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DMS-100 Family

Capacity

Engineering Manual

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- added BCS35 CPU call times
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- added CPU call times for BCS33 and BCS34
- deleted BCS28 call times from Chapter 5, BCS call times
- incorporated DMS-SuperNode SE (SNSE) into Chapter 2, Capacity overview
- added enhanced network (ENET) and SNSE enhanced network (16K ENET) to Chapter 6, Network capacity
- added DMS signaling transfer point (STP) including link interface unit (LIU7) and link peripheral processor (LPP) to Chapter 8, Trunk peripheral capacity
- added LPP flow controls for ISUP trunks to Chapter 13, Overload controls
- added BCS32 Series 40 SuperNode load service curves to Chapter 14, Load service curves
- corrected capacity value of the 1/4-inch streaming cartridge tape drive

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About this manual

This manual serves as an aid for planning and engineering future DMS-100, DMS-100/200, or DMS-200 digital central office switch installations. It is intended for engineers who analyze traffic volumes, patterns, and usage to determine equipment adequacy and project future capacity needs. This document does not address capacity administration in detail. For detailed information on capacity administration, refer to *Capacity Administration Guide,* 297-1001-304.

When to use this manual

Northern Telecom (NT) software releases are referred to as batch change supplements (BCS) and are identified by a number, for example, BCS29. This document is written for DMS-100 Family offices that have BCS35 and up.

More than one version of this manual may exist. The version and issue are indicated throughout the manual, for example, 01.01. The first two digits increase by one each time the document content is changed to support new BCS-related developments. For example, the first release of a manual is 01.01, and the next release of the manual in a subsequent BCS is 02.01. The second two digits increase by one each time a manual is revised and rereleased for the same BCS.

To determine which version of this manual applies to the BCS in your office, check the release information in *DMS-100 Family Guide to Northern Telecom Publications,* 297-1001-001.

How to identify the software in your office

The *Office Feature Record* (D190) identifies the current BCS level and the NT feature packages in your switch. You can list a specific feature package or patch on the MAP (maintenance and administration position) terminal by typing

>PATCHER;INFORM LIST identifier

and pressing the Enter key.

where
identifier is the number of the feature package or patch ID

You can identify your current BCS level and print a list of all the feature packages and patches in your switch by performing the following steps. First, direct the terminal response to the desired printer by typing

>SEND printer_id
and pressing the Enter key.

where
printer_id is the number of the printer where you want to print the data

Then, print the desired information by typing

>PATCHER;INFORM LIST;LEAVE
and pressing the Enter key.

Finally, redirect the display back to the terminal by typing

>SEND PREVIOUS
and pressing the Enter key.

Where to find information

The chart below lists the documents that you require to understand the content of this document, or to perform the tasks it describes. These documents are also referred to in the appropriate places in the text.

More than one version of these documents may exist. To determine which version of a document applies to the BCS in your office, check the release information in *DMS-100 Family Guide to Northern Telecom Publications*, 297-1001-001.

Number	Title
297-1001-103	*DMS-100F Peripheral Modules*
297-1001-120	*DMS-100F Equipment Identification*
297-1001-156	*DMS-100F Power Distribution and Grounding Systems*
297-1001-158	*DMS-100F Grounding Audit Procedure*
297-1001-180	*DMS-100F System Performance Specifications*
297-1001-300	*DMS-100F Basic Administration Procedures*
297-1001-304	*DMS-100F Capacity Administration Guide*
297-1001-453	*DMS-100F Network Management System Reference Manual*
297-1001-455	*DMS-100F Office Parameters Reference Manual*

Number	Title
297-1001-510	*DMS-100F Log Report Manual*
297-1001-514	*DMS-100F Network Modules Maintenance & Man-Machine Reference Manual*
297-1401-110	*DMS-100F Residential Services Planning and Engineering Guide*
297-1401-300	*DMS-100F Residential Services Administration Guide*
297-2401-103	*DMS-100F ISDN Peripheral Modules Description Reference Manual*
297-2401-104	*DMS-100F ISDN Operations, Administration, and Maintenance for ISDN Primary Rate Access to MSL-1 PBX*
297-2401-450	*DMS-100F ISDN Data Engineering Guide*
297-2401-515	*DMS-100F ISDN Peripheral Modules Maintenance Reference Manual*
297-2401-516	*DMS-100F ISDN Line Maintenance Reference Manual*

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Introduction

This manual contains information related to the capacities of individual switch components for DMS-100/200 installations using either NT40, DMS-SuperNode, or DMS-SuperNode SE (SNSE) architecture. It consolidates information presently contained in various Northern Telecom Practices, System Engineering Bulletins, and other publications. It is not intended that this manual replace these publications, but to serve as a centralized reference for the major capacity related subjects. This manual makes reference to other documentation for more detailed information as required.

