00	1.34	0	b

		C (9)	0	0	0.00	1.34	1	b
		E (7)	10	0	0.00	2.00	1	e
		G (5)	0	0	0.00	0.00		
		I (3)	0	0	0.00	0.00		
2	7	B (10)	0	0	0.00	1.18	0	d
		D (8)	0	0	0.00	1.18	1	d
		F (6)	0	0	0.00	0.00		
		H (4)	0	0	0.00	0.00		
		J (2)	0	0	0.00	0.00		

BRITCRD	BRI T LINE CARDS	82
U2B1QCD	BRI 2B1Q U LINE CARDS	384
UAMICD	BRI AMI U LINE CARDS	0
ZCRD	Z LINE CARDS	14
HLSCDS	HIGH LEVEL SERV. CKTS/ISLU	2
DF4WIRE	ISLU 4WR CABLE TO DIST. FRAME	1
BRIMAN	NO. MAN PACK PAIRS - ISLU	1
RG	NO. RG PACK PAIRS - ISLU	1

Figure 14.2-11 ISLU#2 Protocol Handler Assignments

Figure 14.2-12 shows the PSU 1 protocol handler assignments.

sf	a(0)	b(1)	c(2)	d(3)	e(4)	f(5)	p2	p3	ts	p2	p3	p2	p3	p2	p3	sum
4	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
3	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
2	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
1	1.34	1.34	1.18	1.18	2.00	0.00	0	0	0	0	0	0	1	0	9	9
0	1.34	1.34	1.18	1.18	2.00	1.00	0	0	0	0	4	0	1	0	14	14

Figure 14.2-12 PSU 1 Protocol Handler Assignments

Figure 14.2-13 shows the trunk/channel protocol handler assignments.

		PRI		XAT			IP			X.75			X.75p			NUTS	
sf	ch	p2	p3	ch	p2	p3	tk	p2	p3	tk	p2	p3	tk	p2	p3	(32 avl)	
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	1	0	1	6	0	1	2	0	1	0	0	0	2	0	1	11	
Active PIDBs + DPIDBs for ISLU# 1 =								22									
Active PIDBs + DPIDBs for ISLU# 2 =								20									
Total IDCU to TSIU PIDB Ports										0							
Remaining TSIU Ports										2							
ISLU PIDB TS						320		Spare TS for any unit						51			
IDCU PIDB TS						0											
ISTF TS						32		PSU TS demand						11			
DLTU TS						96		Available TS for PSU only						0			
Inter-SM TS						0		IDCU Nail-up TS for TSIU						0			
Packet Trunk TS for PSU						11		Used Nail-up TS for TSIU						22			
Recovered DLTU TS						(0)		Avail Nail-up TS for TSIU						168			

Figure 14.2-13 Trunk/Channel Protocol Handler Assignments**14.2.3.3.2 Office Data Assembler (ODA) Forms**

A set of forms is available in the Office Data Assembler (ODA) system containing Office Records that are similar to and sometimes the same as 5ESS®-2000 Switch Office Records. Both ODA and 5ESS®-2000 Switch Office Records are tabular listings of the actual inventories and assignments of the data base and serve as a means for administering the 5ESS®-2000 switch office. Copies or variations of the Office Record forms may be used as work

sheets to aid administrative and maintenance personnel in translation inputting and data entry into the ODA process. Please note that although many similarities exist between 5ESS®-2000 Switch Office Records and ODA forms, the two are not the same and should never be interchanged. The ODA forms are used in preparing a 5ESS®-2000 switch for startup while 5ESS®-2000 switch Office Records are used only in an already working 5ESS®-2000 switch. Where the records inventory the same data and serve the same purpose, the ODA form and 5ESS®-2000 switch Office Record should have the same number.

As stated previously, ODA forms are used to start up an office. The forms listed in Table 14.2-14 can be referenced to identify the office configuration, but the actual switch verification will show the final office configuration.

Table 14.2-14 ODA Forms

FORM NUMBER	ODA NAME	TITLE/DESCRIPTION
5731	eqislu	Integrated Services Line Unit Equipage Form - used to define ISLU assignments within the SMs.
5732	eqrislu	Remote Integrated Services Line Unit Equipage Form - used to define Remote Integrated Services Line Unit assignments.
5733	eqlgc	Integrated Services Line Unit Line Group Controller Equipage Form - used to define the Line Group Controllers equipped on Remote or Local Integrated Services Line Units.
5741	eqpsu	Packet Switching Unit Equipage Form - used to define the equipped Packet Switching Units.
5742	eqpsuph	PSU Protocol Handler Pack Equipage Form - used to define the Packet Switching Unit Protocol Handlers equipped.
5824	eqisap	Analog Circuit Packs - provides the amount of HLSC operational for this SM.
5942	islulc	(Remote) Integrated Services Line Unit Line Card Form - used to define the Line Cards equipped on Remote or local Integrated Services Line Unit Line Group Controllers in a 5ESS®-2000 switch.

Detailed information on the above ODA Forms can be found in the 5ESS®-2000 Translation Guide (TG-5). The Packet Switch Unit and ISLU sections identify the recommended ODA Form to be used to determine ISDN Office Configuration.

14.2.3.3.3 Office Records

Office records are available on-line at any time on the 5ESS®-2000 switch. Office records are based upon the recent change and verify views of the 5ESS®-2000 switch and are applicable no matter what operational support system is attached to the switch. Office records can be accessed, changed, or input with standard I/O messages on a message-type terminal. These systems include menu mode and text interface recent change as well as Remote Memory Administration System (RMAS) or the master control center (MCC) in the command (CMD) mode.

Verifying the ISDN office configuration is strongly suggested before definition of your ISDN Line Assignment System. Listed in Table 14.2-15 is a list of the Office Records that can be used for the verification:

Table 14.2-15 Office Records

RECORD NUMBER	TITLE/DESCRIPTION
ESS™ 5731	Integrated Services Line Unit Common Record - This form is used to define integrated services line unit assignments in a 5ESS®-2000 switch.
ESS™ 57321	RISLU Common Equipment Record - This form is used to define remote integrated services line unit assignments in a 5ESS®-2000 switch.
ESS™ 57322	RISLU DFI-H2/R2 Pair Record - This form is used to define the equipment required for interfacing the peripheral interface data bus between a host site and remote site. The DFI-H2 is the remote integrated services line unit (RISLU) Host Digital Facility Interface

	(DFI) Type 2 which is located at the host site. The DFI-R2 is the RISLU Remote DFI Type 2 which is located at the remote site.
ESS TM 5741	Packet Switching Unit Common and Shelf 0 Record - This form is used to define the packet switching units (PSUs) equipped in a 5ESS [®] -2000 switch. Only one PSU may be equipped on any given switching module (SM), and PSUs may be equipped only on SMs with packet interface units (PIUs). The PIUs are defined on the SM Record (ESS TM 57001/2).

Detailed information for the Office Records can be found in the *Recent Change Manuals*, 235-118-XXX documentation and/or the TG-5

14.2.3.3.4 Recent Change Views

The RC/V facility is a user interface provided by the 5ESS[®]-2000 switch that allows users to modify or verify the contents of the ODD data base on the 5ESS[®]-2000 switch.

Verifying the ISDN office configuration is strongly suggested. Table 14.2-16 is a list of the RC/V Views that can be used.

Table 14.2-16 Recent Change/View Records

RC/V NUMBER	TITLE/DESCRIPTION
22.2	Packet Switch Unit - used to define the equipped Packet Switching Units.
22.3	Packet Switch Unit Shelf - used to define the Packet Switching Unit Protocol Handlers equipped and the minimum number of spare PHs.
22.5	Integrated Service Line Unit Equipage Record - used to define ISLU assignments within the SMs.
22.6	Line Group Controller - used to define the equipage for a Line Group Controller.
22.7	(Remote) Integrated Service Line Unit Line Card - used to define the Line Cards equipped on Remote or local Integrated Services Line Unit Line Group Controllers.
22.8	Analog Circuit Packs - provides the amount of HLSC operational for this SM.
22.9	Remote Integrated Services Line Unit Equipage Form - used to define Remote Integrated Services Line Unit assignments.
22.16	PSU Protocol Handler Channel Group Assignment - used to define the PH type (PH2 or PH3) and the shelf assignment.

Detailed information on the Recent Change Views can be found in the 235-118-XXX documentation. The Packet Switch Unit and ISLU section identify the recommended Recent Change Views used to determine ISDN office configuration.

14.2.3.3.5 Integrated Service Line Unit (ISLU)

This section identifies the questions that the administrator should ask to determine the ISLU configuration and the answers to those questions. The sample ISA report (Figure 14.2-14) illustrates, with "keyed" values (**Item A**, **Item B**, etc), the location on the ISA report where the questions are answered.

- (1) How many ISDN SMs (Switching Modules) are equipped?

The number of ISDN SMs required are engineered via the DOPS system based on the number of BRIs and/or analog lines and their associated usage. The Office Totals page of the ISA Report identifies the number of ISDN SMs provided in your office. The symbol to look for is as follows:

ISDNSM NUMBER OF ISDN SMs REQUIRED **Item A**

- (2) What SMs are equipped with ISDN?

Once the number of ISDN SMs have been identified, the next step is to determine the actual SM(s) number where the ISDN hardware will be located. The ISDN SM NO. 1 (our example shows number 1) page should indicate the correct SM number. Remember, the traffic engineer should edit the original report with the **entnbr** command in DOPS so that the correct SM number appears on the ISA report (**Item B**).

(3) How many ISLUs are equipped in the ISDN SM?

The number of ISLUs equipped within the SM can be found on the ISLU Protocol Handler Assignment and the ISDN SM No.1 page of the ISA report (**Item C**).

(4) How are the ISLU drawers wired? Are they 2- or 4-wire?

This information is obtained from the 5EMELD report provided to the service provider equipment engineer. Remember, you need to know how the drawers are wired because it makes a difference for the type of cards that can be assigned in them.

(5) How many Line Group Controllers (LGCs) are equipped within each ISLU?

The LGCs are traffic engineered and the ISLU can be equipped with a maximum of 16. The LGCs are numbered 0-15. LGCs 0-7 are resident in ISLU Half 0 and LGCs 8-15 are resident in ISLU Half 1. When your office is engineered, you cannot assume that all LGCs are equipped in the ISLU, or ISLU Half. For example, LGCs 0-5 may be equipped in ISLU Half 0 and LGCs 8-10 may be equipped in ISLU Half 1.

The number of LGCs engineered for your office can be found on the office totals page of the ISA report (**Item E**). The number of LGCs equipped per ISLU can be found on the ISLU Protocol Handler Assignments page of the ISA report (**Item C**).

Other forms that can assist in obtaining or comparing the information noted on the ISA report are listed below:

ODA	Form eqlgc	Provides information on equipped and operational LGCs.
RC/V	22.6	Same as above
Office Record	Form 5733	Same as above

An entry of "O", for OPERATIONAL, in the "EQST" column indicates that the LGC is equipped.

Each equipped LGC must be defined in the Operational Support System used to assign the ISDN lines.

NOTE: The ISA report refers to ISLU Half as half 1 and half 2. All other documentation refer to ISLU Half as 0 and 1. 0 and 1 is the correct reference for ISLU Half.

(6) What type of cards are being provided?

You can be provided with:

- T-Cards (4-wire card) must be assigned in a 4-wire drawer.
- U-Cards (2-wire card) can be assigned in either a 2- or 4-wire drawer.
 - 2B1Q U-Cards-National ISDN U-Cards
 - AMI U-Cards-Nonstandard U-Cards cannot be used for National ISDN BRIs
 - Pseudo U (allocation only, requires no new hardware)
 - Pseudo T (allocation only, requires no new hardware)

- Z-Cards (analog card) can be assigned in either a 2- or 4-wire drawer.

OFFICE TOTALS

CCSPTSM	HD WEIGHTED AVG CCS / BRI CARD	ISLU 10.20	IDCU
BRITCRD	BRI T LINE CARDS	165	Item G
U2B1QCD	BRI 2B1Q U LINE CARDS	768	
UAMICD	BRI AMI U LINE CARDS	0	
ZCRD	Z LINE CARDS	27	
TUZCRD	TOTAL LINE CARDS	960	
TR303	NO. OF TR303 RTS IN IDCUs		0
TR008	NO. OF TR008 RTS IN IDCUs		0
NRT	NO. OF PUB43801 DS1s IN IDCUs		0
DPPS	WEIGHTED AVG PPS / D-CHANNEL	1.60	
PPB	NO. OF PERM. PKT B-CHANNELS	20	0
PPBPPS	PERM. PKT B PEAK PPS PER PPB	32.00	0.00
ODB	NO. OF ON-DEMAND B USERS	30	0
ODBCCS	DPIDB OCCUPANCY CCS PER ODB	5.00	0.00
ODBPPS	ON-DEMAND B PEAK PPS PER ODB	1.00	0.00
PH2SPR	NO. SPARE PH2 / PSU SHELF	1	Item R
PH3SPR	NO. SPARE PH3 / PSU SHELF	1	
XISTF	ISTF OPTION (YES / NO)	Y	
IDCU	NO. OF IDCu UNITS		0
XSPLFCT	UNIFORM INTER-SM CONN. FACTOR	1.20	
BRIPLGC	BRI CARDS/ LINE GRP CNTRLR	32	Item H
MAXPIDB	MAXIMUM PIDBS AT THIS CCS-ISLU	12	
BRILGC	NO. LGC REQD FOR BRI -ISLU	30	Item E
ISDNSM	NUMBER OF ISDN SMs REQUIRED	1	Item A
DLTUSM	NUMBER OF ISDN SMs WITH DLTU	1	
PRI	NO. OF PRI D CHANNELS	1	Item O
XAT	NO. OF XAT CHANNELS	6	
ATPPS	WEIGHTED AVG PPS /XAT-CHAN	16.00	
IP	NO. OF IP TRUNKS	2	Item O
X75	NO. OF X.75 TRUNKS	2	
X75P	NO. OF X.75 PRIME TRUNKS	0	

tpa 816274.01

Summary		ISLU		IDCU	
		Qty	PH	Qty	PH
CCSPTSM	HD WEIGHTED AVG CCS / BRI CARD	10.20			
BRITCRD	BRI T LINE CARDS	165			
U2B1QCD	BRI 2B1Q U LINE CARDS	768			
UAMICD	BRI AMI U LINE CARDS	0			Item I
ZCRD	Z LINE CARDS	27			
TUZCRD	TOTAL LINE CARDS	960	(3)	0	
TR303	NO. OF TR303 RTs IN IDCUs			0	
TR008	NO. OF TR008 RTs IN IDCUs			0	
NRT	NO. OF PUB43801 DS1s IN IDCUs			0	
PPB	NO. OF PERM. PKT B-CHANNELS	20	(3)	0	
PPBPPS	PERM. PKT B PEAK PPS PER PPB	32.00			
DPPS	WEIGHTED AVG PPS / D-CHANNEL	1.60			
ODB	NO. OF ON-DEMAND B USERS	30	(3)	0	
ODBCCS	DPIDB OCCUPANCY CCS PER ODB	5.00			
ODBPPS	ON-DEMAND B PEAK PPS PER ODB	1.00			
X2DTU1H	NO. DFI CIRCUITS	4			
PRI	NO. OF PRI D CHANNELS	1	(3)		
XAT	NO. OF XAT CHANNELS	6	(3)		
XATPPS	WEIGHTED AVG PPS / XAT-CHAN	16.00			
IP	NO. OF IP TRUNKS	2	(3)		
X75	NO. OF X.75 TRUNKS	2	(3)		
PH2RAT	PH2 PER DPIDB (1/4 ISLU BASIS)	4.58			
PH3RAT	PH3 PER DPIDB (1/4 ISLU BASIS)	1.34			
ISMPH	AVG INTER-SM PROTOCOL HANDLERS	0	EST. (ON ph3) 0	ASGN	
PSUSHVS	NO. PSU SHELVES IN THE ISDN SM	2			Item N
DSU2IF	QTY OF ISTF PACKS ON DSU-2	1			
IDCU	NO. OF IDCU UNITS			0	
RPATS	RESERVED RPA/RPM T.S. PER SHF	0			
INSMPPS	EST. PPS FOR INTER-SM PKT TPT	0			
SM PIDB and LG breakdown		PIDBs		LGs	
ISLU#	1	10	15		Item C
ISLU#	2	10	15		
SUM PIDBs		20			
SUM LGs			30		

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ISLU#		1	Item C		--X.25 --				PS		-----	
half	LG	PIDB		DPIDB	PPB	ODB	PH2	PH3	shelf	port		
1	8	10		A (11)	0	0	0.00	1.34	0	a		
				C (9)	0	0	0.00	1.34	1	a		
				E (7)	10	0	0.00	2.00	0	e		
			Item K	G (5)	0	0	0.00	0.00	Item L			
				I (3)	0	0	0.00	0.00				
			Item M									
2	7			B (10)	0	0	0.00	1.18	0	c		
			Item F	D (8)	0	0	0.00	1.18	1	c		
				F (6)	0	30	0.00	1.00	0	f		
				H (4)	0	0	0.00	0.00				
				J (2)	0	0	0.00	0.00				
BRITCRD		BRI T LINE CARDS						83	Item J			
U2B1QCD		BRI 2B1Q U LINE CARDS						384				
UAMICD		BRI AMI U LINE CARDS						0				
ZCRD		Z LINE CARDS						13				
HLSCDS		HIGH LEVEL SERV. CKTS/ISLU						2				
DF4WIRE		ISLU 4WR CABLE TO DIST. FRAME						1	Item D			
BRIMAN		NO. MAN PACK PAIRS - ISLU						1				
RG		NO. RG PACK PAIRS - ISLU						1				

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ISLU#		2		Item C		--X.25B --		----- PSU -----		
half	LG	PIDB		DPIDB	PPB	ODB	PH2	PH3	shelf	port
1	8	10		A (11)	0	0	0.00	1.34	0	b
				C (9)	0	0	0.00	1.34	1	b
				E (7)	10	0	0.00	2.00	1	e
		Item K		G (5)	0	0	0.00	0.00	Item L	
				I (3)	0	0	0.00	0.00		
				Item M						
2	7			B (10)	0	0	0.00	1.18	0	d
				D (8)	0	0	0.00	1.18	1	d
		Item F		F (6)	0	0	0.00	0.00		
				H (4)	0	0	0.00	0.00		
				J (2)	0	0	0.00	0.00		
BRITCRD BRI T LINE CARDS 82										
U2B1QCD BRI 2B1Q U LINE CARDS 384										
UAMICD BRI AMI U LINE CARDS 0										
ZCRD Z LINE CARDS 14										
Item I										
HLSCDS HIGH LEVEL SERV. CKTS/ISLU 2										
DF4WIRE ISLU 4WR CABLE TO DIST. FRAME 1										
Item D										
BRIMAN NO. MAN PACK PAIRS - ISLU 1										
RG NO. RG PACK PAIRS - ISLU 1										

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ITEM Q														
PSU# 1 PROTOCOL HANDLER ASSIGNMENTS														
DPIDB port - ism -trk/cnl spare -total-														
sf	a(0)	b(1)	c(2)	d(3)	e(4)	f(5)	p2	p3	ts	p2	p3	p2	p3	sum
4	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0
3	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0
2	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0
1	1.34	1.34	1.18	1.18	2.00	0.00	0	0	0	0	0	1	0	9
0	1.34	1.34	1.18	1.18	2.00	1.00	0	0	0	0	4	0	1	14

TRUNK/CHANNEL PROTOCOL HANDLER ASSIGNMENTS																
	PRI			XAT			IP			X.75			X.75P			NUTS
sf	ch	p2	p3	ch	p2	p3	tk	p2	p3	tk	p2	p3	tk	p2	p3	(32 avl)
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	1	6	0	1	2	0	1	2	0	1	0	0	0	11

Active PIDBs + DPIDBs for ISLU# 1 = 22

Active PIDBs + DPIDBs for ISLU# 2 = 20

Total IDCU to TSIU PIDB Ports 0

Remaining TSIU Ports 2

ISLU PIDB TS	320	Spare TS for any unit	51
IDCU PDIB TS	0		
ISTF TS	32		

Item S		PSU TS demand	
DLTU TS	96	Available TS for PSU only	0
Inter-SM TS	0	IDCU Nail-up TS for TSIU	0
Packet Trunk TS for PSU	11	Used Nail-up TS for TSIU	22

Recovered DLTU TS (0) Avail Nail-up TS for TSIU 168

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Figure 14.2-14 Sample ISA Report

There are two types of U-cards; AMI and 2B1Q. Each U-card type requires an NT1 device on the customer premises. The NT1s are not interchangeable between AMI and 2B1Q U-cards so it is important to assign the correct type of card. Service orders must specify the proper card to be assigned.

When ISDN offices are equipped with both versions of U-cards (for example, AMI and 2B1Q), the operational support system utilized to perform assignment of the Line Card Equipment Numbers (LCENs), must be able to specify each equipment type as needed for assignment.

NOTE: Drawers equipped with U- and Z-cards require the ISLU to be equipped with HLSCs.

The number of cards engineered for your office can be found in the Office Totals, and ISDN SM No 1 pages

of the ISA report. The symbols to look for are as follows:

BRITCRD	BRI T LINE CARDS	Item G-Office Totals Item I-ISDN SM #1
U2B1QCD	BRI 2B1Q U LINE CARDS	
UAMICD	BRI AMI U LINE CARDS	
ZCRD	Z LINE CARDS	
TUZCRD	TOTAL LINE CARDS	

(7) How many cards are equipped per LGC?

The LGC is a subunit of the ISLU, which can be equipped with up to 32 line cards. It is possible for an LGC to have a mixture of T, AMI U, 2B1Q U, and Z cards. An LGC can be wired for either 2-wire or 4-wire ISDN interfaces (note that analog lines are 2-wire interfaces). All types of cards may be equipped in the 4-wire LGCs, but only U- and Z-cards can be equipped in 2-wire LGCs. The Operational Support System used to assign U- and Z-cards should assign LCENS to 4-wire LGCs only if the 2-wire LGCs have been totally assigned.

Normally, offices are engineered with 32 cards per LGC, but the engineer has several options for customizing the configuration. For example, if high-usage channels are engineered on the same PIDBs with other D-channels, and all the LGCs are equipped in the ISLU, the maximum number of cards that can be equipped per LGC depends on the number of high-usage channels engineered per LGC. High-usage channels are D-channels engineered at greater than eight dpps, and all B-channels. The traffic engineer can tell you how many high-usage channels are engineered per ISLU. Which LGCs in the ISLU these are assigned to is an assignment option (usually, high-usage channels should be spread evenly across the LGCs in an ISLU). The maximum number of cards is limited as shown in Table 14.2-17.

Table 14.2-17 LGC Card Requirements

NUMBER OF HIGH USAGE B	MAXIMUM NUMBER OF CARDS
0	32
1	28
2	24
3	20
4	16
NUMBER OF HIGH USAGE D	MAXIMUM NUMBER OF CARDS
0	32
1	29
2	26
3	23
4	20

In some instances, an ISLU may be engineered at traffic limits and may have less than 32 cards per LGC, even though there are no high-usage channels engineered. In these cases, the traffic engineer can tell from the DOPS run the appropriate value for maximum cards.

The total number of BRI cards to be equipped per LGC can be found on the Office Totals page of the ISA report. The symbol is as follows:

BRIPLGC BRI CARDS / LINE GRP CONTRLR Item H

The number of cards engineered for the ISDN SM can be found on the ISDN SM No.1 (Remember, the traffic engineer should update this form to indicate the actual SM number (**Item B**) page of the ISA report. The symbols to look for are as follows:

BRITCRD	BRI T LINE CARDS	Item I
U2BB1QCD	BRI 2B1Q U LINE CARDS	
UAMICD	BRI AMI U LINE CARDS	
ZCRD	Z LINE CARDS	

The number of cards engineered for the ISLU can be found on the ISLU PROTOCOL HANDLER ASSIGNMENTS page of the ISA report. The symbols to look for are as follows:

BRITCRD	BRI T LINE CARDS	Item J
U2B1QCD	BRI 2B1Q U LINE CARDS	
UAMICD	BRI AMI U LINE CARDS	
ZCRD	Z LINE CARDS	

Other methods to obtain card type and position within the ISLU-LGC are as follows:

ODA	islulc	Provides information on card type, status - equipped, operational, unequipped, or spare
RC/V	22.7	Same as ODA islulc
Office Records	Form 5942	Same as ODA islulc

(8) Are software-controlled spare cards to be used within the ISLU/LGC?

The service provider may choose to designate up to two line cards (position 15 and 31) in each line group as software controlled spares (U-cards only). The decision to spare line cards is a service provider option and should be determined by local practices. It is recommended that the traffic engineer verify whether the software controlled cards are to be allocated. Refer to the TG-5, Division 5, Section 5c for instructions on spare card assignment requirements. Spare cards are specified on the same ODA, RC/V, or Office Records as the line cards in question 7.

(9) How many PIDBs are equipped to provide your circuit switched data and voice traffic?

The ISLU may be equipped with 2 to 16 PIDBs. PIDBs always come in pairs (2, 4, 6, etc). The number of PIDBs equipped on each ISLU in your office depends on the traffic load specified during the engineering process. The number of PIDBs equipped determines the CCS capacity of the ISLU.

The ISLU Protocol Handler Assignments page of the ISA report provides the number of PIDBs engineered per ISLU. Look for the following label:

PIDB **Item K**

10

This is determined by the value of CCSPTSM "HD Weighted AVG CCS/BRI".

Other methods to obtain amount of equipped PIDBs per ISLU Half are as follows:

ODA	eqislu	Used to define ISLU configuration of PIDBs and DPIDBs.
RC/V	22.5	Same as ODA eqislu
Office Records	Form 5731	Same as ODA eqislu

To determine the number of PIDBs equipped on each ISLU- count the number of entries in the PIDB data section of the form that have a type = "SHRD." (Be careful to count the entries for each ISLU since all ISLUs in the office appear in the table and all the ISLUs may not have the same number of PIDBs). Since the table represents a simplex (one side only) view, multiply the number for each ISLU by two.

(10) How many DPIDBs are equipped to provide your packet-switched data traffic?

The ISLU may be equipped with up to 10 DPIDB pairs. The number of DPIDBs equipped on each ISLU in your office depends on the traffic load specified during the engineering.

The ISLU Protocol Handler Assignments page of the ISA report provides the number of DPIDBs by describing the DPIDB path engineered between the ISLU Half and the PSU Shelf (the path to provide access to the PH) **Item\OL**. The report also provides the DPIDB name (A, C, E, etc.) and number (11, 9, 7, etc.). This information is used to allocate the available time slots for assignment as discussed later in the section (**Item M**).

Other methods to obtain amount of equipped DPIDBs per ISLU Half are as follows:

ODA	eqislu	Used to define ISLU configuration of PIDBs and DPIDBs.
RC/V	22.5	Same as ODA eqislu
Office Records	Form 5731	Same as ODA eqislu

The ODA Form "eqislu" and Office Records Form 5731 include DPIDB assignment information for each ISLU. (Refer to Translation Guide TG-5 for an example of Form 5731 and details concerning its completion.)

The software in the 5ESS®-2000 switch allocates odd-numbered (11, 09, 07...) DPIDBs to LGCs 0 through 7 (ISLU half:0), and allocates the even numbered (10, 8, 6...) DPIDBs to LGCs 8 through 15 (ISLU half:1) (**Item M**). In effect, the switch allocates the DPIDB time slots to an ISLU HALF. The Assignment System needs the DPIDB configuration to track the number of time slots still available for assignment. Each time slot is determined and assigned via recent change in the switch.

To determine the number of DPIDBs equipped in each ISLU HALF connected to each of the five PSU shelves, refer to Office Records or ODA Form/Screen 5731. For "ISLU half:0," count the number of odd-numbered entries with type="PSU" for each shelf and enter that data in the appropriate field on the ISLU configuration screen. Be careful to count the entries for each ISLU since all ISLUs in the office appear in the table and the ISLUs may not have the same number of DPIDBs for each "ISLU half:0".

To determine the number of DPIDBs in "ISLU Half:1" refer to ODA Form/Screen 5731, and count the number of even-numbered entries with type="PSU" for each shelf.

- (11) Is the main frame a COSMIC® module frame? Do you have concerns about the short jumper concept?

It is important to find out if your office has a COSMIC® module frame using a short jumper concept in assigning the office equipment to the cable and pair. With this type of application on the frame, the cable and pair determines the assignment of LCENs and may have an affect on the capacity of LCEN or the administrator may have to assign lines using a long jumper. Check with the line and number staff organization in the service provider for more information concerning COSMIC® frames and short jumper concepts.

14.2.3.3.6 Packet Switch Unit (PSU)

This section identifies the questions to ask to determine the configuration of the PSU and where to find the answers.

- (1) How many shelves are equipped?

The Packet Switch Unit (PSU) may be equipped with five shelves. The PSU shelves are numbered 0 through 4. It is not necessary to equip all the shelves in the PSU. The number of shelves equipped in the PSU can be found on the ISDN SM NO. 1 page of the ISA report. The symbol to look for is as follows:

PSUSHVS NO. PSU SHELVES IN THE ISDN SM **Item N**

Item L indicates the actual PSU Shelf number to be equipped.

Other methods to obtain the number of equipped PSU shelves are as follows:

ODA	eqpsu	Used to define the equipped Packet Switch Unit shelves.
RC/V	22.3	Same as ODA eqpsu
Office Records	Form 5941	Same as ODA eqpsu

- (2) How many PHs are equipped per shelf?

A PSU shelf may be equipped with up to 16 PHs. The PHs are engineered for specific functions such as Access PHs (PPB, ODB, and PPD), IP, ISM, PRI, and trunking for XAT, X.75, and X.75. The PH should be used for the function the traffic engineer specified on the ISA report. When capacity issues warrant the reallocation of the PH function, the traffic engineer must be consulted.

The B-PHs are engineered for assignment of 64 Kbps B-channels with X.25 packet switching. Also, PHs for any D-channels with greater than 8 dpps are engineered as B-PHs. The D-PHs are engineered for D-channels with less than 8 dpps and D-channels providing Q.931 signaling.

The ISM PHs are dedicated for packet links between SMs. The interswitch packet trunk (ISPT) PHs are dedicated to trunks between the 5ESS®-2000 switch and the public packet network switch. spare PHs are reserved for maintenance and reliability functions. The OFFICE TOTALS page of the ISA report provides the number of trunks, XAT channels, and PRIs the office was engineered to handle. Each of the X.75, X.75', IP, XAT, and PRI requires a protocol handler assignment. Look for the following symbols in DOPS:

PRI	NO. OF PRI D CHANNELS	Item O
XAT	NO. OF XAT CHANNELS	
IP	NO. OF IP TRUNKS	
X75	NO. OF X75 TRUNKS	
X75P	NO. OF X75' TRUNKS	

The TRUNK/CHANNEL PROTOCOL HANDLER ASSIGNMENTS page of the ISA Report indicates the number of PHs engineered for the "trunking" types and the PSU shelf where they are to be located (**Item P**). It is extremely important to allocate the PHs by type and PSU Shelf assignment since other resources may be used such as nailed-up time slots.

The PROTOCOL HANDLER ASSIGNMENTS page of the ISA report indicates the number of PHs engineered for Access (voice and packet services assigned to DSLs) and Interswitch Module Links (ISM) (**Item Q**).

The 5ESS®-2000 switch requires a spare PH on each shelf of the PSU. Each PH type (PH2, PH3 or PH4) allocation requires a spare PH on each PSU shelf. So, if your office has a mixture of PH2, PH3s or PH4s on the same shelf, it is mandatory to have 2 spare PHs, one for the PH2 one for the PH3 and one for the PH4. It is possible to allocate up to 8 spare PHs on the PSU shelf. The OFFICE TOTALS page of the ISA report allocates the number of spare PHs for the office. Look for the following symbols:

PH2SPR	NO. SPARE PH2 / PSU SHELF	Item R
PH3SPR	NO. SPARE PH3 / PSU SHELF	
PH4SPR	NO.SPARE PH4 / PSU SHELF	

Other methods to obtain number of equipped Protocol Handlers per PSU Shelf are as follows:

ODA	eqpsuph	Used to define the equipped Packet Switch Unit protocol handlers.
RC/V	22.16	Same as ODA eqpsu
Office Records	Form 5742	Same as ODA eqpsu

14.2.3.3.6.1 PH Requirements

The engineering algorithms assume that all packet D-channels use one quarter of a time slot, resulting in loads less than 8 dpps. In some instances, the engineering can be made to accommodate high-usage D-channels by defining extra B-channels to the engineering system. When this is done, the number of PHs ordered is correct; however, their allocation is not accurate. Although the engineering labels them as B-channel PHs, the number of PHs engineered for high-usage D-channels must be defined in your line assignment system as D-PHs. Consult your traffic engineer to determine the accurate allocation for the PHs.

There are multiple B-channels per PH. Consult your equipment engineer to determine whether multiple B-channels are assigned to a PH. The 5ESS®-2000 switch will only allow up to 32 B-channels per PH to be assigned.

14.2.3.3.7 Packet Switch Unit (PSU) to Time Slot Interchanger Unit (TSIU) Time Slots

The PSU is equipped with a PIDB connection from each PSU shelf to the TSIU. Each PSU shelf has a capacity of 32 time slots that are traffic engineered for XAT, X.75, X.75 PRI, RPA/RPM, RISLU, ISM, IP and CDMA (Item S). The DFMP Feature has a PSU shelf capacity of 128 time slots. For further information on DFMP, refer to section 14.2.2.2. It is imperative to monitor the allocation of these time slots since the capacity can easily be reached. Contact the traffic engineer with questions on allocation of these time slots or when you reach 90 percent capacity of the available 32 time slots. Refer to Recent Change View 22.2 to get the actual capacity count.

14.2.3.4 Loading Plan

Once the administrator knows what the office is forecasted to grow, and knows the configuration of the equipment that was engineered, as well as the capacity of the units provided, a loading plan should be established.

The first step is to designate the PH by type (that is, B, ODB, D-channel, ISM, ISPT, PRI, or spare). The service provider traffic engineer should provide this information to the administrator. ISDN must be assigned or loaded the way it was engineered to be assigned or loaded!

The next step is to establish circuit service bands and packet service bands.

NOTE: New bands may be required for Multipoint and ACD/BRCS for heavier usage DSLs. This concept is similar to CCS/Class of Service.

14.2.3.4.1 Circuit-Switched Service Bands

The circuit-switched service bands (CSB) are arbitrary groupings of customer lines, which must be defined by the service provider. These can be based on CCS ranges (that is, high, medium, low) or on specific applications (that is, host computer access, centrex attendant, or secretarial line ACD/BRCS).

A CSB is defined by its maximum usage in CCS.

When determining the service bands for your office, 9(initially and after cutover) consult with the traffic engineer to determine the weighted average CCS (obtain from the ISA Office Totals Report symbols CCSPTSM) and the data (that is, number of BRIs, average voice CCS, and average data CCS) used to engineer the office. Also consult with marketing personnel to determine if this office has unique or heavy traffic applications. Other resources are service planning organizations and other network administration organizations.

NOTE: Once the office is cutover, utilize Traffic 30 Section 77 to study the DSLs for performing CCS/CS studies.

14.2.3.4.1.1 Example CSB Service Bands

Assume that the office in question was engineered to a high-day weighted average of 8 CCS per main station, and the following data was used to establish the high-day weighted average:

10,000	BRIs (including)	8CCS*10,000 Lines = 80,000 CCS
5,000	data BRIs @ 10 CCS	10 CCS x 5,000 Lines = 50,000 CCS
500	computer ports @ 36 CCS	36 CCS x 500 Lines = 18,000 CCS
4,500	voice BRIs @ 2.6 CCS	2.6 CCS x 4,500 Lines = 11,700 CCS
TOTAL	-	- 79,700 CCS

One possible set of bands and corresponding CCS per band could be as follows:

Data	10 CCS
Computer	36 CCS
Voice	2.6 CCS
NONE (packet service only)	0 CCS

Remember that the service bands are arbitrary; different sets may be appropriate for different offices. The goal is to make assignments that distribute the load in a way that approximates the high-day weighted average used to engineer the office. A simple check is to determine the number of lines in each band and calculate the high-day weighted average for the office. If the high-day weighted average is about equal to the high-day weighted average CCS used by the traffic engineer, the bands are appropriate. If the bands are not appropriate, the engineered number of terminations may not be achievable, or service may be degraded.

14.2.3.4.2 Packet Service Bands

The packet service bands (PSB) are a unit of packet switching demand allocation to the switch. It is similar to the idea of usage (CCS) bands in the analog world, but is more complicated.

The PH administration method uses arbitrary groupings of subscriber packet-switched lines called PSBs that are to be evenly distributed across the PHs. They are characterized by service on the same channel (B or D) and by similar packet throughput requirements. These bands are defined by the telephone company before beginning the PH assignment procedures.

14.2.3.4.2.1 Logical Channels

A B-channel is limited to a maximum of 128 logical channels and virtual channels for a PH2, and D-channels are limited to a maximum of 16 logical channels. In each case, 1 logical channel is reserved for signaling. A PH may have a maximum of 128 logical channels active at one time. A PH3 may also have 128 active at one time, but also has a virtual capacity of 255 channels. Each logical channel active per DSL generates additional usage (dpps).

14.2.3.4.3 Packet Service Band Implementation

A packet service band implementation (PSB) is defined by its usage (PH load), the time slot weight, and the number of logical channels allowed (concurrent packet calls). In addition, a PSB can limit the number of D- or B-channels with this PSB that are assigned to a single PH (MAX. PSB per PH).

Each PSB must have a unique name, PSBs band the usage (dpps) of an individual B-channel with X.25 service an individual D-channel with X.25 service. PSBs should be created for each service with more than one logical channel assigned as signalling only or, as stated above, B-channels may have up to 127 channels assigned and active. D-channels may have up to 15 assigned and active. The more channels assigned and active on a DSL, the higher the usage (dpps) generated. Multipoint DSLs may have up to 8 users sharing the D-channel (i.e., the more users, the more usage generated). PSBs should be created for each Multipoint DSL service offering.

The Z-cards do not have PSBs. The B-channels without packet switching service do not have PSBs, and D-channels without X.25 (doing Q.931 signaling protocol only) must have the PSB described previously.

Table 14.2-18 summarizes the relationship between channel configuration, service bands and PSBs (with N/A indicating not applicable).

Table 14.2-18 Channel Configuration and Service Band Relationships

CONFIGURATION	CSB	PSB
BRI (2B+D) (signalling only)	Always Always	
BRI (2B+D)	Always ^a	
B w/X.25	N/A	Yes
B w/o X.25	N/A	No
D w/o X.25	N/A	Always
D w/ X.25	N/A	Yes
Z Card	Always	N/A
Notes:		
a. If no circuit-switched service is assigned to a BRI, it should have a service name = None and service usage = 0.		

14.2.3.4.3.1 PH Load Determination

When determining the PSBs for your office, consult with the traffic engineer to determine the high-day weighted average dpps and the number of B-channels, number of D-channels, average dpps per B-channel, and average dpps per D-channel used to engineer the office. Also consult with marketing personnel to determine if this office has any unique or heavy packet traffic applications.

Engineering algorithms do not support D-channel engineering in the range of 9.25 dpps to 36.99 dpps, PSBs for D-channels should not have PH load values in this range. This restriction arises from the engineering assumption that 4 D-channels are always multiplexed into one time slot. The PH loads in the range of 9.25 dpps to 36.99 dpps result in situations where less than four D-channels are in 1 time slot because a time slot can route to only 1 PH and less than 4 D-channels may be assigned to that PH. The consequence is that the D-channels use more than the designed number of time slots when the ISLUs are assigned to terminal capacity. The extra time slots are taken from the pool of time slots used for circuit switching, thus reducing the circuit-switched capacity of the unit.

14.2.3.4.3.2 Time-Slot Weight Determination

Every PSB must have a time-slot weight. If X is the PH load for the PSB, the time-slot weight is determined as shown in Table 14.2-19 for D-channels.

Table 14.2-19 PSB Time-Slot Weight Determination

PPS/CHANNEL	TIME-SLOT WEIGHT
$X \leq 9.25$	0.25
$8 < x \leq 12.2$	0.33
$10.7 < x \leq 18.5$	0.50
$16 < x \leq 37$	1

The B-channels always require a whole time slot (time-slot weight = 1) because of their 64 Kbps bandwidth. The D-channels providing Q.931 signaling only always require a quarter time slot.

Your line assignment system should use the time-slot weight to ensure that the time slot allocation for each LGC, DPIDB, and PSU shelf matches allocation by software in the switch.

14.2.3.4.3.3 Logical Channel Requirements

A B-channel can have up to 128 logical channels (one of which is reserved for signaling), and a D-channel can have up to 16 logical channels (one of which is also reserved for signaling). Since the number of logical channels a customer has is a subscription parameter, check with your marketing or service planning organizations to determine the correct number of logical channels for each PSB.

The PH software has the capacity to serve 128 "active" logical channels. Your line assignment system should count the number of logical channels assigned to a PH, and stop assigning lines to that PH when the 128 limit is reached. Therefore, a PH could be assignment limited because of the number of active logical channels. Your line assignment system should use logical channels as a secondary parameter in determining the least loaded PH to assign. The primary parameter is the packet usage (dpps); however, to avoid low PH use, the number of logical channels should be accurately reflected or defaulted to a value of 1 [a value of 1 allows all 128 ports on a PH to be assigned, providing the PH capacity limit (50 dpps in PH2 or 200 dpps in PH3) is not exceeded].

14.2.3.4.3.4 MAX PSB Per PH Determination

The MAX PSB per PH is used to limit the number of lines with a particular PSB that are assigned to a PH. For example, if the service provider wished to limit host computer ports to one per PH because of potential heavy usage, this parameter should be set to one.

14.2.3.4.3.5 Example PSBs

For an example, assume that the office in question was engineered to a weighted average of 0.5 dpps per D-channel. There are a total of 10,000 BRIs including the following:

25	B-channel packet	$25 * 32 \text{ PPS} = 800 \text{ PPS}$
10,000	BRIs (including)	$10,000 * .5 \text{ PPS} = 5000 \text{ PPS}$
4,400	D-channel packet	$4,000 * .6 \text{ PPS} = 2640 \text{ PPS}$
5,000	circuit-switched only	$5,000 * .1 \text{ PPS} = 500 \text{ PPS}$
75	computer ports (D-channel).	$75 * 8 \text{ PPS} = 600 \text{ PPS}$
TOTAL	-	- 3740 PPS

One possible set of PSBs is shown in Table 14.2-20 .

Table 14.2-20 Example of Packet Service Bands

BAND	PH LOAD	TIME-SLOT WEIGHT	MAX PSBs/PH	LOG. CHAN.
B-channel	37	1	1	1
D-channel	0.75	0.25	42	1
Computer	22.6	1	1	16
Q.931	0	0.25	128	0

Remember that PSBs are arbitrary, so different sets may be appropriate for different offices. However, to determine if a set of PSBs is appropriate for an office, determine the number of channels in each PSB and calculate the weighted average dpps. If this is about equal to the weighted average dpps used by the traffic engineer (obtain from ISA Office Totals Report symbol DPPS), the bands are appropriate.

14.2.3.4.4 ISM Link Assignment

When the 5ESS®-2000 switch is configured to have more than one SM with the ISDN feature, nailed-up time slots are used to provide the communications path between SMs. These nailed-up time slots are referred to as ISM links. These links terminate on a PH that is dedicated to ISM traffic. The quantity of links (that is, time slots) and the quantity of ISM PHs required in an SM are traffic engineered. To activate an ISM link, the near-end PH and port assignment [referred to as the integrated services channel number (ISCN) by recent change] and the far-end PH and port assignment must be defined in the office dependent data (ODD) for each SM. To define a link between two SMs, it is necessary to do a recent change in each SM.

14.2.3.4.4.1 Engineering Interfaces

Because the number of links and the number of ISM PHs required in each SM are engineered, the administrator needs to obtain this information from the engineer for the site being translated.

14.2.3.4.4.2 Calculating ISM Links Per SM Pair

The engineering rules for ISM links calculate the basic connectivity required between all ISDN SMs. (The DOPS calculates the number of links to interconnect only the SMs engineered in the same run. If the office is engineered in communities of interest, an ISM network is calculated for only that community. If interconnection of these networks is desired, manual adjustments must be made in every ISDN SM in each network. If RSMs and ORMs are to be connected to a network, manual adjustments are required in the remotes and in each ISDN SM to which the remotes connect.) To assign the ISM links it is necessary to determine the number of links between each pair of SMs. The ISM links are translated in SM pairs to ensure that the number of links leaving one SM matches the number of links terminated in the far SM.

14.2.3.4.4.3 Calculating PHs Per ISM Link

The ISM links should be spread across ISM PHs. A link may terminate on only one ISM PH, and multiple links in the same route should be assigned to different ISM PHs. The methodology presented here uses the quantity "ISM PHs per link" to determine the order of assignment. Since a link can terminate on only one ISM PH, this quantity will always be less than or equal to one. Also, the sum of the values for "ISM PH/LINK" for all the links assigned to a

single ISM PH must be less than or equal to one.

To determine the ISM PH/LINK, divide the number of ISM PHs per SM pair by the number of ISM links per SM pair. (The DOPS system does not report the ISM PHs on a per pair basis; therefore, the number of ISM PHs for a pair of SMs must be assumed.)

14.2.3.4.4 ISM Link Assignment Procedure

The following ISM link assignment procedure is used in conjunction with the Link Assignment Form (Figure 14.2-17) located at the end of this section.

- (1) For each SM, identify the PHs designated for ISM service, and enter the PSU shelf and PH number in the space provided on the ISM Link Assignment Form.
- (2) For each SM, enter on a copy of sheet 1 of Figure 14.2-17, the PSU Shelf, PH, and PORT beginning with port 000 on each PH. Fill in one line for each link terminating in the SM. For example, if 4 links are required and 2 ISM PHs are provided, the entries are as follows:

SHELF	PH	PORT
x	0	000
x	1	000
x	0	001
x	1	001

- (3) Beginning with the lowest numbered ISDN SM in the office (referred to as near SM), choose the SM pair that has the highest ISM PH/LINK value and assign it to the first unassigned port on the ISM link assignment form.
- (4) Choose an unassigned port in the destination SM and enter its SM, PSU Shelf, PH, and Port in the space for the "FAR ISCN" next to the port chosen in the near SM. To complete the step, record the assignment chosen in the near SM also as the "FAR ISCN" assignment on the form for the destination SM.
- (5) Enter the value of ISM PH/LINK in the column corresponding to the shelf and PH chosen on each form. If the sum of the values entered in the column is less than one, the assignment is good. If the sum is greater than one, choose a different assignment on a different PH.

14.2.3.5 Assignment Guidelines

This section presents some examples of BRI assignments and gives some of the restrictions for assignments. This is not a comprehensive listing of restrictions.

NOTE: Lucent Technologies is removing the recommendation of segregating assignments of PHs by SM component (ISLU, RISLU, IDCU, ISLU2, AIU, and TR-303 on DNU-S). ISDN customers use the same applications whether the lines terminate in an ISLU, ISLU2, IDCU, etc. The DDPS inputs to 5 DOPS should be obtained from TRFC30 Section 68. Traffic engineers may use the same DPPS entries for each SM component based on actual data or estimated PPS based on specific customer's needs.

In addition to removing the recommendation of segregating assignments of SM component, it is possible to mix Permanent Packet B-Channels with D-Channel Packet and Access Digital Service Lines. To accomplish the required DPPS entries for 5 DOPS, utilize the DPPS from TRFC30 Section 68 from the "Access PHs" as a guideline for forecasting future packet demand.

14.2.3.5.1 Order of Assignment

Before assigning BRIs, it is important to assign spare PHs and dedicated PHs (ISM, ISPT, SPARE, PRI) via recent change on the 5ESS®-2000 switch. (Spare PHs are translated as a quantity per shelf. There is no unique PH

number and port assigned by the administrator.) Access PHs should be assigned by your line assignment system, observing the following guidelines.

- (1) Assign all packet B-channels first. Allocate equipment by class of service and reserve the engineered quantity for assignments. The PHs chosen should be blocked from further assignments for other than B Channel assignments if you choose not to mix B and D Channel PH assignment.
- (2) Next, assign high-usage D-channels. If necessary, use the preassignment option to reserve the engineered quantity of assignments. The PHs chosen should be blocked from further assignments. for other than B Channel assignments if you choose not to mix B and D Channel PH assignments.
- (3) Assign all packet-only BRIs.
- (4) Assign all ISDN attendant positions.
- (5) Assign all ACD/BRCS
- (6) Assign Application Processor (AP) links.
- (7) Assign BRIs requiring special segregation.
- (8) Assign the remaining BRIs with X.25 packet service and Z-cards beginning with the highest usage lines.
- (9) Assign the remaining BRI and Z-cards. If you wish to backfill the PHs assigned in the first two steps, remove the blocked status. (Backfilling is only permitted when PSB "Q" is used and its PHLOAD is zero.)

14.2.3.5.2 Assignment Communities

Some features (BRCS, shared DN, AP links) have operational advantages or memory savings if they are assigned judiciously. Also, certain hardware configurations such as optically remoted module (ORM), remote switching module (RSM), and RISLU define separate communities. One way to achieve separate communities is to maintain separate data bases for each community. This works well for the hardware communities since they are usually separate office identifications (IDs), but is not efficient for communities defined via feature content.

A feature that requires segregation of lines to a minimum number of SMs can be handled by blocking assignments to all SMs except the desired SMs. Then the lines can be assigned, and the restriction removed after all the lines in the community have been assigned. Similarly, packet features can be segregated by blocking all PHs except the desired PHs.

Early office applications need to perform manual checks to assure proper feature segregation.

14.2.3.5.3 Manual Checks

The following segregation rule should be checked.

- AP Links: There should be no more than 16 AP links per SM. Also no more than ten different APs should have AP links assigned to the same SM. All links from a single AP must terminate on the same SM.
- Attendant Console: The attendant console is an SM real-time intensive line and should be evenly spread across the office (do not segregate) so as to have the minimum number possible per SM. If ISDN busy monitor and attendant features are employed, the station spreading should be limited to 13 SMs.
- IDP, Automatic Route Selection (ARS), Uniform Numbering Plan (UNP) and Configuration Groups: The listed features are memory intensive and may need to be segregated. Consult with your traffic engineer and equipment engineer to determine if special administration has been assumed in the engineering. There are no

5ESS®-2000 switch requirements for special handling of these features, but SM memory can be configured, at the service provider's option, in a way that may cause assignment restrictions.

14.2.3.6 ISLU Load Balance

The following key indicators are important to ensure that the ISLUs remain in proper balance. The following list contains key items to monitor after loading the ISLU:

- Check for set up delay (analogous to dial tone delay for analog lines) [TRFC30, Section 53] for U- and T-cards; check for dial tone delay (Section 4) for Z-cards, and terminating blockage (TRFC30 Section 49). Log the terminating blockage and dial tone speed delay (or set up delay) to identify if blockage is occurring.

In the ISLU, blockage may occur at either the PIDB or LIDB buses for circuit-switched voice or data or the DPIDB for On-Demand B set up. Blockage in the PIDB occurs when all the PIDB time slots are being used. To avoid such blockage, it is important to ensure that the usage in the ISLU has not exceeded its capacity which is determined by the number of PIDBs installed. Furthermore, the total CCS load should be distributed as evenly as possible across all ISLUs. In this way, unit-to-unit variations are minimized. An LIDB blockage occurs when there are too many X.25 (including ODB) assignments in an LGC. A DPIDB blockage can occur when the time slots allocated for ODB have been exceeded. If time slot blockage occurs, measurements on a per LGC basis (TRFC30 Section 145) or measurements on individual BRIs in an ISLU (TRFC30 Section 107 or Section 77 in Software release 5E10 and later) can be used to more precisely isolate the problem.

- The switch administrator should monitor the ISLU (TRFC30 Section 49 and 145) data to ensure that the ISLUs are not loaded above the desired capacity level. Daily busy-hour measurements can be compiled to monitor the load balance.
- For situations with high dial tone delay (set up delay) and low terminating blocking, check the occupancy of the switch module processors (SMPs). Half-hour occupancy readings higher than 70 percent (TRFC30, Section 15) for SMP may mean that the SMP is being overloaded under peak calling conditions. Such overloads may produce customer complaints of terminating blocking and slow dial tone.

Also check the TRFC30 reports for out of service (Maintenance Usage) equipment which may cause line origination problems.

- If assignment systems are used, make sure that the CCS/class of service parameters that provide load-directed assignments accurately reflect customer calling usage.
- Inhibit new assignments into the SMs with consistently high CCS, dial tone (Z-cards) delay, set up delay, and terminating blockage.
- To ensure that one ISLU is not used constantly for assignment thus causing it to overload or block consistently, update the USAGE status for each ISLU into the line assignment system.
- The ISLU digital subscriber line measurements (TRFC30, Section 107, or Section 77 in 5E10 and later) may be used to identify high usage customers. Activate Section 107 (or 77 in 5E10 and later) on both high and low usage ISLUs to move high usage lines from one ISLU LGC to a low usage ISLU LGC.
- The LU/ISLU load administration measurements feature can be used to monitor ISLU LGC. Section 145 of the TRFC30 report provides usage counts based on a 100 second scan for each LGC for up to 4000 LGCs. This measurement allows the administrator to perform load administration of the ISLUs.
- Set up weekly studies using TRFC30 Section 145 data. Collect the data for all the ISLUs in the office or for a certain number of ISLUs because no more than 4,000 LGCs can be studied at a time (A maximum of 250 ISLUs with 16 LGCs each). Data collection should include the busy hour of each day of the week or, if the busy

hour is not known, the collection of data should include every half-hour data to validate the busy hour. After the data is collected, analyze Section 145 data using the following balancing process

The maximum value for an LGC depends on the number of nailed-up time slots (PPB-channels). This number can vary from one LGC to another. A PPB nailup uses a dedicated time slot on the LIDB, thereby reducing the number of time slots available for CS calls. This affects the maximum value of the usage traffic count in Section 145.

Time slot contention is an issue for circuit-switching and is the basis for concentration in the ISLU. The 3 units where time slot contention occurs are LIDB TSs, PIDB TSs, and TSI TSs. To determine the maximum LGC capacity, it is necessary to obtain the following information:

- The number of PIDBs connected from the TSI to each ISLU
- The number of ODB and PPB assigned to each LGC in each ISLU.

The number of PIDBs to the ISLU determines the circuit switch capacity of the ISLU by the following formula:

$$\text{Number of PIDBs} \times 32 \text{ TSs} \times 18 [30 \text{ Min CCS/TS}] \times .45 [\% \text{ OCC}]$$

= ISLU CS Capacity

$$\text{ex: } 4 \text{ PIDBs} \times 32 \times 18 \times .45 = 1036.8 \text{ CCS}$$

Since there can only be up to 16 PIDBs engineered to an ISLU, Table 14.2-21 lists the ISLU capacity for up to 16 PIDBs.

Table 14.2-21 ISLU Capacity (CCS/Half-Hour) and LGC Circuit-Switched Capacity

NO. OF PIDBs	NO. OF TSs AVAIL.	ISLU CAP. (30 MIN). CCS	LGC CS CCS CAPACITY [30 MIN] PER PIDB							
			LGC 2	LGC 3	LGC 6	LGC 8	LGC 10	LGC 12	LGC 14	LGC 16
2	64	518.4	259.2	129.6	86.4	64.8	51.8	43.2	37.0	32.4
4	128	1036.8	324.0	259.2	172.8	129.6	103.7	86.4	74.1	64.8
6	192	1555.2	324.0	324.0	259.2	194.4	155.5	129.6	111.1	97.2
8	256	2073.6	324.0	324.0	324.0	259.2	207.4	172.8	148.1	129.6
10	320	2592.0	324.0	324.0	324.0	324.0	259.2	216.0	185.1	162.0
12	384	3110.4	324.0	324.0	324.0	324.0	311.0	259.2	222.2	194.4
14	448	3628.8	324.0	324.0	324.0	324.0	324.0	302.4	259.2	226.8
16	512	4147.2	324.0	324.0	324.0	324.0	324.0	324.0	296.2	259.2

Next, take the ISLU capacity and divide by the number of LGC equipped in the ISLU. Table 14.2-21 also includes the LGC capacity for the number of LGC equipped vs. the number of PIDBs equipped.

NOTE: The CS capacity of the LIDB is only 324 CCS/ half hour.

$$44 \text{ TSs} \times 18 \text{ CCS} \times 0.4091 (\% \text{ OCC}) = 324 \text{ CCS}$$

Thus if we divide the ISLU CS CCS capacity by the number of LGC and the result is higher than 324, then the LIDB is the limiting item and we use the 324 CCS value.

The maximum CCS load for the LIDB or LGC is 324 whether the traffic is for packet switching or circuit switching.

From the LGC capacity table, if the LGC capacity is less than 324 CCS the circuit switch CCS capacity noted previously should not be exceeded; however, the packet switched CCS can occupy the difference. For example, an ISLU has 10 PIDBs and 16 LGCs, so from Table 14.2-21, the LGC circuit switch capacity is 162.0. Since the MAX capacity of the LGC is 324 CCS, then $324.0 - 162.0 = 162.0$ CCS is available CCS for packet switched traffic. The number of PPB lines and ODB reduce the CCS capacity per LGC. See section 14.2.1.1.2.

TRFC30 Section 145 reports the usage for both circuit switch and packet switch traffic, so to determine how much circuit switch CCS is being used, the administrator will have to subtract the packet switch usage. To subtract out packet switch usage, determine the amount of B-channel X.25 users assigned to an LGC. Use this number to compare with the

Section 145 will be output to the EADAS channel. Once Section 145 is activated, raw traffic data on usage is sent directly to EADAS, when requested, at the end of every 30 minutes. From EADAS, only selected data is sent to other downstream processors for load balancing. The tables above should be used as guidelines for flagging a particular LGC.

14.2.3.7 PSU Load Balance

The following list contains key items to monitor after loading the PSU:

- A difference exists between the packet- and circuit-switched networks in that the packet network is nonblocking. Instead, the user experiences poorer performance during overload conditions. These performance degradations are usually manifested in longer file transfer times and real-time breaks during display functions. To ensure good packet-switching service, it is necessary to evenly distribute the packet load across the PHs, and to operate the PH within its packets per second capacity or throughput limitations.

Monitor TRFC30, Sections 52 and 68 for each PH's packet per second. If the throughput of the PH is exceeded, then use TRFC30 Section 67 to determine the high packet users in the PH and move the assignment to a lower packet usage PH.

14.2.4 ISDN APPLICATION PROCESSOR LINK ASSIGNMENT GUIDELINES

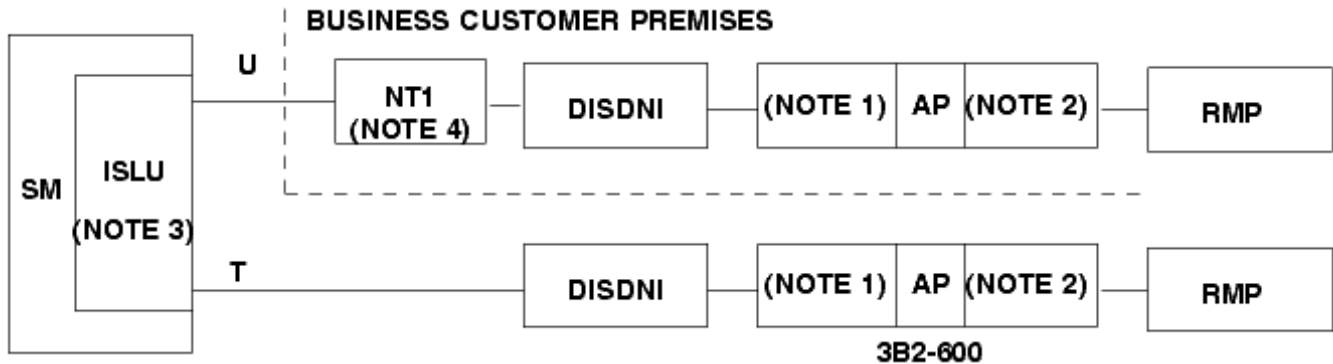
14.2.4.1 Application Processor Feature Description

An application processor (AP) is connected to the 5ESS[®]-2000 switch by a 9.6-Kbps data link. The AP is connected via an ISDN basic rate interface (BRI). This description addresses the ISDN BRI.

Lucent Technologies offers an advanced communications package (ACP) that is a set of software modules that runs on an AP. The feature software is based on a modular design, which means that each feature can be loaded as a separate entity and is basically independent of any other feature. Many of the ACP features receive data, such as Customer Message Service System (CMSS), Electronic Directory Service (EDS), advanced station message detail recording (ASMDR), Facilities Management System (FMS), Traffic Data System (TDS), and Automatic Circuit Assurance (ACA), from a 5ESS[®]-2000 switch.

14.2.4.2 5ESS[®]-2000 Switch Communications Interface

The AP communicates with a 5ESS[®]-2000 switch equipped with ISDN over a BRI line that interfaces with a switching module (SM) equipped with an integrated services line unit (ISLU). This is shown in Figure 14.2-15.

**NOTES:**

1. 3B2/600 = ISC
2. REMOTE MANAGEMENT PACKAGE
3. ISLU/RISLU HAS U- OR T-CARD OPTION
4. NT1 NEEDED ON U-CARD INTERFACE ONLY

Figure 14.2-15 Application Processor Interface

The BRI uses an X.25 Link Access Procedure - D channel (LAPD) protocol and connects to the 7A Direct ISDN Interface (DISDNI) unit that is usually co-located with and connected to the AP. The connection from the 5ESS®-2000 switch to the 7A DISDNI unit may, depending on the distance, be via a T-card interface, a U-card interface, or a U-card and a basic rate interface transmission extension (BRITE) card.

14.2.4.3 Engineering Issues

API links are connected to the 5ESS®-2000 switch via a T-card, a U-card, or a BRITE card. The traffic engineer must provide the correct quantity of cards based on the interface to be used.

The 5ESS®-2000 switch also requires a protocol handler (PH) channel assigned to each link, so the traffic engineer must provide the correct quantity of PHs.

14.2.4.4 Administration Issues

Although the purpose of this section is not to engineer an AP, it is important to know engineering inputs to adequately perform administration functions. The communication links (API links) and the cards (U and T) have impact on the switch.

Administration issues for the switch are capacity on the PHs for the API links and terminations (cards and PH channels).

Assignments of API links and BRI lines can be mixed within ISLUs and PHs. The administrator may want to define a packet service band to reflect the anticipated usage of the link.

Although there are no restrictions to the number of API links that can be assigned to a PH, API link assignments should be spread evenly over the PHs. Also, the links should be assigned to different PHs for reliability (an AP requires a minimum of two links).

The switch administrator should monitor usage on the API links by activating a special study on TRFC30 report section 67. This section provides usage on the individual channel of the PH. Since the API links are assigned to access D-channel PHs, total PH usage should be monitored to provide good service to all customers.

Based on services that originate as voice calls and access the AP, such as the CMSS Deluxe Services, circuit switched usage occurs while the call is in progress. The administrator monitors ILSU usage on TRFC30 section 52

In summary, once the AP services are established, activate a special study to monitor customer usage on the links, then adjust the packet service band accordingly. Monitor the total PH usage on TRFC30 section 68.

The following procedures and guidelines should be used to load AP links onto PHs:

- Based on traffic engineering, determine how many links are to be assigned and what the anticipated usage per link is.
- Once the anticipated usage has been determined, assign the link. The API links require a line card equipment number (LCEN), either U- or T-cards may be used, and a D-channel integrated services channel number (D ISCN).
- Monitor the usage to verify that the anticipated usage agrees with the engineered usage. When the actual usage has been monitored, more links and lines can be assigned to the PH. It is recommended to assign one AP link to the PH until usage in data packets per second (DPPS) indicates that more than one link can be assigned. Use the following equation to find the DPPS:

$$\frac{\text{Packets (TRFC30 Section 68)}}{1800 \text{ CCS (30 min)} \times 2} = \text{DPPS}$$

Figure 14.2-16 is an example of a report from section 68 of TRFC30. In this example, eight packets were generated for two test calls.

- BRIs and AP links can be assigned to the same PHs.
- Usage for all PHs should be continuously monitored.

OP TRFC30 PSPH

TIME 11:00:21

SECTION 68: ISDN PACKET SWITCHING PROTOCOL HANDLER/DSL

					BUF	LCCB	LCCB	LCCB
SM	DSL	SHELF	PH	PACKETS	OVFL	OVFL	ATMPT	USG
16	1	0	3	8	0	0	1	0

Figure 14.2-16 Example Report From TRFC30, Section 68

14.2.5 ASSOCIATED MEASUREMENTS AND KEY SERVICE INDICATORS

There are many sections of the TRFC30 report containing measurements directly related to ISDN. These sections are listed below and described in detail in 235-070-100 Traffic and Plant Measurements Appendix 1.

Measurements play a critical role in any major endeavor. The measurements provided for ISDN are the same basic measurements provided in the TRFC30 including peg counts, usages, and overflows. The difference in the

measurements is the unit the measurement is being taken against and how it is being captured. For example, to measure the delay a customer may experience while attempting to initiate a call, dial tone delay is used for an analog line unit. Since the ISLU uses the D-channel signaling for circuit-switched calls, any delay found in receiving a set up message is the source for the measurement. Both measurements are pegged if the customer waits more than 3 seconds for the sign that they can input the digits for the call.

To support ISDN, 14 sections have been added to the TRFC30 report.

- Section 49 - ISLU
- Section 50 - ISDN office totals
- Section 51 - ISDN packet interface measurements
- Section 52 - ISDN digital subscriber line group
- Section 53 - ISDN SM measurements
- Section 67 - ISDN PH ports
- Section 68 - ISDN packet switching PH/DSL
- Section 69 - ISDN packet switching office totals
- Section 71 - ISDN packet switching group counts
- Section 92 - Packet switching trunk group
- Section 105 - On-demand B-channel
- Section 106 - Packet switching directly connected PIDB
- Section 77 - Digital subscriber line measurements
- Section 119 - Packet Business Groups
- Section 145 - Line Group Controller Measurements.

To support ISDN BRCS, 6 sections have been added to the TRFC30 report and existing Section 59 in the TRFC30 was altered to include measurements on the application processor connected over a BRI.

- Section 59 - Application processor data link measurements
- Section 72 - ISDN BRCS office totals
- Section 73 - ISDN BRCS electronic directory service
- Section 74 - ISDN BRCS message service customer
- Section 75 - ISDN BRCS message service multiline hunt group
- Section 108 - Automatic customer station rearrangement.

These sections may be viewed on the ROP or transmitted to an operational support system just as existing sections. The input command ``ALW" allows the user to activate the desired section for collection. More information on the ``ALW" command can be found in 235-600-700 under ALW:TRFC30.

The format of the ISDN measurements is set up like the analog measurements. The ISDN measurements can be conceptually broken up into circuit-switched data measurements, packet-switched data measurements, and the ISDN BRCS measurements. The ISLU section contains the same types of counts as in the LU Section 11. Usage for circuit-switched calls is measured in CCS and is performed by scanning as in analog calls. Usage for packet-switched data is measured in data packets per second (dpps). Overflows and attempts are measured like peg counts. An ISDN office totals section exists which mirrors Section 3, Office Totals. Note that Section 3 contains the combination of both analog and ISDN measurements for the entire office.

Section 67 is a special study section which can be set up through Recent Change and allows the user to look at a particular PH and all the associated ports on that PH. This section gives the detail at a subscriber level on the ISDN customer.

14.2.5.1 Maintaining Load Balance

When loading is completed, monitor the office closely for changes in the growth pattern or increased CCS/network access lines (NAL) and ensure the load is spread over all the ISLUs. A good class of service spread provides better use of the equipment and better customer service.

[illegible]

SM	NUMBER								
SH__	SH__	SH__	SH__	SH__	SH__	SH__	SH__	SH__	SH__
PH__	PH__	PH__	PH__	PH__	PH__	PH__	PH__	PH__	PH__
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
TOTALS									
SH__	SH__	SH__	SH__	SH__	SH__	SH__	SH__	SH__	SH__
PH__	PH__	PH__	PH__	PH__	PH__	PH__	PH__	PH__	PH__
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
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_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
TOTALS									
SH__	SH__	SH__	SH__	SH__	SH__	SH__	SH__	SH__	SH__
PH__	PH__	PH__	PH__	PH__	PH__	PH__	PH__	PH__	PH__
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
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TOTALS									

Figure 14.2-17 ISM Link Assignment Form

14.3 REMOTE INTEGRATED SERVICES LINE UNIT

14.3.1 DESCRIPTION

14.3.1.1 Universal RISLU

A Universal Remote Integrated Service Line Unit (RISLU) is a line unit that can be remoted up to 175 miles from the host. Typical applications for a RISLU include pair gain system, small community dial office (CDO) replacement, private branch exchanges (PBX) replacement, the introduction of ISDN in non-ISDN exchanges, and provide ISDN services beyond the loop requirements. The RISLUs are also used to provide Operator Service Position System/automatic call distribution (OSPS/ACD) services.

The RISLU is an ISLU that can be remoted from the host 5ESS®-2000 switch via pulse code modulation (PCM) carrier facilities. The hardware in the host switching module (SM) converts data on the peripheral interface data buses (PIDBs) and control information on the peripheral interface control bus (PICBs) into PCM carrier format. The synchronization signals at the RISLU are derived from the incoming data stream, and a remote clock is provided in the RISLU to maintain critical timing.

14.3.1.2 Enhanced RISLU

The enhanced RISLU (ERISLU) combines the features of the ACD/OSPS RISLU and Universal RISLU. The ERISLU supports the full integration of ACD and the MIS with ISDN BRCS functions. In addition, the ERISLU also provides environmental office alarms, on a site-by-site basis. The following points are emphasized for clarity:

- The remote alarm section (RAS), used for environmental alarm units equipage is optional. The unit can be added using the RAS growth procedure.
- When an ACD/OSPS RISLU is equipped with an RAS and is converted to an ERISLU, the resulting ERISLU will be equipped with the RAS after the conversion.
- The conversion of ACD/OSPS RISLUs to ERISLUs requires that all DFI-Hs assigned to the RISLU must be placed OOS. There must also be a static data change, and a full initialization of the host SM.
- The Universal RISLU can be converted to an ERISLU.
- ERISLU will not support the hot spare strategy.
- The RAS requires a T-line card as a data link to interface to the SM.
- The ERISLU can support a mixture of U, T, and Z-cards on the same line group controller without affecting call quality.
- The ERISLU may exist on the position SM and the loaded SM.
- The conversion from ERISLU to ACD/OSPS RISLU is not supported.

14.3.1.3 RISLU on SM-2000

The ISDN on the SM-2000 feature integrates additional features and functionality found on SMs, such as ISDN, onto the SM-2000 platform. With ISDN comes the need to supply an Integrated Services Line Unit (ISLU) vehicle to provide end users with ISDN service. In the 5E10 software release, to provide Integrated Services Line Units on SM-2000, the existing RISLU and RISLU2 are ported from the SMs to the SM-2000. The major improvement of the RISLU2 over the RISLU is its potential for increased line capacities.

The RISLU2 uses *FASTECH*® N-sized (8.5 by 13 inch) circuit packs with eight or sixteen line circuits on each line pack. The RISLU2 provides up to 1024 ISDN terminations (via T8 or U8 line packs) or up to 2048 analog terminations (via Z16 line packs). All RISLU2 terminations are subject to line traffic engineering and it is expected that on the SM/SM-2000, the RISLU2 units will typically support 768 ISDN or 1024 analog Z lines.

The RISLU2 on SM-2000 enhances services provided in ISDN in two ways. First, the RISLU2's multiple circuit line packs allows increased capacity of its U, T, and Z interfaces when compared with the RISLU's interfaces. Second, by providing the RISLU2 on the SM-2000, there will no longer be the pre 5E10 requirement to ship SMs whenever ISDN is required on the 5ESS®-2000 switch. The RISLU2 on the SM-2000 will further the parity between the SM-2000 and the SM. Moving the SM-2000 to SM parity, means that most features and peripherals (or their functional equivalents), found on a SM, but are not currently available on the SM-2000, will be ported to the SM-2000.

14.3.1.3.1 Transparency Issues

The end users' ISDN features as provided by the RISLU2 platform are transparent to the features which were provided by the 5E9(2) RISLU platform with only three exceptions. The exceptions are that the 5E10 RISLU2 platform will not support the following:

- OSPS
- ACD/BRCS
- DSN features

Automatic Power Recovery allows the full, automatic recovery of 5ESS®-2000 switch RISLU2 equipment after an extended commercial AC outage where the battery plant has deeply discharged. This includes the automatic restoral of the power subsystem and automatic software reinitialization after commercial power has returned. No intervention by exchange technicians at the RISLU2 site is required for full recovery. Remote alarms will be available to detect a failure in the automatic recovery hardware.

14.3.1.4 Loop Interfaces

The RISLU supports the T (4-wire) and U (2-wire) interface for ISDN BRI services. A RISLU can support up to 316 BRIs which can be a mixture of T- and U-cards. The Z-cards may also be equipped in the same RISLU with the BRI. The maximum number of cards (T, U, and Z) per RISLU is 512, but no more than 316 of these may be BRIs.

The BRI provides two B-channels which communicates digital voice or data and a single D-channel which is used for control signaling and packet-switched data. The term 2B+D is often used to define the BRI. Each B channel on the BRI has a transmission rate of 64 Kbps. The T-card provides a 4-wire BRI connection into the RISLU, with the distance between the customer terminal and the RISLU being limited, in terms of loss, to 6 dB at 96 kHz. The U-card provides a 2-wire BRI connection into the RISLU, with the distance between the customer terminal and the RISLU being limited, in terms of loss, to 32 dB at 80 kHz.

14.3.1.5 Line Group Controller

Thirty-two line cards are grouped over a common bus, called the group interface data bus (GIDB), to a controller called the line group controller (LGC) as shown in Figure 14.3-1. Control of the line cards is maintained via two control/signaling time slots on the GIDB. The remaining 30 time slots are available for B-channel traffic and D-channels. Up to 16 LGCs may be equipped per RISLU.

14.3.1.6 Line Interface Data Bus

The line interface data bus (LIDB) pair is the output of the LGC. In the RISLU, two LIDBs are provided per LGC,

and are operated in the active-standby configuration. Unlike the ISLU, which has an active-active configuration, the RISLU has a maximum of 30 traffic carrying time slots per LIDB pair compared to a possible 60 time slots per LIDB pair for the ISLU. As a result, the traffic capacity of a RISLU's LIDB pair is considerably less than that of the ISLU's LIDB pair. A discussion of the LIDBs capacity is included in the engineering section.

14.3.1.6.1 Common Data Boards

The common data (CD) boards terminate the LIDBs from each LGC and transfer the time slots to appropriate PIDB ports. Since the RISLU does not have directly connected PIDBs (DPIDBs), all traffic including packet-switched nail-ups leave the CD boards on PIDBs. Each PIDB leaving the CD has 23 traffic carrying time slots, 1 time slot of signaling information and 8 time slots stuffed with idle code. In addition to the PIDBs the CD has a control interface data bus (CIDB) which has the control time slot from each LIDB, and the control information for the CD boards (see Figure 14.3-2) is transferred from the LIDBs to the CIDB.

14.3.1.6.2 Common Control Board

The common control(CC) board takes the control time slots from the CIDB and converts them into PICB format.

14.3.1.6.3 Remote Digital Facility Interface

There are two types of Digital Facility Interface-Remote (DFI-Rs):

- (1) The DFI-R1 converts PIDB data from the CD and PICB data from the CC into PCM carrier format. The DFI-R1 has 24 DSO channels, but one is reserved for control and another is reserved for signaling.
- (2) The DFI-R2 converts PIDB data from the CD into PCM carrier format. The DFI-R2 has 24 DSO channels, of which one is reserved for signaling.

For normal operation, a RISLU must be equipped with two DFI-R1s. Up to ten DFI-R2s may be equipped per RISLU, with the exact quantity per RISLU being determined by traffic considerations.

In addition to terminating PIDBs and PICBs, the DFI-R1 has the ability to monitor and send four alarms; fan, fuse, power, and battery. The DFI-Rs are operated as a pair on either a clear channel facility (64 Kbps) or a nonclear channel facility. All of the DFI-Rs in a given RISLU must operate in the same mode. Clear channel facilities must have Bipolar 8 Zero Substitution (B8ZS) format, which inserts a fixed 8-bit code with bipolar violation in bit positions 4 and 7 when a string of 8 zeros is detected. Nonclear channel facilities employ Zero Code Substitution (ZCS) in which a 1 is substituted in one bit when an 8-bit pattern of zeros is encountered in the data stream. The maximum user bandwidth in this latter arrangement is 56 Kbps clear or 64 Kbps restricted.

NOTE: The ISDN circuit-switched digital capability provides circuit-switched B-channel transport between ISDN terminals at a 56 kb/s or 64 kb/s clear channel data rate. The intra-switch data rate capability depends upon the data rate capability of the host-to-RISLU transmission facilities. To provide 64 kb/s ISDN circuit switched data capability on an RISLU, the umbilical to the RISLU must support that data rate.

14.3.1.6.4 Remote Clock

There are two remote clock circuit packs provided in the RISLU which reside in the digital line trunk unit - remoting - remote end (DLTU-RR) along with the DFI-Rs. They are configured in an ACTIVE/STANDBY mode where the STANDBY side is locked to the ACTIVE side by means of a cross-couple timing signal. One of the DFI-R1 packs (Master) is in control of the RCLKs and is designated by a * on the MCC display. It is also the facility that is providing the timing reference for the RCLKs.

14.3.1.7 T1 Facility

The T1 facility consists of all the channel service unit (DSU), repeaters, digital cross connects (DSX), and carrier terminals installed in the circuit between the RISLU and the host. For a clear channel facility, these units (if appropriate) must be optional for ZCS. All of the equipment in the facility should be optioned for "loop" timing. On each facility, channel 24 is reserved for analog signaling.

14.3.1.7.1 Host Digital Facility Interface

There are two types of digital facility interface-host (DFI-H):

- (1) The DFI-H1 terminates the T1 carrier and converts the PCM carrier formatted data into PIDB and PICB format.
- (2) The DFI-H2 terminates the T1 carrier and converts the PCM carrier formatted data into PIDB format.

In addition to reconstructing the PICB and PIDB format, the DFI-H1 constructs a PICB bit stream containing the alarm states, and passes this information to the switching module processor (SMP). No scan points are required in the host for these alarms.

The translations for the DFI-H/R pair defines whether the T1 facility is operated in clear channel or nonclear channel. This is accomplished via a parameter called the "DFI MODE". In addition to the DFI MODE, the translations also provide for definition of the stuffing pattern for each DFI-H/R pair.

The DFI-Hs reside in another DLTU-R that is identical to the one in the RISLU except that it does not contain RCLK boards and is equipped with DFI-Hs. The DFI-H1 and DFI-H2s are different circuit packs, and these packs are different from the DFI-R1 pack and the DFI-R2 pack. A DLTU-RH can terminate 4 type 1 packs and 12 type 2 packs. Since a RISLU only requires 2 type 1 packs, it is possible for the DLTU-R in the host to support 2 RISLUs, providing that the limit of 12 type 2 packs is not exceeded. The DFI-Hs for a given RISLU may be assigned to different data interface (DI) boards.

14.3.1.7.1.1 Stuffing Pattern Impacts

Figure 14.3-2 is a time slot map for a fully equipped RISLU having four T1 spans. As mentioned before, each LGC has two time slots for control and signaling leaving 30 time slots for traffic. Each T1 span has 24 time slots which are mapped into the PIDBs by stuffing idle code into the time slots indicated by the Xs. In the time slot interchanger (TSI), 96 time slots are assigned to the RISLU. The remaining time slots in the TSI are assigned to other units.

In order to establish a call, a time slot is chosen in the TSI and time slots of the same number must be available on the DFI and in the LGC. The stuffing patterns insure that there are an equal amount of each time slot number available in both the DFIs and the TSI. If the stuffing patterns were incorrectly defined, there would still be an equal amount of each time slot in the DFI and TSI, but there would be some time-slot numbers totally unavailable to the RISLU. For example, if all the DFIs were assigned stuffing pattern a, there would be no TSI time slot numbers 0, 4, 8, 16, 20, 24, and 28. This would reduce the number of paths to each line group by eight, thus reducing the amount of traffic that the LGC can carry. It is important that the stuffing patterns be assigned evenly across the DFI-Hs. If DFIs from a DLTU are assigned on the same DI, it is important that the stuffing patterns be assigned evenly across both the DFI-Hs and DFIs as one community. Failure to spread the patterns evenly can affect the performance of other units assigned to that DI. If only DFIs are assigned to a DI, failure to evenly spread stuffing patterns can cause initialization problems.

14.3.1.7.2 Host Switching Module Resources

To support a RISLU the host SM must have the loaded software configurations. This is required even if no ISDN services are required, for example, Z-card only. If ISDN services are required, the SM must be equipped with a packet switch unit (PSU) and the module controller and TSI unit 2 (MCTU2). All connections to the PSU require

TSI time slots in addition to those required for the DLTU-R.

14.3.1.7.3 Service Circuits

A RISLU may be equipped with three types of service circuits:

- (1) Two ring generator (RG) packs are required if Z-cards are equipped.
- (2) Up to four metallic access network (MAN) packs can be equipped per RISLU. The four packs represent two service groups of two packs each. MAN packs provide access for ringing, metallic test and software-controlled, line-card sparing.
- (3) Up to six high level service circuits (HLSC) may be equipped per RISLU. The HLSCs perform short jobs, for example, power cross tests and ringing job that overflow from the RGs.

14.3.2 ENGINEERING CONSIDERATIONS

In order to engineer a RISLU it is necessary to determine the number of time slots required for each of the following functions:

- (1) D-channel transport
- (2) B-channel X.25 packet switching
- (3) Circuit-switched traffic.

A time slot is a 64 kB-channel. Unlike the ISLU, which has direct interfaces to the PSU, all the RISLUs traffic (both packet-switched and circuit-switched) is offered to the TSI. Time slots carrying packet traffic are nailed up across the TSI, while circuit-switched traffic is load shared (served at 90 percent occupancy or 32.4 ccs high day per time slot). Once the total number of time slots is known, it is possible to calculate the number of T1 spans required, and the number of LGCs required.

14.3.2.1 RISLU Time Slot Calculations

The BRIs D-channel is a 16 kB-channel. Four D-channels can be multiplexed by the RISLU onto a single time slot; however, RISLUs remoted via nonclear T1 spans do not have full use of the 64 kB DSO channel. For nonclear T1 spans the RISLU multiplexes 3 D-channels per time slot. Since each BRI has one D-channel, the number of time slots required for D-channel transport via clear channel facilities can be calculated by dividing the total number of BRIs by 4. Similarly, the number of time slots required for D-channel transport via non clear facilities can be calculated by dividing the total number of BRIs by 3.

The BRIs B-channel is a 64 kB-channel. The B-channels with X.25 packet switching require a whole time slot. The B-channels used for circuit-switched voice and/or circuit-switched data are load shared (CCS sensitive). The Z-cards, when active, require a whole time slot, and are load shared. The number of time slots required for BRI circuit switching can be calculated by dividing the BRI CCS by 32.4 CCS per time slot (90 percent occupancy). Similarly, the number of time slots required for Z-card circuit switching can be calculated by dividing the Z-card CCS by 32.4 CCS per time slot.

The total time slots required per RISLU is the sum of the BRI requirement and the Z-card requirement.

14.3.2.2 Line Interface Data Bus

The LIDBs in a RISLU are operated in an ACTIVE/STANDBY configuration, which provides 32 time slots on a fully duplicated bus. Two of the 32 time slots are used for control and signaling, leaving 30 time slots for circuit-switched

traffic and packet-switched nail-ups. Of the 30 remaining time slots, eight are engineered for D-channel nail-ups when the RISLU is equipped with clear channel facilities. The remaining time slots can carry up to 360 CCS of circuit-switched traffic. If the RISLU is equipped with nonclear facilities, eleven LIDB time slots are engineered for D-channel nail-ups; the remaining time slots can carry up to 252 CCS of circuit-switched traffic. The B-channels with X.25 packet switching reduce the circuit-switched traffic capacity of the LIDB by 36 CCS per channel.

14.3.2.3 Primary Rate Carrier Calculations

There are two modes in which the T1 spans used to remote a RISLU are operated. Mode 1 has 22 DSO channels for traffic and 2 DSO channels reserved for control and signaling. For normal operation two mode 1 T1 spans are required per RISLU. The RISLU will function in simplex state with one mode 1 T1 span. Mode 2 has 23 DSO channels for traffic and 1 DSO channel for signaling of the DFI-R in the RISLU cabinet. Up to 10 mode 2 T1 spans can be equipped on a RISLU.

A minimum of 10 percent spare time slots per RISLU is provided to reduce the potential for time slot mismatch between the RISLU's LIDB and PIDB. Since the CD does not have a TSI, mismatch occurs when a LIDB time slot can not be matched to a same numbered PIDB time slot. In any case, the customer may wish to provide a minimum of 23 extra time slots to provide capacity to recover failed T1 spans.

14.3.2.4 Line Group Controller Calculations

Each LGC in a RISLU is equipped with up to 32 cards, (T, U, or Z). A RISLU may have up to 512 cards, but is limited to 316 BRI cards due to a 190 nail-up restriction on the TSI in the host SM.

Each LGC in a RISLU has 30 traffic carrying time slots. The number of LGCs per RISLU can be limited by the number of cards or by the number of time slots required. The number of LGCs required for BRIs due to time slots can be calculated by dividing the total number of BRI time slots by 30. The number of LGCs required for BRIs due to card constraints can be calculated by dividing the total number of BRIs by 32.

Similarly, the number of LGCs required for Z-cards due to time slots can be calculated by dividing the total number of Z time slots by 30. The number of LGCs required for Z-cards due to card constraints can be calculated by dividing the total number of Z-cards by 32. The larger of the two requirements should be provided. The total number of LGCs (maximum of 16) required is the sum of the requirement and the Z-card requirement.

14.3.2.5 Service Circuit Calculations

If Z-cards are present in the RISLU, two RGs must be provided. Four MAN packs are provided if U-cards or Z-cards are equipped. In addition to metallic access, the MAN packs can provide access for the software-controlled sparing capability. Two MAN packs (one duplicated) will provide one spare per RISLU, and four MAN packs (two duplicated) will provide two spares per RISLU. Spares do not count toward the 316 BRI limit. When sparing U-cards, a maximum of two spare U cards are allowed per unit.

Up to six HLSCs (High Level Service Circuits) can be equipped in a RISLU with Z-cards, with a minimum of 2 HLSCs being provided in a RISLU with U-cards. HLSCs are not required for RISLU's equipped with T cards only. Table 14.3-1 provides the engineering recommendations for HLSCs to support Z-card traffic.

Table 14.3-1 HLSC Engineering Requirements

Z CCS	HLSC ^a
2073.60	2
3110.40	3
4147.20	4
6220.80	5
12441.60	6
Notes:	
a. If U-card, a minimum of two HLSC are required.	

14.3.2.6 Packet Switch Unit Calculations

The minimum number of PSU shelves required for a RISLU is determined by the number of time slots nailed up to the TSI. Each PSU shelf can have a maximum of 32 time slots. Also, the number of PSU shelves could be limited by the number of PH (Protocol Handlers). A maximum of 16 PHs can be equipped per shelf. The number of PHs required is dependent upon the PPS (Packet Per Second) per D-channel and the PPS per B-channel. A 64 kB-channel can carry up to 32 PPS; therefore, each D-channel in the time slot can have an average of 8 PPS. To calculate the number of time slots per PH for a clear channel application, the average PPS per D-channel is divided into 8. Similarly, nonclear channel applications share the PH capacity among three D-channels, resulting in an average of 10.7 PPS per D-channel per time slot. To calculate the TSs (time slots) per PH for nonclear applications, the average PPS per D-channel is divided into 10.7. The minimum number of PHs required to support the D-channel is the number of D-channel time slots divided by the TS per PH. It is necessary to allocate the time slots to PSU shelves being careful not to exceed the 32 time slot limit.

Since the B-channels use a whole time slot, they do not arrive in "groups" of one. The minimum number of PHs required for B-channels can be calculated by multiplying the number of B-channel time slots by the average PPS per B-channel (total B-channel PPS) and dividing by the capacity of the PH. Again, the B-channels (1 time slot each) must be allocated to the PSU shelves to determine the actual number of PHs required. Remember that the number of B-channels and the number of D-channel time slots added together can not exceed 32 time slots per shelf.

The number of ISM (Inter-Switching Module) time slots required and the number of ISM PHs are each dependent upon the total PPS in the network and the PPS in each SM.

The PH provides the capability to define 384 LAPD (Lind Access Procedures D-channel) logical links. One logical link is required for a subscriber to circuit-switched voice and/or circuit-switched data on a BRI. An additional LAPD logical link is required for subscribers to D channel X.25 packet switching. For example, a BRI with two users each with circuit-switched voice and circuit-switched data and one of the users having X.25 D-channel packet switching, will require three LAPD logical links. Since 5E5 and later software releases allow up to eight subscribers per D-channel, each equipped with both circuit switching and packet switching, and since 5E5 and later software releases allow up to 128 D-channels per PH, there could potentially be a demand for 2048 logical links. If the 384 limit is exceeded, the PHs will be equipped with less than 128 channels and more PHs will be provided. Since the logical link is a Q.931 parameter, B-channels are not affected by this limit.

14.3.2.7 Host Switching Module Calculations

An SM can host up to 20 DFI-Rs, 4 DLTU-Rs and 8 RISLUs. An SM is allowed a maximum of 316 BRIs from RISLUs (this does not include ISLU lines) due to the 190 nail-up restriction. In addition, a SM can be DI port limited or time slot set limited in its engineering.

The SM hosting the RISLU must be equipped with the fully loaded software configuration, and be equipped with the MCTU2.

14.3.3 ASSIGNMENT GUIDELINES

14.3.3.1 Universal RISLU

The following assignment rules apply to Universal RISLU:

- (1) Up to eight RISLUs can be supported on a SM.
- (2) A RISLU can be hosted on an SM, an optically remote module (ORM), or a remote switching module (RSM).
- (3) A RISLU must be equipped with two common control (CC) circuits.

- (4) A RISLU must be equipped with two CD circuits.
- (5) A RISLU must be equipped with between 0 and 16 LGCs (0 occurs during growth).
- (6) A RISLU can be equipped with between 2 and 12 PRC facilities. Two of these must be supported on DFI-H1/R1 pairs. The remaining facilities will be supported on DFI-H2/R2 pairs.
- (7) A RISLU must be equipped with two RCLK packs.
- (8) RISLU applications use an active/standby CD configuration.
- (9) A RISLU must be hosted on one and only one DLTU-RH. That is, all host DFIs connected to one RISLU must appear on the same DLTU-RH.
- (10) Up to two RISLUs can be hosted on one DLTU-RH, provided that the total number of facilities needed to support those two RISLUs does not exceed 16.
- (11) It is not possible to move a RISLU from one DLTU-RH to another DLTU-RH without temporarily removing that RISLU from service.
- (12) The assignment rules for the PICBs that are extended through the DFI-H1s to the remoted ISLU CC must follow the same assignment rules established for ISLU CC PICBs (CC 0 controlled by an even PICB, CC 1 controlled by CC 0 PICB +1).
- (13) PIDBs connected to a RISLU should be connected to the same data interface (DI) boards if possible. If the PIDBs must be split across DI boards, they should be split evenly.
- (14) The stuffing code patterns should be assigned to DFIs such that a uniform spread of patterns appears across the DFIs connected to a DI. The stuffing code patterns must also be spread uniformly across the DFIs assigned to a particular RISLU.
- (15) The DFI mode assigned to each DFI on a RISLU must be identical.
- (16) Each RISLU at the remote site must be supported from one and only one DLTU-RR.
- (17) Only one RISLU can be supported per DLTU-RR.
- (18) The DFI-R1 that provides control CC 0 must be equipped in DFI position 1 in the DLTU-RR. The two PIDBs from this DFI-R1 must connect to PIDB connection 0, PIDB side 0 on both CD service groups.
- (19) The DFI-R1 that provides control CC 1 must be equipped in DFI position 2 in the DLTU-RR. The two PIDBs from this DFI-R1 must connect to PIDB connection 1, PIDB side 0 on both CD service groups. This DFI-R1 will also provide the extra set of timing signals to PIDB connection 0, PIDB side 1 on both CD service groups.
- (20) Up to ten DFI-R2s can be equipped per RISLU. They can be equipped in any of the remaining DFI positions in the DLTU-RR. The two PIDBs from DFI-R2 must be connected to the same PIDB connection number on the two CD service groups. They must both be connected to PIDB side 0.

14.3.3.2 Enhanced RISLU

The ERISLU supports a mix of ACD and ISDN call types. The estimated number of calls per hour on the ERISLU varies depending upon the percentage of ACD calls. The throughput of the ERISLU remains the same as that of the Universal RISLU. The response time and blocking rate of the ERISLU due to switch resources remains the same as that of the Universal RISLU. The reliability and maintainability rate of the RISLU is not changed.

14.3.4 PHYSICAL DESIGN

The RISLU is a 1 cabinet remote that is used for universal applications, OSPS applications, and international applications. In the universal application the link adapter unit (LAU) is not supported. An alarm status unit (ASU) may be equipped to provide visual alarm and status information to the craftsperson.

14.3.4.1 Remoting Distance

A RISLU may be remoted up to 175 miles from the host office. When a RISLU is hosted on an RSM, the total distance of the host to the RSM plus the distance from the RSM to the RISLU must not exceed 175 miles.

14.3.4.2 Features

The RISLU provides both analog and ISDN services with the same feature set as provided on the ISLU. However, the RISLU does not support On Demand B-channel Packet Switching. This feature requires that the serving unit be equipped with DPIDBs, but a RISLU does not support DPIDBs. For further information on features, refer to 235-190-101, *Business and Residence Modular Features*, or 235-190-105, *ISDN Feature Description*.

14.3.5 ADMINISTRATION

14.3.5.1 Universal RISLU Administration

The administration for the RISLU is different from the administration of the ISLU. The difference arises from the fact that the RISLU does not have DPIDBs, and requires time slots on the PSU shelves PIDB. The administration requirements for RISLU are as follows:

- (1) A RISLU may have a maximum of 512 cards of which, no more than 316 may be T- or U-cards.
- (2) Each LGC equipped on a RISLU with clear channel facilities may have BRIs assigned to a maximum of eight PHs or DSL groups. This restriction arises from the LIDB time slot engineering that assumes 32 BRIs require no more than eight time slots.
- (3) Each LGC equipped on a RISLU with nonclear channel facilities may have BRIs assigned to a maximum of 11 DSL groups. Again the engineering assumes that 32 BRIs require no more than 11 time slots.
- (4) The LGCs with both Z-cards and BRIs may be restricted to fewer than eight DSL groups, if clear channel facilities and less than 11 PHs, if nonclear channel facilities.
- (5) A PSU shelf can have a maximum of 128 RISLU BRIs assigned.
- (6) Each RISLU permanent packet B-channel (PPB), also called X.25 nailed-up B-channels) channel assigned to a PSU shelf reduces the maximum number of RISLU BRIs per PSU shelf by four, if clear channel facilities, and by three, if nonclear channel facilities.
- (7) Each ISM link assigned to a PSU shelf reduces the maximum number of RISLU BRIs per PSU shelf by four, if clear channel facilities, and by three if nonclear channel facilities.
- (8) Each packet trunk (X.75, IP, 1PSS) reduces the maximum number of RISLU BRIs per PSU shelf by four, if clear channel facilities, and by three if nonclear channel facilities.
- (9) For each DSL group having at least one assignment in a LGC, there should be multiples of three or four DSL assignments (depending upon whether the T1 is clear or nonclear) from that LGC in the same DSL group. When remote clock assigns the quarter time slots for the DSL it only chooses a quarter time slot from a used piggy-back time slot having the same DSL group and LGC association.

To maximize the use of the protocol handler and to populate the quarter time slots efficiently, lines should be

assigned in groups of four when the T1-carrier is clear and in groups of 3 when the T1-carrier is nonclear.

The purpose of this section is to highlight the information needed to administer a RISLU.

14.3.5.1.1 Forecast

The first step to administration of the switch is to determine the amount of working lines in the office and the forecasted growth. Once the total amount of lines for the office has been determined, the next step is to break the list into the amount of lines by type of service, for example, voice, circuit-switched data, packet. This information will be needed to establish a loading plan.

NOTE: Lucent Technologies recommends designating protocol handlers (PH)s for ISDN assignments for each SM component [ISLU, RISLU, IDCU, and PH type; B-Channel (PPB), D-Channel (DPPS), and On-Demand B-Channel (ODB)]. This simplifies determining the total DPPS for PPB, D-Channel, ODB, and virtual calls. This data is required to traffic engineer and load balance the PHs.

Once segregation of PHs is completed by SM component and PH type, the switch administrator can provide total usage on the PHs by using TRFC30 Section 68. The OS used to make PH assignments must make assignments accordingly.

14.3.5.1.2 Equipment Configuration

The next step is to determine the equipment that was engineered for your office. This should be done with your traffic engineer, since the RISLU needs to be assigned as it was engineered, just like the ISLU.

For the host SM the equipment that is required:

- PSU
- DLTU-R
- ISDN Software - Loaded in SM
- MCTU2
- PH
- ISLU - optional.

For the RISLU the equipment that is required:

- LGC
- Cards - U, T, or Z
- 2 RG Packs (Required for Z-cards)
- 4 MAN Packs (Required for U- or Z-cards)
- Up to 6 HLSCs / RISLU
- Time Slots
- DLTU -R.

14.3.5.1.3 Determining Office Capacity

Once the forecasted growth and the equipment configuration is known, the next step is to determine the office capacity.

- (1) CCS Capacity of the RISLU - Obtain from your traffic engineer. The CCS capacity is determined for a RISLU by how many X.25 B-Channel Packet lines are engineered, how many ISMs, how many ISPTs, and whether the T1-carrier is clear channel (360 CCS/LGC) or nonclear channel (252 CCS/LGC).