This manual provides information concerning:

- capacities - call attempts and traffic
- real time models
- engineering and monitoring guidelines
- load service curves
- overload controls, definitions, and indicators
- capacity prediction and measurement tools
- capacity verification tools and procedures
- traffic analysis and data validation models

Capacity overview

Planning needs

Long range planning

Long range capacity planning generally deals with planning future offices and upgrades for a three-to-ten year period. Capacity planning is based on forecasts and determines hardware and software requirements.

Short range planning

Short range, or current planning, considers current capacity and generally looks forward to approximately a three-year time frame. A capacity analysis is made to plan growth and manage upgrades. High-level schedules and costs are developed considering new line and number capacity and exhaust dates

DMS-100 Family hardware architecture

The DMS-100 Family switching system is based on a family concept that provides a wide range of digital switching and network functions. The evolution of the DMS-100 Family is the result of modular design techniques used in the development of both hardware and software. This concept of module and interface design allows the use of related components which may be connected, disconnected, modified, or improved without affecting the operation of other modules in the system or the system as a whole.

Components

For reliability, both the NT40 and the DMS SuperNode have duplicated control components that operate in synchronism, and duplicated messaging components that operate in a load-sharing mode. Duplication offers hardware fault protection, as well as the ability to carry out office extensions and software updated without disrupting service.

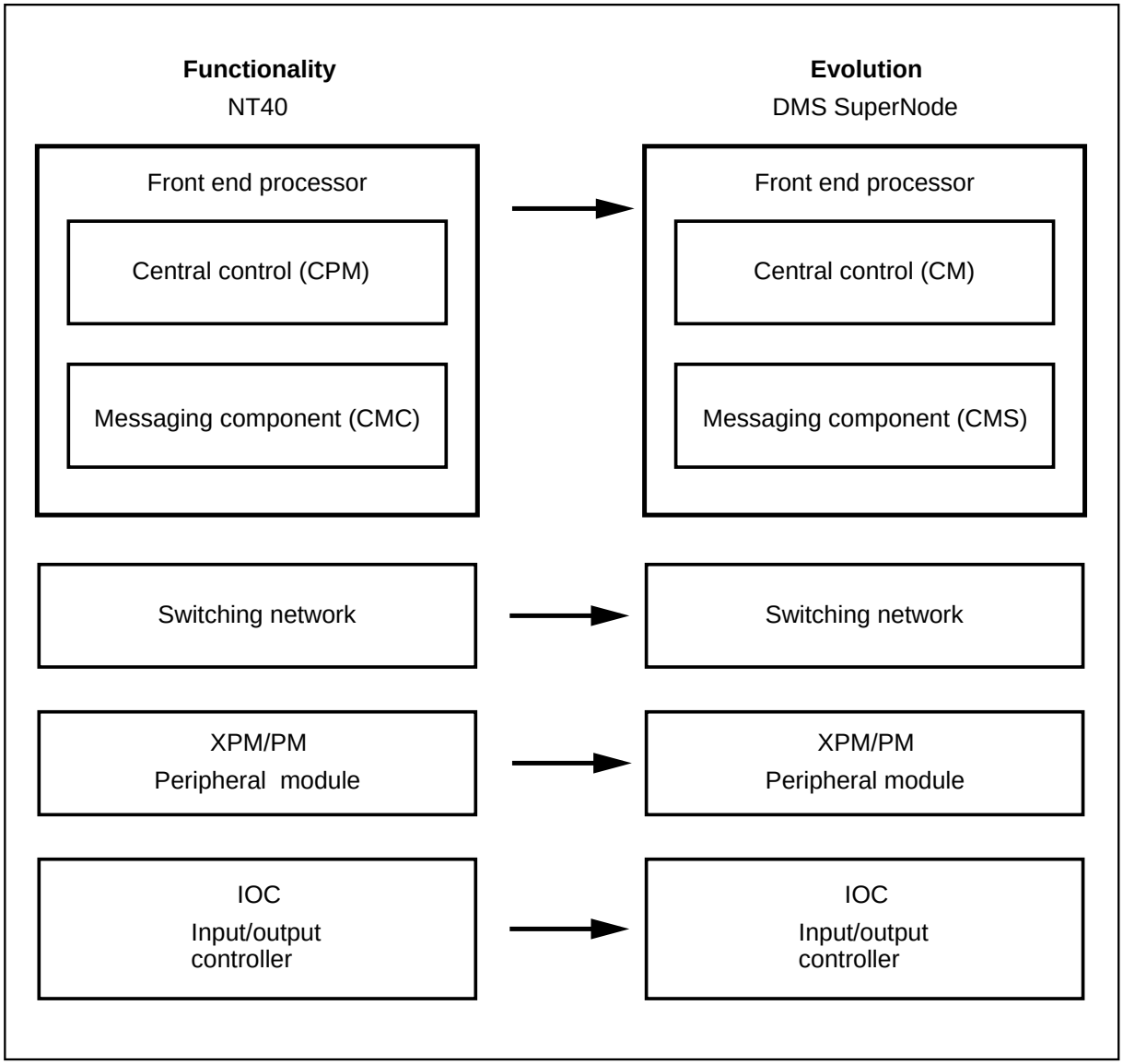
Both the NT40 and the DMS SuperNode have the same functional elements as listed below:

- control component
- messaging component
- switching network
- peripheral modules

- input/output controller

The following block diagram (Figure 2-1) shows this evolutionary process.

Figure 2-1
DMS-100 Family hardware architecture



Control component

The control component shown above coordinates call processing, diagnostics, maintenance, user interface, and controls the actions of the switching network and peripheral modules.

The control component for the NT40 was designated as the central control complex (CCC). The DMS SuperNode control component is called DMS-Core. DMS-Core consists of a duplicated computing module (CM), and a system load module (SLM).

Messaging component

The messaging component routes messages within the DMS-100. There are also two generations of the messaging component. In the NT40, the messaging component is the central message controller (CMC).

In the DMS SuperNode, the messaging component is called DMS-Bus. DMS-Bus consists of high throughput duplicated message switches (MS). The MS is based on the DMS SuperNode CPU and uses some of the same software as the computing module and the central control complex.

Switching network

The switching network is a digital-switching matrix that interconnects the peripheral modules, using time-division multiplexing. The switching network components are micro-processor controlled, digital-switching network modules (NM). The switching network has duplicate network planes for reliability and can be connected to either the central message controller, or the DMS-Bus.

Again, there are two generations of the switching network. The first is the junctored network (J-net), and the second is the enhanced network (E-net). The NT40 can only use the J-net; while the DMS SuperNode can use either the J-net or the E-net.

Peripheral modules

The peripheral modules (PM) provide an interface between the switching network and the outside plant.

Input/output controller

The input/output controller (IOC) provides an interface between the messaging component and input/output devices such as magnetic-tape drives, disk drives, data links, video display units, and printers.

Maintenance and administration position (MAP)

The maintenance and administration position (MAP) is the primary man-machine interface for the NT40 or the DMS SuperNode, providing a visual display unit and keyboard connected to the IOC. A voice communications module is also provided.

CPU

NT40 Central control complex (CCC)

The NT40 central control complex (CCC), commonly known as the central control (CC), is a totally duplicated group of four modules (Figure 2-2). These modules act together to evaluate incoming messages, formulate the proper response, and issue instructions to subsidiary units. The four modules comprising the CCC and their functions are:

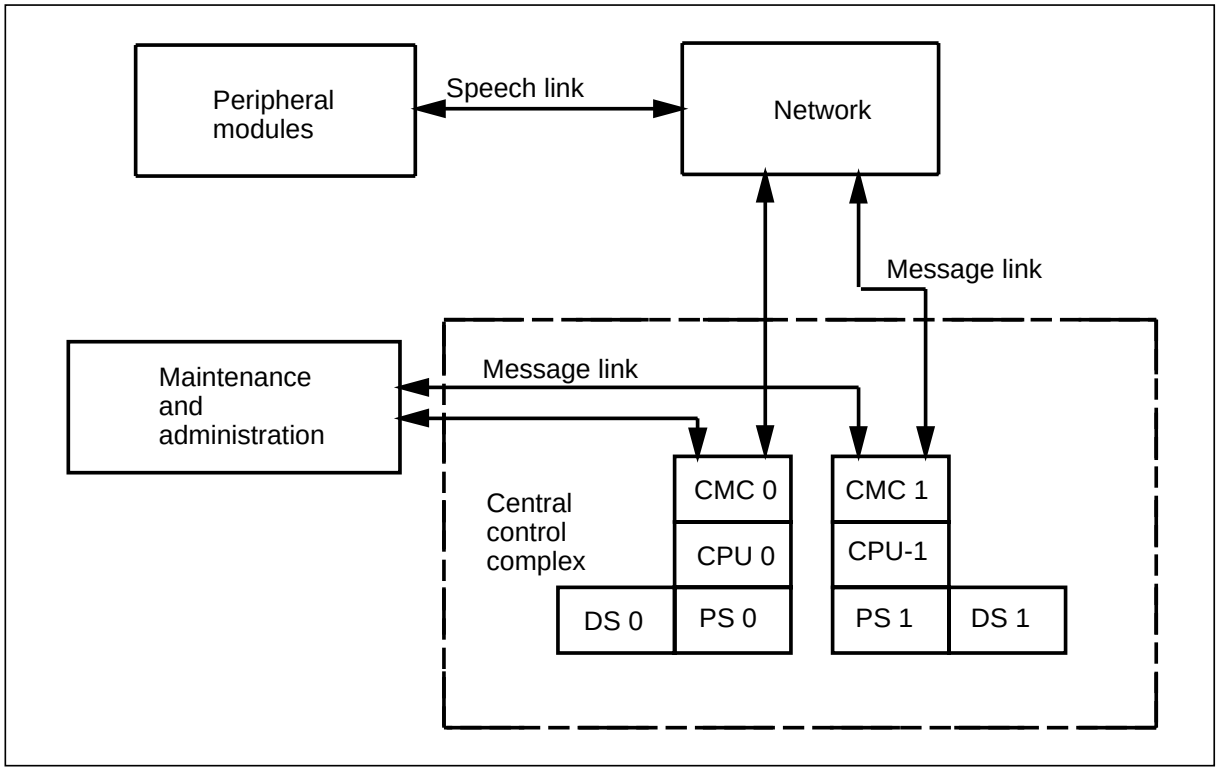
Central message controller (CMC)

The CMC, which is located in a message and device controller (MDC) shelf, controls message flow between the network, maintenance and administration areas, and the central processing unit (CPU). Each CMC performs three tasks.

- connects the 16-bit parallel CPU data bus via serial data links to the network modules (NM) and input/output controller (IOC)
- provides a master clock and framing for the system
- provides a time-of-day clock to the CPU

Each CMC has up to 70 ports to the NM and the IOC. Each port consists of a DS30 link.

Figure 2-2
Central control complex (CCC)



Central processing unit (CPU)

The central processing unit (CPU), which is located in the central processor and memory (CPM) shelf, has access to each CMC and its dedicated memory modules where stored programs are located. The CPU contains the logic required to control all operations of the DMS. The CPU is a 16-bit, stack-oriented, micro-processor. It is equipped with two independent parallel bus memory ports. One port is connected to the external memory that contains variable length program instructions (program store). The other port is connected to:

- The external memory that contains data (data store).
- Two CMCs that provide communication with the other elements of the system.

The fact that program store (PS) and data store (DS) are on separate buses enhances the software reliability and real-time capacity of the system. A separate bus ensures that erroneous DS updates have no chance of corrupting program instructions. Also, higher program instruction execution notes are achieved, since instruction-fetch and date-fetch operations can proceed in parallel.

Program store (PS)

The PS module, which is located in the CPM shelf, is exclusively associated with one CPU and contains program instructions required by that CPU for call processing, maintenance and administrative tasks. Program store word length is 17 bits; one bit for parity and 16 bits for data (program instructions).