- (2) DPPS Capacity of the PH

- (3) Capacity in Terminations

A RISLU can be equipped with a maximum of 512 Z-cards.

A RISLU can be equipped with a maximum of 316 U- or T-cards.

Or a RISLU can have a mixed configuration of DSLs and analog lines:

316 (U- or T-Cards) + 196 (Z Cards) = 512 Cards Maximum

- (4) Primary Rate Carrier (T1 Carrier) - Determine the amount of links, and whether they are clear channel (B8ZS Format) or nonclear channel (ZCS Format).

- (5) Protocol Handlers - Determine the quantity of PHs by type.

- Quantity of X.25 B-channels
- Quantity of X.25 D-channels
- Maximum assignments on BPH/DPH.

- (6) Time Slots - Determine the amount of time slots available to use for line assignments:

Maximum 32 time slots per PSU shelf (TSIU to PSU shelf)

The actual number of time slots equipped in engineering.

The maximum CCS/time slot is 32.4 CCS (90 percent occupancy).

Each PIDB engineered uses 1/2 time slot set.

For example:

1 PIDB pair/shelf (duplicated)

32 TS/PIDB

1 TS can handle a 64-kB channel

or 4 - 16 kB D-channels (Clear)

or 3 - 16 kB D-channels (Nonclear).

So Capacity would be:

$32 \text{ time slots/PIDB} \times 4 \text{ (16 kB D-channels)} = 128 \text{ BRIs per PSU shelf.}$

or

$32 \text{ time slots/PIDB} \times 3 \text{ (16 kB D-channels)} = 96 \text{ BRIs per PSU shelf.}$

- (7) Logical Links - The D PH have a capacity of 384 logical links. One logical link is used for signaling and 1 Logical Link is used for X.25 Packet on the D-channel. (Reminder, this does not affect B-channel.)

- (8) PPB lines, ISM, and ISPT reduce the capacity for line assignments in the RISLU by:

CLEAR T1 Carrier - Reduces capacity by 4 lines for each PPB, ISM, or ISPT assigned.

NONCLEAR T1 Carrier - Reduces capacity by 3 lines for each PPB, ISM, or ISPT assigned.

Based on the previous statements it is VERY important to find out the quantity for your office!

- (9) Loading Plan - Step up a loading plan after you know the forecasted growth, the types of lines - analog or DSL, the equipment configuration of the RISLU and host SM, the capacity of your RISLU.

To establish your loading plan:

- First, review equipment configuration, for the RISLU look at how many LGCs and Cards you are equipped with.
- Second, review the host SMs PSU for the shelves that are equipped and where the PHs are located that will be used for assignments.
- Allocate PHs for RISLU (PSU is shared by ISLU in the same SM) by quantity and type.
- Determine if your T1 carrier is clear or nonclear channel.
- Determine quantity of PPB, ISM, and ISPT PH types /PSU shelf.
- Once you have determined all of the preceding, start assigning lines:

Assign heavy usage lines first and spread them over all LGCs and PHs; the load should be spread evenly over all units provided.

- Assignments Constraints
 - Do not mix host and RISLU assignments on the same PHs.
 - Do not mix BPH and DPH assignments.

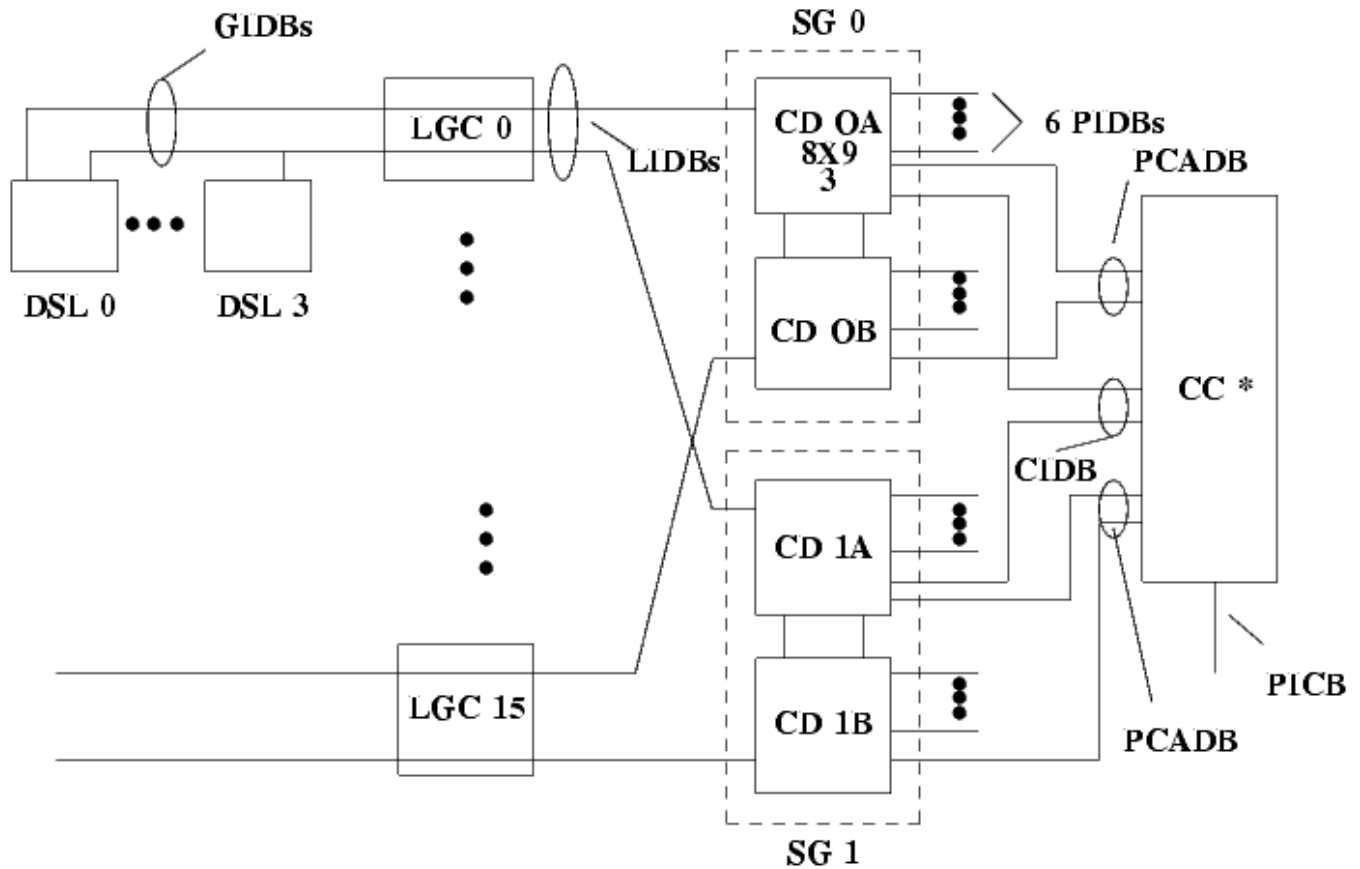
- If clear channel facilities on T1 carrier - Each LGC may assign BRIs to a maximum of eight (8) PHs.
- If nonclear channel facilities on T1 carrier - Each LGC may assign BRIs to a maximum of 11 PHs.
- RISLU does not support on-demand B-channel packet switching (ODB).

14.3.5.2 ERISLU Administration

New TRFC30 measurements are not required. Existing TRFC30 measurements are sufficient to evaluate the ERISLU operation.

The following summarizes the load sharing philosophy of the ERISLU:

- The ERISLU uses the load sharing strategy of the Universal RISLU.
- The ACD/OSPS RISLUs formerly using the hot spare option for DFI-Hs use the load sharing strategy.



* Duplicated

CC - Common Control

CD - Common Data

CIDB - Control Interface Data Bus

DSL - Digital Subscriber Line

GLDB - Group Interface Data Bus

LGC - Line Group Controller

LIDB - Line Interface Data Bus

PCADB - Peripheral Control and Data Bus

PICB - Peripheral Interface Control Bus

PIDB - Peripheral Interface Data Bus

SG - Service Group

Figure 14.3-1 Integrated Services Line Unit

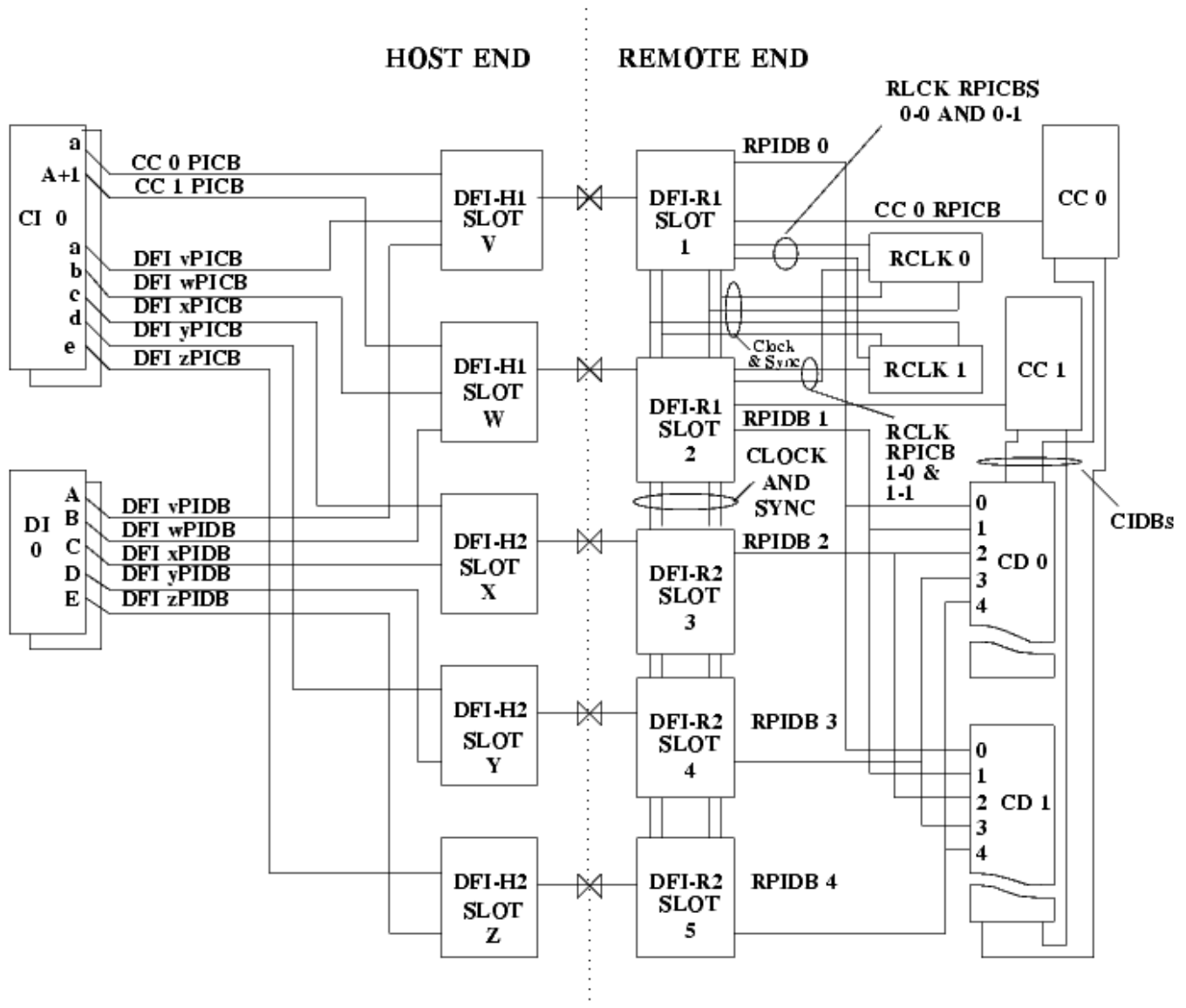


Figure 14.3-2 RISLU Architecture

14.4 INTEGRATED DIGITAL CARRIER UNIT

14.4.1 DESCRIPTION

Integrated Digital Carrier Unit (IDCU) supports integrated digital loop carrier systems using Bellcore TR-008 and Bellcore TR-303 requirements. The TR-303 requirement uses one DS0 time slot, embedded operations channel (EOC), for OAM&P. Another DS0 time slot, time slot management channel (TMC), is used for call processing purposes. Support of OAM&P and call processing functions by designated DS0 TSs facilitates 64 kbps clear channel for Integrated Services Digital Network (ISDN) data applications. In addition to ISDN support, IDCU supports nail-up and hairpin applications for non-switched and non-locally-switched services. Hairpin and nail-up can be defined as follows:

hairpin	A connection in which a time slot is assigned a semi-permanent path between two DS0 ports on the same IDCU. The hairpinned connection does not use SM or CM time slots. Non-switched (single and multi-channel), non-locally-switched lines and ISDN tri-slot Basic rate Interfaces (BRIs) may be hairpinned.
nail-up	A connection in which a time slot is assigned a semi-permanent path through the SM [or the SM and the communication module (CM)], between a DS0 port on IDCU and a DS0 port on another SM peripheral. Non-switched (single channel) and non-locally-switched lines may be nailed up.

The IDCU supports the following remote terminals (RTs):

- **SLC[®] 96 carrier system remote terminals**
 - Mode I
 - Mode II.
- **SLC[®] Series 5 carrier system remote terminals**
 - Feature package 303G (FP303G)
 - (a) TR008 Mode I
 - (b) TR008 Mode II
 - (c) TR303 interface (with concentrated ISDN).
 - Feature Package B (FPB)
 - Enhanced Feature Package B (FPB+) Mode I
 - Enhanced Feature Package B (FPB+) Mode II.
- **SLC[®] 2000 RT**
 - TR008 mode
 - TR303 mode.
- **TR008 compatible RTs**

- TR303 compatible RTs that are equivalent to *SLC*® Series 5 FP303G RT.

The IDCU also supports the following systems with non-switched and non-locally switched services (no switched services are provided for these systems in this feature):

- D4 channel banks
- D5 channel banks
- DACS I
- DACS II
- DACS IV.

Although hybrid signaling (TMC plus ABCD bits) is used in the TR303 mode, CSC is not supported. The IDCU also supports *SLC*® 2000 remote digital terminal (RDT) operating in TR008 or TR303 mode.

The connection to digital loop carrier (DLC) environment is through a DS1 digital system cross-connect interface (DSX-1) in the central office (CO).

The following is the summary of the features provided by the IDCU:

- Interfaces DS1s to peripheral interface data buses (PIDBs) and directly connected peripheral interface data buses (DPIDBs)
 - Switched DS0s and B-channels to PIDBs
 - Time-slot management channel (TMC), EOC, D-channels, and packet B-channels to DPIDBs.
- Supports all switched services supported on digital carrier line unit (DCLU)
- Supports all end-user services provided by line unit (LU) and ANSI U-digital subscriber line (DSL) on integrated service line unit (ISLU)
- Supports concentrated ISDN on TR303 RTs (Four D-channels per DS0)
- Supports TR008 applications using the standard SM
- Supports fiber-to-the-home
- Supports IDCU hair-pinning and SM nail-up of special services
- Provides DS1 facility monitoring and maintenance
- Provides blocked origination call counting
- Provides protection switching of DS1s and the TMC and EOC links
- Transports U-DSL performance monitoring information
- Supports Mode II SPOTS on TR008 RTs.

Figure 14.4-1 is a block diagram of the IDCU. Each block is a pack, and all packs are duplicated except the electrical line interfaces (ELIs).

The ELI receives the DS1 signals. Each ELI may terminate 20 DS1s. A fully equipped IDCU has two ELI packs, but a partially configured IDCU has one. The ELI splits the signals to the active and standby loop interfaces (LSI). The ELIs also terminate the PIDB clock and synchronization signals for PIDBs 1 through 15. ELI A terminates PIDBs 1 through 8 and ELI B terminates PIDBs 9 through 15; thus, 2 ELIs are required when more than 4 TSSs are provided per IDCU.

The LSI receives the DS1 signals. Four LSIs are provided in fully equipped IDCUs: two active and two standby. The LSI converts the DS1 to PIDB-like format on the internal bus to the PIDB transmission interface (PTI). The PIDB is the connection from peripheral units to the time slot interchange (TSI) in the 5ESS®-2000 switch. There are 32 time slots per PIDB.

The PTI contains a TSI function, thus enabling the DS0 time slot to be connected to any PIDB/DPIDB time slot. A maximum of 15 PIDBs is permitted. The sum of PIDBs plus two times the DPIDBs must not exceed 30. The PTI also supports a maximum of 11 DPIDBs.

14.4.2 ENGINEERING CONSIDERATIONS

14.4.2.1 General

It is recommended that the IDCU be engineered for Average Busy Season Busy Hour (ABSBH) and High Day (HD), whichever is more limiting. The following service provider forecasts are needed when planning and engineering for IDCU:

- Total lines installed by the end of the engineering interval
- Line traffic characteristics, for example, CCS/MS (one hundred call seconds per main station)
- Quantities of lines by service class, for example, ISDN, special services, etc.
- The number and configurations of remote terminals (RT).

Engineering algorithms and procedures are used for determining the number of IDCUs required and their affect on quantities of other switch resources, for example, SMs and packet switching units (PSUs). IDCU quantities are a function of :

- Subscriber traffic usage and attempts for both circuit-switched and packet-switched calls
- Blocked attempts in IDCU and concentrated RDTs
- Number of subscriber lines, including U-DSLs
- Number of semi-permanent cross connects for hair-pinned and nailed-up circuits
- Number of DS1s
- Number of RDTs with each type of IDLC interface.

The algorithms and procedures allow a service provider to engineer an IDCU to provide subscriber service consistent with existing grade of service criteria (for example, dial tone delay and matching loss) for ISDN and non-ISDN lines.

The number of PIDBs required is determined by the amounts of circuit-switched traffic. The number of DPIDBs is a function of the quantities of U-DSLs (D-channels), provisioned B-channels, on-demand B-channels, and TR-303 RDTs (EOCs and TMCs).

Signaling messages on the EOC and TMC data links of each TR-303 RDT must be added in calculating the quantities of PHs and PSUs for each SM. Only one PSU is allowed per SM.

The number of RDTs that can be equipped in an IDCU is a function of the total quantity of DS1s used and the quantity of each type of IDLC interface employed. An IDCU can be arranged for 20 or 40 DS1s. This quantity minus the DS1s used for PUB 43801 applications is the number of RDTs that can be served. The 5ESS®-2000 switch software limits the maximum number of RDTs per IDCU to 31.

When zero code suppression is specified for a TR-303 RDT, 10 DS1 time slots are unavailable for calls and semi-permanent cross connections. This reduces the traffic capacity of these facilities and may restrict the number of the lines that can be assigned to the RDT.

The conversion of a SLC® RT from one mode to another may have engineering implications. Precautions must be taken when converting from nonconcentrated to concentrated modes so that the traffic capacity of the remaining DS1s will provide an acceptable grade of service for the offered load.

There are no explicit limits placed on the number of nailed-up and hair-pinned connections that can be assigned to an IDCU. However, switch software resource limitations prevent nailing up or hair-pinning all of an IDCU's DS1 time slots.

14.4.2.2 IDCU on SM-2000

The IDCU on the SM-2000 feature provides applications for IDLC systems for analog, ISDN and special services. The IDCU on the SM-2000 feature is a port to the SM-2000 of the complete IDCU functionality which includes TR-303, both small and large lines, TR-008 and PUB43801 interfaces. A maximum of 37 IDCUs can be present on an SM-2000, with a software range of 42 units.

The porting of the IDCU functionality to the SM-2000 includes all those platforms that are applicable to the 5ESS®-2000 Switch SM, HSM-2000, EXSM-2000, and CDX platform. In order to provide ISDN services on the the IDCU on SM-2000 feature is dependent on the PSU2 being available for the same switch. The PSU2 will also provide service to the 5ESS®-2000 Switch SM. The Data Fanout (DF) interface on the PSU2 will support the IDLC on SM-2000. The IDCU functionalities that are implemented by this feature on the SM-2000 will be transparent with the IDCU functionalities on the 5ESS®-2000 Switch SMs.

14.4.2.3 IDCU RT CALCULATIONS-Ups

The following formulas govern the relationship between CCS, number of RT lines, concentration of RT lines, and packet information (TR303) only. These formulas are useful for quickly determining the number of time slots sets used and line concentration ratio for a given CCS per NAL at 100 percent fill of the RT.

14.4.2.3.1 IDCU for TR303 CCS per Line

Information that the customer must know to use these formulas:

- (1) Percent Blocking 0-20% (TCBH=1.5% EVE=4% HD=7%)
- (2) IDCU ACTIVE TSS 1-8 (Each active PIDB is equal to .5 TSS and a IDCU can have 2-16 active PIDBs)
- (3) Total Number of lines in a IDCU 1-15,360
- (4) Number of ISDN users in a IDCU 0-8190

- (5) Number of Packet Switch Data (PSD) Users 0-8190 (Needed only if the IDCU is supporting multi-point)
- (6) Number of (Permanent Packet B) PPB Users
- (7) Number of TR303 RTs in IDCU 0-20
- (8) PPD PPS / LINE .02-8
- (9) PPB PPS / LINE 8-32
- (10) ODB PPS / LINE 8-12 PPS
- (11) ODB CCS / LINE 1-21 CCS

Line Concentration Ratio (LCR) =

Number of IDCU lines

IDCU ACTIVE TSS × 64

CCS/MS =

POISSON TABLE LOOKUP (P_BLOCKING, Number of circuits = TSS× 64)

NUMBER OF IDCU LINES

Number of PPD DPIDBs =

ROUNDUP (ROUNDUP (Number of IDCU ISDN LINES÷4) +

(Number of TR303 RTs × 4))

 32

Number of PPB DPIDBs =

$$\begin{aligned} & \# \text{PPB LINES} \quad ((\text{PPD DPIDB} \times 32) \\ & (\text{ROUNDUP} (\text{Number of IDCU ISDN LINES} \div 4) + \\ & (\text{Number of TR303 RTs} \times 4))) \end{aligned}$$

32

NOTE: If PPB DPIDBs is negative, then PPB DPIDBs = 0
because there is enough TSs in the PPD DPIDBS
to assign PPB TSs.

Number of PPD PHs =

$$\begin{aligned} & \text{MAX} ((\text{ROUNDUP} (\text{Number of IDCU LINES} \div 4) + (\text{Number of} \\ & \text{TR303 RTs} \times 4)] \div 32, \\ & (\text{Number of ISDN lines} \times \text{PPD PPS/LINE} \div 200), \\ & (\text{Number of PSD users} / 128)) \end{aligned}$$

Number of PPB PHs =

$$\begin{aligned} & \text{MAX} ((\text{Number of PPB lines} \times \text{PPB PPS/LINE} \div 200), \\ & (\text{Number of PPB lines} \div 32)) \end{aligned}$$

Number of ODB PH3/PH4 =

MINIMUM of 32 or $(200 \text{ PPS} \div \text{number of PPS per ODB}) =$

"X" users per ODB

$36 \text{ CCS} \times 0.625 \text{ occupancy} \div \text{number of CCS per ODB} = \text{"Y" users}$

MINIMUM of (32, or "X"x"Y") = "Z" ODB user per PH3/4

Number of ODB users per IDCU $\div$ "Z" = number of PH3/4 for ODB

Number of ODB DPIDBs =

$(\text{Number of ODB users per IDCU}) \times (\text{ODB CCS per user})$

$(720 \text{ CCS per DPIDB})$

14.4.2.3.2 IDCU for TR008 CCS per Line

Each RT assumes 96 lines. These table values apply both to Modes I and II and both modes have fully equipped DS1s. Based on these assumptions, Table ### is constructed using the following calculations:

$96 \times 8 \text{ RT} \times 2.24 \text{ (ABS)} = 1,720 \text{ CCS}$

$96 \times 8 \text{ RT} \times 2.38 \text{ (EVE)} = 1,827 \text{ CCS}$

$96 \times 8 \text{ RT} \times 2.46 \text{ (HD)} = 1,889 \text{ CCS}$

Line concentration ration = $8 \times 96 \div 64 = 12$

14.4.2.4 Capacities, Limitations, and Restrictions

An IDCU can be equipped with up to 40 DS1s. The RDTs with varying numbers of DS1s and using either the TR303 or TR008 interface can be mixed on the same IDCU. The RDT capacity of an IDCU is a function of the number of DS1s, the number of subscriber lines, and the traffic load generated by subscribers. Up to 60 RT TR303s may exist per SM. This is an IDCU limit.

Within an SM, up to 4,096 POTS and ISDN lines can be served by one or more IDCUs. A maximum of 1,024 ISDN Subscribers can be assigned/IDCU.

The PIDBs for an IDCU are arranged in two service groups, an active group and a standby group. Each group can contain up to 23 (D)PIDBs. The number of PIDBs required is a function of an IDCU's circuit-switched traffic usage.

A maximum of 7 IDCUs can be present in an SM. An IDCU can be configured for 15 active PIDBs. Since an IDCU must have a standby for each of its active PIDBs, a maximum of 15 active and 15 standby PIDBs can be assigned in an SM. A total of 31(0-30) PIDBs are available for assignment in an SM. The 32nd PIDB(number 31) is reserved for pumping(reloading software) an SM.

The ISDN is only available from RDTs using the TR303 interface with IDCU. If an IDCU serves ISDN lines, it must be installed in an ISDN SM(or a loaded SM). If an IDCU does not serve any TR-303 RDTs, it may be installed in a Standard SM. Up to 11 active/standby DOIDB pairs can be connected to the packet switch unit(PSU) to serve the packet-switched traffic for an IDCU. The messages carried on the EOC and TMC data links are also routed to the PSU. The use of DPIDBs reduces the maximum number of PIDBs available for circuit-switched traffic per IDCU. The number of available PIDBs is reduced by two(2) for each DPIDB deployed.

The IDCU does not terminate tri-slot ISDN, but services requiring this type of signaling, BRITE circuits for example, can be arranged as hairpins.

The IDCU does not support DSLs employing the T-interface, and thus, does not support OSPS applications. All DS1s from any one RT must be assigned to the same IDCU, and each loading division should be engineered separately.

14.4.2.5 Remote Terminal Assignment Guidelines

The following procedures must be followed when assigning RTs to the IDCUs:

- Make a list of all the RTs and the engineered DS1s. The RTs that have four DS1s with a protection line should be assigned first followed by other RTs down to those with one DS1 and no protection.
- Assign the DS1s from one RT equally between both LSIs of a fully equipped IDCU to take advantage of modularity. For example, for an RT with four DS1s, assign two DS1s to LSI-A and the other two DS1s to LSI-B.
- Assign each RT to a different IDCU subtracting the engineered DS1s and protection lines from the totals allowed. Assign succeeding RTs to the SMs with the most RT/DS1 space remaining until all RTs are assigned.

14.4.2.6 Assignment Methodology

14.4.2.6.1 Objectives

Assignments made within the IDCU depend upon the cable and pair assignment, or the SLC[®] unit and pair. Lucent Technologies recommends making permanent assemblies in your line assignment system (currently used in DCLU line assignment). A permanent assembly is a connection of the cable and pair to the office equipment (OE).

Parameter	Resource
Termination and Type	Remote Terminal - SLC [®] Unit and Card (TR008)

Termination and Type	Remote Terminal Line Size (TR303) - 1-2048
Terminations/IDCU	4096 POTS and ISDN lines
Remote Terminals TR303/SM	60 Remote Terminals
IDCU CCS Capacity	Quantity of PIDBs
ISDN Capacity	Quantity of DPIDBs, PIDBs, PHs
PH Termination	PH3/PH4 - 128 Terminations
ISDN DPPS Capacity	PH3/PH4 - 200 DPPS

If more than one SM is engineered for TR303 with the ISDN capability, inter-SM protocol handlers are provided in 5DOPS.

NOTE: Lucent Technologies is removing the recommendation of segregating assignments of PHs by SM component (ISLU, RISLU, IDCU, ISLU2, AIU, and TR-303 on DNU-S). ISDN customers use the same applications whether the lines terminate in an ISLU, ISLU2, IDCU, etc. The DDPS inputs to 5 DOPS should be obtained from TRFC30 Section 68. Traffic engineers may use the same DPPS entries for each SM component based on actual data or estimated PPS based on specific customer's needs.

In addition to removing the recommendation of segregating assignments of SM component, it is possible to mix Permanent Packet B-Channels with D-Channel Packet and Access Digital Service Lines. To accomplish the required DPPS entries for 5 DOPS, utilize the DPPS from TRFC30 Section 68 from the "Access PHs" as a guideline for forecasting future packet demand.

5DOPS requires inputs for engineering RT DPPS. As a result, all assignments on one RT may be assigned to one PH.

14.4.2.6.2 Equipment Configuration

The first step in making line assignments is to know the configuration of the engineered equipment. This section identifies the information required to understand how the office is configured for TR008, TR303, and PUB43801. Office configuration and capacity information may be obtained from the 5DOPS Equipment Report (TR008), 5DOPS ISA Report (TR008 and TR303), ODA (Office Data Assembler) Forms, Office Records, and/or Recent Change Views.

14.4.2.6.2.1 5DOPS Equipment Report

The 5DOPS Equipment Report is part of the Traffic Equipment Order (TEO) and lists all the equipment provided for the 5ESS®-2000 switch. The equipment report is generated for initial offices or growth jobs. Engineered equipment for the IDCU TR008 application may be found on this report. Lucent recommends verification of the equipment report with actual switch office records, ODA Records, or Recent Change Views. Discrepancies should be reported to the traffic engineer to be resolved and 5DOPS updated, if necessary.

14.4.2.6.2.2 5DOPS ISA Report

The ISA report is created in 5DOPS when Integrated Services Digital Network (ISDN) is engineered in the 5ESS®-2000 switch. The ISA Report shows the equipment configuration of the ISDN hardware in the SM. In 5DOPS, the ISA report may be accessed from three levels; ISDN, ISLU (Integrated Services Line Unit), or PSU (Packet Service Unit). The ISA report also provides the IDCU TR303 equipment configuration.

The ISA report is part of the Traffic Equipment Order (TEO). The traffic engineer has the responsibility to maintain the 5DOPS data base for each 5ESS®-2000 switch office, including ISDN/IDCU. It is imperative that 5DOPS be updated to reflect any deviation from the configuration reflected on the ISA Report. Changes may be made to the original order of the ISDN/IDCU/PSU equipment layout if the traffic engineer has not specified a proposed equipment layout or if the Lucent Technologies regional engineer identifies potential equipment savings or problems. When there is a need for Lucent Technologies to modify the original request for equipment on the TEO, the service provider equipment engineer MUST be notified and MUST give Lucent Technologies permission to change the order. The switch administrator must report any discrepancies noted on the ISA report to the traffic

engineer to resolve.

NOTE: In the current 5DOPS, subsequent to Lucent engineering, the user may assign the correct number to the ISDNSM, PSU, or IDCU by using the external number command. The 235-060-110 *DOPS Users Guide Document* has detailed information on editing the ISDN SM number using the extnbr command.

14.4.2.6.2.3 Using the ISA Report

The ISA report is used by traffic engineers and switch administrators. The traffic engineer uses the ISA report to convey to Lucent and line and number personnel the assignment of ISDN resources.

The switch administrator uses the ISA report to determine the equipment layout of the ISDN equipment; including the ISLU, IDCU, LGC, BRI cards, PIDBs, DPIDBs, PSU, shelves, protocol handlers, and packet trunking. Although references are made to the ISLU and associated equipment, we will focus only on the IDCU portion of the ISA report.

The ISA report can be changed. It is important that the ISA report used is the MOST current version available. The 5DOPS data base MUST be updated by the traffic engineer to reflect any changes. Administrators should contact their respective traffic engineer to verify the ISA report is the most current issue.

Since changes may be made to the original ISA report, once the ISDN equipment is in the 5ESS®-2000 switch, the switch administrator and/or the traffic engineer should verify the equipment layout on the ISA report with the actual switch configuration. Request your Switching Control Center (SCC) or technicians to obtain the office records or recent change views (RC/V) to be used to verify the ISDN equipment layout. Detailed information for the Recent Change Verify Views, Office Data Assembler (ODA) Forms, and Office Records can be found in Sections 14.4.2.6.2.5 through 14.4.2.6.3 .

When there are any discrepancies between the switch and the ISA report, the traffic engineer MUST be notified so the differences can be resolved and the ISA report updated.

14.4.2.6.2.4 Sample TEO Version of IDCU 5DOPS Reports

The following is an example of an rtlist (list of remote terminals), ISDN SM Assignments (ISA report), Equipment Report, and Capacity Report for TR008 and TR303, respectively. The first step in engineering an office for IDCU TR008 and/or TR303 is to determine the number of RTs, CCS/NAL and when TR303 is engineered, ISDN characteristics. Information for engineering an IDCU is found in the Engineering Procedures Document. Examples of the rtlist, ISDN SM Assignments (ISA report), Equipment Report, and Capacity Report will be used to answer questions typically asked by administration personnel.

The traffic engineer determines the number of RTs to engineer for IDCUs by the use of marketing forecasts or customer requests for service. In addition to the number of RTs, the traffic engineer accumulates additional data to input into 5DOPS, such as projected CCS/NAL, number of hairpin and nailup, projected penetration of ISDN/RT, number of packet users by type (PPB, ODB, DPKT), Circuit Switch Voice and data users per ISDN line.

Refer to the 235-060-110, *5DOPS Switch Engineering Procedures (SEP)* for a complete list of all 5DOPS symbols used to engineer the 5ESS®-2000 switch.

Sample 5DOPS Remote Terminal List for TR008 and TR303 Applications:

```
rtlist
```

(IDCU-1 SM #1)	IDCU-2 NON-ISDN	IDCU-3 NON-ISDN	IDCU-4 NON-ISDN
TR3-49 TR3-53	TR8-1 TR8-25	TR8-2 TR8-26	TR8-3 TR8-27
TR3-50 TR3-54	TR8-7 TR8-31	TR8-8 TR8-32	TR8-9 TR8-33
TR3-51 TR3-55	TR8-13 TR8-37	TR8-14 TR8-38	TR8-15 TR8-39
TR3-52 TR3-56	TR8-19 TR8-43	TR8-20 TR8-44	TR8-21 TR8-45
IDCU-5 NON-ISDN	IDCU-6 NON-ISDN	IDCU-7 NON-ISDN	
TR8-4 TR8-28	TR8-5 TR8-29	TR8-6 TR8-30	
TR8-10 TR8-34	TR8-11 TR8-35	TR8-12 TR8-36	
TR8-16 TR8-40	TR8-17 TR8-41	TR8-18 TR8-42	
TR8-22 TR8-46	TR8-23 TR8-47	TR8-24 TR8-48	

Sample 5DOPS ISA report for TR008 and TR303 Applications:

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

.

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

NPA	= 303	LD	= Base Load Division	LOCATION	= domestic
CLLI	= grfngama22c	TYPE	= host	CATEGORY	= ISDN
ORDNO	= 12345	STATE	= sto	XGEN	= 9.10

OFFICE TOTALS

		ISLU	IDCU
CCSPTSM	HD WEIGHTED AVG CCS / BRI CARD	2.02	
BRITCRD	BRI T LINE CARDS	0	
U2B1QCD	BRI 2B1Q U LINE CARDS	0	
UAMICD	BRI AMI U LINE CARDS	0	
ZCRD	Z LINE CARDS	0	
TUZCRD	TOTAL LINE CARDS / IDCU LINES	0	5152
TR303	NO. OF TR303 RTs IN IDCUs	8	
TR008	NO. OF TR008 RTs IN IDCUs	48	
NRT	NO. OF PUB43801 DS1s IN IDCUs		14
DPPS	WEIGHTED AVG PPS / D-CHANNEL	0.02	
PPB	NO. OF PERM. PKT B-CHANNELS 0	8	
PPBPPS	PERM. PKT B PEAK PPS PER PPB	0.00	20.00
ODB	NO. OF ON-DEMAND B USERS	0	0
ODBCCS	DPIDB OCCUPANCY CCS PER ODB 0.00	0.00	
ODBPPS	ON-DEMAND B PEAK PPS PER OD 0.00	0.00	
PH2SPR	NO. SPARE PH2 / PSU SHELF 1		
PH3SPR	NO. SPARE PH3 / PSU SHELF 1		
XISTF	ISTF OPTION (YES / NO)	n	
IDCU	NO. OF IDCU UNITS	7	
XSPLFCT	UNIFORM INTER-SM CONN. FACTOR	1.20	
BRIP LGC	BRI CARDS / LINE GRP CNTRLR 0		
MAXPIDB	MAXIMUM PIDBS AT THIS CCS-ISLU	0	
BRILGC	NO. LGC REQD FOR BRI - ISLU 0		
ISDNSM	NUMBER OF ISDN SMS REQUIRED 1		
DLTUSM	NUMBER OF ISDN SMS WITH DLTU	0	

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

```

-----
NPA    = 303          LD    = Base Load Division    LOCATION = domestic
CLLI   = grfngama22c  TYPE  = host                  CATEGORY  = ISDN
ORDNO  = 12345        STATE = sto                    XGEN      = 9.10
-----

```

ISDN SM No. 1

		ISLU	IDCU
Summary		Qty PH	Qty PH
CCSPTSM	HD WEIGHTED AVG CCS / BRI CARD	2.02	
BRITCRD	BRI T LINE CARDS	0	
U2B1QCD	BRI 2B1Q U LINE CARDS	0	
UAMICD	BRI AMI U LINE CARDS	0	
ZCRD	Z LINE CARDS	0	
TUZCRD	TOTAL LINE CARDS / IDCU LINES	0	736 (3)
TR303	NO. OF TR303 RTs IN IDCUs		8
TR008	NO. OF TR008 RTs IN IDCUs		0
NRT	NO. OF PUB43801 DS1s IN IDCUs		2
PPB	NO. OF PERM. PKT B-CHANNELS	0	8 (3)
PPBPPS	PERM. PKT B PEAK PPS PER PPB	0.00	
DPBS	WEIGHTED AVG PPS / D-CHANNEL	0.02	
ODB	NO. OF ON-DEMAND B USERS	0	0

ODBCCS	DPIDB OCCUPANCY CCS PER ODB	0.00
ODBPPS	ON-DEMAND B PEAK PPS PER ODB	0.00
PH2RAT	PH2 PER DPIDB (1/4 ISLU BASIS)	0.00
PH3RAT	PH3 PER DPIDB (1/4 ISLU BASIS)	0.00
ISMPH	AVG INTER-SM PROTOCOL HANDLERS	0 EST. (ON PH3) 0 ASGN
PSUSHVS	NO. PSU SHELVES IN THE ISDN SM	1
DSU2IF	QTY OF ISTF PACKS ON DSU-2	0
IDCU	NO. OF IDCU UNITS	1
RPATS	RESERVED RPA/RPM T.S. PER SHF	0
INSMPPS	EST. PPS FOR INTER-SM PKT TPT	0

SM PIDB and LG breakdown	PIDBs	LGs
IDCU# 1	6	
SUM PIDBs	6	
SUM LGs		0

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

ISSUE: 16.00 VERSION: 2 DATE: 21FEB94 @ 13:18 CST

NPA = 303	LD = Base Load Division	LOCATION = domestic
CLLI = grfngama22c	TYPE = host	CATEGORY = ISDN
ORDNO = 12345	STATE = sto	XGEN = 9.10

IDCU PROTOCOL HANDLER ASSIGNMENTS

IDCU#	1	-- X.25B --		----- PSU -----				
	PIDB	DPIDB	PPB	ODB	PH2	PH3	shelf	port
6	A (0)		0	0	0.00	1.00	0	a
	B (1)		0	0	0.00	1.00	0	b
	C (2)		0	0	0.00	1.00	0	c
	D (3)		0	0	0.00	1.00	0	d
	E (4)		0	0	0.00	0.00		
	F (5)		0	0	0.00	0.00		
	G (6)		0	0	0.00	0.00		
	H (7)		0	0	0.00	0.00		
	I (8)		0	0	0.00	0.00		
	J (9)		0	0	0.00	0.00		
	K (10)		0	0	0.00	0.00		

IDCU#	1	PROT ISDN ANALOG		PIDB				
RT#	TR	IDENTIFIER	DS1	LINE	LINES	LINES	USERS	NUTS
49	303		4	0	20	72	20	0
50	303		4	0	20	72	20	0
51	303		4	0	20	72	20	0
52	303		4	0	20	72	20	0
53	303		4	0	20	72	20	0
54	303		4	0	20	72	20	0
55	303		4	0	20	72	20	0
56	303		4	0	20	72	20	0
NRT	PUB		2					0

PSU# 1 PROTOCOL HANDLER ASSIGNMENTS

	DPIDB port						- ism -			- trk/cnl -			spare		total	
sf	a(0)	b(1)	c(2)	d(3)	e(4)	f(5)	p2	p3	ts	p2	p3	p2	p3	p2	p3	sum
4	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
3	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
2	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
1	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
0	1.00	1.00	1.00	1.00	0.00	0.00	0	0	0	0	0	0	1	0	5	5

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

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DATE: 21FEB94 @ 13:18 CST

NPA = 303	LD = Base Load Division	LOCATION = domestic
CLLI = grfngama22c	TYPE = host	CATEGORY = ISDN
ORDNO = 12345	STATE = sto	XGEN = 9.10

Active PIDBs + DPIDBs for IDCU# 1 = 11

Total IDCU to TSIU PIDB Ports 6

Remaining TSIU Ports 23

ISLU PIDB TS	0	Reserved TS for NXDS0	0
IDCU PIDB TS	96	Spare TS for any unit -->	414
ISTF TS	0	PSU TS demand	0
DLTU TS	0	Available TS for PSU only	0

Inter-SM TS	0	IDCU Nail-up TS for TSIU	0
Packet Trunk TS for PSU	0	Used Nail-up TS for TSIU	0
Recovered DLTU TS	(0)	Avail Nail-up TS for TSIU	190

Sample 5DOPS Equipment Report for TR303 Application:

5ESS Switch Engineering System

EQUIPMENT REPORT

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

NPA = 303	LD = Base Load Division	LOCATION = domestic
CLLI = grfngama22c	TYPE = host	CATEGORY = idcu-1
ORDNO = 12345	STATE = sto	XGEN = 9.10

		E				
5 DOPS		/				
SYMBOL	5 DOPS TITLE	PRESENT	ADDL	DEF	PROPOSED	O
CU303RT	TR303 RT(S) IN THIS IDCU	0	8		8	
PIDB	TSIU PIDB(S)/IDCU	0	6		6	
PPBX25D	PPB CHANNELS ON DPIDB-D	0	8		8	
DPAPH3	PH3(S) ASSOCIATED WITH DPIDB-A	0.00	1.00		1.00	
DPBPH3	PH3(S) ASSOCIATED WITH DPIDB-B	0.00	1.00		1.00	
DPCPH3	PH3(S) ASSOCIATED WITH DPIDB-C	0.00	1.00		1.00	

DPDPH3	PH3(S) ASSOCIATED WITH DPIDB-D	0.00	1.00	1.00
IDCU	ONE IDCU EQP FOR 20 DS1(S)	0	1	1
IDCUADL	ADD'L 20 DS1(S) FOR ONE IDCU	0	1	1

Sample 5DOPS TR303 Capacity Report:

5ESS Switch Engineering System

CAPACITY REPORT

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

NPA = 303	LD = Base Load Division	LOCATION = domestic
CLLI = grfngama22c	TYPE = host	CATEGORY = idcu-1
ORDNO = 12345	STATE = sto	XGEN = 9.10

5 DOPS

SYMBOL	5 DOPS TITLE	QTY	DEMAND	CAPACITY %UTL
IDCUHD	IDCU TCBH HD TO ABS RATIO	1.00		
IDCUBLK	PCT BLOCKING ON IDCU		1.50	
ABSCCS	WT AVG DS1 ABS NON-NU CCS/LINE	3.50		
HDCCS	WT AVG DS1 HD NON-NU CCS/LINE	3.50		
PTSLCR	IDCU CIRCUIT SWITCHED LCR	9.74		
CULINES	IDCU TR008 + TR303 LINES	736		
CURTDS1	IDCU RT DS1 MINUS PROT LINES		32	
CUTSHR	IDCU RT TIME SLOT INFO HEADER	***		
DS1TSD	TR008 + TR303 DS1 TIME SLOT DE		204	

CSTSD	TR008/TR303 CKT SW AND ODB TS	92	
PPDNUTS	TR303 PPD TIME SLOTS		40
PPBNUTS	TR303 PPB TIME SLOTS		8
TSINUTS	TR008+TR303 TSI NON-SW SPC TS	0	
HPINUTS	IDCU HAIRPIN TIME SLOTS	32	
MTCETS	TR003 EOC/TMC TIME SLOTS	32	
DS1TSC	TR008+TR303 DS1 TIME SLOT CAP		768
DS1TSU	TR008+TR303 DS1 TIME SLOT UTL		27
CUPUDS1	IDCU NRT DS1(S)	2	
CUPUTS	NRT TSI NON-SWITCH SPECIAL TS		0
PITSDEM	IDCU PIDB TIME SLOT DEMAND	92	
PITSCAP	IDCU PIDB TIME SLOT CAPACITY		96
PITSUTL	IDCU PIDB TIME SLOT UTL		96
CUUSGHR	IDCU USAGE INFO HEADER	***	
CUCCSDE	IDCU PIDB WT. AVG. CCS/LINE DE	3.50	
CUCCSCA	IDCU PIDB CCS/LINE CAPACITY		5
CUCCSUT	IDCU PIDB CCS/LINE UTL		70
IDCUTD	IDCU PIDB LINE DEMAND	736	
IDCUTC	IDCU PIDB LINE CAPACITY	768	
IDCUTU	IDCU LINE UTL		96
CUUSGTD	IDCU PIDB USAGE DEM - LINES	736	
CUUSGTC	IDCU PIDB USAGE CAP - LINES		889
CUUSGCD	IDCU PIDB USAGE DEMAND - CCS	2576	
CUUSGCC	IDCU PIDB USAGE CAP - CCS	3111	
CUUSGU	IDCU USAGE UTL		83
IDCUMLU	IDCU MOST LIMIT - USG (ABS,HD)	abs	
IDCUML	IDCU MOST LIMIT - (USG, LINES)	lines	

IDCUMLC	IDCU ML CAPACITY IN LINES	768	
CUDCHI	IDCU D-CHAN PKT INFO HEADER		***
CUPKTLN	IDCU ISDN LINES	160	
CUDPPS	IDCU WT. AVG. D-CH DATA PPS/LN	2.00	
DCHDPD	IDCU D-CHAN DPIDB(S)	3	
DCHPDPB	IDCU D-CHAN PER DPIDB RATIO	80.00	
DPPSDEM	IDCU D-CHAN DPPS DEMAND	320	

5ESS Switch Engineering System

CAPACITY REPORT

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

NPA = 303	LD = Base Load Division	LOCATION = domestic
CLLI = grfngama22c	TYPE = host	CATEGORY = idcu-1
ORDNO = 12345	STATE = sto	XGEN = 9.10

5 DOPS

SYMBOL	5 DOPS TITLE	QTY	DEMAND	CAPACITY	%UTL
DPPSCAP	IDCU D-CHAN DPPS PH CAPACITY			480	
DPPSUT	IDCU D-CHAN DPPS PH UTIL.				67
CUPPBI	IDCU PPB PKT INFO HEADER		***		
IDCUPPB	IDCU PPB CHANNELS	8			
CUBPPS	IDCU WT. AVG. PPB DATA PPS/LN	20.00			

PPBDPD	IDCU PPB DPIDB(S)	1	
PPBPDPD	IDCU PPB PER DPIDB RATIO	8.00	
BPPSDEM	IDCU PPB DATA PPS DEMAND	160	
BPPSCAP	IDCU PPB DATA PPS PH CAPACITY	160	
BPPSUTL	IDCU PPB DATA PPS PH UTIL		100
CUODBI	IDCU ODB USER INFO HEADER	***	
IDCUODB	IDCU ODB USERS	0	
CCSPODB	IDCU WT AVG CCS/ODB USR -DPIDB	0.00	
PPSPODB	IDCU WT AVG DATA PPS/ODB USER	0.00	
ODBDPD	IDCU ODB DPIDB(S)	0	
ODBDPDE	IDCU ODB CCS DPIDB DEMAND	0	
ODBDPCA	IDCU ODB CCS DPIDB CAPACITY	0	
ODBDPUT	IDCU ODB CCS DPIDB UTL		0
AVGUSPH	IDCU ODB AVG USERS/PH - DEMAND	0	
ODBASPH	IDCU ODB USERS/PH - CAPACITY	0	
AVGUSUT	IDCU ODB AVG USERS/PH - UTL		0

Sample Equipment Report for a TR008 Application:

5ESS Switch Engineering System

EQUIPMENT REPORT

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

NPA = 303	LD = Base Load Division	LOCATION = domestic
CLLI = grfngama22c	TYPE = host	CATEGORY = idcu-2
ORDNO = 12345	STATE = sto	XGEN = 9.10

5 DOPS

SYMBOL	5 DOPS TITLE	PRESENT	ADDL	DEF	PROPOSED
CU008RT	TR008 RT(S) IN THIS IDCU	0	8		8
PIDB	TSIU PIDB(S)/IDCU	0	6		6
IDCU	ONE IDCU EQP FOR 20 DS1(S)	0	1		1
IDCUADL	ADD'L 20 DS1(S) FOR ONE IDCU	0	1		1

Sample Capacity Report for TR008 Application:

5ESS Switch Engineering System

CAPACITY REPORT

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

NPA = 303	LD = Base Load Division	LOCATION = domestic
CLLI = grfngama22c	TYPE = host	CATEGORY = idcu-2
ORDNO = 12345	STATE = sto	XGEN = 9.10

5DOPS

SYMBOL	5 DOPS TITLE	QTY	DEMAND	CAPACITY	%UTL
IDCUHD	IDCU TCBH HD TO ABS RATIO	1.00			
IDCUBLK	PCT BLOCKING ON IDCU		1.50		
ABSCCS	WT AVG DS1 ABS NON-NU CCS/LINE	3.50			

HDCCS	WT AVG DS1 HD NON-NU CCS/LINE	3.50	
PTSLCR	IDCU CIRCUIT SWITCHED LCR	8.00	
CULINES	IDCU TR008 + TR303 LINES	736	
CURTDS1	IDCU RT DS1 MINUS PROT LINES	32	
CUTSHR	IDCU RT TIME SLOT INFO HEADER	***	
DS1TSD	TR008 + TR303 DS1 TIME SLOT DE	124	
CSTSD	TR008/TR303 CKT SW AND ODB TS	92	
PPDNUTS	TR303 PPD TIME SLOTS	0	
PPBNUTS	TR303 PPB TIME SLOTS	0	
TSINUTS	TR008+TR303 TSI NON-SW SPC TS	0	
HPINUTS	IDCU HAIRPIN TIME SLOTS	32	
MTCETS	TR003 EOC/TMC TIME SLOTS	0	
DS1TSC	TR008+TR303 DS1 TIME SLOT CAP	768	
DS1TSU	TR008+TR303 DS1 TIME SLOT UTL	17	
CUPUDS1	IDCU NRT DS1(S)	2	
CUPUTS	NRT TSI NON-SWITCH SPECIAL TS	0	
PITSDEM	IDCU PIDB TIME SLOT DEMAND	92	
PITSCAP	IDCU PIDB TIME SLOT CAPACITY	96	
PITSUTL	IDCU PIDB TIME SLOT UTL	96	
CUUSGHR	IDCU USAGE INFO HEADER	***	
CUCCSDE	IDCU PIDB WT. AVG. CCS/LINE DE	3.50	
CUCCSCA	IDCU PIDB CCS/LINE CAPACITY	5	
CUCCSUT	IDCU PIDB CCS/LINE UTL	70	
IDCUTD	IDCU PIDB LINE DEMAND	736	
IDCUTC	IDCU PIDB LINE CAPACITY	768	
IDCUTU	IDCU LINE UTL	96	
CUUSGTD	IDCU PIDB USAGE DEM - LINES	736	

CUUSGTC	IDCU PIDB USAGE CAP - LINES	889	
CUUSGCD	IDCU PIDB USAGE DEMAND - CCS	2576	
CUUSGCC	IDCU PIDB USAGE CAP - CCS	3111	
CUUSGU	IDCU USAGE UTL		83
IDCUMLU	IDCU MOST LIMIT - USG (ABS,HD)	abs	
IDCUML	IDCU MOST LIMIT - (USG, LINES)	lines	
IDCUMLC	IDCU ML CAPACITY IN LINES	768	
CUDCHI	IDCU D-CHAN PKT INFO HEADER	***	
CUPKTLN	IDCU ISDN LINES	0	
CUDPPS	IDCU WT. AVG. D-CH DATA PPS/LN	0.00	
DCHDPD	IDCU D-CHAN DPIDB(S)	0	
DCHPDPB	IDCU D-CHAN PER DPIDB RATIO	0.00	
DPPSDEM	IDCU D-CHAN DPPS DEMAND	0	

5ESS Switch Engineering System

CAPACITY REPORT

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

NPA = 303	LD = Base Load Division	LOCATION = domestic
CLLI = grfngama22c	TYPE = host	CATEGORY = idcu-2
ORDNO = 12345	STATE = sto	XGEN = 9.10

5DOPS

SYMBOL	5 DOPS TITLE	QTY	DEMAND	CAPACITY	%UTL

DPPSCAP	IDCU D-CHAN DPPS PH CAPACITY	0	
DPPSUT	IDCU D-CHAN DPPS PH UTIL.		0
CUPPBI	IDCU PPB PKT INFO HEADER	***	
IDCUPPB	IDCU PPB CHANNELS	0	
CUBPPS	IDCU WT. AVG. PPB DATA PPS/LN	0.00	
PPBDPD	IDCU PPB DPIDB(S)	0	
PPBPDPD	IDCU PPB PER DPIDB RATIO	0.00	
BPPSDEM	IDCU PPB DATA PPS DEMAND	0	
BPPSCAP	IDCU PPB DATA PPS PH CAPACITY	0	
BPPSUTL	IDCU PPB DATA PPS PH UTIL		0
CUODBI	IDCU ODB USER INFO HEADER	***	
IDCUODB	IDCU ODB USERS	0	
CCSPODB	IDCU WT AVG CCS/ODB USR -DPIDB	0.00	
PPSPODB	IDCU WT AVG DATA PPS/ODB USER	0.00	
ODBDPD	IDCU ODB DPIDB(S)	0	
ODBDPDE	IDCU ODB CCS DPIDB DEMAND	0	
ODBDPCA	IDCU ODB CCS DPIDB CAPACITY	0	
ODBDPUT	IDCU ODB CCS DPIDB UTL		0
AVGUSPH	IDCU ODB AVG USERS/PH - DEMAND	0	
ODBASPH	IDCU ODB USERS/PH - CAPACITY	0	
AVGUSUT	IDCU ODB AVG USERS/PH - UTL		0

14.4.2.6.2.5 Office Data Assembler (ODA) Forms

The ODA Forms are used to start up an office in translations. The forms can be referenced to identify the office configuration, but the actual switch verification will show the final office configuration. Detailed information on the ODA Forms/Office Records can be found in the 235-080-100 , *Translation Guide (TG-5)*. The ODA Forms and/or Office Records that can be used are as follows:

Form Number	ODA Form	Form Title

Name

Form 5174-1	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
Form 5174-2	rterm	Remote Terminal (TR008) Record - used to define the Channel Unit Type (CUTYPE) equipped in the remote terminal.
Form 5174-4	rterm	Remote Terminal (TR303) - used to define the Remote Terminal IFAC termination, ISCN for the TMC and DPIDB, ISCN for the EOC and DPIDB.
Form 5741-1	eqpsu	Packet Switching Unit Equipage Record - used to define the equipped Packet Switching Unit.
Form 5741-2	eqpsu	Packet Switching Unit Equipage Record - used to define the PSU to TSIU Time slots.
Form 5207	nailup	Nail-up and Hairpin Specification Record - used to define the OEs.
Form 5742	eqpsuph	PSU Protocol Handler Pack Equipage Record - used to define the Protocol Handlers.
Form 5846	eqidcu	Integrated Digital Carrier Unit Record - used to

define the SM, IDCU, PIDB, and DPIBDs.