Data store (DS)

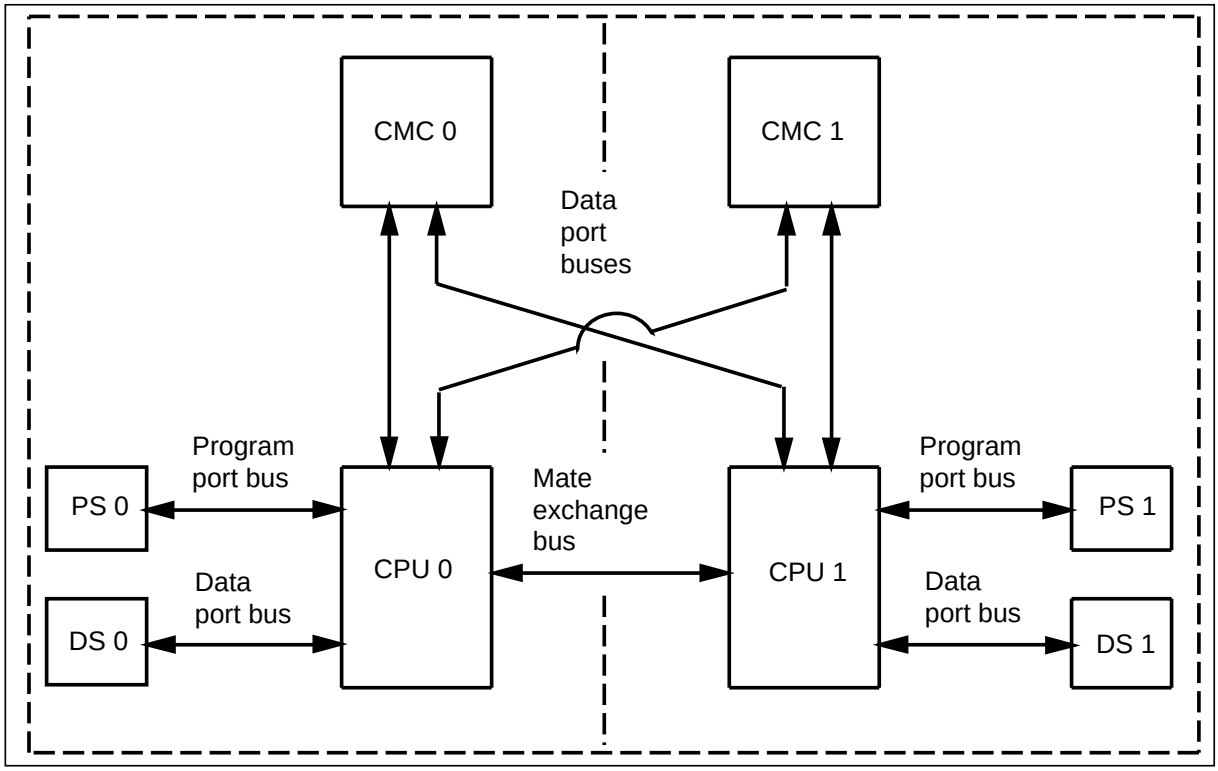
The DS module is exclusively associated with one CPU and contains transient information on a call basis, as well as customer data and office parameters. Data store word length is 17 bits; one bit for parity and 16 bits for data.

Components

Bus interfaces

The CPU, which controls all operations of the DMS, must have an interface to all of the modules comprising the CCC. The data port bus, program port bus, and mate/maintenance exchange bus comprise these communication links (Figure 2-3).

Figure 2-3
CCC bus interfaces



Data port bus

The data port bus is a parallel bus and provides the following:

- interfaces each CPU to its dedicated data store memory
- interfaces CPU to both CMC

Program port bus

The program port bus is also a parallel bus and provides the following:

- interfaces each CPU to its dedicated program store memory

Mate/maintenance exchange bus

The mate/maintenance exchange bus is also a parallel bus, providing the following:

- interconnects the two (2) CPU

- provides an exchange of information between the CPU in order to perform synchronization, matching, and maintenance functions

Central processor unit (CPU)