Form 5847 eqifac IDCU Facility Equipment (IFAC) - used to define
the connection between the IDCU and the Remote
Terminal or PUB.

14.4.2.6.2.6 Office Records

Office records are available on-line at any time on the 5ESS[®]-2000 switch. Office records are based upon the recent change and verify views of the 5ESS[®]-2000 switch and are applicable no matter what operational support system is attached to the switch. Office records can be accessed, changed, or input with standard Input/Output (I/O) messages on a message-type terminal. These systems include menu mode and text interface recent change as well as Remote Memory Administration System (RMAS) at the master control center (MCC) in the command (CMD) mode.

Verifying the IDCU office configuration is strongly suggested before definition of your ISDN Line Assignment System. Following is a list of the office records that can be used for the verification.

Refer to Section 14.4.2.6.2.5, Office Data Assembler (ODA) Forms, for listing of office records form number and description.

Detailed information on the office records can be found in the *Recent Change Manuals* 235-118-XXX documentation and/or the TG-5. Sections 14.4.2.6.3.1 and 14.4.2.6.4.1 identify the recommended office records used to determine IDCU office configuration.

14.4.2.6.2.7 Recent Change Views

The RC/V facility is a user interface provided by the 5ESS[®]-2000 switch that allows users to modify or verify the contents of the office dependent data (ODD) data base on the 5ESS[®]-2000 switch.

Verifying the ISDN office configuration is strongly suggested. The following is a list of the RC/V Views that can be used:

18.15	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, RT Line Size (TR303), Channel Unit Type (CUTYPE), Remote Terminal IFAC termination, ISCN for the TMC and DPIBD, ISCN for the EOC and DPIBD.
22.2	Packet Switching Unit Equipage Record - used to define the equipped Packet Switching Unit and to define the PSU to TSIU Time slots.
7.11	Nail-up and Hairpin Specification Record - used to define the OEs.
22.4	PSU Protocol Handler Pack Equipage Record - used to define the Protocol Handlers.
19.12	Integrated Digital Carrier Unit Record - used to define the SM, IDCU, ELI, PIDB, and DPIBDs.
20.23	IDCU Facility Equipment (IFAC) - used to define the connection between the IDCU and the Remote Terminal or PUB.
22.3	Packet Switch Unit Shelf - used to define the Packet Switching Unit Protocol Handlers equipped and the minimum number of spare PHs.
22.16	PSU Protocol Handler Channel Group Assignment - used to define the PH type (PH2 or PH3) and the shelf assignment.

Detailed information on the above Recent Change Views can be found in the *Recent Change Manuals* 235-118-XXX documentation. Section 14.4.2.6.3.1 and 14.4.2.6.4.1 identify the recommended Recent Change Views used to determine IDCU Office Configuration.

14.4.2.6.3 Integrated Digital Carrier Unit (IDCU)

14.4.2.6.3.1 General

This section identifies the questions the administrator should ask to determine the IDCU configuration and the information required to answer those questions. Sample 5DOPS rtlist, ISDN SM Assignments (ISA report), equipment report and capacity report by IDCU are illustrated with "keyed" values. Items associated with office totals (that is, equipment report, capacity report, and ISA Report) will be identified with "**Item 1, Item 3**, etc." and items associated with individual SMs will be identified with "**Item A, Item B**, etc.". When all IDCUs are engineered the same, only one equipment report and capacity report is necessary to determine the IDCU configuration for TR008 or TR303 applications, as is the case in our example.

The following rtlist is our sample office and is referenced throughout the TR008 Applications Section 14.4.2.6.3.2 and TR303 Applications Section 14.4.2.6.3.3 :

rtlist

```
(IDCU-1  SM #1)   IDCU-2 NON-ISDN   IDCU-3 NON-ISDN   IDCU-4 NON-ISDN

TR3-49  TR3-53    TR8-1   TR8-25    TR8-2   TR8-26    TR8-3   TR8-27

TR3-50  TR3-54    TR8-7   TR8-31    TR8-8   TR8-32    TR8-9   TR8-33

TR3-51  TR3-55    TR8-13  TR8-37    TR8-14  TR8-38    TR8-15  TR8-39

TR3-52  TR3-56    TR8-19  TR8-43    TR8-20  TR8-44    TR8-21  TR8-45
```

```
IDCU-5 NON-ISDN   IDCU-6 NON-ISDN   IDCU-7 NON-ISDN

TR8-4   TR8-28    TR8-5   TR8-29    TR8-6   TR8-30

TR8-10  TR8-34    TR8-11  TR8-35    TR8-12  TR8-36

TR8-16  TR8-40    TR8-17  TR8-41    TR8-18  TR8-42

TR8-22  TR8-46    TR8-23  TR8-47    TR8-24  TR8-48
```

The rtlist provides a listing of all remote terminals engineered within an IDCU. Obtain the following information from the rtlist report:

SM #1	IDCUs on a specific Loaded SM
NON-ISDN	IDCUs on a Standard SM
IDCU Number	IDCU-1, IDCU-2, IDCU-3, etc.
TR3	Lists TR303 Remote Terminals within an IDCU
TR8	Lists TR008 Remote Terminals within an IDCU
TR8-1-48	TR008 Remote Terminal Number
TR3-49-56	TR303 Remote Terminal Number

NOTE: A total of 48 TR008 RTs matches **Item 2** on the ISA Office Totals Report. In our example office all TR008 IDCUs have been engineered uniformly, so one equipment report, one capacity report, etc. is reflective of IDCU-2 and all other IDCUs.

14.4.2.6.3.2 TR008 Applications

1. Is the IDCU in a Standard or Loaded SM?

The rtlist (reference Section 14.4.2.6.3.1) indicates the TR008 RTs are assigned to Standard SMs. The TR008 may work in a Standard or Loaded SM. No ISA Report is generated when only TR008 IDCUs are assigned to a Standard SM. The 5DOPS Equipment Report identifies the information needed for the IDCU configuration.

2. What interface is provided on the IDCU: TR008, TR303, PUB43801, or both TR008 and TR303?

TR008 is an SLC[®] 96 type interface for the IDCU. A TR008 IDCU supports SLC[®] 96 RTs, SLC[®] Series 5 RTs with Feature Package B or enhanced Feature Package B, and Feature Package 303G operating in the TR008 mode. Each of the systems listed above may be either Mode I or Mode II. Only analog lines may be assigned in TR008 interfaces.

PUB43801 or non-remote terminals (NRT) are non-switched/switched specials from a D4/D5 Channel Bank to an IDCU via a DS1.

TR303 is addressed in Section 14.4.2.6.3.3. The following text addresses TR008 equipment quantities.

The 5DOPS Equipment Report identifies TR008 IDCU-2. Look for the following symbol:

```
CU008RT    TR008 RT(s) IN THIS IDCU 8
      Item 1
```

Notice the 8 RTs in IDCU-2 match the 8 RTs on the rtlist report for IDCU-2.

The 5DOPS ISA Report - Office Totals identify the number of TR008 RTs (remember the ISA Report is generated when TR008 and TR303 IDCUs are engineered in the office). Look for the following symbol:

```
TR008      No. of TR008 RTs in IDCUs    48    Item 2
```

Notice the 48 RTs on the ISA Report - Office Totals match the 48 RTs reflected on the rtlist Report for IDCU-2 through IDCU-7.

The 5DOPS ISA Report - ISDN SM No. 1 identify the quantity of TR008 RTs per IDCU. Look for the following symbol:

```
TR008      No. of TR008 RTs in IDCUs    0      Item A
```

Notice the quantity of TR008 RTs in our example is 0. The only time the quantity would be different is when the SM has a mixed TR008 and TR303 configuration.

The 5DOPS ISA Report - Office Totals identifies the total number of PUB43801 assigned to TR008 and TR303 IDCUs using the following symbol:

```
NRT        No. of PUB43801 DS1s in IDCUs 14    Item 7
```

The 5DOPS Capacity Report identifies the total number of PUB43801 for IDCU-2 using the following symbol:

```
CUPUDS1    IDCU NRT DS1(S)              2      Item 8
```

Remember, all the IDCUs in the sample office engineered the same. Recall the office is engineered with 6 TR008 IDCUs. Determine the quantity of PUB43801s for TR008 applications as follows:

*6 IDCUs (Refer to rtlist) 2 (NRT DS1s per IDCU-2) = 12 NRT DS1s
per total*

office

Notice the 5DOPS ISA Office Totals Report, NRT symbol (**Item 7**) indicates there are 14 PUB43801 DS1s. The ISA Office Totals are for both TR008 and TR303 applications. The equation shown above shows there are 12 NRT DS1s. The remaining 2 DS1s are for the TR303 IDCU application.

The 5DOPS rtlist identifies remote terminals assigned to ISDN and non-ISDN SMs.

Other methods to obtain the interface is provided on the IDCU for TR008 and are as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

3. How many IDCUs are equipped?

A maximum of 7 IDCUs may be present in an SM.

The 5DOPS rtlist Report identify the total number of IDCUs. In our example rtlist (Section 14.4.2.6.3.1) notice IDCU 1 through 7 are engineered.

The 5DOPS ISA Report - Office Totals identifies the total number of TR008 and TR303 IDCUs as follows:

IDCU No. of IDCU UNITS 7 **Item 4**

The number of IDCUs equipped in the SM may also be found as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

4. How many ELIs are equipped?

The ELI receives the DS1 signals. Each ELI may terminate 20 DS1s. A fully equipped IDCU has two ELI packs, but a partially configured IDCU has one. The ELI splits the signals to the active and loop standby interfaces (LSI). The ELIs also terminate the PIDB clock and synchronization signals for PIDBs 1 through 15. The ELI A terminates PIDBs 1 through 8 and ELI B terminates PIDBs 9 through 15.

The 5DOPS Equipment Report identifies the quantity of DS1s equipped for IDCU-2. As previously stated, an ELI pack may terminate 20 DS1s thus, one ELI pack is engineered for every 20 DS1s engineered. Look for the following symbol:

IDCU ONE IDCU EQP FOR 20 DS1(s) 1

Item 3

IDCUADL ADD'L 20 DS1(s) FOR ONE IDCU 1 **Item 5**

Remember, all the TR008 IDCUs in our example are engineered the same. So, we are able to use the information found on the equipment report for IDCU-2 and duplicate the equipment configuration for all the other TR008 IDCUs.

The number of ELIs equipped in the SM can also be found as follows:

ODA	eqidcu	Integrated Digital Carrier Unit Record - used to define the SM, IDCU, ELI, PIDB, and DPIBDs.
RC/V	19.12	Same as ODA eqidcu
Office Records	Form 5174-1	Same as ODA eqidcu

5. How many remote terminals are assigned in the IDCU?

The number of RDTs that may be assigned in an IDCU is a function of the total of DS1s used and the number of each type of IDLC interface employed. The 5ESS®-2000 switch software limits the maximum number of RDTs per IDCU to 31.

Refer to question number 2 for the 5DOPS Reports information. Remember, the 5DOPS rtlist provides information on the equipped IDCUs and lists all the remote terminals by type for each IDCU.

The number of remote terminals equipped in the IDCU may also be found as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

6. How many DS1s are equipped per RT? Do you have a protection line?

An IDCU may be arranged for 20 or 40 DS1s. Reference question number 4.

The number of DS1s (IFAC) per remote terminal equipped in the IDCU can also be found as follows:

ODA	eqifac	IDCU Facility Equipment (IFAC) - used to define the connection between the IDCU and the Remote Terminal or PUB.
RC/V	20.23	Same as ODA eqifac
Office Records	Form 5847	Same as ODA eqifac

The protection line can be found as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

7. How many lines can be assigned in the remote terminals, including hairpin and nailup?

The number of lines available for assignment within the remote terminals equipped in the IDCU for TR008 can be found as follows:

The number of lines that can be assigned within a remote terminal is dependent on the the vendor's equipment. Check your local practices for guidelines.

The 5DOPS Capacity Report - IDCU-2 provides the number of TR008 and TR303 lines and the number of hairpin and nailup time slots (each line requires a time slot) that may be assigned. Look for the following symbol:

CULINES *IDCU TR008 + TR303 LINES* 736 **Item 9**

HPINUTS *IDCU HAIRPIN TIME SLOTS* 32 **Item 10**

CUPUTS *NRT TSI NON-SWITCH SPECIAL TS 0* **Item 11**

Remember, IDCU-2 is a TR008 application, so in our example, all the 736 lines that may be assigned are analog for the office. To determine the number of lines that can be assigned per RT, perform the following equation:

CULINES + HPINUTS + CUPUTS ÷ 8 RTs per IDCU = Total lines assigned per RT

$$736 + 32 + 0 \div 8 = 96$$

The number of lines available for assignment within the remote terminals equipped in the IDCU for TR303 may be found as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
ODA	nailup	Nail-up and Hairpin Specification Record - used to define the OEs.
RC/V	18.15	Same as ODA rterm
RC/V	7.11	Same as ODA nailup
Office Records	Form 5174-1	Same as ODA rterm
Office Records	Form 5207	Same as ODA nailup

8. What types of services can be deployed from the remote terminal?

The types of lines that can be assigned within a TR008 IDCU are dependent on the cards that are equipped in the *SLC*[®] unit. Contact your outside plant engineer to obtain the type of cards equipped in the *SLC*[®] unit or the card types can be found as follows:

ODA	rterm	Remote Terminal (TR008) Record - used to define the Channel Unit Type (CUTYPE) equipped in the remote terminal.
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-2	Same as ODA rterm

9. How many loop side interfaces are equipped?

The LSI receives the DS1 signals. Four LSIs are provided in fully equipped IDCUs: two active and two standby. The LSI converts the DS1 to PIDB-like format on the internal bus to the PIDB transmission interface (PTI). The PIDB is the connection from peripheral units to the time slot interchange (TSI) in the *5ESS*[®]-2000 switch. There are 32 time slots per PIDB.

The number of LSIs equipped in the IDCU can also be found as follows:

ODA	eqifac	IDCU Facility Equipment (IFAC) - used to define the connection between the IDCU and the Remote Terminal or PUB.
RC/V	20.23	Same as ODA eqifac
Office Records	Form 5847	Same as ODA eqifac

10. How many PIDBs are equipped?

The PTI contains a TSI function, thus enabling the DS0 time slot to be connected to any PIDB/DPIDB time slot. A maximum of 16 PIDBs is permitted. The sum of PIDBs plus two times the DPIDBs must not exceed 30.

The PIDBs for an IDCU are arranged in two service groups, an active group and a standby group. Each group can

contain up to 23 (D)PIDBs. The number of PIDBs required is a function of an IDCUs circuit-switched traffic usage.

An IDCU service group can be configured for 15 PIDBs when installed in a Standard SM. Since an IDCU must have a standby for each of its active PIDBs, a maximum of 15 active and 15 standby PIDBs can be assigned to all of the IDCUs in an SM. A total of 31 PIDBs are available in an SM. The 31 PIDBs in the SM are reserved for pumping an SM.

The 5DOPS Equipment Report identifies the number of PIDBs equipped for IDCU-2. Remember, all the other TR008 IDCUs in our example are configured the same. Look for the following symbol:

PIDB TSIU PIDB(s)/IDCU 6 Item 6

The PIDBs configuration equipped in the SM can also be found as follows:

ODA	eqidcu	Integrated Digital Carrier Unit Record - used to define the SM, IDCUs, ELI, PIDB, and DPIDBs.
RC/V	19.12	Same as ODA eqidcu
Office Records	Form 5174-1	Same as ODA eqidcu

11. How many time slots sets are engineered per IDCU?

The number of time slots sets (TSS) engineered per IDCU is determined by dividing the number of engineered PIDBs by 4 (4 PIDBs equal one TSS). Question 10 identifies the reports where the engineered PIDBs may be found. The sample Equipment Report shows 6 PIDBs are engineered for IDCU-2. In our sample office, the number of TSSs engineered is 1+. (6 PIDBs divided by 4 PIDBs per TSSs).

12. What is the capacity of the IDCU?

The 5DOPS Capacity Report has a wealth of information that can be used to aid in administration of your IDCU. The capacity report tells you the engineering criteria used, for example, average busy season or high day, per cent blocking, line concentration ratio, number of hair pin time slots, CCS capacity, etc. More detail information can be found in the 235-060-110 *5ESS®-2000 Switch Engineering Practice*.

Sample Equipment Report for a TR008 Application:

5ESS Switch Engineering System

EQUIPMENT REPORT

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

```

-----
NPA    = 303          LD      = Base Load Division  LOCATION = domestic
CLLI   = grfngama22c  TYPE    = host                CATEGORY  = idcu-2
ORDNO  = 12345        STATE   = sto                 XGEN      = 9.10
-----

```

5DOPS

SYMBOL	5 DOPS TITLE	PRESENT	ADDL	DEF	PROPOSED
CU008RT	TR008 RT(S) IN THIS IDCU	0	8		8 Item 1
PIDB	TSIU PIDB(S)/IDCU	0	6		6 Item 6
IDCU	ONE IDCU EQP FOR 20 DS1(S)	0	1		1 Item 3
IDCUADL	ADD'L 20 DS1(S) FOR ONE IDCU	0	1		1 Item 5

Sample 5DOPS ISA report for TR008 and TR303 Applications:

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

```

-----
NPA    = 303          LD      = Base Load Division  LOCATION = domestic
CLLI   = grfngama22c  TYPE    = host                CATEGORY  = ISDN
ORDNO  = 12345        STATE   = sto                 XGEN      = 9.10
-----

```

OFFICE TOTALS

		ISLU	IDCU
CCSPTSM	HD WEIGHTED AVG CCS / BRI CARD	2.02	
BRITCRD	BRI T LINE CARDS	0	

U2B1QCD	BRI 2B1Q U LINE CARDS	0	
UAMICD	BRI AMI U LINE CARDS	0	
ZCRD	Z LINE CARDS	0	
TUZCRD	TOTAL LINE CARDS / IDCU LINES	0	5152
TR303	NO. OF TR303 RTs IN IDCUs	8	
TR008	NO. OF TR008 RTs IN IDCUs	48	Item 2*
NRT	NO. OF PUB43801 DS1s IN IDCUs		14 Item 7
DPPS	WEIGHTED AVG PPS / D-CHANNEL	0.02	
PPB	NO. OF PERM. PKT B-CHANNELS 0	8	
PPBPPS	PERM. PKT B PEAK PPS PER PPB	0.00	20.00
ODB	NO. OF ON-DEMAND B USERS	0	0
ODBCCS	DPIDB OCCUPANCY CCS PER ODB 0.00	0.00	
ODBPPS	ON-DEMAND B PEAK PPS PER ODB	0.00	0.00
PH2SPR	NO. SPARE PH2 / PSU SHELF 1		
PH3SPR	NO. SPARE PH3 / PSU SHELF 1		
XISTF	ISTF OPTION (YES / NO)	n	
IDCU	NO. OF IDCU UNITS	7	Item 4
XSPLFCT	UNIFORM INTER-SM CONN. FACTOR	1.20	
BRIPLGC	BRI CARDS / LINE GRP CNTRLR 0		
MAXPIDB	MAXIMUM PIDBS AT THIS CCS-ISLU	0	
BRILGC	NO. LGC REQD FOR BRI - ISLU 0		
ISDNSM	NUMBER OF ISDN SMS REQUIRED 1		
DLTUSM	NUMBER OF ISDN SMS WITH DLTU	0	

* Note: No. of TR008 RTs in IDCUs; 48, matches the total number of RTs on the rtlist.

Remember the ISA report is generated when both TR008 and TR303 are engineered at the same site (central office).

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

NPA = 303	LD = Base Load Division	LOCATION = domestic
CLLI = grfngama22c	TYPE = host	CATEGORY = ISDN
ORDNO = 12345	STATE = sto	XGEN = 9.10

ISDN SM No. 1

		ISLU	IDCU
Summary		Qty PH	Qty PH
CCSPTSM	HD WEIGHTED AVG CCS / BRI CARD	2.02	
BRITCRD	BRI T LINE CARDS	0	
U2B1QCD	BRI 2B1Q U LINE CARDS	0	
UAMICD	BRI AMI U LINE CARDS	0	
ZCRD	Z LINE CARDS	0	
TUZCRD	TOTAL LINE CARDS / IDCU LINES	0	736 (3)
TR303	NO. OF TR303 RTs IN IDCUs		8
TR008	NO. OF TR008 RTs IN IDCUs		0 Item A*
NRT	NO. OF PUB43801 DS1s IN IDCUs		2
PPB	NO. OF PERM. PKT B-CHANNELS 0		8 (3)

PPBPPS	PERM. PKT B PEAK PPS PER PPB	0.00	
DPPS	WEIGHTED AVG PPS / D-CHANNEL	0.02	
ODB	NO. OF ON-DEMAND B USERS	0	0
ODBCCS	DPIDB OCCUPANCY CCS PER ODB	0.00	
ODBPPS	ON-DEMAND B PEAK PPS PER ODB	0.00	
PH2RAT	PH2 PER DPIDB (1/4 ISLU BASIS)	0.00	
PH3RAT	PH3 PER DPIDB (1/4 ISLU BASIS)	0.00	
ISMPH	AVG INTER-SM PROTOCOL HANDLERS	0 EST. (ON PH3)	0 ASGN
PSUSHVS	NO. PSU SHELVES IN THE ISDN SM	1	
DSU2IF	QTY OF ISTF PACKS ON DSU-2	0	
IDCU	NO. OF IDCU UNITS	1	
RPATS	RESERVED RPA/RPM T.S. PER SHF	0	
INSMPPS	EST. PPS FOR INTER-SM PKT TPT		0

SM PIDB and LG breakdown	PIDBs	LGs
IDCU# 1	6	
SUM PIDBs	6	
SUM LGs		0

* Note there will not be any value for TR008 since they are assigned in a Standard SM in our example.

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

```

-----
NPA    = 303          LD      = Base Load Division  LOCATION = domestic
CLLI   = grfngama22c  TYPE    = host                CATEGORY  = ISDN
ORDNO  = 12345        STATE   = sto                 XGEN       = 9.10
-----

```

IDCU PROTOCOL HANDLER ASSIGNMENTS

IDCU# 1 -- X.25B -- ----- PSU -----

	PIDB	DPIDB	PPB	ODB	PH2	PH3	shelf	port
6	A	(0)	0	0	0.00	1.00	0	a
	B	(1)	0	0	0.00	1.00	0	b
	C	(2)	0	0	0.00	1.00	0	c
	D	(3)	0	0	0.00	1.00	0	d
	E	(4)	0	0	0.00	0.00		
	F	(5)	0	0	0.00	0.00		
	G	(6)	0	0	0.00	0.00		
	H	(7)	0	0	0.00	0.00		
	I	(8)	0	0	0.00	0.00		
	J	(9)	0	0	0.00	0.00		
	K	(10)	0	0	0.00	0.00		

IDCU# 1 PROT ISDN ANALOG PIDB

RT#	TR	IDENTIFIER	DS1	LINE	LINES	LINES	USERS	NUTS
49	303		4	0	20	72	20	0
50	303		4	0	20	72	20	0

51	303	4	0	20	72	20	0
52	303	4	0	20	72	20	0
53	303	4	0	20	72	20	0
54	303	4	0	20	72	20	0
55	303	4	0	20	72	20	0
56	303	4	0	20	72	20	0
NRT	PUB	2					0

PSU# 1 PROTOCOL HANDLER ASSIGNMENTS

DPIDB port							- ism -			trk/cnl				spare		total
sf	a(0)	b(1)	c(2)	d(3)	e(4)	f(5)	p2	p3	ts	p2	p3	p2	p3	p2	p3	sum
4	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
3	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
2	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
1	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
0	1.00	1.00	1.00	1.00	0.00	0.00	0	0	0	0	0	0	1	0	5	5

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

NPA	= 303	LD	= Base Load Division	LOCATION	= domestic
CLLI	= grfngama22c	TYPE	= host	CATEGORY	= ISDN
ORDNO	= 12345	STATE	= sto	XGEN	= 9.10

Active PIDBs + DPIDBs for IDCU# 1 = 11

Total IDCU to TSIU PIDB Ports 6

Remaining TSIU Ports 23

ISLU PIDB TS	0	Reserved TS for NXDS0	0
IDCU PIDB TS	96	Spare TS for any unit -->	414
ISTF TS	0	PSU TS demand	0
DLTU TS	0	Available TS for PSU only	0
Inter-SM TS	0	IDCU Nail-up TS for TSIU	0
Packet Trunk TS for PSU	0	Used Nail-up TS for TSIU	0
Recovered DLTU TS	(0)	Avail Nail-up TS for TSIU	190

Sample Capacity Report for TR008 Application:

5ESS Switch Engineering System

CAPACITY REPORT

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = idcu-2

ORDNO = 12345 STATE = sto XGEN = 9.10

5DOPS

SYMBOL	5 DOPS TITLE	QTY	DEMAND	CAPACITY	%UTL

IDCUHD	IDCU TCBH HD TO ABS RATIO	1.00			

IDCUBLK	PCT BLOCKING ON IDCU	1.50	
ABSCCS	WT AVG DS1 ABS NON-NU CCS/LINE	3.50	
HDCCS	WT AVG DS1 HD NON-NU CCS/LINE	3.50	
PTSLCR	IDCU CIRCUIT SWITCHED LCR	8.00	
CULINES	IDCU TR008 + TR303 LINES	736	Item
CURTDS1	IDCU RT DS1 MINUS PROT LINES	32	
CUTSHR	IDCU RT TIME SLOT INFO HEADER ***		
DS1TSD	TR008 + TR303 DS1 TIME SLOT DE	124	
CSTSD	TR008/TR303 CKT SW AND ODB TS	92	
PPDNUTS	TR303 PPD TIME SLOTS	0	
PPBNUTS	TR303 PPB TIME SLOTS	0	
TSINUTS	TR008+TR303 TSI NON-SW SPC TS	0	
HPINUTS	IDCU HAIRPIN TIME SLOTS	32	Item 10
MTCETS	TR003 EOC/TMC TIME SLOTS	0	
DS1TSC	TR008+TR303 DS1 TIME SLOT CAP	768	
DS1TSU	TR008+TR303 DS1 TIME SLOT UTL		17
CUPUDS1	IDCU NRT DS1(S)	2	Item 8
CUPUTS	NRT TSI NON-SWCH SPECIAL TS	0	Item 11
PITSDEM	IDCU PIDB TIME SLOT DEMAND	92	
PITSCAP	IDCU PIDB TIME SLOT CAPACITY	96	
PITSUTL	IDCU PIDB TIME SLOT UTL		96
CUUSGHR	IDCU USAGE INFO HEADER	***	
CUCCSDE	IDCU PIDB WT. AVG. CCS/LINE DE	3.50	
CUCCSCA	IDCU PIDB CCS/LINE CAPACITY	5	
CUCCSUT	IDCU PIDB CCS/LINE UTL		70
IDCUTD	IDCU PIDB LINE DEMAND	736	
IDCUTC	IDCU PIDB LINE CAPACITY	768	

IDCUTU	IDCU LINE UTL		96
CUUSGTD	IDCU PIDB USAGE DEM - LINES	736	
CUUSGTC	IDCU PIDB USAGE CAP - LINES		889
CUUSGCD	IDCU PIDB USAGE DEMAND - CCS	2576	
CUUSGCC	IDCU PIDB USAGE CAP - CCS		3111
CUUSGU	IDCU USAGE UTL		83
IDCUMLU	IDCU MOST LIMIT - USG (ABS,HD)	abs	
IDCUML	IDCU MOST LIMIT - (USG, LINES)	lines	
IDCUMLC	IDCU ML CAPACITY IN LINES	768	
CUDCHI	IDCU D-CHAN PKT INFO HEADER	***	
CUPKTLN	IDCU ISDN LINES	0	
CUDPPS	IDCU WT. AVG. D-CH DATA PPS/LN	0.00	
DCHDPD	IDCU D-CHAN DPIDB(S)	0	
DCHPDPB	IDCU D-CHAN PER DPIDB RATIO	0.00	
DPPSDEM	IDCU D-CHAN DPPS DEMAND	0	

5ESS Switch Engineering System

CAPACITY REPORT

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

NPA = 303	LD = Base Load Division	LOCATION = domestic
CLLI = grfngama22c	TYPE = host	CATEGORY = idcu-2
ORDNO = 12345	STATE = sto	XGEN = 9.10

5DOPS

SYMBOL	5 DOPS TITLE	QTY	DEMAND	CAPACITY	%UTL
DPPSCAP	IDCU D-CHAN DPPS PH CAPACITY			0	
DPPSUT	IDCU D-CHAN DPPS PH UTIL.				0
CUPPBI	IDCU PPB PKT INFO HEADER	***			
IDCUPPB	IDCU PPB CHANNELS	0			
CUBPPS	IDCU WT. AVG. PPB DATA PPS/LN	0.00			
PPBDPD	IDCU PPB DPIDB(S)	0			
PPBPDPD	IDCU PPB PER DPIDB RATIO	0.00			
BPPSDEM	IDCU PPB DATA PPS DEMAND		0		
BPPSCAP	IDCU PPB DATA PPS PH CAPACITY			0	
BPPSUTL	IDCU PPB DATA PPS PH UTIL				0
CUODBI	IDCU ODB USER INFO HEADER	***			
IDCUODB	IDCU ODB USERS	0			
CCSPODB	IDCU WT AVG CCS/ODB USR -DPIDB	0.00			
PPSPODB	IDCU WT AVG DATA PPS/ODB USER	0.00			
ODBDPD	IDCU ODB DPIDB(S)	0			
ODBDPDE	IDCU ODB CCS DPIDB DEMAND		0		
ODBDPCA	IDCU ODB CCS DPIDB CAPACITY			0	
ODBDPUT	IDCU ODB CCS DPIDB UTL				0
AVGUSPH	IDCU ODB AVG USERS/PH - DEMAND		0		
ODBASPH	IDCU ODB USERS/PH - CAPACITY			0	
AVGUSUT	IDCU ODB AVG USERS/PH - UTL				0

14.4.2.6.3.3 TR303 Applications

1. Is the IDCU in a Standard or Loaded SM?

The rtlist (reference Section 14.4.2.6.3.1) indicates the TR303 RT is assigned to a Loaded SM. TR303 works only

in a Loaded SM. An ISA report is generated for TR303 IDCUs.

2. What interface is provided on the IDCU: TR008, TR303, PUB43801, or both TR008 and TR303?

The TR008 is addressed in Section 14.4.2.6.3.2 .

The TR303 is a generic interface for the IDCU system. The major advantage for a generic interface is that it allows operating companies to mix remote digital terminals and local digital switches from different vendors. Analog and ISDN lines can be assigned in TR303 interfaces. TR303 requires a Loaded SM.

PUB43801 or non-remote terminals (NRT) are non-switched/switched specials from a D4/D5 Channel Bank to an IDCU via a DS1.

The 5DOPS Equipment Report for IDCU-1 identifies TR303 using the following symbol:

CU303RT TR303 RT(S) IN THIS IDCU 8

Item 1

Notice the 8 RTs (see above) in IDCU-1 match the 8 RTs on the rtlist Report for IDCU-1.

The 5DOPS ISA Report - Office Totals identify the quantity of TR303 RTs using the following symbol:

TR303 No. of TR303 RTs in IDCUs 8

Item 2

Notice the 8 RTs on the ISA Report - Office Totals match the 8 RTs reflected on the rtlist Report for IDCU-1.

The 5DOPS ISA Report - ISDN SM No 1 identify TR303 using the following symbol:

TR303 No. of TR303 RTs in IDCUs 8

Item A

The 5DOPS ISA Report - Office Totals identify the total number of PUB43801 assigned to TR008 and TR303 IDCUs using the following symbol:

NRT No. of PUB43801 DS1s in IDCUs 14 **Item 3**

The 5DOPS ISA Report - ISDN SM No.1 identify the number of PUB43801 assigned to TR303 IDCUs using the following symbol:

NRT No. of PUB43801 DS1s in IDCUs 2 **Item B**

The 5DOPS rtlist identifies ISDN and non-ISDN remote terminals. The 5DOPS Capacity Report identifies the total number of PUB43801 for IDCU-1 using the following symbol:

CUPUDS1 IDCUs NRT DS1(S) 2

Item 8

Other methods to obtain the interface is provided on the IDCU; TR303, and PUB43801 are as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCUs Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

3. How many IDCUs are equipped?

A maximum of 7 IDCUs can be present in an SM.

The 5DOPS ISA Report - Office Totals identifies the total number of TR008 and TR303 IDCUs as follows:

IDCU No. of IDCU UNITS 7
Item 5

The 5DOPS ISA Report - ISDN SM No 1 identifies TR303 IDCUs in a SM as follows:

IDCU No. of IDCU UNITS 1
Item C

The 5DOPS rtlist Report identifies the total number of IDCUs. In our example rtlist (Section 14.4.2.6.3.1) notice IDCU 1 through 7 are engineered. IDCU-1 is engineered for TR303.

Notice the quantity of IDCUs on the rtlist matches the quantity of IDCUs on the ISA Office Total Report. IDCU-1 is assigned to an ISDN SM.1.

The number of IDCUs equipped in the SM can also be found as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

4. How many ELIs are equipped?

The ELI receives the DS1 signals. Each ELI can terminate 20 DS1s. A fully equipped IDCU has two ELI packs, but a partially configured IDCU has one. The ELI splits the signals to the active and loop standby interfaces (LSI). The ELIs also terminate the PIDB clock and synchronization signals for PIDBs 1 through 15. ELI A terminates PIDBs 1 through 8 and ELI B terminates PIDBs 9 through 15.

The 5DOPS Equipment Report identifies number of ELIs equipped per IDCU. Look for the following symbol:

IDCU ONE IDCU EQP FOR 20 DS1(s)
Item 4

IDCUADL ADD'L 20 DS1(s) FOR ONE IDCU **Item 6**

The number of ELIs equipped in the SM can also be found as follows:

ODA	eqidcu	Integrated Digital Carrier Unit Record - used to define the SM, IDCU, ELI, PIDB, and DPIBDs.
RC/V	19.12	Same as ODA eqidcu
Office Records	Form 5174-1	Same as ODA eqidcu

5. How many remote terminals are assigned in the IDCU?

The number of RDTs that can be equipped in an IDCU is a function of the total quantity of DS1s used and the quantity of each type of IDLC interface employed. The 5ESS®-2000 switch software limits the maximum number of RDTs per IDCU to 31.

The 5DOPS ISA Report - Office Totals identifies the office total number of TR303 RTs using the following symbol:

TR303 No. of TR303 RTs in IDCUS 8 **Item 1**

The 5DOPS ISA Report - ISDN SM No 1 identifies the number of TR303 RTs per SM using the following symbol:

TR303 No. of TR303 RTs in IDCUs 8 **Item A**

The 5DOPS rlist provides information on the engineered RTs per IDCUs.

The number of remote terminals equipped in the IDCU can be found as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

6. How many DS1s are equipped per remote terminal? Do you have a protection line?

An IDCU can be arranged for 20 or 40 DS1s. This quantity minus the DS1s used for PUB43801 applications is the number of DS1s available for IDCU systems and indirectly limits the number of RDTs that can be served.

The 5DOPS Equipment Report identifies the number of DS1s provisioned for IDCU-1 as follows:

IDCU ONE IDCU EQP FOR 20 DS1(S) 1

Item 4

IDCUADL ADD'L 20 DS1(S) FOR ONE IDCU 1 **Item 6**

The 5DOPS ISA Report - ISDN SM No 1 identifies the number of DS1s per remote terminal (**Item D**) and protection line(**Item E**).

The number of DS1s (IFAC) per remote terminal equipped in the IDCU can also be found as follows:

ODA	eqifac	IDCU Facility Equipment (IFAC) - used to define the connection between the IDCU and the Remote Terminal or PUB.
RC/V	20.23	Same as ODA eqifac
Office Records	Form 5847	Same as ODA eqifac

The protection line can be found as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

7. How many lines can be assigned in the remote terminals, including hairpin and nailup?

The number of lines that can be assigned within a remote terminal is dependent on the version of IDCU; TR008 or TR303 and the vendor's equipment. The IDCU allows 1 to 2048 lines per remote terminal. Check your local practices for guidelines.

The 5DOPS ISA Report - ISDN SM No 1 identifies the number of Analog Lines (**Item F**), ISDN Lines (**Item G**), and Users (**Item H**).

The 5DOPS Capacity Report - IDCU-1 provides the number of TR008 and TR303 lines and the number of hairpin and nailup time slots (each line requires a time slot) that may be assigned. Look for the following symbol:

CULINES *IDCU TR008 + TR303 LINES* 736 **Item 7**

HPINUTS *IDCU HAIRPIN TIME SLOTS* 32 **Item 9**

CUPUTS *NRT TSI NON-SWITCH SPECIAL TS 0* **Item 10**

IDCU-1 is a TR303 application. In our example, the 736 lines may be assigned analog and/or ISDN for the IDCU. To determine the number of lines that can be assigned per RT, perform the following equation:

CULINES + HPINUTS + CUPUTS ÷ 8 RTs per IDCU = Total lines assigned per RT

$$736 + 32 + 0 \div 8 = 96$$

The number of lines equipped for assignment within the remote terminals equipped in the IDCU for TR303 can also be found as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

8. What types of services can be deployed from the remote terminal?

The types and quantities of lines that are to be assigned within the IDCU can be found on the ISA Report. (**Item F, G, and H**).

The types of lines available for assignment within the remote terminals equipped in the IDCU for TR303 can also be found as follows:

ODA	rterm	Remote Terminal (TR008) Record - used to define the Channel Unit Type (CUTYPE) equipped in the remote terminal.
RC/V	18.15	Same as ODA rterm

9. How many Loop Side Interfaces (LSI) are equipped?

The LSI receives the DS1 signals. Four LSIs are provided in fully equipped IDCUs: two active and two standby. The LSI converts the DS1 to PIDB-like format on the internal bus to the PIDB transmission interface (PTI). The PIDB is the connection from peripheral units to the time slot interchange (TSI) in the 5ESS®-2000 switch. There are 32 time slots per PIDB.

The number of LSIs equipped in the IDCU can also be found as follows:

ODA	eqifac	IDCU Facility Equipment (IFAC) - used to define the connection between the IDCU and the Remote Terminal or PUB.
RC/V	20.23	Same as ODA eqifac
Office Records	Form 5847	Same as ODA eqifac

10. How many PIDBs are equipped?

The PTI contains a TSI function, thus enabling the DS0 time slot to be connected to any PIDB/DPIDB time slot. A maximum of 16 PIDBs is permitted. The sum of PIDBs plus two times the number of DPIDBs must not exceed 30.

The PIDBs for an IDCU are arranged in two service groups, an active group and a standby group. Each group can contain up to 23 (D)PIDBs. The number of PIDBs required is a function of an IDCU circuit-switched traffic usage.

An IDCU service group can be configured for 14 PIDBs when installed in an ISDN SM. Since an IDCU must have a standby for each of its active PIDBs, a maximum of 14 active and 14 standby PIDBs can be assigned to all of the IDCUs in an ISDN SM. The reason it is limited to 14 active and 14 standby PIDBs is due to the PSU Shelf PIDB assignment which also requires a mirror image on the TSIU. Thus, an ISDN SM equipped with one or more IDCUs may not exceed 7 TSSs. A total of 31 PIDBs are available in an SM. PIDB 31 in the SM is reserved for pumping an SM.

The 5DOPS Equipment Report identifies the number of PIDBs per IDCU. Look for the following symbol:

PIDB TSIU PIDB(s)/IDCU 6

Item 11

The 5DOPS ISA Report - ISDN SM No 1 identifies the number of PIDBs equipped per IDCU(**Item I** and **Item J**).

The PIDBs configuration equipped in the SM can also be found as follows:

ODA	eqidcu	Integrated Digital Carrier Unit Record - used to define the SM, IDCU, ELI, PIDB, and DPIBDs.
RC/V	19.12	Same as ODA eqidcu
Office Records	Form 5174-1	Same as ODA eqidcu

11. How many time slots sets are engineered per IDCU?

The number of time slots sets (TSS) engineered per IDCU is determined by dividing the number of engineered PIDBs by 4 (4 PIDBs equal one TSS). Question 10 identifies the reports where the engineered PIDBs may be found. The sample Equipment Report shows 6 PIDBs are engineered for IDCU-1. In our sample office, the number of TSSs engineered is 1+. (6 PIDBs divided by 4 PIDBs per TSSs).

12. How many DPIDBs are equipped?

The number of DPIDBs is a function of the quantities of U-DSLs (D-channels), provisioned B-channels, on-demand B-channels, and TR-303 RDTs (EOCs and TMCs).

The equipped DPIDBs can be found on the 5DOPS Equipment Report as follows:

DPAPH3 PH3(S) ASSOCIATED WITH DPIDB-A

DPBPH3 PH3(S) ASSOCIATED WITH DPIDB-B

DPCPH3 PH3(S) ASSOCIATED WITH DPIDB-C

Item 12

DPDPH3 PH3(S) ASSOCIATED WITH DPIDB-D

The 5DOPS ISA Report - ISDN SM No 1 identifies the DPIDB (**Item K**), PSU Shelf (**Item L**), and Port (**Item M**).

The DPIDBs configuration equipped in the SM can also be found as follows:

ODA	eqidcu	Integrated Digital Carrier Unit Record - used to define the SM, IDCU, ELI, PIDB, and DPIBDs.
RC/V	19.12	Same as ODA eqidcu
Office Records	Form 5174-1	Same as ODA eqidcu

13. What is the capacity of the IDCU?

The 5DOPS Capacity Report has a wealth of information that can be used to aid in administration of your IDCU.

The capacity report will tell you the engineering criteria used, for example, average busy season or high day, per cent blocking, line concentration ratio, number of hair pin time slots, CCS capacity, etc. More detail information can be found in the 235-060-110, *5ESS®-2000 Switch Engineering Practice*.

14.4.2.6.4 Packet Switch Unit (PSU)

14.4.2.6.4.1 General

This section identifies the questions to ask to determine the configuration of the PSU and where to find the information. The PSU is the same unit used for ISLUs and may be shared with IDCUs. Lucent recommends allocating separate protocol handlers for IDCUs and ISDN, and by D-Channel, PPB, PDB, etc.

1. How many shelves are equipped?

The Packet Switch Unit (PSU) has five shelves. The PSU Shelves are numbered 0 to 5. It is not necessary to equip all the shelves in the PSU. The number of shelves equipped in the PSU can be found on the ISDN SM NO. 1 page of the ISA report. The symbol to look for is as follows:

PSUSHVS NO. *PSU SHELVES IN THE ISDN SM* **Item O**

Item I indicates the actual PSU shelf number that is to be assigned.

Other methods to obtain the equipped PSU shelves are as follows:

ODA	eqpsu	Used to define the equipped PSU shelves.
RC/V	22.3	Same as ODA eqpsu
Office Records	Form 5941	Same as ODA eqpsu

2. How many PHs are equipped per shelf?

A PSU may be equipped with up to 16 PHs. The PHs are engineered for specific functions such as Access PHs (PPB, ODB,, ISLU, RISLU, and IDCUs), PRI (Primary Rate Interface), IP (Internal Protocol), ISM (Interswitch Module Link), XAT, trunking for X.75, and X.75'. Protocol handlers are to be used for the function they were engineered. When capacity issues warrant the reallocation of the PH type, the traffic engineer MUST be notified (**Item P**).

The ISM PHs are dedicated for packet links between SMs. The interswitch packet trunk (ISPT) PHs are dedicated to trunks between the 5ESS®-2000 switch and the public packet network switch. Spare PHs are reserved for maintenance and reliability functions.

The OFFICE TOTALS page of the ISA report provides the amount of trunks, XAT channels, ISMs, and PRIs the office was engineered to handle. Each of the X.75, X.75P, IP, XAT, and PRI requires a protocol handler assignment.

Look for the following symbols in 5DOPS:

PRI	Number of PRID Channels
XAT	Number of XAT Channels
IP	Number of IP Trunks
X75	Number of X75 Trunks
X75P	Number of X75 Prime Trunks
ISM	Number of ISM Trunks

The TRUNK/CHANNEL PROTOCOL HANDLER ASSIGNMENTS page of the ISA report indicates the amount of PHs engineered for the "trunking" types and the PSU shelf they are to be located in. It is extremely important to

allocate the PHs by type and PSU shelf assignment since other resources may be used as nailed-up time slots.

The PROTOCOL HANDLER ASSIGNMENTS page of the ISA Report indicates the amount of PHs engineered for Access (voice and packet services assigned to DSLs, packet trunks, Interswitch Module Links (ISM), and spare). Other methods to obtain the number of equipped PIDBs per ISLU Half and/or IDCU are as follows:

ODA	eqpsuph	Used to define the equipped Packet Switch Unit protocol handlers.
RC/V	22.16	Same as ODA eqpsu
Office Records	Form 5742	Same as ODA eqpsu

Sample 5DOPS Equipment Report for TR303 Application:

5ESS Switch Engineering System

EQUIPMENT REPORT

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NPA    = 303          LD      = Base Load Division  LOCATION = domestic
CLLI   = grfngama22c  TYPE    = host                CATEGORY  = idcu-1
ORDNO  = 12345        STATE   = sto                 XGEN      = 9.10
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5DOPS

SYMBOL	5 DOPS TITLE	PRESENT	ADDL	DEF	PROPOSED	O
CU303RT	TR303 RT(S) IN THIS IDCU	0	8		8	Item 1
PIDB	TSIU PIDB(S)/IDCU	0	6		6	Item 11
PPBX25D	PPB CHANNELS ON DPIDB-D	0	8		8	
DPAPH3	PH3(S) ASSOCIATED WITH DPIDB-A	0.00	1.00		1.00	
DPBPH3	PH3(S) ASSOCIATED WITH DPIDB-B	0.00	1.00		1.00	Item 12
DPCPH3	PH3(S) ASSOCIATED WITH DPIDB-C	0.00	1.00		1.00	

DPDPH3	PH3(S) ASSOCIATED WITH DPIDB-D	0.00	1.00	1.00
IDCU	ONE IDCU EQP FOR 20 DS1(S)	0	1	1 Item 4
IDCUADL	ADD'L 20 DS1(S) FOR ONE IDCU	0	1	1 Item 6

Sample 5DOPS ISA Report for TR008 and TR303 Applications:

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

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NPA = 303	LD = Base Load Division	LOCATION = domestic
CLII = grfngama22c	TYPE = host	CATEGORY = ISDN
ORDNO = 12345	STATE = sto	XGEN = 9.10

OFFICE TOTALS

		ISLU	IDCU
CCSPTSM	HD WEIGHTED AVG CCS / BRI CARD	2.02	
BRITCRD	BRI T LINE CARDS	0	
U2B1QCD	BRI 2B1Q U LINE CARDS	0	
UAMICD	BRI AMI U LINE CARDS	0	
ZCRD	Z LINE CARDS	0	
TUZCRD	TOTAL LINE CARDS / IDCUs	0	5152
TR303	NO. OF TR303 RTs IN IDCUs	8	Item 2

TR008	NO. OF TR008 RTs IN IDCUs	48	
NRT	NO. OF PUB43801 DS1s IN IDCUs		14 Item 3
DPPS	WEIGHTED AVG PPS / D-CHANNEL	0.02	
PPB	NO. OF PERM. PKT B-CHANNELS 0	8	
PPBPPS	PERM. PKT B PEAK PPS PER PPB	0.00	20.00
ODB	NO. OF ON-DEMAND B USERS	0	0
ODBCCS	DPIDB OCCUPANCY CCS PER ODB 0.00	0.00	
ODBPPS	ON-DEMAND B PEAK PPS PER ODB	0.00	0.00
PH2SPR	NO. SPARE PH2 / PSU SHELF 1		
PH3SPR	NO. SPARE PH3 / PSU SHELF 1		
XISTF	ISTF OPTION (YES / NO)	n	
IDCU	NO. OF IDCU UNITS	7	Item 5
XSPLFCT	UNIFORM INTER-SM CONN. FACTOR	1.20	
BRIPLGC	BRI CARDS / LINE GRP CNTRLR 0		
MAXPIDB	MAXIMUM PIDBS AT THIS CCS-ISLU	0	
BRILGC	NO. LGC REQD FOR BRI - ISLU 0		
ISDNSM	NUMBER OF ISDN SMS REQUIRED 1		
DLTUSM	NUMBER OF ISDN SMS WITH DLTU	0	

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

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NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = ISDN

ORDNO = 12345

STATE = sto

XGEN = 9.10

ISDN SM No. 1

		ISLU	IDCU
Summary		Qty PH	Qty PH
CCSPTSM	HD WEIGHTED AVG CCS / BRI CARD	2.02	
BRITCRD	BRI T LINE CARDS	0	
U2B1QCD	BRI 2B1Q U LINE CARDS	0	
UAMICD	BRI AMI U LINE CARDS	0	
ZCRD	Z LINE CARDS	0	
TUZCRD	TOTAL LINE CARDS / IDCU LINES	0	736 (3)
TR303	NO. OF TR303 RTs IN IDCUs		8 Item A
TR008	NO. OF TR008 RTs IN IDCUs		0
NRT	NO. OF PUB43801 DS1s IN IDCUs		2 Item B
PPB	NO. OF PERM. PKT B-CHANNELS 0		8 (3)
PPBPPS	PERM. PKT B PEAK PPS PER PPB	0.00	
DPBS	WEIGHTED AVG PPS / D-CHANNEL	0.02	
ODB	NO. OF ON-DEMAND B USERS	0	0
ODBCCS	DPIDB OCCUPANCY CCS PER ODB 0.00		
ODBPPS	ON-DEMAND B PEAK PPS PER ODB	0.00	
PH2RAT	PH2 PER DPIDB (1/4 ISLU BASIS)	0.00	
PH3RAT	PH3 PER DPIDB (1/4 ISLU BASIS)	0.00	
ISMPPH	AVG INTER-SM PROTOCOL HANDLERS	0 EST. (ON PH3)	0 ASGN
PSUSHVS	NO. PSU SHELVES IN THE ISDN SM	1 Item O	
DSU2IF	QTY OF ISTF PACKS ON DSU-2 0		
IDCU	NO. OF IDCU UNITS		1 Item C

RPATS RESERVED RPA/RPM T.S. PER SHF 0

INSMPPS EST. PPS FOR INTER-SM PKT TPT 0

Item I

SM PIDB and LG breakdown PIDBs LGs

IDCU# 1 6

SUM PIDBs 6

SUM LGs 0

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ISDN SM ASSIGNMENTS

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NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = ISDN

ORDNO = 12345 STATE = sto XGEN = 9.10

IDCU PROTOCOL HANDLER ASSIGNMENTS

IDCU# 1 Item K -- X.25B -- ----- PSU -----

Item J	PIDB	DPIDB	PPB	ODB	PH2	PH3	shelf	port
6	A (0)	0	0	0.00	1.00	0	a	
	B (1)	0	0	0.00	1.00	0	b	
	C (2)	0	0	0.00	1.00	0	c	
	D (3)	8	0	0.00	1.00	0	d	
	E (4)	0	0	0.00	0.00	Item L	Item M	

F (5)	0	0	0.00	0.00
G (6)	0	0	0.00	0.00
H (7)	0	0	0.00	0.00
I (8)	0	0	0.00	0.00
J (9)	0	0	0.00	0.00
K (10)	0	0	0.00	0.00

Item D Item E Item G Item F Item H

IDCU# 1 PROT ISDN ANALOG PIDB

RT#	TR	IDENTIFIER	DS1	LINE	LINES	LINES	USERS	NUTS
49	303		4	0	20	72	20	0
50	303		4	0	20	72	20	0
51	303		4	0	20	72	20	0
52	303		4	0	20	72	20	0
53	303		4	0	20	72	20	0
54	303		4	0	20	72	20	0
55	303		4	0	20	72	20	0
56	303		4	0	20	72	20	0
NRT	PUB		2					0

PSU# 1 PROTOCOL HANDLER ASSIGNMENTS

DPIDB	port	- ism -			trk/cnl			spare total								
sf	a(0)	b(1)	c(2)	d(3)	e(4)	f(5)	p2	p3	ts	p2	p3	p2	p3	p2	p3	sum
4	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
3	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
2	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0 Item P
1	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0

0 1.00 1.00 1.00 1.00 0.00 0.00 0 0 0 0 0 0 1 0 5 5

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

NPA = 303	LD = Base Load Division	LOCATION = domestic
CLLI = grfngama22c	TYPE = host	CATEGORY = ISDN
ORDNO = 12345	STATE = sto	XGEN = 9.10

Active PIDBs + DPIDBs for IDCU# 1 = 11

Total IDCU to TSIU PIDB Ports 6

Remaining TSIU Ports 23

ISLU PIDB TS	0	Reserved TS for NXDS0	0
IDCU PIDB TS	96	Spare TS for any unit -->	414
ISTF TS	0	PSU TS demand	0
DLTU TS	0	Available TS for PSU only	0
Inter-SM TS	0	IDCU Nail-up TS for TSIU	0
Packet Trunk TS for PSU	0	Used Nail-up TS for TSIU	0
Recovered DLTU TS	(0)	Avail Nail-up TS for TSIU	190

Sample 5DOPS TR303 Capacity Report:

5ESS Switch Engineering System

CAPACITY REPORT

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

```

-----
NPA    = 303          LD      = Base Load Division  LOCATION = domestic
CLLI   = grfngama22c  TYPE    = host                CATEGORY  = idcu-1
ORDNO  = 12345        STATE   = sto                 XGEN       = 9.10
-----

```

5DOPS

SYMBOL	5 DOPS TITLE	QTY	DEMAND	CAPACITY	%UTL
IDCUHD	IDCU TCBH HD TO ABS RATIO	1.00			
IDCUBLK	PCT BLOCKING ON IDCU	1.50			
ABSCCS	WT AVG DS1 ABS NON-NU CCS/LINE	3.50			
HDCCS	WT AVG DS1 HD NON-NU CCS/LINE	3.50			
PTSLCR	IDCU CIRCUIT SWITCHED LCR	9.74			
CULINES	IDCU TR008 + TR303 LINES	736	Item 7		
CURTDS1	IDCU RT DS1 MINUS PROT LINES	32			
CUTSHR	IDCU RT TIME SLOT INFO HEADER	***			
DS1TSD	TR008 + TR303 DS1 TIME SLOT DE		204		
CSTSD	TR008/TR303 CKT SW AND ODB TS		92		
PPDNUTS	TR303 PPD TIME SLOTS		40		
PPBNUTS	TR303 PPB TIME SLOTS		8		
TSINUTS	TR008+TR303 TSI NON-SW SPC TS		0		
HPINUTS	IDCU HAIRPIN TIME SLOTS		32	Item 9	
MTCETS	TR003 EOC/TMC TIME SLOTS		32		
DS1TSC	TR008+TR303 DS1 TIME SLOT CAP			768	
DS1TSU	TR008+TR303 DS1 TIME SLOT UTL				27

CUPUDS1	IDCU NRT DS1(S)	2	Item 8	
CUPUTS	NRT TSI NON-SWTC SPECIAL TS		0	Item 10
PITSDEM	IDCU PIDB TIME SLOT DEMAND		92	
PITSCAP	IDCU PIDB TIME SLOT CAPACITY			96
PITSUTL	IDCU PIDB TIME SLOT UTL			96
CUUSGHR	IDCU USAGE INFO HEADER	***		
CUCCSDE	IDCU PIDB WT. AVG. CCS/LINE DE		3.50	
CUCCSCA	IDCU PIDB CCS/LINE CAPACITY			5
CUCCSUT	IDCU PIDB CCS/LINE UTL			70
IDCUTD	IDCU PIDB LINE DEMAND		736	
IDCUTC	IDCU PIDB LINE CAPACITY			768
IDCUTU	IDCU LINE UTL			96
CUUSGTD	IDCU PIDB USAGE DEM - LINES		736	
CUUSGTC	IDCU PIDB USAGE CAP - LINES			889
CUUSGCD	IDCU PIDB USAGE DEMAND - CCS		2576	
CUUSGCC	IDCU PIDB USAGE CAP - CCS			3111
CUUSGU	IDCU USAGE UTL			83
IDCUMLU	IDCU MOST LIMIT - USG (ABS,HD)	abs		
IDCUML	IDCU MOST LIMIT - (USG, LINES)	lines		
IDCUMLC	IDCU ML CAPACITY IN LINES		768	
CUDCHI	IDCU D-CHAN PKT INFO HEADER	***		
CUPKTLN	IDCU ISDN LINES		160	
CUDPPS	IDCU WT. AVG. D-CH DATA PPS/LN		2.00	
DCHDPD	IDCU D-CHAN DPIDB(S)		3	
DCHPDPB	IDCU D-CHAN PER DPIDB RATIO		80.00	
DPPSDEM	IDCU D-CHAN DPPS DEMAND			320

5ESS Switch Engineering System

CAPACITY REPORT

ISSUE: 16.00 VERSION: 2

DATE: 21FEB94 @ 13:18 CST

```

-----
NPA    = 303          LD      = Base Load Division  LOCATION = domestic
CLLI   = grfngama22c  TYPE    = host                CATEGORY  = idcu-1
ORDNO  = 12345        STATE   = sto                XGEN      = 9.10
-----

```

5DOPS

SYMBOL	5 DOPS TITLE	QTY	DEMAND	CAPACITY	%UTL
DPPSCAP	IDCU D-CHAN DPPS PH CAPACITY			480	
DPPSUT	IDCU D-CHAN DPPS PH UTIL.				67
CUPPBI	IDCU PPB PKT INFO HEADER	***			
IDCUPPB	IDCU PPB CHANNELS	8			
CUBPPS	IDCU WT. AVG. PPB DATA PPS/LN	20.00			
PPBDPD	IDCU PPB DPIDB(S)	1			
PPBPDPD	IDCU PPB PER DPIDB RATIO	8.00			
BPPSDEM	IDCU PPB DATA PPS DEMAND		160		
BPPSCAP	IDCU PPB DATA PPS PH CAPACITY			160	
BPPSUTL	IDCU PPB DATA PPS PH UTIL				100
CUODBI	IDCU ODB USER INFO HEADER	***			
IDCUODB	IDCU ODB USERS	0			
CCSPODB	IDCU WT AVG CCS/ODB USR -DPIDB	0.00			
PPSPODB	IDCU WT AVG DATA PPS/ODB USER	0.00			

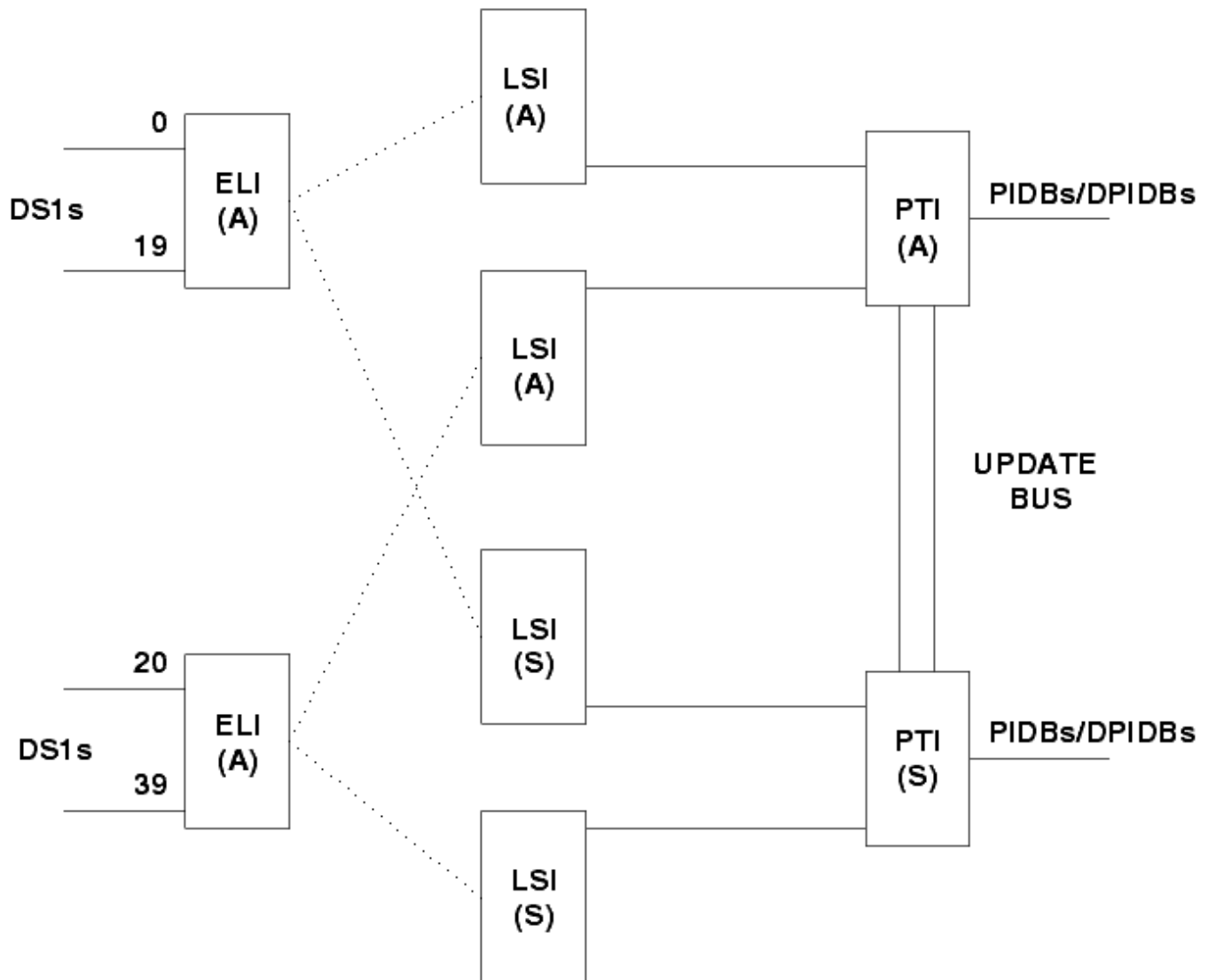
ODBDPD	IDCU ODB DPIDB (S)	0		
ODBDPDE	IDCU ODB CCS DPIDB DEMAND	0		
ODBDPCA	IDCU ODB CCS DPIDB CAPACITY		0	
ODBDPUT	IDCU ODB CCS DPIDB UTL			0
AVGUSPH	IDCU ODB AVG USERS/PH - DEMAND	0		
ODBASPH	IDCU ODB USERS/PH - CAPACITY		0	
AVGUSUT	IDCU ODB AVG USERS/PH - UTL			0

14.4.3 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

Traffic measurement sections 139, 140, 141, 142, and 143 are available in TRFC30.

- Attempts, blocked attempts, traffic usage, maintenance usage, and DS1 time slot quantities for each RDT
- PIDB traffic for each IDCU
- DPIDB traffic for each IDCU
- Message traffic on the EOCs and TMCs for TR-303 RDTs in existing packet counts.

Traffic and hardware related events associated with IDCU are counted, as appropriate, in existing hourly, 24-hour, and monthly plant measurements. When a nailed-up or hair-pinned circuit is disconnected due to a failure, the existing count for nail-up failures (lost nail-up connections, part 1A of 24-hour plant report) are incremented.

**LEGEND:**

ELI - ELECTRICAL LINE INTERFACE

LSI - LOOP SIDE INTERFACE

PTI - PERIPHERAL TRANSMISSION INTERFACE

(A) - ACTIVE

(S) - STANDBY

Figure 14.4-1 IDCU Block Diagram

14.5 ISDN SOFTWARE UPDATES

14.5.1 ISDN FEATURE INFORMATION

ISDN related software changes are constantly evolving and changing with each new software release. Information regarding ISDN features such as feature descriptions, engineering considerations, retrofit and growth procedures, may be found in the 5ESS®-2000 switch 235-100-125 *System Description*, feature manuals in the 235-190-XXX *Feature Description* series, and 235-105/106-XXX *Maintenance/Retrofit/Update/Growth Documents*. Features impacting switch administration, and engineering that is applicable to ISDN administration tasks are discussed in the appropriate sections of this document.

14.5.1.1

14.5.1.1.1

14.5.1.1.1.1 Measurements

Measurements on the TRFC30 Section 92 are provided for each X.75' trunk group. The incrementing of counts in these measurements is a function of the activity on the individual trunk group. When alternate routing between trunk groups results in activity (attempts or calls) on more than one trunk group for the same call, the measurements are incremented for each trunk group independent of what might have been counted on other groups. This strategy is consistent with existing internal protocol (IP) trunk group alternate routing.

In addition, calls that transit from one X.75' port to another X.75' port in the same switch peg the "Tandem Calls" count on TRFC30 Section 69. (The tandem calls count on TRFC30 Section 69 now includes IP-IP, IP-X.75', IP-X.75, X.75'-X.75', X.75'-X.75, and X.75-X.75 tandem calls.)

14.5.2 Traffic Counts for Trunk Group Engineering

The IPC, OPC, and OFL in TRFC30 Section 12 are incremented once for each narrow band or wideband call. Trunk group counts are provided for incoming, outgoing, and overflow "total DS0s" (IPCTT, OPCTT, and OFLTT). These counts are pegged **N** times for the total trunks requested for all calls. Data generated by these counts support trunk group engineering. Counts of IPC and OPC can be compared with IPCTT and OPCTT respectively to determine the extent of wideband traffic on a trunk group.

Data reported in IPC and IPCTT provide a view of bulk arrival of incoming traffic on a trunk group during the period being studied. For OPC and OPCTT, the data provide a view of bulk use of facilities for outgoing calls on a trunk group. In the case of a PRI trunk group, OPC and OPCTT can also provide a view of the extent of wideband traffic to a particular customer during a period of interest.

The value of OFLTT compared to OFL can be used to determine patterns in overflow by traffic types. If OFL is low compared to OFLTT, wideband calls are overflowing the trunk group. This provides a view of quality of service provided for wideband calls. If the trunk group is PRI, the quality of service can be related to a particular customer. If the trunk group is ISUP7, overflow provides a measure of the extent that the trunk group is serving the network objectives for wideband connectivity.

Patterns on these counts during study intervals can be used in conjunction with random outputs from the OP:CHANMAP command to determine the DS0 vs. wideband traffic patterns on a trunk group. On narrow band trunk groups, the data generated by existing peg counts IPC, OPC, and OFL are the same as "total trunk" counts IPCTT, and OFLTT.

14.5.2.1 Engineering Considerations

Table 14.5-1 shows the acceptable NCT link occupancy levels for SMs supporting Fractional DS1/ISDN.

Occupancy is controlled by leaving a certain number of time slots unused and is based on the bandwidth of the supported calls. The table shows the acceptable NCT link occupancy for 384, 768 and 1536 Kbps data rates.

For an existing SM, the number of unused time slots depends on the current vs. acceptable NCT link occupancy for the bandwidth of the supported calls on the SM. Occupancy is measured by the Network Time Slot Usage (NTSUSG) count in TRFC 30 Section 9, a 100-second scan of all 512 network time slots in the SM.

NOTE: The SMs in Tables 14.5-1 and 14.5-2 also include RSMs and ORM with TRCUs that are equipped with inter-SM trunking and 2-mile optically remoted modules.

Table 14.5-1 Acceptable NCT Link Occupancy Levels

	SM			ORM w/TRCU
	1536 Kbps	786 Kbps	384 Kbps	384 Kbps
PERCENT OCCUPANCY	73	78	79	75

To calculate occupancy from NTSUSG, use the formula:

$$Occupancy = \frac{NTSUSG}{18432} \times 100$$

The number of unused time slots needed can be achieved by deloading the SM. This can be accomplished by removing a Line Unit or a Trunk Unit from the SM. Removing either unit frees 64 unused time slots. A second alternative is to remove a DFI pack which frees 32 time slots. Table 14.5-2 shows the number of unused time slots needed to achieve the acceptable NCT link occupancy level for 384 Kbps, 768 Kbps and 1536 Kbps calls.

If all wideband calls originate and terminate on the same SM (intra-SM calls), NCT link occupancy is within normal levels and it is not necessary to provide unused time slots.

Table 14.5-2 Unused Time Slots Based on Current NCT Occupancy

CURRENT OCCUPANCY	SM			ORM w/TRCU
	1536 Kbps	786 Kbps	384 Kbps	384 Kbps
72	0	0	0	0
73	0	0	0	0
74	32	0	0	0
75	32	0	0	0
76	32	0	0	32
77	32	0	0	32
78	32	0	0	32
79	32	32	0	32
80	64	32	0	32
81	64	32	32	32
82	64	32	32	64
83	64	32	32	64
84	64	32	32	64
85	64	64	32	64
86	96	64	32	64
87	96	64	64	64

14.5.3 Redefine PH2 Access Image

To provide continued support for the Protocol Handler Model 2 Access Image (PH2A), this feature relieves potential PH2A memory exhaust in ISDN and OSPS applications. This feature also preserves the usefulness of the large embedded base of 1681PH2s. By removing packet data (X.25) capabilities from the PH2A, sufficient memory is recovered allowing existing and future voice and circuit switched data features to be provisioned on the lower cost PH2A.

As a result of the PH2 redefinition, only the four PH channels 0, 4, 8, or 12 can be assigned for Inter-Switch Module

nail-up in the PH2. For limitations due to this feature, refer to 235-190-105, *Custom ISDN Features*, and 235-190-110, *National ISDN Feature Descriptions*.

14.5.3.1 Engineering Consideration

To retrofit a 5ESS®-2000 switch from 5E8 to a later software release, all Integrated Services Digital Network (ISDN) lines using packet data features must be terminated on PH3s or PH4s. This requires one of the following actions:

- Reassigning ISDN X.25 lines to existing PH3s or PH4s
- Replacing PH2s with PH3s or PH4s
- Adding sufficient PH3s to handle the X.25 traffic then reassign ISDN X.25 lines to PH3s or PH4s
- Reassign all ISM channels to PH channels 0, 4, 8, or 12 only.

The amount of reassignment of lines to PH3s or PH4s depends upon the packet feature penetration and upon previous packet feature assignment philosophy used by the switch administrators.

14.5.4 PERFORMANCE ESTIMATES FOR X.25 PACKET SWITCHING

Delay throughput curves are provided for the PH2 access PHs and inter-SM PHs as well as the inter-SM time slot. The primary use of the delay throughput curves is to estimate the data transfer delays on intra- and inter-SM reference connections. The data transfer delay is defined as the time between the entry of the last byte of a packet into the originating SM and the departure of the first byte of the packet from the terminating SM. Components of the reference connections are shown in Figure 14.5-1.

14.5.4.1 Inter-SM Reference Connection

An inter-SM connection is between two SMs on the same switch. Inter-SM connections involving RSMs are specifically excluded. This exclusion results from protocol differences between SMs and RSMs which affects packet delays. The components of the data transfer delay on an inter-SM connection are as follows:

- Sending Access PH — The access PH acts as the main processing element end-user B- and D-channels. It terminates the X.25 access protocol and originates the IP protocol which is used between the sending and receiving access PHs.
- Packet Bus — The packet bus operates at 10 Mbps and is used for transporting packets between PHs in an SM. It does not contribute significantly to the data transfer delay when it is operated at the projected loads.
- Sending Inter SM PH — The inter-SM PH provides an interface to the 64 kb/s time slots, and performs minimal routing functions.
- Inter-SM Time slot — The 64 kb/s inter-SM time slots are "nailed-up" between SM pairs, and provide packet connectivity between them.
- Receiving Inter-SM PH — The inter-SM PH provides an interface to the 64 kb/s time slots, and performs minimal routing functions.
- Receiving Access PH — The receiving access PH terminates the IP protocol and communicates with the receiving terminal using the X.25 protocol.
- Queuing for the Receiving B- or D-channel — If packets are processed by the receiving access PH faster than they can be inserted onto the B- or D-channel, they are queued in the receiving access PH. The B- or

D-channel queuing delays are completely determined from the load which the user places on the channel.

14.5.4.2 Intra-SM Reference Connection

An intra-SM reference connection is within a single SM. The connection is inter-PH (where sending and receiving lines are on different PHs). For an intra-SM, inter-PH connection, the delay components are:

- Sending access PH
- Packet bus
- Receiving access PH
- Queuing for the receiving B- or D-channel.

14.5.4.3 Methodology

14.5.4.3.1 Protocol Handlers

The delay throughput curves for the PHs were constructed using a detailed simulation model. The input parameters for the PH2 [5E2(4)] simulation were obtained by scaling the PH1 parameters to reflect an internal clock speed up from 8 MHz to 10 MHz, and they were adjusted to reflect increased processing time due to 128 channels in PH2 as compared to 16 channels in PH1. The simulation model was then validated against measurements. For PH2 (5E5 software release), the input parameters are based on real-time measurements that were made following significant software improvements made for this software release.

14.5.4.3.2 Model Assumptions

The following are the assumptions made for the delay throughput curves for the PHs:

- All the curves are constructed assuming Poisson arrivals to the components. For inter-SM PHs, the traffic is likely to be close to Poisson or perhaps even smoother than Poisson. However, for the access PHs, this assumption is optimistic: traffic data is anticipated to be more bursty than Poisson estimates, thus yielding higher delays.
- Traffic was assumed to be balanced. (that is, the number of originating and terminating packets are equal on each PH or time slot.) If traffic is unbalanced, delays will increase.
- The data packet mixes which were used to estimate the receiving B- and D-channel delays and the time slot delays are provided in Table 14.5-3. The time slot delays are computed assuming no IP credits because these credits are normally issued only in congestion.

Table 14.5-3 Data Packet Mixes for Time Slot B- and D-Channel Delays

MIX	BYTES
1	All 256 bytes
2	Equal mix 1, 64, 128, 256 bytes
3	All 128-bytes
4	40 percent 1 byte, 25 percent 64 bytes 25 percent 128-bytes, 10 percent 256 bytes
5	All 25 bytes
6	All 1 byte

14.5.4.3.3 Simulation Assumptions

The following simulation assumptions are made for the delay throughput curves for the PHs:

- The simulations are shown for 128-byte packets. In reality, there is a small dependency of processing time on packet size.
- The delay curves were constructed assuming that the CPE sends explicit Layer 2 acknowledgments to all packets. The delays would be reduced if the CPE piggy-backed Layer 2 acknowledgements.

14.5.4.4 Interpretation of Figures

Figure 14.5-2 through 14.5-6 provide the sending and receiving delays for PH2 5E7 LAPD access PH. Figures 14.5-7 through 14.5-13 illustrate the PH3 sending and receiving delays.

The following points are helpful in interpreting the figures:

- Access PH delays are separated into sending and receiving delays corresponding to the sending and receiving PHs. The sending or receiving delay is defined as the delay from the time that the last byte of a packet enters the PH until processing is completed on the last byte of the packet and the packet is transferred to the output queue. Two delay throughput curves are shown in each figure. The bottom curve corresponds to the mean delay, and the top curve corresponds to the mean plus two standard deviations of the delay. A calculation of the entire delay distribution must be made to determine the precise percentile corresponding to the mean plus two standard deviations. However, significant statistical difficulties are encountered in using a simulation to estimate tail percentile with precision.
- The PH capacities are quoted in dpps. The number of dpps is the total number of data packets per second that are processed by the PH. The number of dpps is the total number of packets per second that are processed by the PH.
- The time slot and receiving B- and D-channel delays and capacities correspond to a single direction. The time slots and B- and D-channels are fully duplex. The delays do not include transmission, and correspond to the time between the arrival of the last byte of a packet to the transmission queue and the departure of the first byte from the transmission queue.

14.5.4.5 Comparison With Measurements

The PH2 predicted delays were validated against measurements. An X.25 load generator was used to place background loads on the connection, and delays were monitored for the following configurations:

- 1-byte data packet on an intra-SM reference connection
- 128-byte packet on an intra-SM reference connection
- 1-byte packet on an inter-SM reference connection
- 128-byte packet on an inter-SM reference connection with 128-byte background on the time slot.

In all configurations, the sending and receiving access PHs were LAPB, the originating and terminating lines were on different PHs, and in the inter-SM configurations all inter-SM traffic was on the same inter-SM time slot. The load generator produced the required load by generating packets on 6 B-channels. The load on each B-channel was generated at equally spaced intervals and there was a random synchronization between B-channels which could not be recorded or controlled. Thus, the observed delays are expected to be between the predicted delays based on equally spaced or deterministic arrivals and Poisson arrivals.

14.5.4.6 X.25 Data Transfer Delay

Several delay measurements are discussed:

- **Mean Delay** — The mean switch delay for a reference connection can be computed by summing the mean delays for each component. However, because of the distributed nature of the 5ESS®-2000 switch architecture, it is not readily apparent how to estimate the loads on different switch components. One assumption is that each component is operating at engineered capacity. This probably over estimates observed delays since it is likely that not all switch components are operating as engineered capacity simultaneously, but the 5ESS®-2000 switch should be able to support such a configuration.
- **Zero Load Delay** — The zero load delay is calculated by assuming that the switch is completely unloaded, and therefore, there is no queuing for any component in the reference connection. This delay is useful because it represents the minimum achievable delay for a particular reference connection.
- **Delay Percentiles** — It is difficult to estimate higher percentiles of the switch delay because there is limited information about the delay distribution of the PHs and the time slots. As an example, the data transfer delay for an inter-SM reference connection is the sum of the random variables:

X_1	The delay in the sending access PH
X_2	The delay queuing for and being transmitted on the packet bus
X_3	The delay in the originating inter-SM PH
X_4	The queuing delay for the inter-SM time slot
X_5	The transmission on the inter-SM time slot
X_6	The delay in the receiving inter-SM PH
X_7	The delay queuing for and being transmitted on the packet bus
X_8	The delay in the receiving access PH
X_9	Queuing delay for the receiving B- or D-channel.

Thus, the data transfer delay may be expressed as:

$$S = \sum_{i=1}^9 X_i$$

14.5.5 PROTOCOL HANDLER REAL-TIME USAGE

The following tables display the real time associated with data packets and packet-switched calls. Real time for call attempts include both setup and teardown of the call. Since the PH capacities are given in data packets per seconds, the effect of call setups on the PH occupancy may be accounted for using these tables. However, the rate of call setups for all known and expected applications in the field is negligible compared to the PH capacity, making this unnecessary.

The real time for data packet is stated for 128-byte packets. The real time per data packet may be up to 1 ms less for smaller data packet sizes.

14.5.5.1 Access Protocol Handler Real Times

Table 14.5-4 provides the real times associated with different packet types and call types in the Access PH. ``Originating" refers to a packet or call entering the PH from the D- or B-channel, and ``terminating" refers to a packet entering the PH from the packet bus. The real times for data packets assumes an inter-PH, inter-SM reference connection. The real times for intra-SM, intra-access PH, and intra-SM, interaccess PH packets are slightly less.

Additionally, for billed packet-switched calls, there is a software limit of 1.3 calls per second per PH, typically in the originating access PH (an exception is reverse billed calls.) For all known and expected applications in the field, this does not limit the traffic that can be offered to the switch.

Table 14.5-4 Access Protocol Handler Real Times(ms)

TRAFFIC TYPE	5E10/5E13 PH2	5E10/5E13 PH3/4
Originating Data Packet (LAPB 128 Bytes)	12.1	3.7
Originating Data Packet (LAPD 128 Bytes)	12.7	3.7
Terminating Data Packet (LAPB 128 Bytes)	11.7	3.7
Terminating Data Packet (LAPD 128 Bytes)	10.8	3.3
Originating Free Packet-Switched Call	50	15
Terminating Free Packet-Switched Call	50	15
Originating Billed Packet-Switched Call	80	25
Terminating Billed Packet Switched Call	50	15
Uncompleted Call Attempt	80	27
Originating Q.931 Packet	5	2
Terminating Q.931 Packet	5	2

14.5.5.2 Inter-SM Protocol Handler Real Times

Table 14.5-5 provides the real time associated with different packet types and call types in the inter-SM PH. Since billing records are not generated in the inter-SM PH, there is no distinction between billed and free calls.

``Originating" refers to packets entering the inter-SM PH from the packet bus, and ``terminating" refers to packets entering from the inter-SM time slot.

Table 14.5-5 Inter-SM Protocol Handler Real Times(ms)

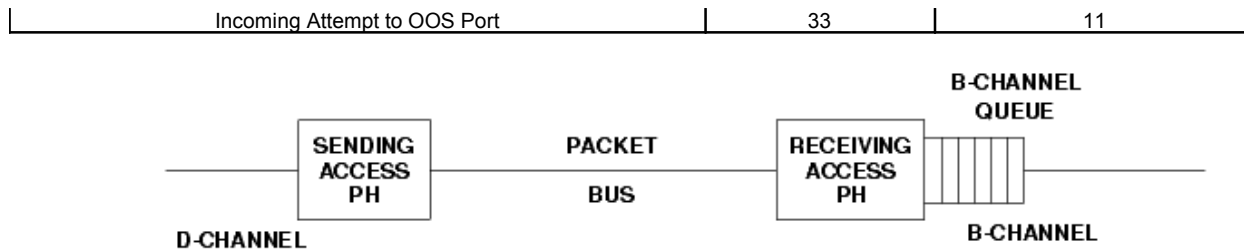
TRAFFIC TYPE	5E10/5E13 PH2	5E10/5E13 PH3/4
Originating Data Packet (128 bytes)	6.1	1.6
Terminating Data Packet (128 bytes)	6.0	1.6
Originating Packet-switched call	17	4.8
Terminating Packet-switched call	17	4.8

14.5.5.3 X.75 and X.75' Protocol Handler Real Times

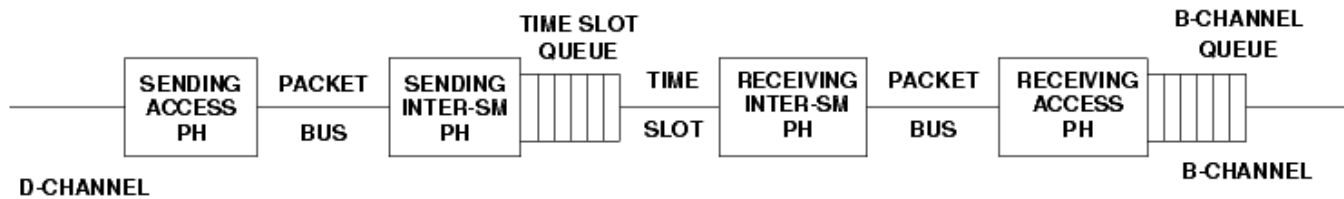
Table 14.5-6 provides the real time associated with different packet types in the X.75 and X.75' PH. ``Incoming" refers to packets entering the PH from the interswitch link, and ``outgoing" refers to packets or call requests delivered by the PH to the interswitch link. Billing records are not generated in an X.75' PH, so there is no distinction between billed and free calls. In an X.75 PH, billing records are generated in both the incoming and outgoing directions. As in the access PH, there is a software limit of 1.3 billed calls per second per PH. For all known and expected applications in the field, this does not limit the traffic that can be offered to the switch.

Table 14.5-6 X.75/X.75' Protocol Handler Real Times(ms)

TRAFFIC TYPE	PH2	5E10/5E13 PH3/4
Incoming Data Packet (128 bytes)	11.3	3.7
Outgoing Data Packet (128 bytes)	11.6	3.7
Incoming Free Packet-switched called	50	15
Outgoing Free Packet-switched call	50	15
Incoming Billed Packet-switched call (X.75 only)	80	25
Outgoing Billed Packet-switched call (X.75 only)	80	25
Incoming Attempt to Invalid Number	24	8