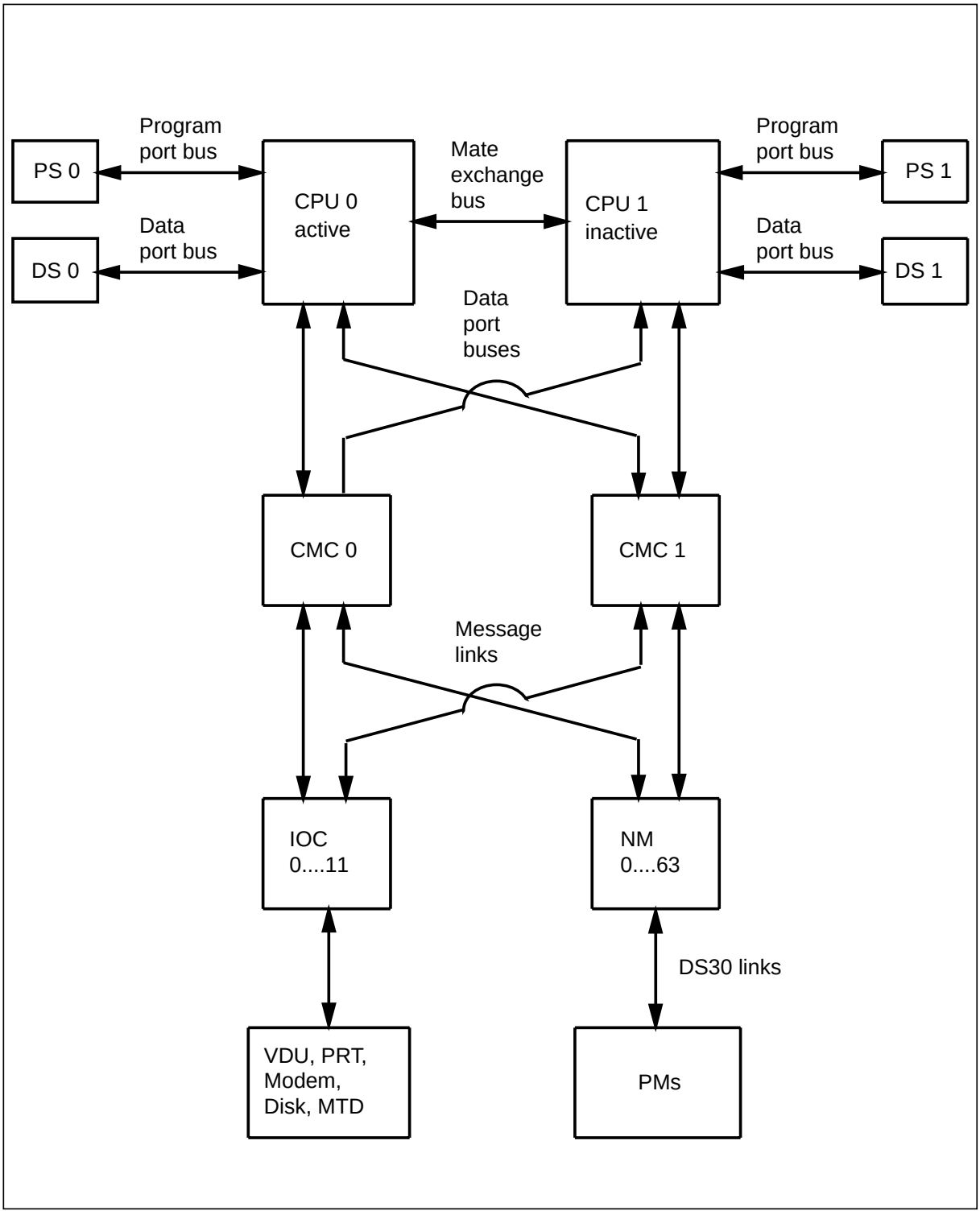
The CPU can be operated in two basic modes; duplex and simplex. These modes are described in the following paragraphs.

Duplex mode

The duplex mode is the normal mode of operation (Figure 2-4). In this mode, both CPUs are online and running in micro-synchronism; one CPU is active and the other is inactive (standby). While running in synchronization each CPU is doing the exact same thing during any instance of time. The memory unit of both CPUs contain, and are updated with, identical information. The major difference between the active and inactive processors is that only the active processor is using the CMC to send messages to the peripheral equipment. Since the inactive processor has no capability of communication to the peripheral equipment, only the active processor has control of the DMS system.

Each CPU compares data and parity on its own data port with that of its mate via the mate exchange bus (MEB). If an inequality is detected, a mismatch interrupt is generated and each CPU invokes an identical trouble-shooting subroutine. The recovery program will isolate the insane CPU, switch activity if the active CPU is insane, and offline the faulty CPU. This is accomplished without any loss of calls in the DMS.