A) COMPONENTS OF INTRA-SM DELAY COMPUTATION



B) COMPONENTS OF INTER-SM DELAY COMPUTATION

Figure 14.5-1 Components of SM Delay Computation

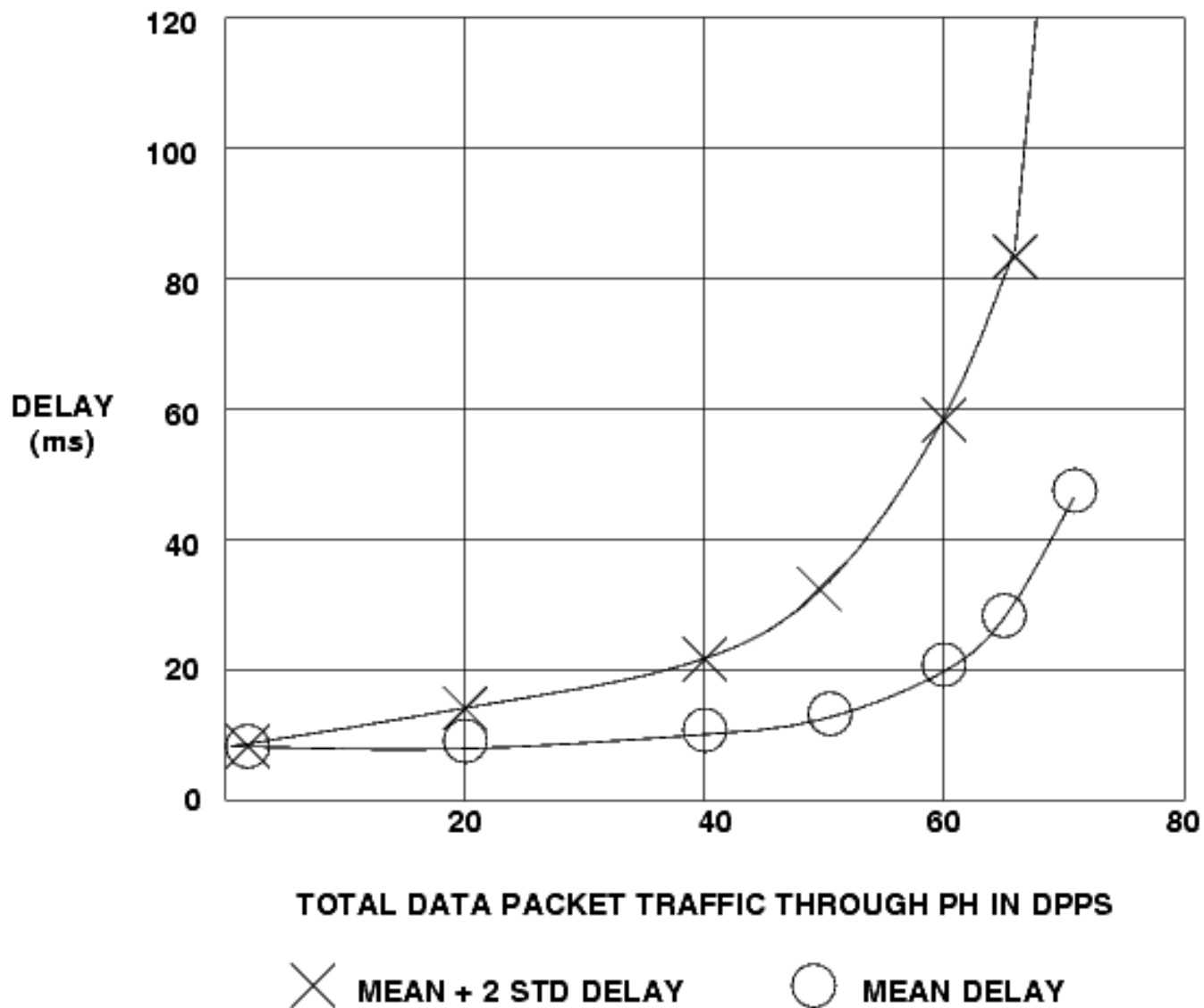


Figure 14.5-2 PH2 5E7 and Later Software Release LAPD Access PH Sending Delay

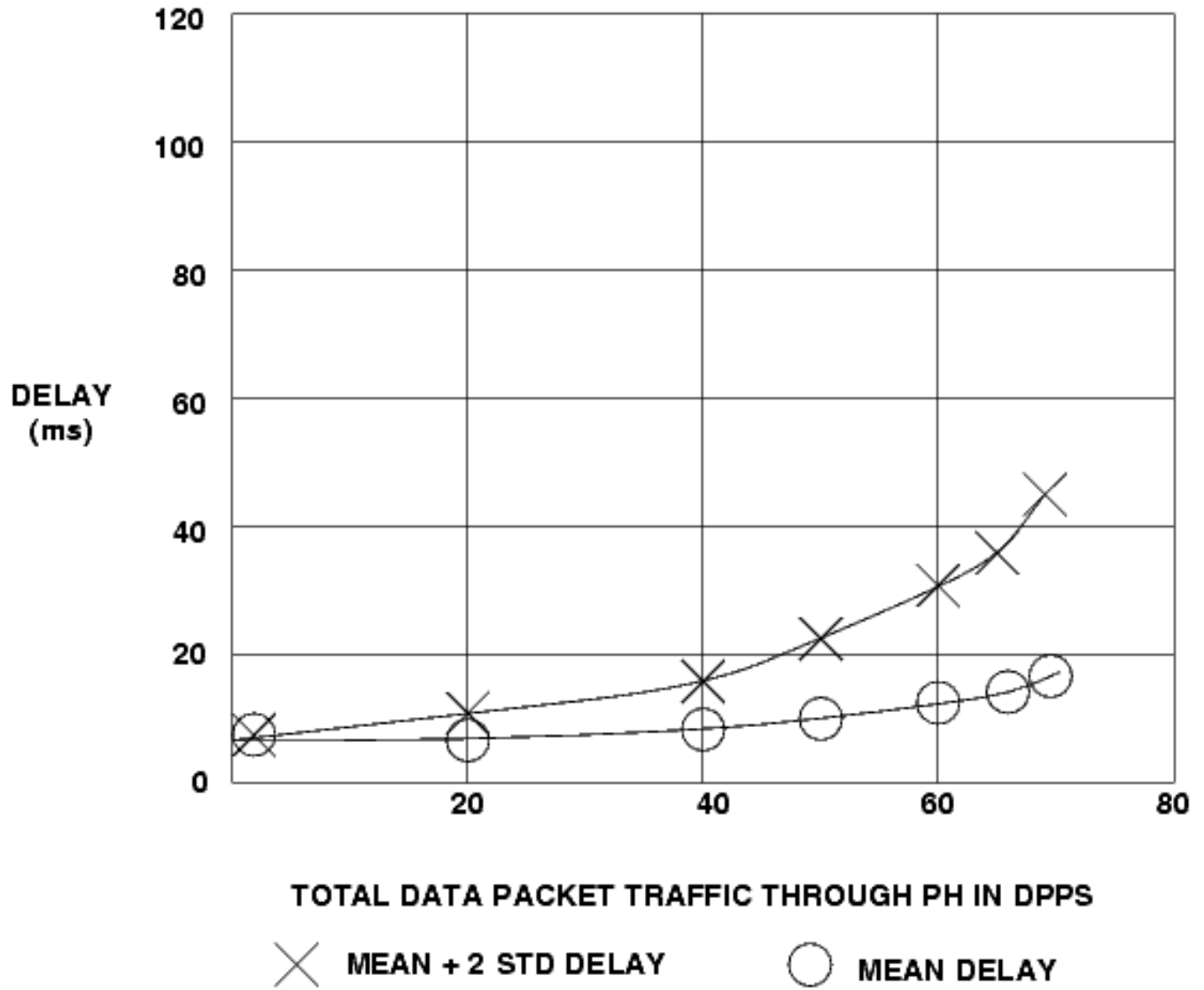


Figure 14.5-3 PH2 5E7 and Later Software Release LAPD Access PH Receiving Delay

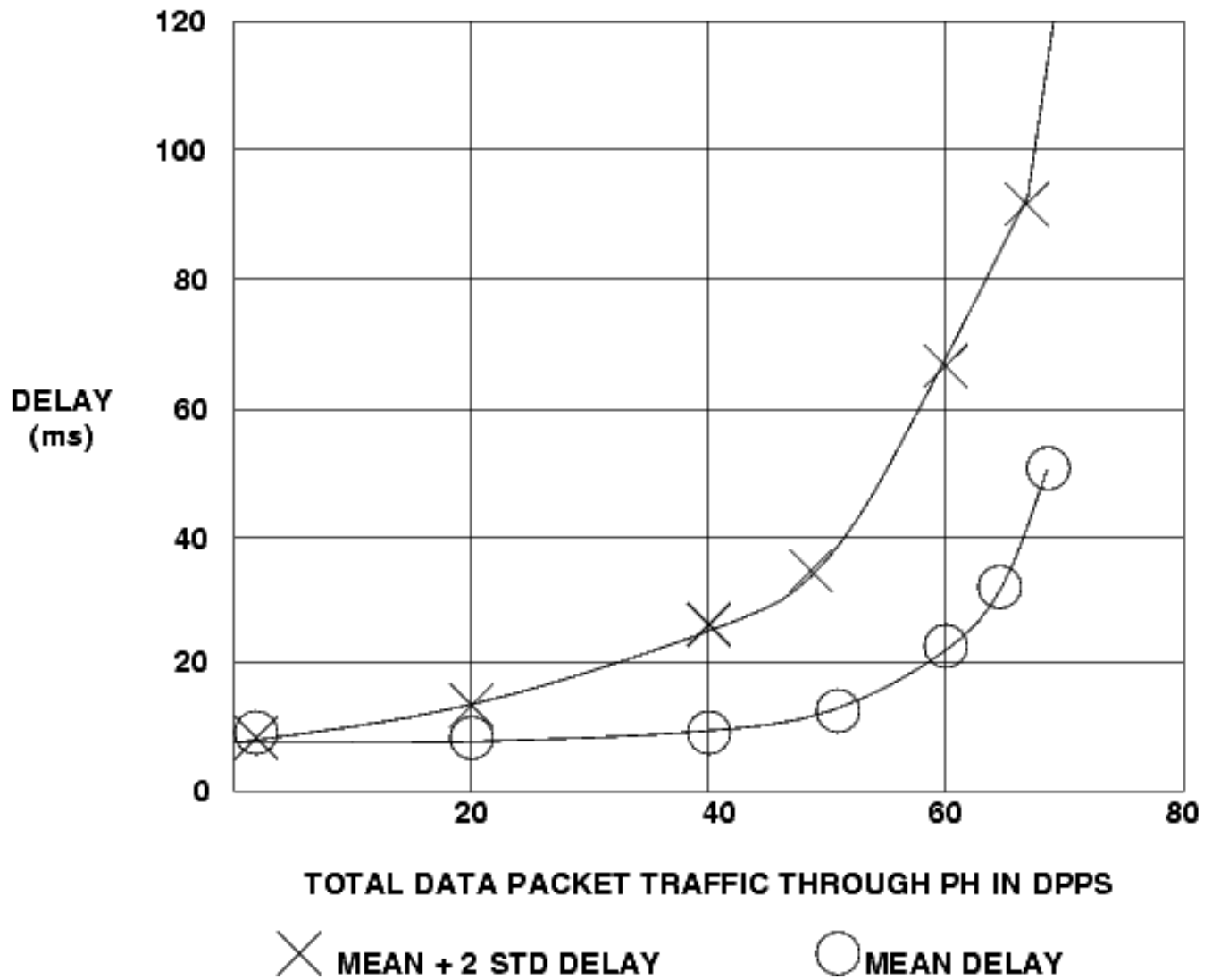


Figure 14.5-4 PH2 5E7 and Later Software Release LAPB Access PH Sending Delay

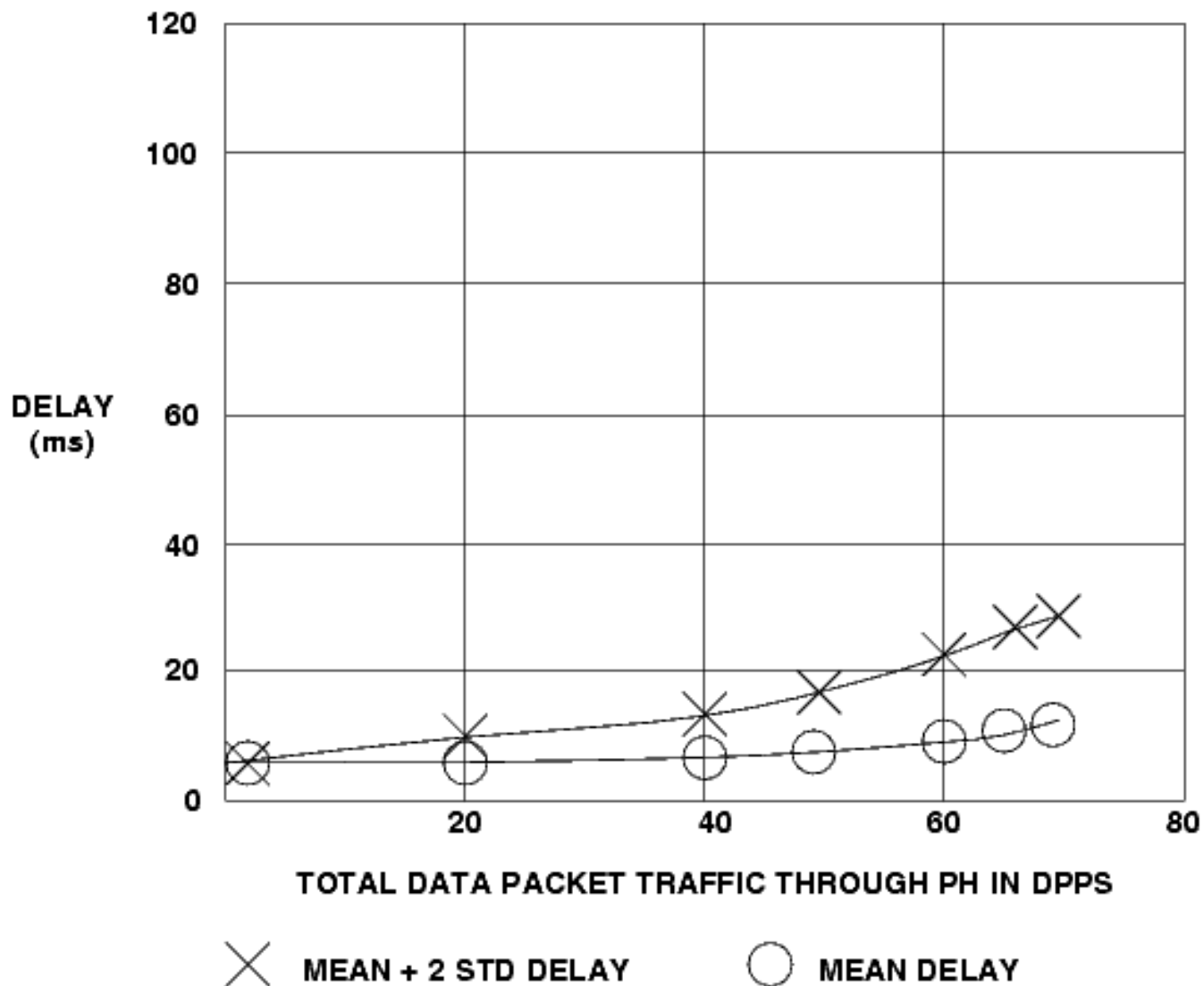


Figure 14.5-5 PH2 5E7 and Later Software Release LAPB Access PH Receiving Delay

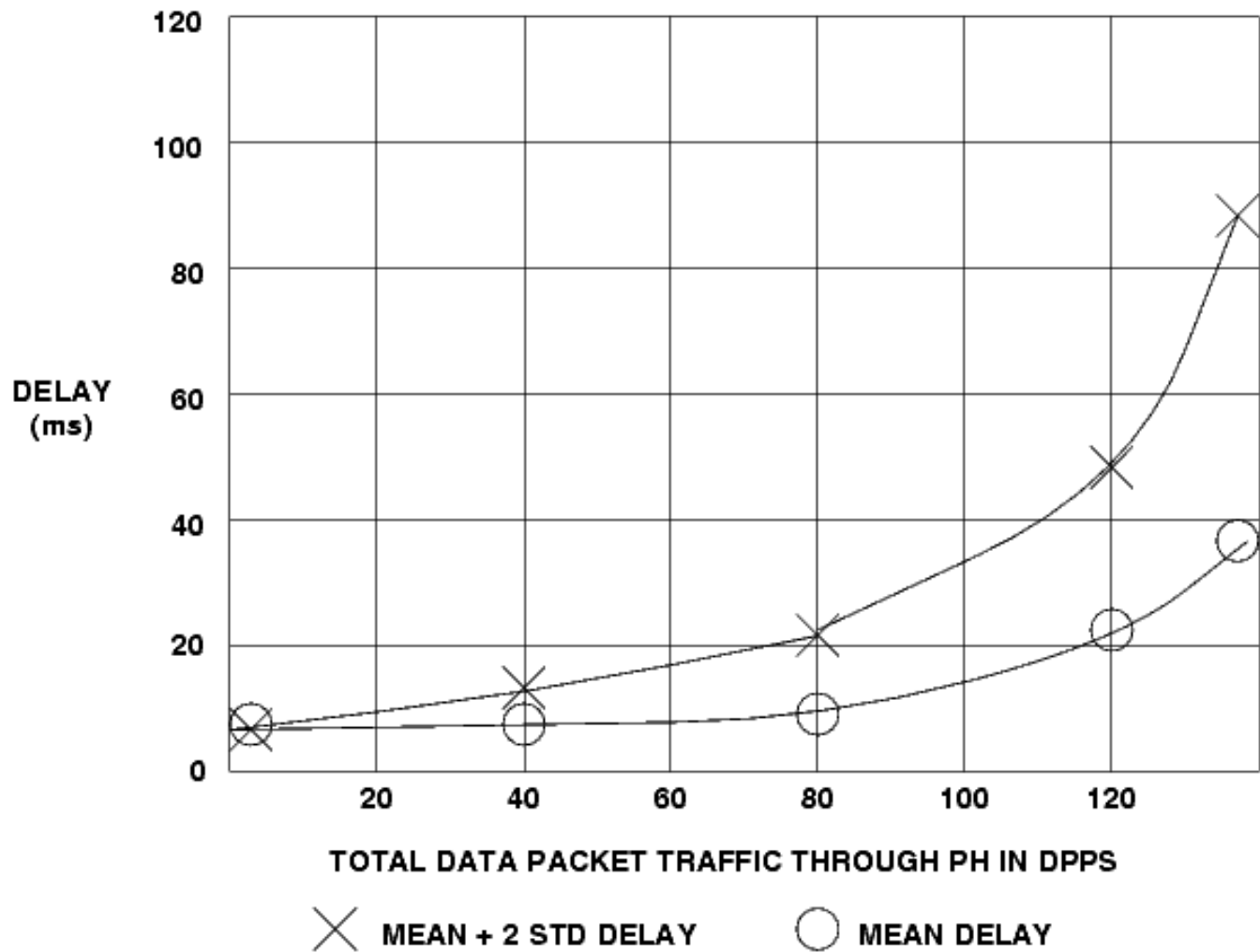


Figure 14.5-6 PH2 5E7 and Later Software Release Inter-SM PH Sending and Receiving Delay

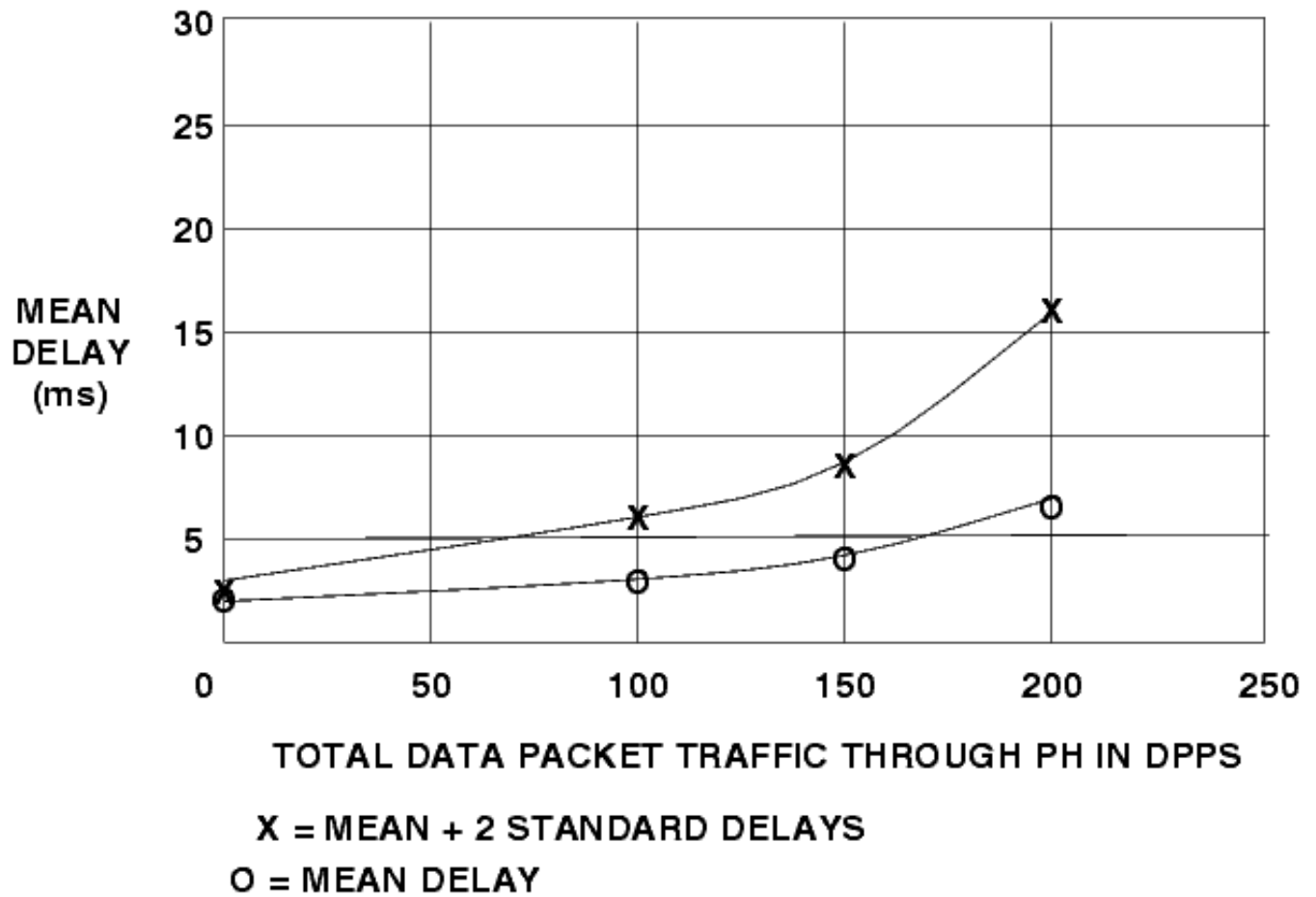


Figure 14.5-7 PH3 PH4 5E8 and Later Software Release LAPD Access PH Sending Delay

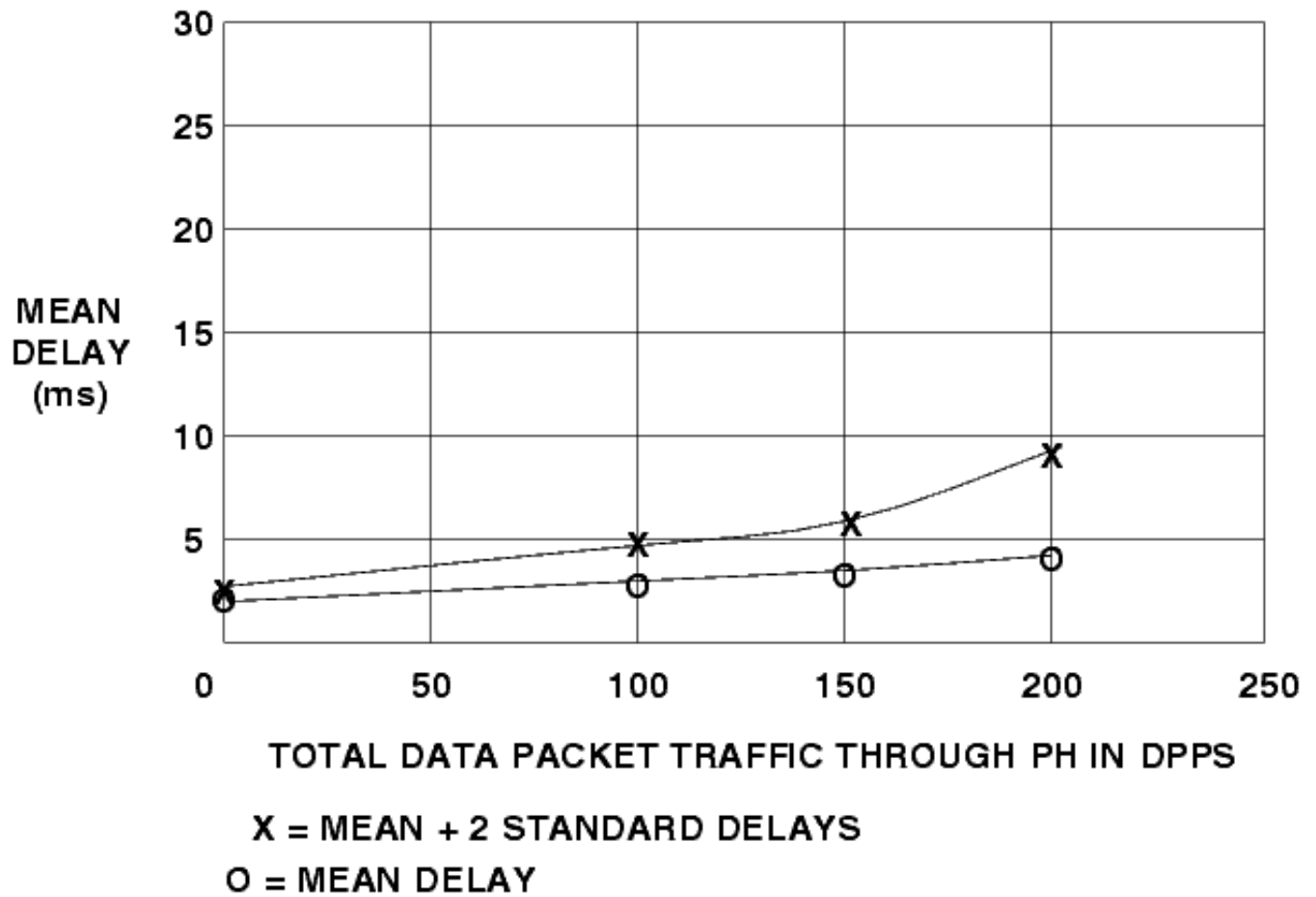


Figure 14.5-8 PH3 PH4 5E8 and Later Software Release LAPD Access PH Receiving Delay

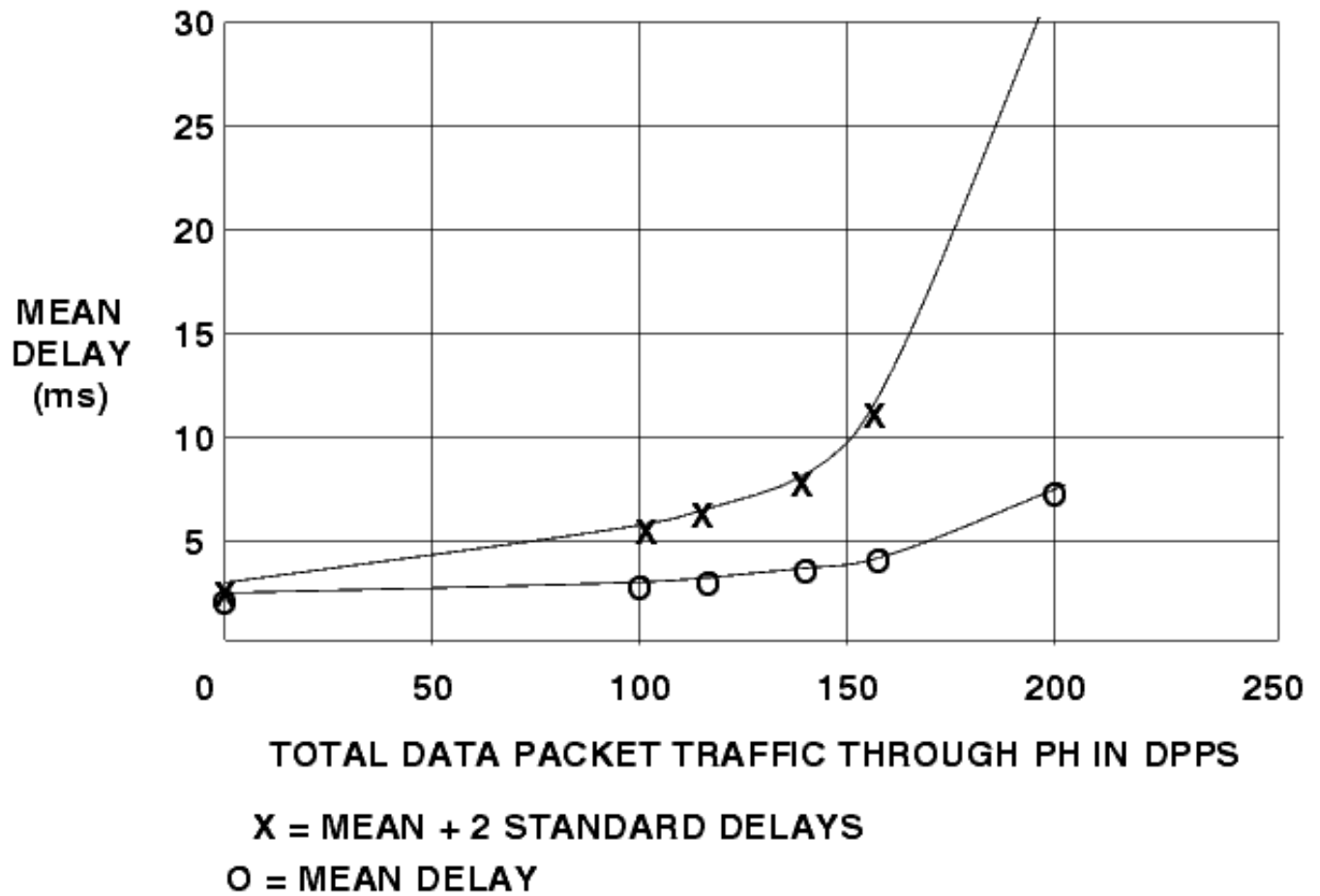


Figure 14.5-9 PH3 PH4 5E8 and Later Software Release LAPB Access /X.75' PH Sending Delay

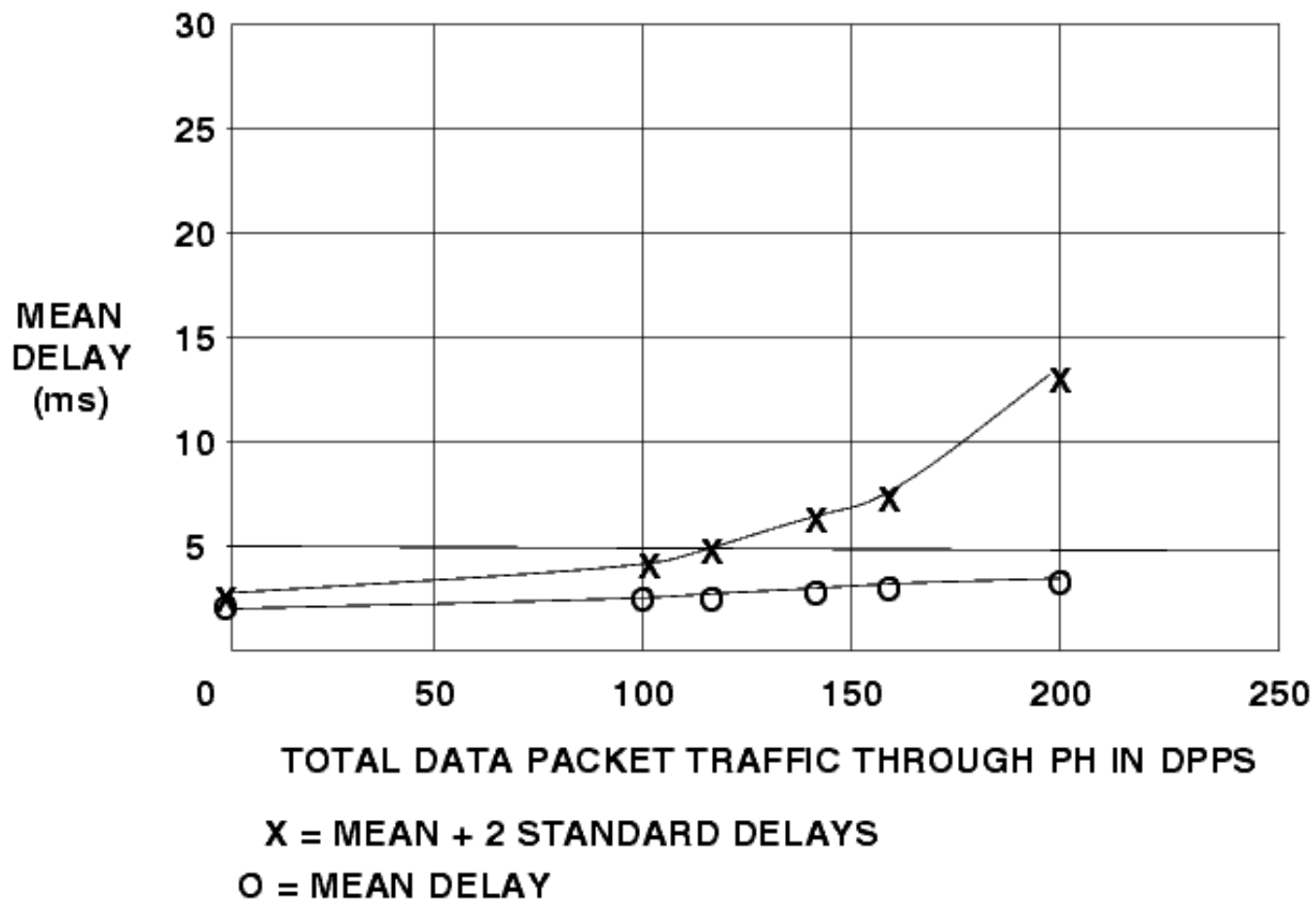


Figure 14.5-10 PH3 PH4 5E8 and Later Software Release LAPB Access X.75/X.75' PH Receiving Delay

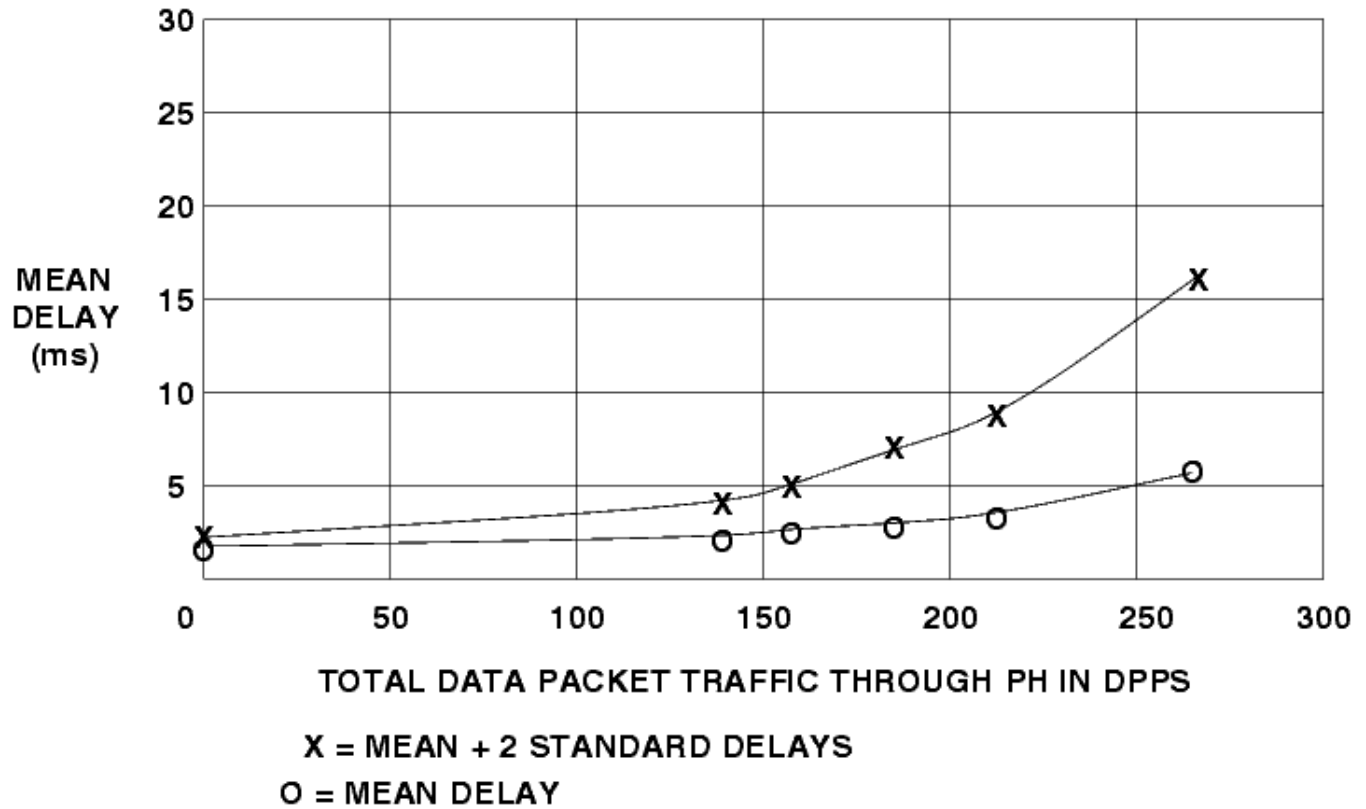


Figure 14.5-11 PH3 PH4 5E8 and Later Software Release IP Interswitch PH Sending Delay

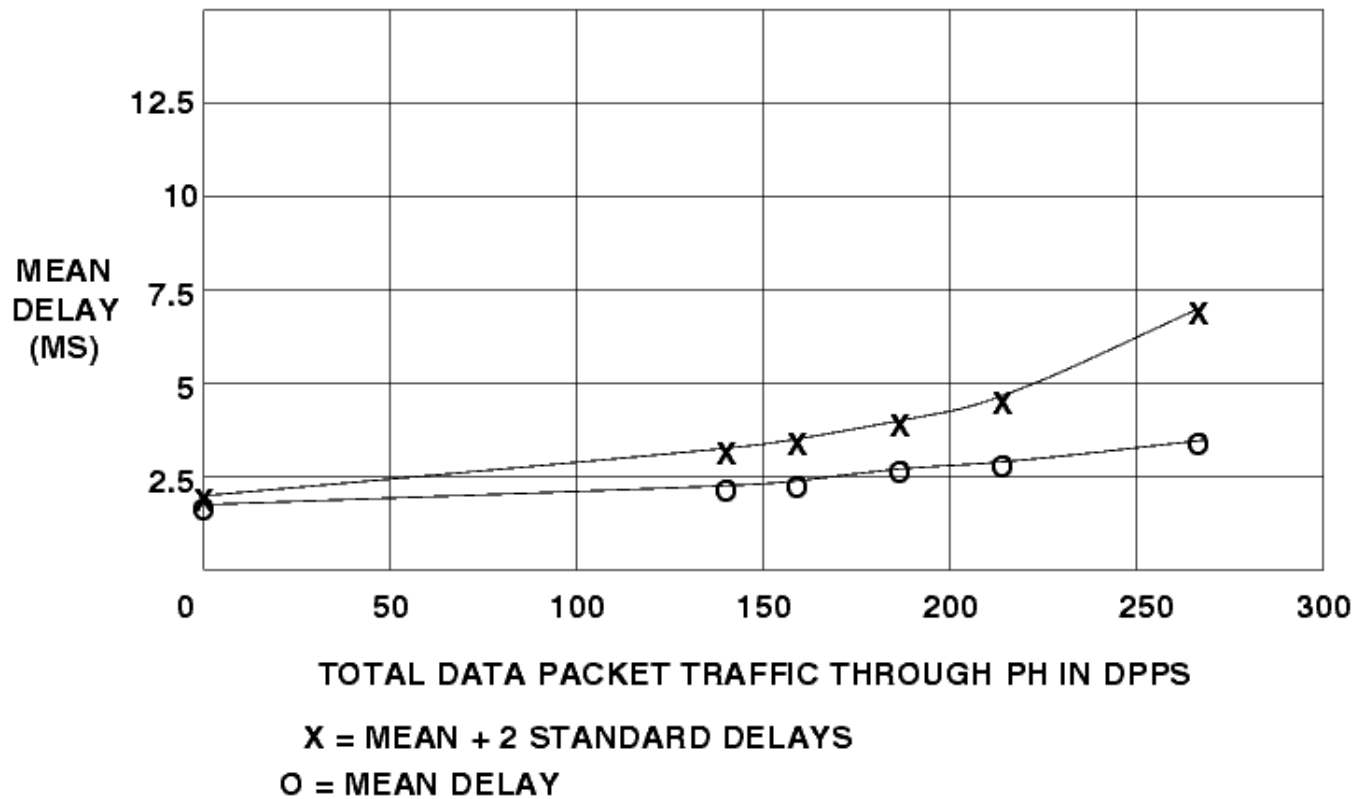


Figure 14.5-12 PH3 PH4 5E8 and Later Software Release IP Interswitch PH Receiving Delay

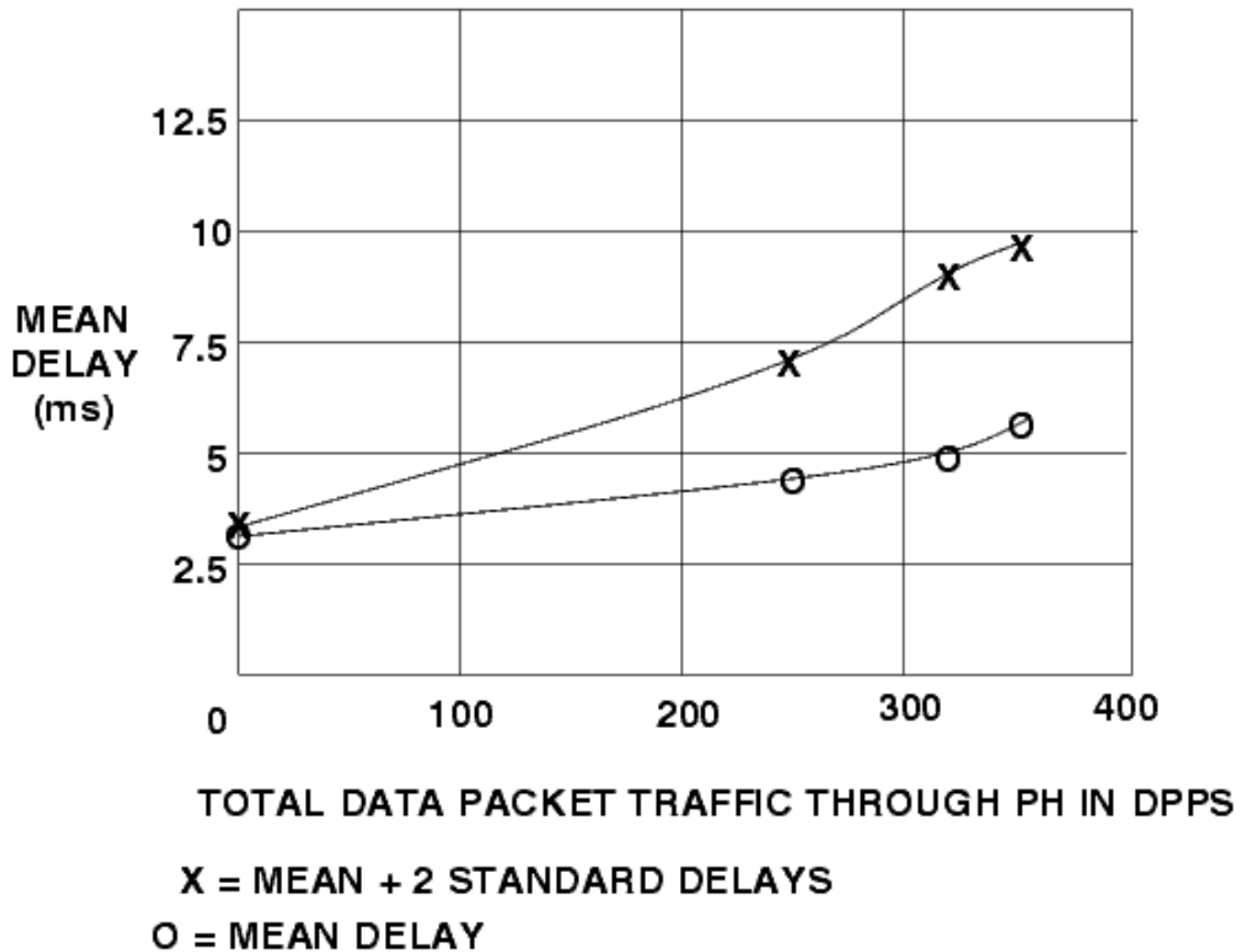


Figure 14.5-13 PH3 PH4 5E8 and Later Software Release Inter-SM PH Sending and Receiving Delay

15. PRIMARY SERVICE INDICATORS AND MEASUREMENT THRESHOLDS

15.1 INTRODUCTION

This section provides information for key service indicators and traffic related thresholds that may be monitored by the administrator. These indicators and thresholds may be described in other sections related to the particular 5ESS®-2000 switch resources, but are grouped together here for quick reference. Indicators and thresholds that are not directly related to a particular resource [such as the no circuit (NCKT) indicator] are described here.

15.2 PRIMARY SERVICE INDICATORS

The key service indicators are those indicators that give the administrator a quick view of the overall quality of service being provided to the subscribers. These indicators, listed in Table 15-1, are contained in the 30-minute report that is transmitted to Engineering and Administrative Data Acquisition System (EADAS), and later processed by the Central Office Equipment Report (COER) system.

15.2.1 DIAL TONE DELAY PEG COUNT

In the 5ESS®-2000 switch, the dial tone delay peg count (DTDPC) indicates the ability of the machine to provide dial tone to customers within 3 seconds during the measuring interval. It is the key measurement for evaluating the capability of providing originating customer service. Each call in the 5ESS®-2000 switch is sampled for dial tone delay, and the number of calls sampled is recorded by the dial tone delay sample count (DTDSC). The DTDSC count is incremented only when an originating customer experiences dial tone delay of more than 3 seconds. Both DTDSC and dial tone delay peg count (DTDPC) are available for each switching module (SM). These measurements are obtained from Section 4 of the 30-minute traffic report.

Receipt of dial tone indicates only the readiness of the SM. It is possible that the administrative module (AM) could have problems that may cause the customer to experience post dial tone processing delay.

Typically, the most common reason for excessive dial tone delay is blocking in the line unit (LU). Blocking in the high-level service circuit (HLSC) or tone decoder (TD) is also possible, but this is not as likely as LU blockage. Another remote possibility for excessive dial tone delay is high switching module processor (SMP) occupancy.

15.2.2 TONE DECODER ATTACHMENT DELAY

The TDs are used to perform dial pulse and touch-tone digit collection from lines. The TDs also perform multifrequency and dial pulse (except bylink) digit collection from trunks. For nonbylink trunks, TD attachment delay is the equivalent of dial tone delay for lines.

The tone decoder attachment delay (TDAD) measurement is a count of the number of times, during the measuring interval, that TDAD exceeded 3 seconds. This measurement is found in Section 4 of the 30-minute traffic report.

Table 15-1 Key Service Indicators

COUNT	DEFINITION	UNIT	COMMENT
DTDPC (TRFC30 Section 4)	Dial Tone Delay Peg Count	SM	Caused by LU blocking, HLSC blocking, TD blocking, high SMP occupancy, or a sudden burst of originations
TDAD (TRFC30 Section 4)	Tone Decoder Attachment Delay	SM	Caused by TD blocking, high SMP occupancy, or sudden burst of originations
% Occup (TRFC30 Section 13/15)	Percent Occupancy	SM/AM	No processor problem if below 85% in the SM or 50% in the AM.
TMBLK (TRFC30)	Terminating Blocking	LU/DCLU/ISLU/ ISLU2/	Caused by heavy traffic or hardware

Sections 6,11,21,49, 138,139)		IDCU/IDCU-RT/ (E)AIU/ TR303 on DNUS	trouble
SHTOV RNGOVF (TRFC30 Section 8)	Short Job Overflow or Ringing Overflow	HLSC-LU/ISLU	May be multiple counts per overflow. Disconnect overflows are not service affecting.
TD TOTUSG (TRFC30 Section 7/9)	Tone Decoder Total Usage	TD/SM	Due to differences in the frequency of sampling between the TOTUSG and MTUSG counter, a small discrepancy may exist between these two counts.
CCOFL (TRFC30 Section 10)	Conference Ckt Overflow	Office	—
BLKOVD (TRFC30 Section 4)	Blockage Due To AM/CMP Overload	Office	AM/CMP processor overload
RGVL (TRFC30 Section 6)	Ring Generator Overflow	SM	Excessive demand on RG resources
NOCKT (TRFC30 Section 5)	No Circuit Available	Office	Resource final failure
UMOFL (TRFC30 Section 23)	No Umbilical Time slot Available	RSM	Umbilicals are traffic busy.
TGOFL (TRFC30 Section 12)	No Outgoing Trunk Group Available	TG	More than one overflow per call is possible if alternate trunk groups are provisioned in the office.
PS-TGOFL (TRFC30 Section 92)	No Packet Switching Outgoing Trunk Group Available	PSTG	—
PACKET (TRFC30 Sections 52,68)	Packet Usage	PH	See PH Throughput Table 14.2-6
TTOVFL (TRFC30 Section 60)	Tone Transceiver Overflow	SM	—
ODBOVFL (TRFC30 Section 105,142)	ISLU On Demand B Overflow/ IDCU On Demand B Overflow	SM	Attempt to establish ODB channel failed
ISUP FAILURES (TRFC30 Section 120)	ISUP Problems	Office	Attempt to establish an ISUP call failed
ASP FAILURES (TRFC30 Section 118)	ASP Problems	Office	Attempt to establish an ASP call failed
NS FAILURES (TRFC30 Section 91)	NS Problems	Office	Attempt to establish an NS call failed
REORD (TRFC30 Section 4)	Reorder	SM	Customer hears reorder tone
MGRNR (TRFC30 Section 18)	Message Switch Receiver Not Ready	MMP	MMP overload
T1UG (TRFC30 Section 37)	Multimodule RSM Intra-RSM Communication Link Total Usage	MMRSM site	The total amount of time that the ICL time slots are out of service between each pair of RSMs in the MMRSM.
OVLD (TRFC30 Section 51)	Packet Interface Time in Overload	SM	Number of 6-second time intervals that the packet interface was in overload.
OVLD (TRFC30 Section 52)	Protocol Handler Time in Overload	PH	Expressed as a percent to two decimal places.
SETUP_DELAY (TRFC30 Section 53,138,139)	Setup Message Response Delay	ISLU/IDCU-RT IDCUI-LINE ISLU2/AIU	Number of circuit switched calls exceeding 3 seconds between receipt and acknowledgment of setup message.
BUF OVFL (TRFC30 Section 68)	Buffer Overflow	PH	Unsuccessful attempts to seize PH buffer space
LCCB OVFL (TRFC30 Section 68)	Logical Channel Control Block Overflow	PH	Unsuccessful attempts to seize space for LCCB
OVLDEN (TRFC30 Section 69)	Calls Denied Due to Overload	Office	PH, PI, or SMP overload

CMP (TRFC30 Section 126)	Call Percent Occupancy	CMP	No processor problem if below 50 percent.
PIDB OVFL (TRFC30 Section 140)	PIDB Overflow	IDCU	Unsuccessful attempt to seize IDCUC PIDB.

15.2.3 PERCENT OCCUPANCY

The percent occupancy is the percentage of time the processor (AM, CMP, or SM) spends performing call processing and other nondeferrable activities. As the SMP percent occupancy approaches 85 percent, longer dial tone delays may be experienced. When the AM or CMP processor occupancy approaches its maximum capacity (depending upon the software release involved), the customer may experience longer post dial tone call processing delay. Should the AM/CMP processor occupancy exceed these values, operations, administration, and maintenance (OA&M) response times may be affected. The percent occupancy measurement for the AM and SM is found in Section 13/15 of the TRFC30. The percent occupancy measurement for the CMP is found in TRFC30 Section 126.

15.2.4 TERMINATING BLOCKING

If terminating blocking occurs, the maintenance usage of the particular LU, ISLU, IDCUC, or DCLUC should be checked. If maintenance usage is not a factor, the capacity of the unit should be checked. If the LU, ISLU, IDCUC, or DCLUC is at or near capacity and causing service degradation, the unit should be monitored closely. The appropriate response depends upon factors such as expected growth and the length of time until the busy season. Severe overloading may require deloading of the LU, ISLU, IDCUC, or DCLUC. Terminating calls are given priority to originating calls because terminating calls, which are nearly completed, have used more resources than originating calls. The percentage of terminating blocking is calculated as follows:

$$\text{Percent Terminating Blocking} = \left[\frac{TMBLK}{TMCALLS} \right] \times 100$$

Where:

TMBLK mark = Number of Terminating Calls Blocked

TMCALLS lineup = Number of Terminating Calls

15.2.4.1 TMBLK in the LU

This indicator is based on the count of terminating calls that fail to complete because of A- or B-link unavailability. The terminating blocking measurements are found in Section 11 of the 30-minute traffic report and are made for each LU.

If the LU is not near its capacity, but it is experiencing terminating blocking, the LU should be checked for a possible balancing problem.

The terminating blocking peg count is registered when an attempt to seize an A- or B-link fails because no link is available. The terminating blocking measurements are found in Section 11 of the 30-minute traffic report.

If terminating blocking occurs, the maintenance usage of the particular LU should be checked. If maintenance usage is not a factor, then the capacity of the LU should be checked. If the LU is at or near capacity and causing service degradation, the LU should be monitored closely. The appropriate response depends on factors such as expected growth and the length of time until the busy season. Severe overloading may require deloading of the LU.

15.2.4.2 TMBLK in the AIU

This peg count is the number of terminating circuit-switched (Z-Interfaces) call attempts that failed due to the inability to select an idle time slot. This report is found in Section 6 of the 30-minute traffic report.

15.2.4.3 TMBLK in the ISLU

This indicator is based on the count of terminating calls that fail to complete because of a PIDB time slot unavailability. The terminating blocking measurements are found in Section 49 of the 30-minute traffic report and are made for each ISLU.

15.2.4.4 TMBLK in the DCLU

This indicator is based on the count of terminating calls failing to complete because an SDFI time slot is unavailable. The terminating blocking measurements are found in Section 21 of the 30-minute traffic report, and are made for each DCLU.

15.2.4.5 TMBLK in the IDCU

This indicator is based on the count of terminating calls failing to complete because of a SDFI time slot unavailability. The terminating blocking measurements are found in TRFC30 Section 130 and 139 and are made for each IDCU and IDCU-RT, respectively.

15.2.5 SHORT JOB AND RINGING OVERFLOWS AND TOTAL USAGE

The short job and ringing overflows and total usage measurements are made for the HLSCs. The short jobs are those line tests performed by the HLSC at origination, termination, and disconnect. The HLSC also performs ringing functions for lines. Multiple short job overflow counts may be made for any call that incurs HLSC blocking.

It is important to note that some short job overflows are not service affecting. In particular, the disconnect short job performs only a line restore-verify function and can be skipped during periods of high HLSC demand without affecting service. For an originating call, the originating short job is queued until an HLSC is available. The ringing job is attempted again after a delay of a few hundred milliseconds. Ringing overflows should be extremely rare. The short-job and ringing overflow measurements are found in Section 8 of the 30-minute traffic report.

15.2.6 TONE DECODER TOTAL USAGE AND OVERFLOW

The TD total usage (TOUSG) count provides the usage for TD groups. This count represents the sum of the traffic and maintenance usage for the group.

Tone decoders should be monitored for any groups that approach or exceed capacity [1442 hundred call second (CCS) per 56 decoders at 1.0 percent blocking]. When the TDs exceed capacity, originating calls suffer. Originating customers cannot be provided dial tone if a TD is not available. Corrective actions may include the addition of more TDs, or moving TDs from one SM to another. The TD overflow count represents the number of unsuccessful attempts made to access a tone decoder. Tone decoder usage and overflow measurements are found in Section 7/9 of the 30-minute traffic report.

On each DSU2 board (one is always provided in each of the two fuse groups or SGs) there are seven digital signal processors (DSPs). These may be configured by firmware into a combination of tone generators, tone decoders, or transceivers.