Figure 2-4
CPU duplex mode

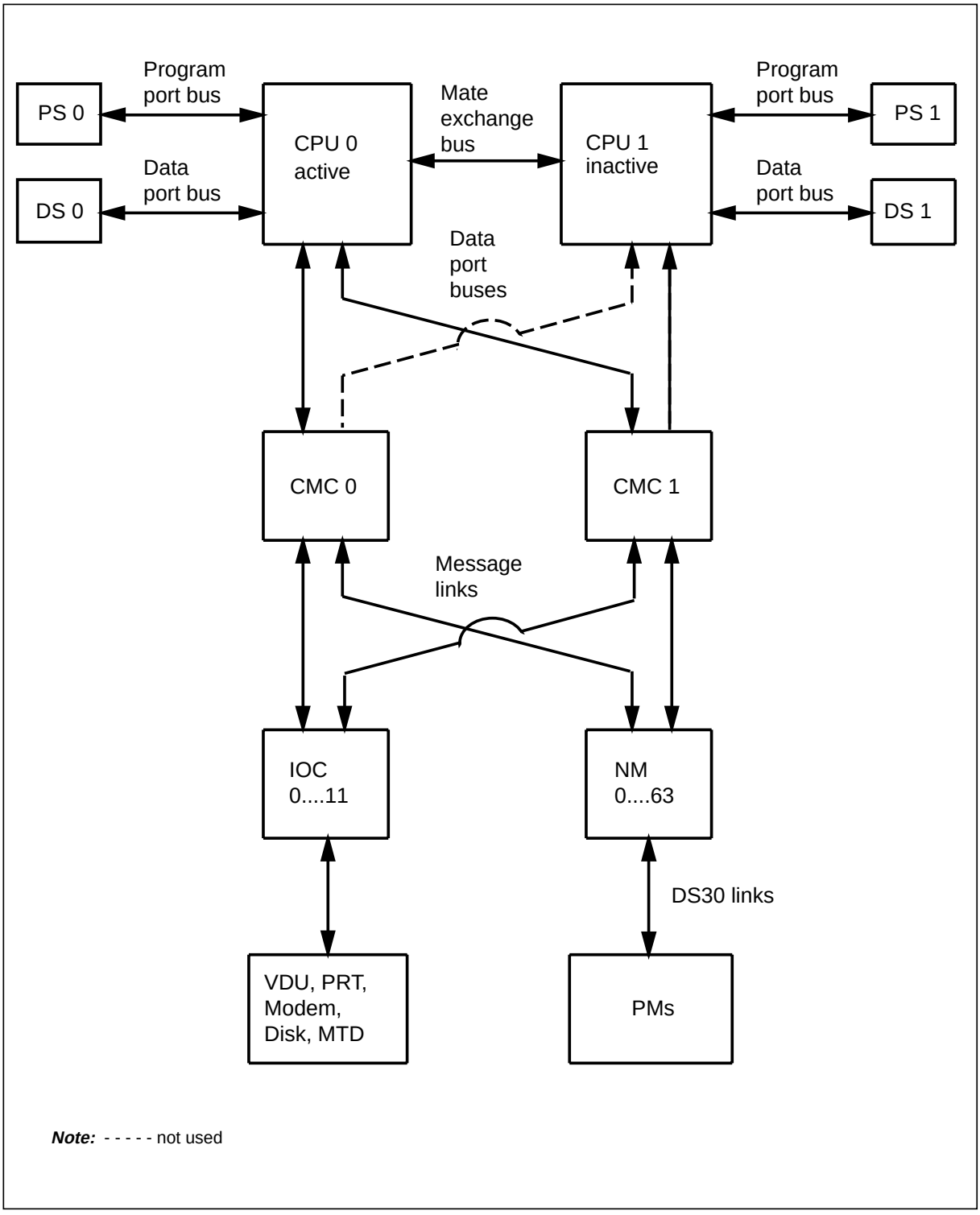


Simplex mode

The simplex mode is not the normal mode of operation. In this mode, one CPU is online and controlling the system and the remaining CPU is offline. There is no synchronization in the simplex mode, and therefore, the offline CPU is not being updated as the memory locations in the active CPU change (Figure 2-5).

Since there is no synchronization in the simplex mode of operation, the MEB is not used to detect error mismatches. Therefore, each CPU contains built-in self-checking logic to detect error conditions. The MEB will be utilized by the active CPU to perform maintenance oriented tasks on the offline central control.