One DSP per board is configured for tone generation (this is equivalent to the DSU1). The transceivers are engineered and spread among the DSU2s. The remaining DSPs are configured as decoders. Each DSP converted to a decoder is equivalent to five servers, and normally five or six DSPs are assigned the decoder function. This configuration is the equivalent of 50 to 60 decoder servers. The DSU2s of course may be used for other functions

such as RAF packs.

15.2.7 RING GENERATOR OVERLOAD

This peg count is the number of times a terminating call is blocked due to a ring generator overload condition, for a line on an AIU. To create this report a new field (RGOVL) is added to the previous report, used for ISLUs. The peg count is against the AIU. Therefore, an overloaded RG may cause peg count increases in multiple AIUs. This count is found in Section 6 of the 30-minute traffic report.

15.2.8 CONFERENCE CIRCUIT OVERFLOW

The conference circuit overflow (CCOFL) count represents the number of times that requests for 3- or 6-port conference circuits cannot be served due to unavailability. This has no affect on plain old telephone service (POTS) calls, but it does affect such features as 3-way calling and conference calling. The conference circuit overflow measurement is found in Section 10 of the 30-minute traffic report.

15.2.9 BLOCKAGE DUE TO OVERLOAD

The calls blocked during AM/CMP overload (BLKOVD) count is incremented when it is determined in the SM that a route request message cannot be sent to the AM/CMP because it is in an overload condition. This condition results in the call being routed to reorder. This count should not normally exceed zero. The BLKOVD measurement is found in Section 4 of the 30-minute traffic report.

15.2.10 NO CIRCUIT

The NOCKT count is taken, on a per-office basis, separately for incoming, intraoffice, originating, outgoing, tandem, and terminating calls. This count represents the number of calls lost due to unavailable resources. These resources could be:

- High Level Service Circuit (ring overflow and short job overflow)
- Tone decoder
- Final outgoing trunk group overflow
- Universal conference circuit
- Tone transceivers (used with voice path assurance and ICLID)
- Revertive pulse transceivers (used for interoffice trunk signaling).

The NOCKT indicator cannot point directly to a problem, but it does provide an indication that a problem exists. Other indicators (such as usage and overflow counts made for the associated resources reported in the TRFC30 sections) can then be observed to determine the cause of the problem. The no-circuit measurements are found in Section 5 of the 30-minute traffic report.

The following call types are affected because of circuit unavailability:

- **Originating Call** — this call occurs when the switch receives and analyzes sufficient digits so that the call is ready to be offered to the first link path. It may be either a line-to-line or line-to-trunk call. The ORIGINATING NOCKT overflow count is the number of originating calls for which a resource failure occurs for a HLSC, universal conference circuit (UCC), revertive pulse transceivers, tone decoders, outgoing trunks, or tone transceiver. When this occurs, companion NOCKT counts of either OUTGOING or INTRAOFF and TERMINAT are also pegged. However, if only the ORIGINATING NOCKT count is pegged, originations are experiencing a resource failure before the destination of the call is known. The NOCKT is not pegged for

network path failure.

- **Incoming Call** — any call which is incoming to and whose digits are received by the incoming switch. This is a trunk-to-line call. The INCOMING NOCKT overflow count is the number of incoming calls for a HLSC or tone decoder. When this occurs, companion NOCKT counts of either TERMINAT or TANDEM and OUTGOING are also pegged if a determination of the destination is made.
- **Intraoffice Call** — any call that originates and terminates within the same office. An intraoffice call is a line-to-line call where originating and terminating parties are served by the same switch. The INTRAOFF NOCKT overflow count is the number of incoming calls for a HLSC, UCC, or tone transceiver (ICLID function).
- **Outgoing Call** — an originating call routed out of the office. This is a line-to-trunk call. An outgoing call results when the switch recognizes that the destination of the call is another office and the call is ready to be offered to the first selected trunk group. The OUTGOING NOCKT overflow count is the number of originating calls for which a resource failure occurs for reverive pulse transceivers, outgoing trunks, or tone transceivers. When this occurs, the ORIGINATING NOCKT count is also pegged for line-originated calls or NOCKT INCOMING and NOCKT TANDEM is also pegged for incoming trunk-originated calls.
- **Terminating Call** — an intraswitch call or an incoming call to be completed in the switch. It may be either a line-to-line or trunk-to-line call. The TERMINATING NOCKT overflow count is the number of terminating calls requiring either a HLSC or tone transceiver. When this occurs, companion NOCKT counts of either INCOMING or ORIGINAT and INTRAOFF are also pegged.
- **Tandem Call** — any call that is received in an office on one trunk and is routed out of the office on another trunk. This is a trunk-to-trunk call. The TANDEM NOCKT overflow count is the number of tandem calls for which an outgoing trunk failure is received. When this count is pegged the INCOMING NOCKT and OUTGOING NOCKT counters are also pegged.

15.2.11 REORDER

The calls sent to reorder (REORD) count represents the number of calls sent to reorder tone. This count is similar to NOCKT in that it represents lost calls due to unavailable resources. This count does not isolate the trouble; instead, it indicates that overflow and usage counts for other resources should be observed. The reorder measurement is found in Section 4 of the 30-minute traffic report. The following situations cause the REORDER count in Section 4 to peg:

- Resources
 - Overflow trunk groups including announcement groups
 - HLSC shortages
 - Trunk tone decoder shortages
 - Tone generator shortages
 - Time slot mismatches (TRFC30 Section 4).
- Peripherals
 - LU, ISLU, IDCU, or DCLU blockages.
- Customer Actions

- Dialing irregularities
- Ineffective attempts (PERMSIG, PDTIMO).
- Features
 - Overflow conference circuits, RAFs
 - SFG and MLHG overflows
 - Overflow of software retry buffer for hunting lines
 - Activating or accessing features that are not available on a line
 - Cannot connect OSPS operator to customer
 - Overflow feature data structure (TRFC30 Section 13 and 26).
- Miscellaneous
 - Routing failures
 - Station restrictions
 - AM/CMP blocked in overload condition
 - SM/RSM standalone
 - Path setup failure
 - Hardware failures
 - Per call test failures
 - Unavailable software data blocks (overload messages)
 - Cannot connect operator to customer.

To determine the problem cause of REORDER, examine the TRFC30 reports previously mentioned. If the problem is not resolved from the TRFC30 reports, use the REORD field feature. Some calls may be routed to reorder instead of an announcement, and these calls do not represent lost calls due to unavailable resources. If this type of routing is employed, the value of REORD count as key service indicator is reduced.

15.2.12 MESSAGE SWITCH RECEIVER NOT READY

The module message processor (MMP) receiver-not-ready (MGRNR) count, taken on a per-MMP basis, represents the number of times the MMP could not accept messages from an SM due to blockage or full message buffers. This count should not normally exceed zero. The MGRNR measurement is found in Section 18 of the 30-minute traffic report. The T1 carrier usage (T1UG) measurement is found in Section 37 of the 30-minute traffic report. This measurement is an indication of the usage of intercluster link (ICL) time slots between specific RSMs in the MMRS cluster.

15.2.13 MESSAGE SWITCH BASE LEVEL CYCLES

For TRFC30 Section 19 - MSGS (Message Switch) Section 19 reports parameters for the MSCU: base level cycles, BLCYC, and messages to and from the AM for the 30-minute period. The CM is a duplexed component so each side has a MSGS/MSCU. Capacities are engineered assuming a simplex configuration so there would be no degradation in the case of a single failure. However, the CM runs in duplex mode except for certain circumstances such as REX. This makes it difficult to state a single number to watch for to determine if the MSGS is under stress. The switch administration document has a method for determining the capacity of the MSGS but requires analysis of several days worth of data to determine the capacity of the particular switch configuration because when both MSGSs are sharing the message load each sees only about half the total load. It is possible to make a less detailed estimate of the MSGS capacity but it requires knowing the base level cycle count for the MSCUs during periods of low message traffic. These periods are typically late evening or early morning hours. Then, if during the busy hours the base level cycles approach one half of the number of base level cycles observed during the low load period the MSGS would be at capacity if it had to run in simplex. The number of base level cycles at low or no message load depends on what type of AM (3B20D or 3B21D), whether or not the switch has a DLN, and the number of SMs equipped. Therefore each switch has to be looked at separately. A much riskier method to see if the MSGS is nearing capacity is to place the MSGS in a simplex mode during the busy hours. Then all the messages will traverse the single MSCU. The base level cycle counts will give an indication of how close to messaging capacity the switch is. Capacity is defined as the message load that results in 1 base level cycle per millisecond. That is a TRFC30 BLCYC value of 1800. The no load base level cycle count is usually on the order of 40000. If the observed count in the simplex mode gets below 3000 a more detailed examination is warranted. (This method is not recommended.) For almost all 5ESS[®]-2000 switches the MSGS is not a capacity concern.

15.2.14 NETWORK TIME SLOT OCCUPANCY

The quantity "NTSOCC" of Traffic 30, Section 122 is the highest occupancy observed in the 100-second scans of the network side time slots during the 30 minute period covered by the report. "NTSOCC" should be used along with the quantity "TSUSG" of the TRFC30 Section 7. "NTSUSG" is the accumulated usage for the network side time slots over the 30 minute period. If "NTSOCC" is consistently over 95% and "NTSUSG" is consistently over 75% during the same 30 minute period growing in another pair of NCT2 links to the SM-2000 may be necessary. The quantity "TSMM" of the TRFC30 Section 4 - SAD tells if any originating calls failed because corresponding time slots for the originating and terminating SMs could not be found. "TSMM" should be zero. If it is not more NCT2 links should be grown or the SMs should be deloaded to reduce the offered call load.

15.2.15 CONTROL TIME SLOT OCCUPANCY

For TRFC30 Section 125 - CTS (Control Time Slots) Engineering rules exist for determining when an SM-2000 should equip for QLPS. These rules are based on the application (Metro, Suburban, tandem, etc.) and do not give values to watch for in the TRFC30 Section 125 report. TRFC30 Section 125 provides, on a per SM basis, average and peak six second occupancies for both receive and transmit directions for both CTS links. If for any SM-2000 the average occupancy of any link-direction is consistently greater than 75% and the link-direction has a peak occupancy greater than 90% the SM-2000 should be set to use the QLPS. (Note: there have been some offices with QLPS that have not done the necessary RC for some SM-2000s to utilize the QLPS network.) For SMs (not SM-2000s) it may be useful to examine what features are executed on the SM. By moving the routing function to a different SM the CTS occupancy can be reduced. Also, deloading or changing the lines and/or trunk mixture on the SMs could help.

15.2.16 MESSAGE HANDLERS

For TRFC30 Section 185 - MH (Message Handler) The SMP-2000 uses the first Message Handler, MH0, to send and receive messages over the CTS and QLPS links. The MH uses a base level cycle to process its tasks. During each base level cycle the MH0 does the following: 1) receives messages from the links and sends them to the SMP (or other destination, perhaps its own processor) and 2) checks for messages from the SMP and if any, sends them to the appropriate destination, i.e., CTS or QLPS links. MHs are duplexed but run active-standby so all messages go through the active MH. Therefore it is easier to check to see if the MH is near exhaust than it is for the

MSG/MSCU. The capacity is defined as the message load that results in one base level cycle per millisecond. The no-load cycle count is on the order of 30000. If the observed count consistently gets below 3000 the data should be more extensively investigated. If the MH0 is the MH that is being stressed it will be necessary to lower the call load on the SM-2000. If the MH is for a different application, i.e., for DNU-S, EAIUs, or as an MHEIB, it will be necessary to equip an additional MH (no more than 3 MHs can be equipped, including MH0) or redistribute the peripherals. Similar to the MSG/MSCU, most offices and SM-2000s should not have MH capacity problems.

15.2.17 UMBILICAL TIME-SLOT OVERFLOW

Umbilical links are used to interface the DLTU(s) in the host SM with the DLTU(s) in the RSM. The umbilical time slot overflow count represents the number of times that a request for a voice time slot failed. This may indicate a need to reevaluate usage and add T1 links. For the RSM host umbilical, check for UMOFL counts greater than 0 in TRFC30 Section 23.

15.2.18 TRUNK GROUP OVERFLOW AND PACKET SWITCHED TRUNK GROUP OVERFLOW

Trunks that overflow do have a significant affect on the AM/CMP load. Not only does the switch have to look for an alternate trunk group, but if the overflowed trunk group is a final route, then it may also cause a significant number of reorders or announcements which in turn might cause more user retries. Trunk groups that overflow regularly or overflow consistently over 10 percent should be evaluated for the proper trunk group thresholds or have corrective action taken on the size or maintenance.

The TG OVERFLOW indicator is based on the count of outgoing calls that fail to complete in a given trunk group because of no available trunks due to an insufficient number of trunks or trunks that are out of service for maintenance. The trunk group overflow measurements are found in Section 12 of the 30-minute traffic report; the packet switch trunk group measurements are found in Section 92 of the 30-minute traffic report, and both are reported for each trunk group.

NOTE: Network controls can also impact on trunk overflows. Information on the amount of network control in place for an office should be known.

15.2.19 TONE TRANSCEIVERS OVERFLOW

The tone transceiver is a function associated with, and located in the digital service unit - model 2 (DSU-2), and DSU-3, where the digital service circuits are translated for tone transceiver functions.

The transmit and receive functions of the tone transceivers are used with the following: voice path assurance (VPA), incoming calling line identification (ICLID) for analog lines, visual message waiting indication (VMWI) for analog lines, and voice band data services (VBS) for analog lines.

The OVFL indicator in Section 60 of the traffic 30 reports counts the number of times that an attempt was made to use a tone transceiver, but no idle tone transceiver was available. If overflow is consistently greater than zero, more digital service circuits may have to be translated to tone transceivers.

15.2.20 ASP AND NUMBER SERVICES FAILURES

The ASP failures are counted in Section 118 of the traffic 30 reports, and NS failures are counted in Section 91. Several measurements are available to determine why the failure occurred. In the case of the "CALL PROCESSING FAILURE" counts being greater than zero, the problem can be isolated to translation errors, resources unavailable, or maintenance issues. Resource unavailability or maintenance problems can be singled out if the "RESOURCE UNAVAILABILITY" counts (ASP ONLY) also peg. Translation errors or maintenance problems can be isolated if the "MESSAGE ERROR" counts are pegged.

15.2.21 MATCHING LOSS MEASUREMENTS

This feature provides seven matching loss measurements. Matching loss is the inability of a call to find a linked path through the network at any stage of the call. Only the unavailability of network path results in a matching loss. For example, the unavailability of a resource such as high level service circuits does not result in a matching loss.

15.2.21.1 Measurements

The 5ESS®-2000 switch provides the following seven matching loss measurements in TRFC30 Section 5:

- Incoming matching loss
- Tandem matching loss
- Incoming first failure to match
- Intrasytem matching loss
- Outgoing matching loss
- Originating matching loss
- Terminating matching loss.

Definitions for seven matching loss counts are presented below. An incoming matching loss count is pegged whenever any one of the following conditions is encountered during the setup of an incoming call:

- Unavailability of concentrator path (A or B links) to a Line Unit
- Unavailability of PIDB time slots to an ISLU
- Unavailability of PIDB time slots to a DCLU
- Unavailability of time slots in the TSI-TMS-TSI path
- Unavailability of time slots on RSM umbilicals.

Incoming matching loss due to any resource failure (such as HLSC) is excluded from this count.

A tandem matching loss count is pegged whenever any one of the following conditions is encountered during setup of a tandem call:

- Unavailability of time slots in the TSI-TMS-TSI path
- Unavailability of time slots on RSM umbilicals.

Tandem matching loss due to resource failure are excluded from this count.

An incoming first failure to match occurs the first time an incoming call encounters a matching loss. This count is pegged when an incoming call encounters a matching loss regardless of whether the call succeeds on a retry.

All the reasons listed for incoming matching loss are the same for incoming first failure to match. Thus, IFFM counts must be greater than or equal to IML count. IFFMs due to resource failure are excluded from the count.

NOTE: IFFM is also IML to individual lines when there are no retries.

An intrasytem matching loss count is pegged whenever any one of the following conditions is encountered on an

intrasystem call:

- Unavailability of concentrator path (A or B links) to a Line Unit
- Unavailability of PIDB time slots to an ISLU
- Unavailability of PIDB time slots to a DCLU
- Unavailability of time slots in the TSI-TMS-TSI path
- Unavailability of RSM umbilicals or inter-RSM communication links (ICLs) :

If any of the following conditions occur at a call on an RSM site or a Multi-Module RSM site, then a matching loss occurs:

- RSM umbilicals are traffic busy.
- ICLs are traffic busy.
- RSM umbilicals are severed and the ICLs are traffic busy.
- ICLs are out of service and RSM umbilicals are traffic busy.

Intrasystem matching loss due to resource failure (such as HLSC) is excluded from this count.

An outgoing matching loss count is pegged whenever any one of the following conditions is encountered on an outgoing call:

- Unavailability of time slots in the TSI-TMS-TSI path
- Unavailability of time slots on RSM umbilicals.

Outgoing matching loss due to resource (such as HLSC) failure is excluded from this count.

If a call is routed to an announcement that involves the use of trunk circuits in the trunk unit (examples: 13A Announcement System or 14A Announcement System) or directed to a DSU-2/RAF, then that call is treated like an outgoing call.

An originating matching loss count is pegged whenever any one of the following conditions is encountered on an originating call:

- Unavailability of concentrator path (A or B links to a line unit)
- Unavailability of PIDB time slots to an ISLU
- Unavailability of PIDB time slots to a DCLU
- Unavailability of time slots in the TSI-TMS-TSI path
- Unavailability of RSM umbilicals or inter-RSM communication links (ISMs):

If any of these following conditions occur at a call on an RSM site or a Multi-Module RSM site, then a matching loss occurs:

- RSM umbilicals are traffic busy.
- ICLs are traffic busy.
- RSM umbilicals are severed and the ICLs are traffic busy, and
- ICLs are out of service and RSM umbilicals are traffic busy.

Originating matching loss due to resource (such as HLSC) failure is excluded from this count.

A terminating matching loss occurs when a terminating call fails to complete due to unavailability of a path (on the final attempt) through the system's network at any stage of that call.

15.3 INTEGRATED SERVICES DIGITAL NETWORK (ISDN) KEY SERVICE INDICATORS

The implementation of ISDN provides several new key service indicators that are related specifically to ISDN services. These indicators are described in the following paragraphs and are shown in Table 15-1.

15.3.1 PACKET THROUGHPUT OF THE PH

A difference exists between the packet and circuit switched networks in that the packet network is nonblocking. Instead, the user experiences poorer performance during overload conditions. These performance degradations are usually manifested in longer file transfer times and real-time breaks during display functions. To ensure good packing switching service, it is necessary to evenly distribute the packet load across the PHs, and to operate the PH under its packets per second capacity or throughput See Table 14.2-6.

The PACKET indicator is based on the count of send and receive packets that go through the PH. The PACKET measurements per PH are found in Section 52 of the TRFC30 reports for Q.931 signaling packets, in Section 68 for packets other than Q.931. Table 15-2 indicates the maximum packet count in the TRFC30 reports and its corresponding DPPS capacity for both the PH2 and PH3 and PH4.

Table 15-2 Packets (Section 52 and Section 68) Versus DPPS

PH TYPE	PACKET NUMBER FROM TRFC30	DPPS CAPACITY
PH2 ACCESS	180,000	50
PH2 ISM 3TSS	345,600	96
PH2 ISM 2TSS	230,400	64
PH2 ISPT	144,000	40
PH3 ACCESS	576,000	200
PH3 ISM 10TSS	1,152,000	320
PH3 ISM 6TSS	691,200	192
PH4 ACCESS	576,000	200
PH4 ISM 10TSS	1,152,000	320
PH4 ISM 6TSS	691,200	192

15.3.2 PACKET INTERFACE TIME IN OVERLOAD

The OVLD measurement is reported as the number of 3-second increments that the packet interface was in an overload condition. Overload refers not only to processor real time, but also to near exhaustion of software resources. The OVLD measurement for the packet interface can be found in Section 51 of the 30-minute traffic report.

15.3.3 PROTOCOL HANDLER (PH) TIME IN OVERLOAD

This OVLD measurement represents a count of 3-second increments that the PH is in overload. Overloads are in terms of processor real time or near exhaustion of software resources (for example, real-time buffer utilization.) The OVLD measurement for the PH can be found in Section 52 of the 30-minute traffic report.

15.3.4 SETUP MESSAGE RESPONSE DELAY

The SETUP_DELAY measurement is the number of circuit-switched calls that exceeded 3 seconds between the receipt of a SETUP message and the transmission of an acknowledge or a call proceeding (block mode) message. Delays in the ISLU, TD, PI, PH, and SMP are all possible causes. The SETUP_DELAY measurement can be found in Section 53 of the 30-minute traffic report.

15.3.5 BUFFER OVERFLOW

This overflow count is the number of unsuccessful attempts to seize buffer space in the PH. This count includes all types of PHs. All frames are buffered. Buffer use is a function of frame size, window size, and delay. Buffer space is allocated in 64-byte blocks. The current capacity is 500 blocks. The BUF OVFL measurement is found in Section 68 of the 30-minute traffic report.

15.3.6 LOGICAL CHANNEL CONTROL BLOCK (LCCB) OVERFLOW

The LCCB OVFL measurement is the count of unsuccessful attempts to seize space for LCCBs. One LCCB is required for each virtual call. Current capacity is 128 LCCBs. The LCCB OVFL measurement is found in Section 68 of the 30-minute traffic report.

15.3.7 CALLS DENIED DUE TO OVERLOAD

The OVLDEN measurement represents the total number of X.25 originating calls plus internal protocol (IP) incoming calls denied due to PH (originating access, inter-SM, interswitch, or terminating access), PI, or SMP overload. The OVLDEN measurement is found in Section 69 of the 30-minute traffic report.

15.3.8 ON-DEMAND B OVERFLOW

The On-Demand B overflow measurements are recorded in Sections 105 and 106 of the Traffic 30 reports. Any value greater than zero indicates either an overload condition of the On-Demand B PH (Analyze section 68 and 52 for overload conditions and high PACKET USAGE) or a translation error where the customer cannot obtain a path to the On-Demand B PH.

15.3.9 ISUP MEASUREMENT FAILURES

The ISUP failure measurements are recorded and in Section 120 of the Traffic 30 reports. See 235-070-100 Appendix 1, *Traffic and Plant Measurements*, for a detailed description of problem and probable causes.

15.4 SUGGESTED THRESHOLDS

The administrator can set thresholds for measurements to be automatically monitored by EADAS or a similar administrative data collection system. When the thresholds are exceeded, EADAS generates exception reports that are returned to the administrator to prompt further investigation or system adjustments.

The counts observed are typically in percent blocking, percent delay, percent occupancy, etc., and total usage. The percentage counts may have thresholds set slightly above the expected average busy season (ABS) values so that one or two occurrences do not cause exception reports. The administrator needs to know when there is significant blockage. During the busy season, it may be desirable to raise the thresholds to avoid more frequent exception reports.

The usage thresholds may be set slightly under the expected ABS values because the ABS values represent significant usage and the administrator may need time to make adjustments before reaching the ABS levels. Generally, usage measurements are not likely to create spurious exception reports. Again, it may be necessary to raise the thresholds during the busy season to avoid continual reports.

The thresholds that the administrator can set and monitor are shown in Table 15-3. Suggested thresholds related to ISDN are shown in Table 15-4.

Table 15-3 Suggested Threshold Guidelines

INDICATOR	THRESHOLD	COMMENT
Conference Circuit Percent Occupancy	a	—
Conference Circuit Percent Occupancy	1.5%	Threshold set in range between ABS and OAM points to avoid unnecessary reporting.
Conference Circuit Holding Time	90-380 sec.	—
Umbilical Overflow	UMOFI > 0	—
Trunk Group and Packet Switched Trunk Group Overflow	OVFL 10% or less	—
SM Percent Occupancy	70%	Capacity has not yet been reached, so it may be adjusted upward. Load is becoming somewhat heavy. Should be concerned if consistently over 80%.
LU/AIU/DCLU/ISLU/ ISLU2/IDCU Percent Terminating Blockage	1% to 7%	Depending on Engineering
AIU Ring Generator	1	—
DCLU Total Usage	850 for 1 TSS, 1700 for 2 TSS	Assumes approximately 75% occupancy
Tone Transceiver Overflow	TTOVF < 1	—
DLTU Percent Occupancy	80%	Could be as high as 96% (no concentration)
CMP Percent Occupancy	40% - 5E6 and later Software Releases	This level does not mean that capacity has been reached, so it may be adjusted upward. Load is becoming somewhat heavy.
Percent Dial Tone Delay Failures	1.5% to 2%	5ESS®-2000 switch does not distinguish between DP and TT
HLSC Percent Occupancy	30%	Works for 4, 5, or 6 HLSCs
HLSC Percent Overflow	0.5%	Only multiple overflows are important.
HLSC Holding Time	0.5 to 4.6 sec.	—
Incoming Calls Abandoned	INCPC × 0.1	10% of INCPC (incoming call peg count) in busy hour
Incoming Call False Starts	INCPC × 0.1	10% of INCPC in busy hour
Incoming Call Partial Dials	INCPC × 0.1	10% of INCPC in busy hour
Incoming Call Partial Dial Time-Outs	INCPC × 0.1	10% of INCPC in busy hour
Incoming Call Permanent Signals	INCPC × 0.1	10% of INCPC in busy hour
ASP Failures	0	—
Number Service Failures	0	—
MMP Base Level Cycles Completed	2 million/hr 1 million/BLCYC < .80	Approaching 80% capacity. BLCYC (TRFC30 Sec 18)
QGP Base Level Cycles Completed	3 million/hr 1.5 million/BLCYC < .80	Approaching 80% capacity BLCYC (TRFC30 Sec 175)
QGP-QLPS PIPE	80%	(TRFC30 Sec 176)
MH-QLPS PIPE	80%	(TRFC30 Sec 177)
MH Base Level Cycles Completed	3 million/hr 1.5 million/CYCLS < .80	Approaching 80% capacity CYCLES (TRFC30 sec 185)
MMP Receiver-Not-Ready Messages	0	Always except 0
Message Switch Base Level Cycles Completed	3 million/BLCYC < .80 (if no load ≅ 12 million) 6 million/BLCYC < .80 (if no load ≅ 24 million)	Approaching 80% capacity. (No-load values depend on whether or not there is a DLN in ring-equipped offices and also on the software release employed.) BLCYC (TRFC30 Sec 19)
Network Time Slot Occupancy	NTSOCC > 95%	TRFC30 Sec 122

Orig. Calls Abandoned	HD ORIGPC $\times$ 0.1	10% high day orig. peg count
Orig. Call False Starts	HD ORIGPC $\times$ n	n = 50% evening or 30% daytime
Orig. Call Partial Dial Abandon	HD ORIGPC $\times$ 0.1	10% high day orig. peg count
Orig. Call Partial Dial Time-Out	HD ORIGPC $\times$ 0.1	10% high day orig. peg count
Orig. Permanent Signals	HD ORIGPC $\times$ n	n = 30% evening or 10% daytime
SLC [®] 96 Carrier Percent Occupancy	50%	Mode I or II
Percentage of Term. Calls Blocked	2%	May change to 10% if expecting above 2%
Tone Decoder Percent Occupancy	a	—
Tone Decoder Percent Overflow	2%	—
Tone Decoder Attachment Delay Percent	3%	Trunks are more sensitive to delay than lines.
Tone Decoder Holding Time	1.8-15.0 sec.	Tone decoder holding time for line is much higher than for trunks.
TU Percent Occupancy	80%	No concentration or blocking
MMRSM ICL Total Usage	660 $\times$ number of ICLs	—
AM SODD ^b (Static ODD)	AVAIL < 512 K or PCT USED 85%	Inform PECC through organizational lines.
AM UODD ^b (Dynamic ODD)	AVAIL < 100 K or PCT USED >85%	Inform PECC through organizational lines.
AM DISK ^b (Disk ODD)	PCT USED > 95%	Inform PECC through organizational lines.
SM RODD ^b (Redundant ODD)	AVAIL < 256 K	Contact SCC to allocate more memory for SM RODD.
SM NRODD ^b (Nonredundant ODD)	AVAIL < 256 K	Contact SCC to allocate more memory for SM NRODD.
SM UODD ^b (Dynamic ODD)	AVAIL < 128 K	Contact SCC to allocate more memory for SM UODD.
Notes:		
a. Threshold = ABS capacity Poisson P.001/36 $\times$ Number of ckts installed		
b. Obtained from OP:ODD report.		

Table 15-4 Suggested ISDN Threshold Guidelines

INDICATOR	THRESHOLD	COMMENT
Terminating Circuit Blocked Calls/ Terminating Circuit Call Attempts	0.01	No more than 1 percent blocking. Most offices, analog or digital, are engineered at this value.
Packet Interface Time in Overload	1	Any overload occurrences should be monitored.
Packet Interface Processor Occupancy	60 %	0 percent indicates no work is waiting to be processed, and 100 percent indicates work waiting in every queue.
Protocol Handler Time in Overload	1	Any overload occurrence should be monitored.
Protocol Handler Processor Occupancy	55 %	0 percent indicates no work is waiting to be processed, and 100 percent indicates work waiting in every queue.
Packet Throughput	Packet < DPPS Capacity	See PH Throughput Table 14.2-6
Setup Message Response Delay/ISDN Originating Request	0.01	No more than 1 percent blocking. Most offices, analog or digital, are engineered at this value. This is analogous to dial tone delay.
Buffer Overflow	1	Each overflow occurrence should be monitored.
Logical Channel Control Block Overflow (LCCB OVFL)	1	Each overflow occurrence should be monitored.
On Demand B Overflow	1	Each overflow occurrence should be monitored.
ISUP Failures	1	Each overflow occurrence should be monitored.
Calls Denied Due to Overload	1	Each overflow occurrence should be monitored.

Group Overflow/Group Terminating Attempts	0.01	No more than 1 percent of the MLHG attempts should overflow.

GLOSSARY

The following abbreviations, acronyms and terms are used in these guidelines:

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2-Mile Optically Remoted Module (TRM)

An SM located up to 2 miles from the CM and connected by a multimode optical fiber that serves as an extended NCT link.

A-Link

The A-link connects the first- and second-stage switches of the line unit.

ABBH (Average Bouncing Busy Hour)

The ABBH load value is the BBH load averaged across the BS. The ABBH is also referred to as the mean daily peak (MDP).

ABS (Average Busy Season)

The three months with the highest average traffic in the busy hour.

ABSBH (Average Busy Season Busy Hour)

ABSBHL (Average Busy Season Busy Hour Load)

The average of the TCBH traffic loads for 3 months, not necessarily consecutive, that have the highest average traffic. The busy season data excludes extremely high traffic days that can be attributed to unusual events. It may also exclude weekends if the traffic is low during these days.

ACB (Automatic Callback)

This feature allows the subscriber, after reaching a busy station, to hang up the telephone and dial the activation code and the busy station directory number to activate automatic callback. When the busy station goes on-hook and the calling station is on-hook, the calling station will receive a distinctive ringing pattern. When answered, a call will automatically be completed to the previously busy station.

ACBC (Automatic Callback Calling)

ACCED (Access Editor)

An administrative memory module function that controls the freeing and use of terminating number assignments.

ACD (Automatic Call Distribution)

A feature that automatically distributes calls to attendant or agent positions according to the call parameters (for example, to an agent who has been idle for the longest period).

ACD/BRCS (Automatic Call Distribution/Business and Residence Custom Services)

Enables ACD agents to operate in a centrex environment, to have access to BRCS features, and to be in the same business group as non-ACD users.

ACSR (Automatic Customer Station Rearrangement)

An ISDN feature permitting the end-user to relocate their terminal equipment and associated directory number.

ACT (Alternative Code Treatment)

A capability that allows customers to give alternative treatments to specified IDP codes at certain times. This is

done by associating a valid ID code with an alternative code treatment set (ACT set). The ACT set is associated with an on/off indicator and alternative treatment instructions. When the indicator is off, normal treatment is given when a line dials a code in the ACT set. When the indicator is on, alternative treatment is given when a line dials a code in the ACT set.

ADP (Average Daily Peak)

A statistical variable value used in the EVE methodology. The ADP is the average of the highest loads, each day, averaged over a typical period of 20 days.

AIS (Automatic Intercept System)

An OA&M feature permitting calls from Class 5 offices to nonworking telephone numbers or to calls to telephone numbers placed on trouble intercept to be connected to announcements or to operators.

AIU (Analog Interface Unit)

The AIUs are hardware such as the LUs and TUs that interface wires from the MDF to peripheral interface control, and data buses to the module processor and TSI.

ALIT (Automatic Line Insulation Test)

An OA&M feature enabling routine testing of analog line appearances that terminate directly on the switch. Tip-to-ring, tip-to-ground, and ring-to-ground leakage tests are performed.

AM (Administrative Module)

The part of the 5ESS®-2000 switch which performs call processing, administration, and maintenance which cannot be economically distributed to the switching modules. The AM consists of the processor, disk storage, and tape backup units. The AM processor performs the centralized processing functions, controls the high-speed tape, and the flow of data between the other dedicated processors distributed throughout the remaining units. The processor functions are fully duplicated (except for the port switch) in order to assure continued processing capability.

AMA (Automatic Message Accounting)

The automatic accumulation of call data such as calling number, called number, date, time, duration, etc., which will subsequently be processed by the RAO to render a customer's telephone bill. Magnetic tapes and disks are used to store the information pertinent to local and toll calls for billing purposes.

AMAT (AMA Teleprocessing)**AMATPS (Automatic Message Accounting Teleprocessing System)**

A billing system feature where the 5ESS®-2000 switch forwards billing information over a data link to a centralized AMA data collection system. The AMA data collection system interfaces with an RAO.

ANI (Automatic Number Identification)

A feature of a local switching office that automatically identifies the calling party without operator intervention.

AOC (Announce Only Channel)**AP (Attached Processor)****APR (Automatic Power Recovery)**

Automatically restores powers up SM to at least simplex state after a system-wide power outage.

AR (Automatic Recall)**ARS (Automatic Route Selection)**

This feature directs outgoing, business customer calls to the customer's most preferred available route. The customer may preselect a sequence of up to four private routes for each code point in the DDD network for

which a charge applies.

ASCII (American Standard Code for Information Interchange)**ASP (Auxiliary Services Position)****ASP (Advanced Services Platform)****AT (Access Tandem)**

An *ESSTM* switch used to provide carrier access to end offices and possibly to co-located stations by the station user to directly control, in stages, the routing of an outgoing tie trunk call through the originating, as well as any intermediate switches. The user is said to "cut-through" these offices. These trunks are referred to as "nonsenderized" or "tandem" tie trunks.

AUTOVON (Automatic Voice Network)

A private 4-wire telecommunication network used by authorized agencies of the government. This network provides its subscribers with services similar to the public network plus unique features specific to the government applications. The terms AUTOVON, DSN, and DSN/AUTOVON are used interchangeably when referring to this network.

AVRT (Avoidance Routing)**Administration**

Administration is a number of related functions with the objective of ensuring the overall provision of service by the *5ESS[®]*-2000 switch. Administration includes the assignment of lines and trunks to the system, memory management, collection of traffic and plant data, provisions for additions and modifications to the switch, service evaluation, and capabilities to control and manage the *5ESS[®]*-2000 switch. The primary objective of administration is to assure that the *5ESS[®]*-2000 switch delivers a high level of quality service to the subscribing customers. This is accomplished by monitoring and evaluating system performance. Potential problems that could cause service deterioration are identified.

Attempt

This is a peg count of an effort to use a facility or a circuit. An attempt may be a success or a failure.

Attribute

This is a column in a data table having unique names.

B-Link

The B-links are the outputs from 16 line unit (LU) half-grids that are multiplied onto 64 different paths.

BBH (Bouncing Busy Hour)

The BBH is the candidate busy hour (CBH) in which the daily peak (DP) load occurs.

BFG (BRCS Feature Grouping)

The BFG function provides group feature assignment to lines. A BFG is a group of features and parameters. A BFG is not a group of DNs, terminals or MLHG members, but a BFG may be assigned to any number of DNs, terminals or MLHG members.

BH (Busy Hour)

The hour among the CBHs having the highest average traffic load during the BS (busy season).

BIC (Bus Interface Controller)

A unit which interconnects a duplex bus selector to the microprogrammer controller of the PIC.

BLKOVD (AM/CMP overload)

BLL (Base Level Loop)

The software loop where the routine functions of the system are performed.

BORSCHT

Battery feed, overvoltage protection, ringing, supervision coding and decoding, hybrid (2-wire, 4-wire conversion) and testing. These functions are provided in the LU.

BPOQ (Base Priority Output Queue)**BRCS (Business and Residence Custom Services)**

The 5ESS[®]-2000 switch software that makes revenue generating features available to both business and residential customers.

BRCSDB (BRCS Data Block)**BRI (Basic Rate Interface)**

The customer interface to the ISLU that combines two B-channels and one D-channel.

BS (Busy Season)

Same as ABS

BSTR (Bootstrapper)

A part of the "fast pump" data link that interfaces with the processor update bus to gain access to SM processor memory. (Also see Bootstrap.)

BWM (Broadcast Warning Message)

Obsolete term. See Software Update.

BLL (Base Level Loop)

The software loop where the routine functions of the system are performed.

BRI (Basic Rate Interface)

The customer interface to the ISLU that combines two B-channels and one D-channel.

BIOQ (Base Input/Output Queue)**BSTR (Bootstrapper)**

A part of the "fast pump" data link that interfaces with the processor update bus to gain access to SM processor memory. (Also see Bootstrap.)

BX.25

Lucent Technologies Bell Laboratories version of the Telecommunications Standardization Sector (ITU-T) protocol X.25. This protocol is used for exchanging messages between the MSGS and the SM.

Bootstrap

An initialization action which results in a memory reload and software initialization.

Bylink

This link is used when the distant central office originates a call on a trunk and the distant central office cannot hold the dialed digits until a signal processor is attached. If the digit receiver is not attached quickly, the first received digit may be mutilated. When dialed digits are recognized, they are counted and stored in temporary memory.

Byte

The number of bits (usually 8) in a binary word.

C&D (Control and Display)**CAMA (Centralized Automatic Message Accounting)**

This feature permits a 5ESS®-2000 switch office to collect and store toll information and message unit billing on the CAMA calls originated by local offices served by the CAMA office.

CANF (Cancel — From Control)**CAPFIT (Capacity Fit)****CBH (Candidate Busy Hours)**

The hours that the daily peak load occurs. It is assumed that the CBHs in each day are fixed, and the number of CBHs is an office parameter.

CCBCOM (Channel Control Block Communication Region)**CCIS**

See Common Channel Signaling.

CCITT (International Telegraph and Telephone Consultative Committee)

See ITU-T.

CCOFL (Conference Circuit Overflow)**CCS (Common Channel Signaling)**

An operating capability of the 5ESS®-2000 switch software release that is compatible with the CCIS6, ECIS6, DSIS6, CCS7 and ITU-T message protocols and permits the 5ESS®-2000 switch to access the No. 2 STP network.

CCS (Hundred Call Seconds)

A unit of traffic. One user using one facility (for example, a trunk) for 1 hour generates 36 CCS (3600 seconds in 1 hour divided by 100).

CCS7 (Common Channel Signaling 7)**CCSA (Common Control Switching Arrangement)**

The common control switching arrangement is groups of trunks and one or more switching machines used to switch calls in a private leased network. All stations connected in the private network may call one another without using the public toll facilities. In addition, CCSA provides access to DDD network for network inward calling to the centrex group, direct outward dialing to the DDD network, and other features to access the exchange network.

CDAR (Customer-Dialed Account Recording)

A BRCS feature enabling a business group customer to associate a personal account number with a call and have it recorded on the AMA record. The customer can use this record for allocating charges on both outgoing and incoming calls.

CDI (Control and Data Interface)

The circuit providing the TU service group interface through the PICB and PIDB to the MCTU.

CDO (Community Dial Office)

A small automatic central office, located and sized to serve a small community, usually unattended, and often having trunks to only one other office. Operator services are provided from a nearby attended office.

CDX 5ESS®-2000 Switch Compact Digital Exchange)

CF (Control Fanout)

A pack that provides the distribution of control information to and from PHs.

CFNS (Call Forwarding Night Service)**CFPF (Call Forwarding Over Private Facilities)**

A BRCS feature enabling a customer with private facilities such as foreign exchange lines, WATS, CCSA, etc., and has dial access or automatic route selection access to these facilities, to use the private facilities during the call forwarding activation process.

CFR (Centralized Flexible Rating)

An OSPS feature introduced with software release 5E4 providing the mechanism for issuing a rating query to and receiving a reply from, the Centralized Flexible Rating data base external to the OSPS on real-time rated calls.

CFV (Call Forwarding Variable)

A BRCS feature allowing a station user to redirect calls intended for that station to another telephone.

CG (Concentrator Group)

Synonymous with LU pair of concentrators. There may be 4, 6, 8, or 10 concentrators to an LU.

CGA (Carrier Group Alarm)

This feature allows the local switching system to infer the failure of a carrier group from observed call failures on only a few trunks in the trunk group.

CHDB (Channel Data Bank)**CI (Carrier Interconnect)**

Provides an interface between the local exchange and the interexchange carrier.

CI (Control Interface)

A subunit of the TSIU, the control interface: provides the interface and monitors communications between SM processor and the interface units and reports errors detected; receives, latches, and reports service requests from interface units to the SM processor; and distributes control and clock signals to the module PUs by way of the peripheral interface control bus.

CIB (Control Interface Bus)

The bus carrying the control messages between the control fanout and the data fanout.

CID (Call Identifier)**CIP (Critical Indicator Panel)****CLDB (Calling Leg Data Block)****CLNK (Communication Link)****CM (Communication Module)**

Hardware that provides the interface between the AM and the SM(s). In a multimodule office, the CM consists of the message switch and the TMS.

CM2 (Communications Module 2)

An updated version of the CM that is physically smaller but has an increased call handling capacity. This has been accomplished by use of the new operationally larger TMS2 and MSG2, now housed in the CM2 cabinet instead of separate TMS and MSGS cabinets.

CM2C (Compact CM2)**CMCU (Communications Module Control Unit)**

The CMCU, a part of CM2, provides message interface and timing facilities used to synchronize the time division network in the TMS by way of the TMSU. The CMCU consists of a DMI, NCLK2, TMS controller, and metallic interface. The CMCU is not used in the CM1 configuration (see MICU).

CMP (Communication Module Processor)

Introduced in 5E6, the CMP is a two board processor that increases the call processing and OA&M capacity of the switch by down-loading some of the former functions of the AM to the CM.

CN (Change Notice)**CNCC (Customer Network Control Center)****CNI (Common Network Interface)**

The CNI functions as a packet switching system in the signaling network. The CNI is not a stand-alone switching system but requires configuration to an application such as the 5ESS[®]-2000 switch. The CNI consists of several peripheral processors (RPCs and LNs) serially interconnected and a central processor that performs the basic operating system duties in a distributed I/O processing architecture.

CNI/IMS (Common Network Interface/Interprocess Message Switch)

The CNI/IMS consists of a single 5ESS[®]-2000 switch cabinet that provides two types of ring nodes: RPCs and LNs. the CNI/IMS is connected to the AM by way of a dual serial channel and also interfaces with DDS facilities.

CO (Central Office)

The central office is the switching equipment in a building that provides exchange telephone service for a given location. In some cases, there is more than one central office serving the same area. A central office may include more than one central office code.

CODEC (Coder — Decoder)**COER (Central Office Equipment Report)**

This is a centrally located traffic data retention and reporting system. This is a Lucent Technologies OS that helps determine traffic load capacities.

CORC (Customer-Originated Recent Change)

A customer-originated data base change to initiate a change in characteristics (lines, trunks, equipment and/or features associated with the customer's telephone numbers).

COT (Central Office Terminal)

Hardware that changes electromechanical signals to analog signals.

CP (Central Processor)

The central processor provides the primary control for operating the equipment that directs calls through the central office and aids in detecting and analyzing any faulty equipment involved in this task. In the 5ESS[®]-2000 switch, the AM is the central processor.

CPE (Customer Premises Equipment)

Telephone equipment located on the customer's premises.

CRA (Call Recorder Assembler)**CRO (Cancel Rerouted Overflow)**

CS (Call Store)**CSR (Customer Station Rearrangement)**

A BRCS feature that allows customers to make changes affecting their telephone service from an on-premises terminal, for example; to move or swap directory numbers, change or display features associated with their lines, and verify that the data assigned to their lines or features is correct.

CSS (Cyclic Sequential Search)

A path hunt used in the 5ESS[®]-2000 switch call processing software.

CSU (Combined Services Unit)

A unit that combines the functions of a DLTU, MMSU, DSU-2-SAS, and GDSF in one shelf.

CTS (Control Time Slots)

The periods in time when control signals are transmitted during multiplexing or received during demultiplexing.

CTTU (Centralized Trunk Test Unit)

An OS providing centralized trunk maintenance through a data link. This allows the switching control center maintenance personnel to perform remote trunk testing from a work station on a local switching office. .GW"Call" A call consists of two half-calls. The count is represented by the sum of the originating peg count and the incoming peg count. .GW"Call Attempt" Call attempt is a line or trunk origination (off-hook) that is connected to a UTD or signal processor, plus at least one digit dialed before the line or trunk goes on-hook.

Call Gapping

A control which regulates the maximum rate at which calls are released towards a destination code.

Call Type

A 3-digit code generated by a class 5 office which identifies the type of call being originated.

Central Office Code

The central office code is a 3-digit code that designates a group of 10,000 consecutive telephone numbers. A switch may have more than one central office code. The central office code is the first three numbers or digits of the 7-digit customer number.

Circuit Pack

A circuit pack is a plug-in unit used as a convenient means for assembling, on a single mounting, one or more components such as capacitors, inductors, diodes, resistors, transistors, etc. The components are interconnected to perform one or more circuit functions, such as amplification, gating, timing, etc., required in a circuit.

Complaint Observing

Complaint observing is used when repeated trouble reports on a customer station indicate the need for further efforts to resolve the problem. All AMA calls are detailed billed (flagged) with a special mark.

Component

A server such as a trunk, tone decoder, or service circuit that is a shared resource as opposed to being dedicated.

Concentrator

A digital switching entity that permits more customers to share common output lines (for example, a 2:1 concentrator permits 48 customers to share the 24-channel capacity of a single T1 line)

Concentration Ratio

The ratio of the number of lines terminated on the LU to the time slots available for the LU (64 time slots per LU).

Constructed Feature

Feature defined by a 5ESS[®]-2000 switch user (such as a service provider) for their particular needs.

Customization

This is a modification of a preconstructed BRCS feature resulting in a unique feature that can be assigned to lines or trunks.

DALB (D-Channel Application Linkage Block)**DBM (Data Base Manager)**

Provides interfaces and access mechanisms between the different types of software systems and data in the data base.

DCBU (D-channel Backup)

Enables a standard PRI to have an "active" and a "stand-by" D-channel.

DCE (Data Communication Equipment)**DCIS6 (Direct Common Channel Interoffice Signaling #6)**

A protocol permitting CCIS6 direct signaling messages to be sent over CCS7 signaling links.

DCLU (Digital Carrier Line Unit)

This unit terminates the T1 carrier from the SLC[®] 96 carrier systems to the 5ESS[®]-2000 switch.

DCO (Digital Central Office)**DCTU (Directly Connected Test Unit)**

A unit accessing each line and trunk to provide a number of facility tests required.

DDD (Direct Distance Dialing)

Direct distance dialing is a toll service that permits customers to dial their own long distance calls.

DDL (Derived Data Links)

Data links used to communicate with other RSMs in an multimodule remote switching module (MMRSM) when in a stand-alone mode.

DDS (Digital Data Service/System)

A dedicated digital transport network that provides data communications over point-to-point or multipoint private lines and systematically supports *DATAPHONE*[®] data communications service. The DDS is designed for digital data only (up to 56 kb/s), there is no provision for voice transmission.

DDSBS (Duplex Dual Serial Bus Selector)

A channel which permits the connection of two dual serial channels to a single I/O device.

DEN (Digital Equipment Number)

A 7-digit number used in translation to identify the location of a DLTU channel so that it may be accessed.

DESEP (Destination Separation Class)

The destination class on the traffic separation report.

DF (Data Fanout)

A pack that provides the distribution of data signals to and from the PHs.

DFA (Digital Facilities Access)

Access point for digital facilities in a 5ESS[®]-2000 switch.

DFC (Disk File Controller)

A microprocessor-controlled unit that is programmed to accept tasks from the AM, and then assigns each task to a disk drive work queue.

DFI (Digital Facility Interface)

The circuitry in a DLTU that terminates a single T1 span line from a T-carrier RSM.

DID (Direct Inward Dial)

A feature that allows an incoming call from the exchange network, except foreign exchange or wide area telephone service, to reach a specific centrex or PBX station line (or group of lines if in a hunt group) without attendant assistance.

DISPDB (Display Data Block)**DLI (Dual Link Interface)**

Connects the TSI to the NCT links, inserts control messages between the module processor and the AM or other module processors, and provides buffering and timing.

DLN (Direct Link Node)

A node on the CNI ring performing signaling message processing normally performed by the AM. The DLN is connected with other nodes on the ring by way of the dual ring bus.

DLTU (Digital Line Trunk Unit)

Hardware that terminates digital trunks with SMs by way of T1 lines.

DMA (Direct Memory Access)

Provides direct access to the main store by peripheral units without involving the AM.

DMERT (Duplex Multi-Environment Real-Time)

The software operating system program used by the AM.

DMI (Duplex Message Interface)

Circuitry terminating the message interface fuses from the module message processors.

DMMP (Dual Multimodule Processor)

An optional (beginning with software release 5E6) feature allowing equipping of more hardware providing greater reliability of full message transfer capacity in CM2 equipped offices.

DMU (Data Manipulation Unit)

The hardware of the 3BCC containing the rotate/shift mask unit, the arithmetic/logic unit and the general/temporary firmware registers.

DN (Directory Number)

A 7-digit telephone number made up of a 3-digit central office code and a 4-digit station number. It is also called TN.

DNET (Defer Nonessential Tasks)**DNUS (Digital Networking Unit-SONET)**

An SM-2000 Unit that functions similar to the DLTU by terminating trunks interfaces to the SM-2000.

DOPS (Digital Ordering and Planning System)

The standard engineering ordering and pricing vehicle for the 5ESS®-2000 switch.

DP (Daily Peak)

The maximum of the CBH loads in a day.

DP (Dial Pulse)

Method of transmitting digits (address information) between telephone customers and the central office or between central offices. It consists of DC pulses caused by momentarily opening the loop (usually at 10 "opens" per second). The numerical value of each digit is represented by the number of opens in a train of pulses.

DPAT (Dialing Access Plan Treatment)**DPBX (Digital Private Branch Exchange)****DPIDB (Directly Connected Interface Data Bus)**

The bus that carries user and control messages between the integrated services line unit (ISLU) and the packet switch unit (PSU).

DS3

A transmission medium that can be fiber-optic or digital radio at a rate of 44.736 MB/s.

DSCH (Dual Serial Channel)

A bus in the CNI that provides packet data transfer between the RPCs, LNs, and the AM.

DSL (Digital Subscriber Line)**DSN (Defense Switched Network)**

A private 4-wire telecommunications network that is used for the transaction of official business of the government at Department of Defense and military installations. The DSN incorporates unique features specific to government applications, including the use of 5ESS[®]-2000 switches as multifunction switches. The DSN has control to access or limit access to commercial telephone company central office and trunk lines and to restrict commercial access to the DSN as deemed necessary. The terms DSN, AUTOVON, and DSN/AUTOVON are used interchangeably when referring to this network.

DSP (Digital Signal Processor)

A specialized microprocessor used to perform signal processing operations in the universal tone decoder, universal conference circuit, and transmission test facility.

DSU (Digital Service Unit)

A functional part of the SM that generates and decodes tones, tests ISDN lines and CCS trunks, and provides recorded announcements for the OSPS.

DSX (Digital Cross-Connect)

An internal interface that acts as a central point for cross-connecting, rearranging, patching, and testing digital equipment and facilities.

DTA (Dial Through Attendant)

A BRCS feature allowing a station user to complete the dialing of other than station-to-station calls after the attendant selects the private facility on attendant-handled calls.

DTD (Dial Tone Delay)

This is the time it takes the switching system to return dial tone to an originating line after the subscriber goes off-hook.

DTDPC (Dial Tone Delay Peg Count)**DTDSC (Dial Tone Delay Sample Count)****DTF (Dial-Tone-First)**

A type of coin service which allows the customer to dial certain types of calls (for example, N11 and other local free calls, 0-, 0+, etc.) without making an initial deposit.

DTMF (Dual Tone Multifrequency)

Method of transmitting digits (address information) from telephone customers to the central office. It consists of sending a simultaneous combination of one of a lower group of frequencies and one of a higher group of frequencies to represent each digit (1 through 0), and symbols (* and #).

DTT (Digital Transmission Terminals)**DUCS (Digital Universal Conference Service)**

A 3-port or 6-port conference circuit capable of conferencing up to three or six parties, respectively.

Data

Data is any coded information that is taken in, operated on, or outputted by a computer or other machine designed for handling such information. A descriptive type of information used as a basis for making decisions.

Data Base

Electronically stored information which may be retrieved and updated by way of DBM interface primitives.

Data Interface

A subunit of the TSIU that provides the interface for the PCM data, signaling bits and the clock and time-slot synchronization between the TSI and the interface units.

Dial Tone

Dial tone is an audible tone which indicates that a customer digit receiver has been attached and that dialing may begin.

Dictionaries

A data base in the 5ESS®-2000 switch that provides information such as access-type, relation and attribute identifications, number of subattributes, domain identifications, etc., in the memory structure.

Direct Connect

Direct connect allows a customer to signal and be automatically connected to another station by removing the handset from the switchhook.

Disk Drives

Memory storage hardware that uses magnetic recording on rotating flat disks. Disk drives provide reliable and flexible mass memory storage for infrequently used programs and data.

Domain

In a data base, the set of allowable values that an attribute may have.

Dynamic Memory

The equipment used to magnetically store information which is changed frequently, such as equipment and work status, work queues, etc. Dynamic memory, dynamic data, and dynamic ODD are used interchangeably.

E911 (Enhanced 911)

Provides the public safety answering point with caller identification.

E&M (Signaling Leads)

A signaling system that derives its name from historical designations of the signaling leads on the circuit drawings covering these systems. The M-lead carries supervisory (and sometimes dial pulse) signals from the switching equipment to the signaling/transmission equipment. The E-lead carries supervisory signals from the signaling/transmission equipment to the switching equipment. As a result, signals from office A to office B leave on the M-lead at office A and arrive on the E-lead at office B.

EADAS (Engineering and Administration Data Acquisition System)

An automated traffic data collection system which collects and summarizes data obtained from central office switches to be used for administrative and engineering purposes.

EAE0 (Equal Access End Office)

An ESS[®] switch used to provide carrier access to co-located stations.

EAI (Emergency Action Interface)

The interface connecting craft inputs to the central control for certain maintenance functions.

EAS (Equal Access Signaling)

A signaling method introduced by the carrier interconnect feature.

ECD (Equipment Configuration Data)

A data base that describes the physical and logical configurations (that is, interfaces of IOP and AM) of the 3B20D or 3B21D computer and peripheral hardware. It also contains configuration and control information for the audit and craft interface software system.

ECIS (Embedded CCS Protocol)**ECIS6 (Embedded CCS Protocol #6)**

A transmission protocol used for CCS6 banded messages using the link level of the CCS7 signaling protocol message transfer part. This protocol allows the 2STP CCS network to use 56 kb/s signaling links and build up the signaling capacity.

EOP (End-of-Period)

A statistical term used in engineering methodology that denotes the end of a predetermined engineering period. The time between scheduled equipment growth or modification operations.

EPROM (Erasable, Programmable, Read-Only Memory)

A type of ROM (read-only-memory) that can be electrically erased and re-written.

EPSCS (Enhanced Private Switched Communications Service)

A private switched network of dedicated facilities providing full duplex communication on all connections. It provides a center from which the customer can exercise, monitor, and control functions relative to the performance of the network.

EQPOTS (Equivalent POTS)**ESSX (Private Facilities Feature Emulating a PBX)****ETN (Electronic Tandem Network)****ETS (Electronic Tandem Switching)****EVE (Extreme Value Engineering)**

A method of engineering a switching system based on the extreme (that is, the highest use, most space required, most lines needed).

EVHD (Expected Value High-Day)

A statistical variable value used in the EVE methodology. The EVHD represents a statistical equivalent of the traditional HD criteria and is based on the three high-month busy season data.

EMM (Expanded Main Memory)

EXM-2000 (Extended SM-2000)

An SM-2000 that performs the functions of a remote SM.

Erlang

A measure of communications traffic intensity representing the full-time use of a communications facility. One Erlang equals 36 CCS.

FC (Feature Control)

This is responsible for the sequencing of a call which includes collection of digits and interpretation of customer signals.

FIU (Facilities Interface Unit)

Used between the RSMs and the host SMs and connects the T1 format to the NCT format.

FPC (Foundation Peripheral Controller)

A peripheral control in the input output processor used to provide AM interface to the TMS and maintenance access to the message switch. The FPC issues time slot path requests to the TMS and acts as an interface between the peripheral subunits and the MSGS. In the CM1 configuration, the FPC is part of the MSPU. Under direction of the AM processor, the FPC controls the configuration of hardware in the MICUS. In the CM2 configuration, the FPC is part of the MSCU2. Under direction of the AM processor, the FPC controls the configuration of hardware in the MSCU2s.

FRL (Facilities Restriction Level)**FX (Foreign Exchange Service)**

Provides customer access to a distant central office by private (FX) trunks. Incoming foreign exchange calls are placed to the listed (FX) directory number and are answered by the attendant. Outgoing calls may be made on an attendant basis and/or on a station user direct-dial basis.

Fractional DS1 Switching (Fractional DS1/ISDN)

Enables customers to establish calls with other customers at rates between 128 and 1,536 Kbps.

Frame

Overhead control bits usually encapsulating a packet. These bits contain frame delimiters, addresses, error detection information, frame type identifiers, etc. In certain protocols such as X.25, a frame need not contain a packet.

GDSF (Global Digital Service Function)

A single unit that replaces the GDSU, TTF, and ISTF units in the SM. This unit may also be assigned on the SM-2000.

GDSU (Global Digital Service Unit)

A part of an SM that provides up to eight digital service circuits for low usage functions such as 3-port and 6-port conferences, test tones, responses to test tones, and processing test responses.

GDX (Gated Diode Crosspoint)

Electronic devices used to pass current in either direction and used in the LU line concentrator.

Growth

Growth is the systematic modification of central office equipment to provide increased call-handling capacity and improved service. Growth is required to make a 5ESS[®]-2000 switch evolve economically over a wide range of services and traffic needs.

Hairpinning

A connection established between one channel on a DS1 (or time slot on a T1) to another on the same IDCU.

HD (High Day)

The one day in a 10-day average that has the highest traffic during the busy hour.

HDBH (High-Day Busy-Hour)

The traffic load level in the BH (busy hour) of the HD (high day).

HLSC (High-Level Service Circuit)

A service circuit in the LU used to perform all line service circuit functions which cannot be provided through the TSI.

HOC (Host Office Collector)

A centralized AMA data collection system which collects AMA data over data links from several telephone switching offices.

HSM (Host Switching Module)

The SM in the host office terminating umbilicals from one or more RSMs.

Half-Call

A half-call is the establishment of a path between a peripheral unit and the TSI. The terminating part of a call represents a half-call and the originating part of the call represents the other half-call. Each half-call generates a terminal process.

Hundred Call Seconds (CCS)

A unit of traffic. One user using one facility (for example, a trunk) for 1 hour generates 36 CCS (3,600 seconds in 1 hour divided by 100).

I-CNIS (ISDN Calling Number Identification Services)

An enhancement to calling party number and billing number feature.

IAO (Intraoffice)

Intraoffice describes calls switched by a single switching machine. Intraoffice equipment is the equipment used to carry traffic between customers within the same switching machine.

IAQ (IP-to-AP Queue)**IC (Inter-LATA Carrier)**

A carrier designed to service traffic which crosses a LATA boundary.

ICL (Inter-RSM Communications Links)

The links that interconnect SMs in a multimodule RSM.

ICLID (Incoming Call Line Identification)

This feature provides calling party identification of calls originated from both analog and digital lines on the same 5ESS®-2000 switch for ISDN subscribers and attendants.

IDCU (Integrated Digital Carrier Unit)

A digital loop carrier system supporting Bellcore TR-008 and TR-303 requirements.

IDCU (Integrated Digital Carrier Unit)

Provides analog and ISDN interface to SLC® remote terminals.

IDDD (International Direct Distance Dialing)

Customer direct dialing of international calls.

IDP (Individualized Dialing Plan)

The individualized dialing feature of the 5ESS®-2000 switch can be used to incorporate any number of the

following special operational functions requested by the customer: critical interdigital timing for dialing plan; attendant control of facilities; group numbering plan that includes intercom dialing by way of 1- to 5-digit basis, access to an attendant by way of the digit "0", access to private facilities via a 1- to 7-digit code, redefinition of feature access codes from the standard POTS codes and overriding the group dialing plan; single-digit dialing; speed calling; and customer-changeable speed calling.

ILUM (Individual Line Unit Measurement)

Allows the administrator to request traffic measurements of any 128 individual lines in the office.

IMS (Interprocessing Message Switch)

Hardware and software in the SM used to support OSPS, BRCS, CSDSCII, and the ICLID for interoffice calls and 16 kb/s intraoffice packet switching.

INSEP (Incoming Separation Class)

The incoming class of the traffic separation report.

INWATS (Inward Wide Area Telephone Service)

Calls to area code 800 subscribers from one or more predetermined geographical areas at a rate based on expected usage. These calls are toll free to the calling parties.

I/O (Input/Output)

Input/output is the process of transmitting information from an external source to an external destination.

IOMI (Input-Output Microprocessor Interface)

A unit that provides the interface between the 16-bit PIC and up to 16 of the 8-bit MMPs.

IOP (Input Output Processor)

The IOP controls transfers between the MAS of the AM and the MCC, operation and maintenance center, and remote terminals. The IOP provides interfaces to visual display units and hard-copy printers in the MCC, other work stations, and to magnetic tape drives.

ISAT (Integrated Services Attendant Console)**ISDN (Integrated Services Digital Network)**

An international plan originated by the ITU-T representing the latest step of the evolution of the analog telephone to an all-digital network. Digital voice, circuit-switched, and packet-switched data may be transmitted simultaneously over the same interface.

ISLU (Integrated Services Line Unit)

This unit houses the basic rate interface (BRI) cards in the SM and provides analog and digital services to subscribers by support of the following interfaces: ISLU-T, a 4-wire BRI that provides the basic Integrated Services Digital Network 2B+D access over a range of up to 1,000 meters; ISLU-U, a 2-wire BRI that provides the basic ISDN 2B+D access using echo-canceled hybrid technology appropriate for all carrier serving area nonloaded loops; ISLU-Z, for analog lines (that is, POTS, coin-first coin lines, party lines, etc.) which normally terminates on the analog-concentrated line unit. The ISLU-Z interface can have a concentration ratio of up to 8:1.

ISM (Integrated Services Module)**ISP (Intermediate Switching Point)****ISTF (Integrated Services Test Facility)****ISUP (ISDN User Part)****ITU-T (Telecommunications Standardization Sector)**

Successor to CCITT.

IU (Interface Unit)

Part of the 5ESS[®]-2000 switch that provides customer terminations.

Incoming Calls

These calls originate (as far as the switch is concerned) on trunks and are routed either to other trunks (tandem) or to lines.

Incoming Response Delay

This is the time from the arrival of an incoming seizure signal to the return by the receiving exchange of a proceed to send or an equivalent signal.

Interoffice

Interoffice describes calls between two or more switching machines. Interoffice is the trunk groups between two separate switching machines or the traffic carried by such trunk groups.

kB (Kilobyte)

1024 bytes.

KIP

Kilobytes in Progress

Key

Designation assigned to one or more data base attributes that will provide access to a particular tuple.

Key Service Indicators

These indicators give the administrator a quick view of the overall quality of service being provided to the subscribers.

LAMA (Local Automatic Message Accounting)

A message accounting system located within a local office and serving on subscribers assigned to that office or group of offices.

LAN (Local Area Network)

An ISDN feature introduced in software release 5E4 allowing packet switching over a 16 kb/s D-channel on a BRI. Access for individual subscribers is by the standard 2B + D format. Packet-switched data and signaling is carried on the 16 kb/s D-channel. Computer access is available using one or more digital subscriber lines carrying multiplexed packet data on the 64 kb/s B-channel.

LAPD (Link Access Protocol D)**LASS (Local Area Signaling Services)****LATA (Local Access and Transport Area)**

A defined geographical area where equal access end offices and/or access tandem offices can provide carrier access to the local exchange.

LDIT (Local Digit Interpreter Table)**LDN (Listed Directory Number)**

The LDN calls originate outside the customer group and complete to a centrex attendant.

LDSU (Local Digital Service Unit)

A part of the SM that provides high-usage service circuits such as tone decoding, tone generation, conferencing and voice-frequency testing.

LDSUB (Local Digital Service Unit Bus)

A data connection terminating the time slot interchanger in the MCTU and the serial data interface circuit on the DSC pack. The LDSUB is the path over which digitized tone samples pass to and from the DSU2.

LDSUF (Local Digital Service Unit Function)

Part of the DSU2 that generates and decodes tones.

LEN (Line Equipment Number)

An 8-digit number used in translations to identify a customer's line so that it may be accessed.

LGC (Line Group Controller)

The interface between switched information on the group interface data bus and the link interface data bus.

LIDB (Line Information Data Base)

A 32-time slot bus that connects the line group controllers (LGC) and the common data boards in the ISLU.

LMOS (Loop Maintenance Operations System)**LN (Link Nodes)**

A part of the CN1 that performs the message handling protocol, control functions, and self-diagnostics. The LN establishes the connection to the signaling network by way of A-links.

LONAL (Local Off-Network Access Line)**LSS (Load Service Summary)**

This report provides load volumes, processor occupancies, and ineffective attempt information.

LTD (Local Test Desk)

The local test desk provides equipment that performs local primary line testing. It may be used to test parts of the toll

LTMA (Lightwave Termination and Multiplex Assembly)**LTP (Line Trunk Peripheral)**

Consists of the LU, TU, MSU, DCLU, FIU, and the modular metallic service unit.

LU (Line Unit)

This unit interfaces the analog (subscriber) lines to the SM of the 5ESS[®]-2000 switch.

LUCUM (Line Unit Concentrator Utilization Measurements)

Enables the administrator to request traffic measurements on individual line to determine if they are experiencing blocking, to assist in determining what lines are being affected, and indicate how the call load may be redistributed to alleviate a high blocking situation.

Lightwave Termination and Multiplex Assembly (LTMA)**Locally Switched Lines**

Lines that are dynamically switched within an office containing an IDCU.

LUTS (Locked Up Trunk Scan)**Loss Probability**

The loss probability is the failure to connect a call after sufficient address signaling information (dialed digits) has been received. It includes network and service circuit blocking and any system faults, but excludes trunk blocking.

MACSTAR® Computer Program

A Lucent Technologies 3B2 computer program used as a front-end adjunct to the Remote Memory Administration System (RMAS) as part of the CSR (customer station rearrangement) feature.

MAS (Main Store)

The MAS is RAM which in the AM contains information needed for operating the 5ESS®-2000 switch, such as the software release for AM functions, translations, call processing registers and billing registers. The MAS is duplicated for reliability.

MASU

See MAS.

MB (Megabyte)

Consists of 1,048,576 bytes.

MCB (Message Control Block)**MCC (Master Control Center)**

The MCC provides the local human-machine interface to the 5ESS®-2000 switch including system status displays, hard-copy printers, and manual control over system operations.

MCD (Minimum Chargeable Duration)

The minimum chargeable duration is the length of time that answer supervision has been continuously detected, beyond which a call is defined as billable. The MCD period is 2 seconds.

MCTU (Module Controller and TSI Unit)**MDF (Main Distributing Frame)**

This is a connection system that interfaces between loop cable pairs and switching equipment.

MDR (Message Detail Recording)**MDSL (Multiplexed Digital Subscriber Lines)****MEU (Memory Expansion Unit)**

Hardware that provides additional memory capacity for SMs and/or RSMs.

MF (Multifrequency)

Signaling method in which pairs of selected tones, representing digits, are sent to the common control switching system. Voice transmission from the calling customer is inhibited during MF pulsing.

MFC (Modular Feature Construction)

A type of software construction used in BRCS version of the 5ESS®-2000 switch that permits simplified grouping of several capabilities into feature groups that provide many revenue producing services, tailored to individual customer needs.

MFOS (Multifunction Operating System)**MGRNR (Message switch receiver not ready)****MHD (Moving Head Disk)**

A high-capacity, random-access digital data storage device used for storing infrequently accessed programs and data by the AM.

MIB (Message Interface Bus)

MICU (Message Interface Control Unit)

This is a unit in a message switch which consists of the network clock and the NCT link interface from the message switch.

MLH (Multiline Hunt)**MLHG (Multiline Hunt Group)**

A group of customer facilities which are identified as a group in translations. When calls are placed to the MLHG, the 5ESS[®]-2000 switch hunts for an idle member of the group beginning with the dialed DN.

MLSS (Machine Load and Service Summary)

This report provides cumulative service year-to-date and additional capacity information for each SM.

MLT (Mechanized Loop Testing System)

An external operations system for testing of the customer lines (loops) in the 5ESS[®]-2000 switch.

MMC (Maintenance Message Consolidation)**MMP (Module Message Processor)**

Circuitry in the MSPU that handles control message protocol on the link to the SMs.

MMRSM (Multimodule Remote Switching Modules)

The MMRSM consists of one to four RSMs interconnected by dedicated T1 links. Each RSM is also connected to an SM at the 5ESS[®]-2000 switch by dedicated T1 links.

MMSU (Modular Metallic Services Unit)

Provides metallic access, miscellaneous scanning and distributing functions, automatic line insulation test, and gated diode crosspoint compensation.

MPI (Module Processor Interface)**MS (Main Station)**

A telephone that is connected directly to the central office either by an individual or shared line. Main stations include the principal telephone of each party or a party line. They do not include telephones that are manually or automatically connected to the central office through a PBX or extension telephones (telephones that have been added to an individual or shared line to extend the telephone service to other parts of the subscriber's home or business premises).

MSCU (Message Switch Control Unit)

The MSCU is a part of the CM and is responsible for handling control information between the AM and module processors.

MSG (Message Switch)

This is the unit that performs internal interprocessor message switching, provides terminations for CCS (common channel signaling), and contains the message interface clock unit.

MSGs (Message Switch)

The MSGs, one of two switches that comprise the CM, performs as a switch for passing control messages between any two SMs or an SM and the AM. The TMS is the other switch in the CM.

MSPU (Message Switch Peripheral Unit)

Hardware unit of the CM that switches interprocessor messages on the control time slots.

MSPU3 (Message Switch Peripheral Unit 3)

An improved version of MSPU1 and MSPU2 that includes MMP. The MSPU3 reduces software required for message handling and required processor real time per message.

MSS (Message Service System)

The MSS (also known as the Customer Service System) is a feature introduced in software release 5E4 that offers the business customer personalized call answering from a centralized location. In addition to the call coverage functions, MSS supports entry, storage, and retrieval of messages.

MSU (Metallic Service Unit)

Provides an access network in the 5ESS®-2000 switch which can interconnect analog facilities and DC test equipment; provides scan and distribute functions, metallic access, automatic line insulation testing, and gated diode crosspoint compensation.

MTB (Metallic Test Bus)

The bus connecting the modular metallic service unit to the test access circuit within each trunk unit. This bus is used for maintenance and routine test activities.

MTIB (Metallic Test Interface Bus)

See MTB.

MTTY (Maintenance Teletypewriter)

The human-machine interface to the administration module.

MUPH (Multiple Position Hunt)

A BRCS feature introduced in software release 5E2(1) that distributes calls over a group of console positions, each of which can handle several types of calls. Each position has dedicated terminals, rather than call indicator lamps, for receiving the different call types.

MWI (Message Waiting Indicators)

An ISDN feature introduced with software release 5E4 informing a customer of a message waiting. Three types of indicators can be provided.

- (1) ***Audible Message Waiting Indicator*** : Provides a tone when the customer goes off-hook.
- (2) ***Electronic Billboard***: Provides name of person having messages.
- (3) ***Visual Message Waiting Indicator*** : Activates a message waiting lamp on the station set.

Manual Line Service

Manual line service is a centrex feature which allows a centrex station to be connected to an operator or attendant by taking the receiver off-hook, without dialing any digits. Manual line service is similar to direct connect, a noncentrex feature.

Maximum Call Capacity

This is the capacity of an ideal switch with a central processing unit with 73 percent call processing occupancy and 98 percent processor occupancy. This call capacity is a level that is sustainable for an indefinite period of time; however, no allowance is made for craft interaction.

Message

A message is used to pass information between processes. A message may consist of data, requests, commands, and/or acknowledgments. The message count represents the number of messages exchanged between processors.

Metallic Test Interface Bus (MTTB)

See MTB.

Modular Queuing Capability

A BRCS feature that provides, in the 30-minute traffic report, measurements on the queues and announcements.

Multiparty Service

Provides 4- or 8-party telephone service to a maximum of eight customers on a common line.

NAC (Network Administration Center)

A work group interfaced to the SCCS (Switching Control Center System) and designated to automatically receive the following: 15-minute traffic reports; 5-minute, 1-hour, 24-hour and monthly plant reports; and 30-minute traffic reports upon request.

Nail-Up

A connection established between any channel on a DS1 to any other specified time slot on a peripheral unit of the 5ESS®-2000 Switch.

NCD (Network Call Denial)

This capability enables a carrier switch to block inter-LATA calls from non-paying customers.

NCLK (Network Clock)

The digital reference clock for the network.

NCT (Network Control and Timing)

A fiber-optic path which connects an SM to the TMS, provides time-slot paths for network connections, carries a control time slot to the SM, and distributes timing to the SM.

NFAS (Nonfacility Associated Signaling)

Provides a D-channel signaling channel which can control calls to DS0 channels on more than one PRI for a Bellcore standard PRI.

NM (Network Management)

This is a real-time surveillance and control activity utilizing techniques to optimize use of the call carrying capacity in a network under stress due to traffic overload or failure.

NMC (Network Management Center)**NOCKT (No Circuit)****NPA (Numbering Plan Area)****NRODD (Nonredundant Office Dependent Data)**

Office dependent data that is not backed up (call processing data, for example).

No Circuit

This represents the number of calls lost due to unavailable resources.

OA&M (Operations, Administration, and Maintenance)**OAM Load (Once-A-Month Load)**

A statistical variable value used in EVE methodology, that indicates the traffic load which is expected to be exceeded only once a month. This is defined as the 95th percentile of the DP distribution.

ODA (Office Data Assembler)

The mechanism by which initial translation information may be assembled for a 5ESS®-2000 switch. Information for the 5ESS®-2000 switch is entered by way of a video terminal and transferred into an ODA computer, assembled, then sent to the 5ESS®-2000 switch.

ODB (Office Data Base)**ODBE (Office Data Base Editor)**

A feature of the 5ESS®-2000 switch memory management that allows manual changing of information contained in the data base.

ODD (Office Dependent Data)

A data base specific to a particular office.

ODD (Static)

Data that establishes the types and amounts of various equipment which comprise the office (lines, trunks, equipment, etc.). The protected area of memory.

OGT (Outgoing Trunk)

An outgoing trunk is a 1-way trunk where only originating traffic can access a distant office to complete telephone calls. Originating traffic in the distant office cannot access this trunk.

OM (Output Message)**ONAL (Off-Network Access Line)****ONTC (Office Network and Timing Complex)****ONI (Operator Number Identification)**

A method to obtain billing information by connecting the calling party to an operator position.

OOS (Out of Service)**ORB (Office Repeater Bay)**

A bay in the office, usually near the digital system cross-connect bays, that houses the digital repeaters used to regenerate the PCM data for a T1 line.

ORM (Optically Remoted Switching Module)

A type of remoted SM that is interfaced to the 5ESS®-2000 switch through the CM instead of a host SM. This is done by way of DS3 transmission or T1 facilities (fiber-optic, digital radio, cable, or T1) at a rate of 44.736 MB/s.

ORP (Office Records Printer)

A local or remote printer that uses a 7N47B to interface into the input/output processor (IOP). This is an RS232C interface for a full duplex, asynchronous, 1200-baud terminal. If the ORP is remoted, a modem and a dial-up line must be used to establish the data link.

OS (Operating System)

Software that enables a computer to supervise its own activity.

OSDS (Operating System for Distributed Switching)**OSO (Originating Screening Office)**

This feature allows the 5ESS®-2000 switch to screen originating 800 service calls. Routing information is obtained by accessing a remote data base.

OSO-INWATS

800-Service originating screening office.

OSPS (Operator Services Position System)

The OSPS uses features provided by a host 5ESS[®]-2000 switch and dedicated peripheral equipment to support operator and attendant services.

OSS(Operational Support System)

Computer systems which may be used to provide additional administrative support (for example, EADAS, COER, SCCS, etc.)

OTC (Operating Telephone Company)

Telephone Company owning 5ESS[®]-2000 switch.

OUTWATS (Outward Wide Area Telephone Service)

A service that allows customers to make calls to certain zone(s) or band(s) on a direct dialing basis for a flat monthly charge or a charge based on accumulated usage. Users can also call WATS operators for assistance.

OVLD (Overload)**OVLDEN (Calls denied due to overload)****Office Records**

Office records for the 5ESS[®]-2000 switch are tabular listings of the actual inventories and assignments of the data base and serve as a means for administering the office. An explanation of the form entries is included in the translation guide TG-5.

Operational Capacity

This capacity is the indefinitely sustainable operation point while processing calls with an ideal, fault-free exchange and an unlimited supply of internal resources and external facilities.

Originating Calls

These calls originate on lines and are routed to either other lines (intraoffice) or to trunks (interoffice).

Outgoing Calls

These calls are routed to trunks.

Overflow Count

Overflow count is a cumulative count of the number of call attempts which failed to seize a member of a specified group of facilities because no idle member was available.

PB (Packet Bus)

The packet interface between the PSU and the MTCU.

PBX (Private Branch Exchange)

A customer premises switching system.

PC (Peripheral Controller)

Circuitry in the input-output processor that interfaces with peripherals outside the 5ESS[®]-2000 switch AM.

PCB (Process Control Block)**PCM (Pulse Code Modulation)**

A technique for coding analog signals for transmission on a digital circuit.

PDB (Process Data Block)**PDN (Packet Data Network)****PF (Packet Fanout)**

A pack that provides the distribution of data packets to and from the PHs.

PFA (Private Facilities Access)

This feature allows subscribers to have dial access to various types of public and private switching arrangements.

PH (Protocol Handler)

Circuitry that switches control messages between the BRI and the MCTU.

PHDB (Protocol Handler Data Bus)

Data bus internal to the PSU that is the interface between the PH and the data fanout circuitry.

PI (Packet Interface)

MCTU pack that controls packet data interface to and from peripheral units.

PIB (Packet Interface Bus)

Packet bus internal to the PSU; that is, the interface between the packet fanout and the control fanout circuitry.

PIC (Peripheral Interface Controller)

The PIC controls the movement of commands and data between the AM processor and the peripheral controllers.

PICB (Peripheral Interface Control Bus)

A duplex set of wires carrying control information between the module controller and an interface unit on the SM.

PID (Process Identification)**PIDB (Peripheral Interface Data Bus)**

A duplex set of wires providing 32 time slots between the data interface and interface units.

POTS (Plain Old Telephone Service)

Basic voice service by way of telephone.

PP (Precedence and Preemption)

Customers on the AUTOVON interface switch may be assigned the local PP feature. This feature provides six levels of precedence calling: flash override (FO); flash (F); immediate (I); priority (P); executive override (EO); and routine (R). An FO precedence level call has the highest precedence, and an R call has the lowest precedence. The local PP feature is used for intraoffice calls on the local AUTOVON interface switch.

Precedence and preemption is also used for AUTOVON calls (calls involving the AUTOVON tandem switch). In the AUTOVON network, five levels of precedence calling are used. The precedence levels in the AUTOVON network are the same as the local PP calling precedence levels with the exception of the EO level. Preemption refers to the act of interrupting (and terminating) an existing call to establish a higher level precedence call.

PPC (Pump Peripheral Controller)

Circuitry in the MSGS that is responsible for the rapid reinitialization of the SM in case of total failure of the SM.

PPSN (Public Packet Switch Network)**PRI (Primary Rate Interface)**

An ISDN feature supporting digital interface to digital PBX on a primary rate carrier (1.544 MB/s).

PSIU (Packet Switch Interface Unit)**PSM (Packet Switch Module)**

PSU (Packet Switch Unit)

The PSU contains circuitry that provides a centralized high bandwidth interface to support packetized signaling messages and packet data switching. The PSU is a part of the SM and occupies from one to five equipment shelves in a single cabinet.

PTSB (PIDB Time Slot Block)**PU (Peripheral Unit)**

Equipment such as the LU, TU, DLTU, DCLU, and GDSU which work in conjunction with but are not a part of the AM, CM or SM. Peripheral units reside in the SM.

Packet

A group of bits that is switched as an integral unit. Typically, packet contains data, destination and origination information, and control information, arranged in a particular format.

Pages

Fixed-length areas of memory in which relations (data tables) are stored.

Parameters

Parameters define resources (lines, screening indexes, BRCS) which are used as key attributes in data base relations to describe the makeup of the 5ESS[®]-2000 switch.

Path Hunting

This is a routine used by the 5ESS[®]-2000 switch to select the A- and B-link that connect a given line with an available channel circuit. In addition to finding this path, the path hunt software updates the A- and B-link status maps.

Peak Call Capacity

This is the capacity of an ideal switch with a central processing unit with 87 percent call processing occupancy and 99 percent processor occupancy. This occupancy level can be sustained for short periods of time (approximately 1 second).

Peg Count

A cumulative count of the number of times a specified event occurs during a given time interval. In some cases, the event may be an attempt to take some action, not necessarily a successful attempt.

Percent Occupancy

This is a percentage of time the processor spends doing call processing and other nondeferrable work.

Plant Measurements

These measurements provide data to evaluate equipment and craft performance.

Poisson Capacity Table

A statistical table, based on a theoretical mathematical formula, that is used to estimate the types and amounts of telecommunications equipment required to provide certain levels of service to a known or projected number of subscribers.

Preconstructed Feature

Feature defined by Lucent and is available to all 5ESS[®]-2000 switch users (service providers).

Protocol

An agreed-upon procedure for transmitting information between two or more entities.

QGP (QLPS Gateway Processor)

Provides the interface between the QLPS and the CM.

QLI (Quad Link Interface)

The QLIs terminate the NCT links from each of the hosts and local SMs. The fabric provides the space switching of the time slots received over the NCT links.

QLPS (Quad Link Packet Switch)

A high-bandwidth message transport network between the SM-2000 and other components of the 5ESS®-2000 switch.

QKEY Trunks

Trunks which are either outgoing first-in-first-out hunted or outgoing rotate hunted.

RAF (Recorded Announcement Function)

A feature of the 5E4 and later software releases, that provides independent playback of prerecorded, variable length, and variable content OSPS (Operator Services Position System) announcements.

RAI (Recorded Announcement Interface)**RAM (Random Access Memory)**

A type of memory that can be both read from and written to. It can contain resident information (static) or transient information (dynamic).

RAO (Revenue Accounting Office)

A telephone company central computation center where per-message charges are calculated from AMA billing data, combined with other fixed monthly charges, and prepared for delivery to telephone customers.

RAU (Recorded Announcement Unit)

A totally electronic storage device (no moving parts) which uses magnetic bubble memory to store recorded messages in digital form. Using a maximum of four 13A announcement machines, the RAU provides up to 32 channels of recorded messages.

RBHC (Regional Bell Holding Company)**RC (Recent Change)**

This is the ability to change the system data base to reflect changes in customer or system capabilities.

RCF (Remote Call Forwarding)

This BRCS feature provides for all calls to a specified local DN to be forwarded to a remote 7- or 10-digit telephone number. The customer specifies the maximum number of simultaneous RCF calls.

REORD (Reorder)**REORG**

A memory reorganization that may be needed when the processing speed is reduced.

RISLU (Remote Integrated Services Line Unit)

The RISLU terminates digital and analog lines. It consists of an ISLU and a DLTU-R, and it is connected to a host SM by T1 carrier. The RISLU may be located up to 150 miles from the host 5ESS®-2000 switch. The RISLU is a remote version of the central office equipment and provides analog and digital services (including some 5ESS®-2000 switch features) to remote subscribers. The RISLU provides up to 496 terminations and can be remoted over 24- and 30-channel pulse code modulation facilities. The RISLU provides the same three types of interfaces (T, U, and Z) as the ISLU.

RLI (Remote Link Interface)**RLT (Release Link Trunk)**

RMAS (Remote Memory Administration System)

An operational support system used to load translation changes into the 5ESS[®]-2000 switch.

RODD (Redundant Office Dependent Data)**ROM (Read-Only Memory)**

Memory whose data content is preset by the manufacturer. Data content in ROM will not change even if power to memory is removed.

ROP (Receive-Only Printer)

The printer used only for receiving messages at the MCC.

RP (Revertive Pulse)

A signaling pulse made by an LDSU transceiver to another LDSU transceiver on the same line. The LDSU2 does not provide RP transceivers.

RPC (Ring Peripheral Controller)

A part of the CNI that transports signaling messages and internal control CNI/IMS messages between the AM processor and the ring by way of a dual serial channel. The RPC node does not provide network connection. The 5ESS[®]-2000 switch uses two RPCs.

RR (Remoting Remote)**RSM (Remote Switching Module)**

This is a type of SM that is located a considerable distance away from the 5ESS[®]-2000 switch. The RSM provides the switching capabilities of the 5ESS[®]-2000 switch to areas that cannot economically support an ESSTM switch.

RT (Remote Terminal)

A software release term denoting the remote vehicle in any pair gain or remote switch systems.

RTR (Real Time Reliable)**Relation**

A rectangular data table (matrix) that has rows called tuples and columns called attributes.

Reorder Tone

Reorder tone is an audible low tone signal (interrupted at a 120-IPM rate) sent to the calling party to indicate that the call cannot be completed due to busy or unavailable equipment. Reorder tone is sometimes called fast busy.

Route Index

A code used in selecting the path a call will take through an office.

SAPI (Service Access Point Identifier)**SAS (Service Announcement System)**

An announcement system that provides transparency with the existing RAF platform to provide DTA, AOC, and DA announcements.

SCA (Selected Call Appearance)**SCANS (Software Change Administration and Notification System)**

A dial-up system which uses a 2048 data set to distribute software changes in stored program control programs to the telephone company in the form of Software Updates. SCANS serves the responsible

Switching Control Center System (SCCS).

SCB (Stack Control Block)

SCC (Switching Control Center)

A centralized location from which the operations for one or more switches can be monitored and controlled.

SCCS (Switching Control Center System)

A system that centralizes control, administrations, and maintenance of the switching systems for several central offices.

SCP (Service Control Point)

SCSI (Small Computer System Interface)

An industry standard interface between the AM and (SCSI) disk drives. This interface is available beginning with software release 5E6.

SDN (Switched Digital Network)

SFG (Simulated Facilities Group)

SG (Service Group)

The maximum set of resources which can be affected by a single hardware fault.

SILC (Selective Incoming Load Control)

A feature that prevents the spread of traffic congestion from IC networks into the local network switching system by limiting the maximum rate of processing IC incoming calls.

SLC[®] 96 Carrier

A digital loop carrier pair gain system used as a supplement or replacement for cable. It serves up to 96 subscribers over T1 transmission facilities.

SLE (Screen List Editing)

SLIM (Subscriber Loop Interface Module)

Replaces the standard office repeater bay used in direct mode I or II interfaces and terminates T-carrier from mode III shelves in D4 format.

SM (Switching Module)

The SM connects all external lines and trunks to the 5ESS[®]-2000 switch and handles most of the call processing tasks. The SM converts signals received from the lines and trunks into internal digital time-division format of the office.

SMC (Switch Maintenance Control)

SMP (Switching Module Processor)

The SMP is a part of the SM that performs call-processing functions for lines and trunks terminating on the SM and maintenance functions for the SM equipment. There are two SMPs (an active and standby) in each SM. Each SMP is augmented by a separate signal processor located in the TSIU (time slot interface unit).

SMPU (Switching Module Processor Unit)

The SMPU is a part of the SM and consists of a duplicated SM processor (model 2) and the bootstrapper.

SM ODD (SM Office Dependent Data)

SONET (Synchronous Optical NETwork)

A standard universal data transfer format

SP (Signal Processor)

Circuitry in the SM that performs supervisory scanning. It also detects incoming bylink pulses from step-by-step offices.

SPCS (Stored Program Control System)

A system whereby control circuitry executes a series of basic, internal instructions that make up the machine language of the device being controlled.

SST (Short Supervisory Transition)

An SST is a recognized on-hook to off-hook transition signal in which the off-hook state is less than the minimum chargeable duration interval, and the on-hook state is less than that required to release the connection.

STLWS (Supplementary Trunk Line Work Station)

Additional (one or more) trunk test facilities (digital), usually in larger offices, that provide the craftsman access to the TLWS (trunk and line work station) by way of the MCC (master control center). The STLWS need not be physically close to the MCC.

STP (Signal Transfer Point)**Screening**

A translation process to determine what type of treatment a line should be given. Screening information is used in the routing process.

Service Measurements

These measurements provide data used to evaluate the quality of telephone service to the customer.

Signaling Leads (E&M)

A signaling system that derives its name from historical designations of the signaling leads on the circuit drawings covering these systems. The M-lead carries supervisory (and sometimes dial pulse) signals from the switching equipment to the signaling/transmission equipment. The E-lead carries supervisory signals from the signaling/transmission equipment to the switching equipment. As a result, signals from office A to office B leave on the M-lead at office A and arrive on the E-lead at office B.

Software Release

The software release is a fixed software program that makes up the basic operating system and is the same in all 5ESS[®]-2000 switch offices with the same program name and issue. It uses individual office translations to allow different features from office to office. This software program was formerly known as "generic".

Software Update

A electronic message containing a software release "fix" or update that is disseminated on a priority or urgent basis.

Software Updates

Messages, distributed by SCANS, that contain software changes (binary overwrite data) in stored program control programs and/or related data for craftsman.

Space Division

Space division is a method of serving a number of simultaneous calls by assigning different physical transmission paths through a switching network to those calls. In the 5ESS[®]-2000 switch, the space division switching is performed by the TMS.

Speed Calling

This feature allows the customer to associate some digit string with a 1- or 2-digit code. The 5ESS®-2000 switch looks up the corresponding digit string and routes the call according to it.

Stable Call

After all the switching functions are completed and a talking state (the called party answers the telephone) is reached, a stable call is established.

Static Memory

Equipment used to store information which is changed infrequently, such as, characteristics of a particular telephone office (types and amounts of equipment, lines, trunks) and features associated with telephone numbers. Static memory, static data, and ODD (office dependent data) are used interchangeably.

Switching Delay

This is the time from arrival of sufficient address information until the exchange starts sending a seizing signal on an outgoing circuit, a calling signal on a subscriber line, or another appropriate indication (for example, congestion tone).

System Process

Software process that exists as long as the 5ESS®-2000 switch is functioning. System processes are associated with non-call-processing tasks such as maintenance and billing functions.

T1

A 24-channel PCM channel wire or cable transmission medium operating at a rate of 1.544 MB/s.

T&A (Toll and Assistance)**TAC (Test Access Circuit)****TCB (Time Control Block)****TCBH (Time-Consistent Busy-Hour)**

The four consecutive 15-minute intervals commencing at the same time each day for which the average traffic is the greatest during the days of observation.

TD (Tone Decoder)

The TD resides in the LDSU of the SM and performs digit reception and decoding functions for dial pulse and touch-tone originating calls from lines.

TDAD (Trunk Decoder Time Delay)**TEI (Terminal Endpoint Identifier)****TEN (Terminal Equipment Number)**

A 7-digit number used in translation to identify the location of a DCLU channel or trunk circuit so that it may be accessed.

TDUSG (Dial Tone Total Usage)**TEO (Telephone Equipment Order)**

The order to Lucent Technologies specifying equipment required to construct the desired 5ESS®-2000 switch office.

THD (Ten High-Day)

The ten busiest days during the ABS (average busy season) in terms of observed TCBH (time-consistent busy-hour) load.

THDBH (Ten High-Day Busy Hour)

The average traffic load in the TCBHs of the THDs.

TLWS (Trunk and Line Work Station)

Provides local craft access for lines and trunks, an interface to circuit administration, and supports portable testing equipment for the 5ESS[®]-2000 switch.

TMS (Time Multiplexed Switch)

The TMS, one of two switches that comprise the CM1, performs the time-shared space division switching such as voice and data between any two SMs or between an SM and the AM. The MSGS is the other switch in CM1.

TMSLNK (TMS NCT Link)

See NCT.

TMS NCT Link (TMSLNK)

See NCT.

TMSU (Time Multiplexed Switch Unit)

Circuitry within the TMS that terminates 30 NCT links and performs space switching of the time slots received.

TN (Telephone Number)

A 7-digit telephone number made up of a 3-digit central office code and a 4-digit station number. It is also called DN.

TOD (Time of Day)

This feature provides the ability for COERs to be automatically scheduled at particular times during the day and on particular days of the week.

TOPAS (Test Operations, Provisioning, and Administration System)**TRK (Trunk Group)****TRM (2-Mile Optically Remoted Module)**

An SM located up to 2 miles from the CM and connected by a multimode optical fiber that serves as an extended NCT link.

TSDB (Time Slot Data Base)**TSI (Time Slot Interchanger)**

This is the equipment arrangement in the SM that takes information coming to it or from the TMS and switches it onto the time slot corresponding to the line or trunk involved in the call.

TSIU (Time Slot Interchange Unit)

The TSIU is the part of the SM that performs time slot switching. The TSIU consists of a TSI, data interface, dual link interface, control interface, and signal processor.

TSS (Time Slot Set)

A group of 64 time slots assigned to a peripheral unit (LU, TU, DCLU, DLTU, or GDSU).

TTF (Transmission Test Facility)**TTY (Teletypewriter)**

An output device used to print information within the switch in a form readable by humans.

TU (Trunk Unit)

Hardware that terminates 64 local or toll interoffice analog trunks without concentration. A minimum of one is

required for each office.

TUP (Telephone User Part)**Telephone Equipment Order (TEO)**

The order to Lucent Technologies specifying equipment required to construct the desired 5ESS[®]-2000 switch office.

Telephone Number (TN)

A 7-digit telephone number made up of a 3-digit central office code and a 4-digit station number. It is also called DN.

Terminal Group

A way of associating two or more lines and/or trunks.

Terminal Process

A software process in the SMP which controls a terminal (line, trunk, or channel) during a call or call attempt. The terminal process is created and exists only as long as the terminal it controls is active.

Terminating Calls

These calls are routed to lines.

Time Division

Time Division is a method of serving a number of simultaneous calls by assigning different time slots through a switching network to those calls. In the 5ESS[®]-2000 switch, the time division switching is performed by the TSI.

Traffic Measurements

These measurements provide the current status of the 5ESS[®]-2000 switch as well as indications to support the switching system with additional resources.

Traffic-Sensitive Component

A group of servers that provides less than 100 percent switched capacity.

Transient Call

A transient call is a telephone call that is not in a stable (talking) connection. Examples are dialing, ringing, etc.

Trunk

A trunk is the facility between two different entities; such as central offices and sections of the same switching system, and is used for transmission and/or signaling.

Trunk Circuit

The trunk circuit of a switching system is used to supervise a connection within the system and/or to associate the system with a transmission facility or another switching entity.

Tuple

This is a row in a data table (relation).

Two-Party Service

Provides telephone service to a maximum of two customers on a common terminal appearance on the network.

UCC (Universal Conference Circuit)

A service circuit (3- or 6-port) used to connect 3 to 6 customers for service features.

UCD (Uniform Call Distribution)

A type of line hunting providing an even distribution of incoming calls among the available members of a hunt group.

UNP (Uniform Numbering Plan)

A customer-specified 7-digit numbering plan identifying all business group stations interconnected by the facility network. Each customer switch connected by the ETN is identified by a 3-digit code. Stations on the switch have 4-digit extension numbers. More than one 3-digit code can be used per customer premises switch to accommodate additional station numbers.

Uniform Numbering Plan (UNP)

A customer-specified 7-digit numbering plan identifying all business group stations interconnected by the facility network. Each customer switch connected by the ETN is identified by a 3-digit code. Stations on the switch have 4-digit extension numbers. More than one 3-digit code can be used per customer premises switch to accommodate additional station numbers.

UODD (Unprotected Office Dependent Data)

This term is interchangeable with Dynamic ODD.

UTD (Universal Tone Decoder)

Decodes dial pulse, multifrequency, and touch-tone signals.

UTG (Universal Tone Generator)

Creates digital tones for touch-tone, busy tone, dial tone, and multifrequency.

Usage Count

Usage count is a measure of the total amount of time the members of a group of facilities are busy during a given interval. Usage is obtained by examining a specified group at regular intervals and accumulating the number found in a busy state at each scan over a fixed period of time.

Usage — Maintenance

The number of times that a component was unavailable for customer traffic due to conditional maintenance. Usage is obtained by examining a specified group at regular intervals and accumulating the number found in a busy state at each scan over a fixed period of time. The maximum usage is obtained on a 100-second scan basis.

Usage — Total

The total load measured on a group of facilities, whether the load is customer generated or due to a maintenance busy condition. The total usage is obtained on a 100-second scan basis.

Usage — Traffic

The generated load excluding maintenance busy usage. The traffic usage is obtained on a 10-second scan basis.

VAR (Variable)**VDT (Video Display Terminal)****VLMM (Very Large Main Memory)****VPA (Voice Path Assurance)**

A test providing a voice path for common channel signaling trunks. This test ensures the integrity of the voice path inasmuch as the voice and signaling paths are separated on CCS trunks.

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