Figure 2-5
CPU simplex mode



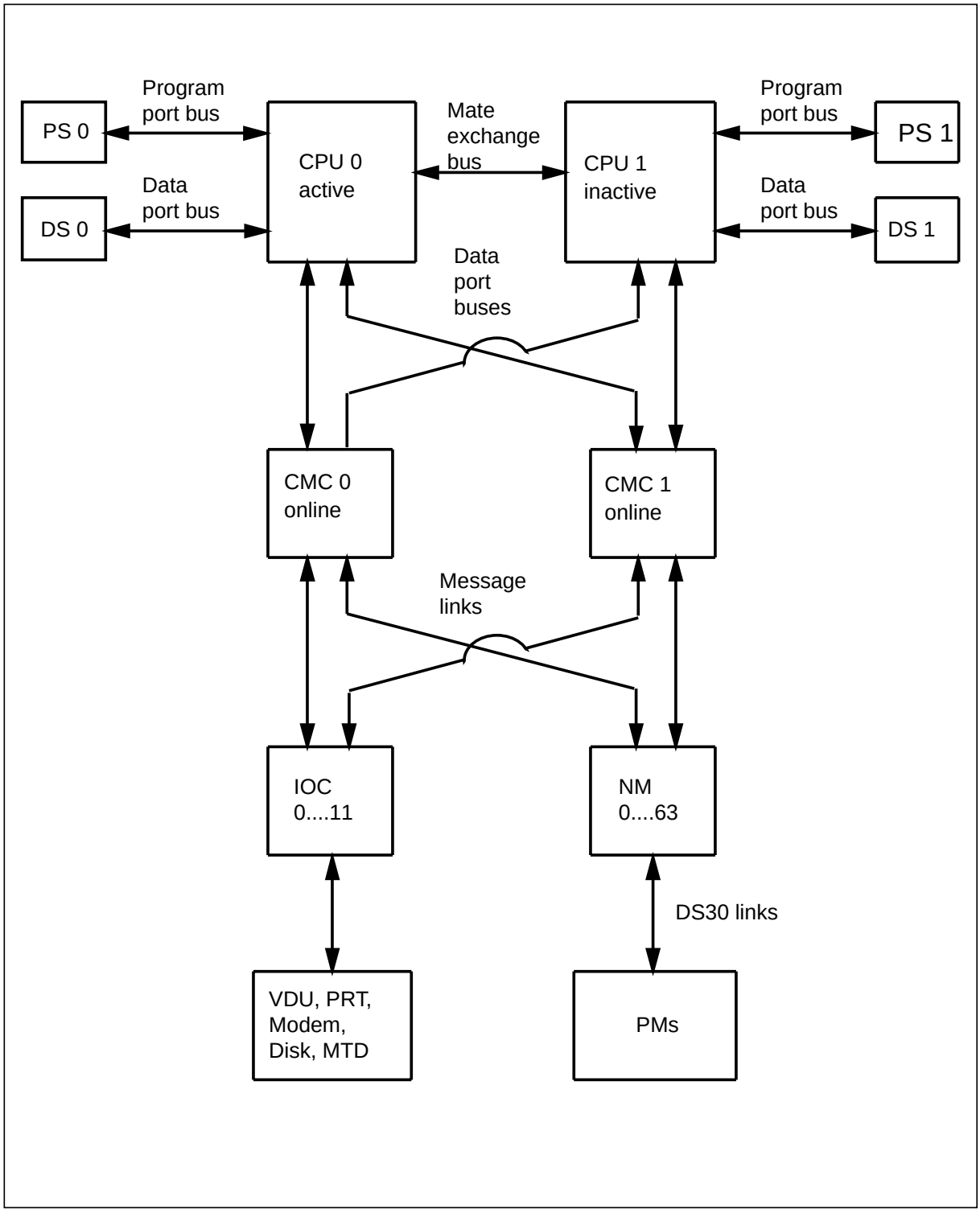
Central message controller (CMC)

In the normal mode of operation, both CMCs are online and are being load-shared by the active CPU (Figure 2-6).

The active CPU receives and sends messages to and from the various DMS processor-based modules via the CMC. At any given instance of time, each CMC is receiving or sending a message for the active CPU.

Each CMC physically interfaces all of the DMS peripheral equipment modules. Therefore, a malfunction in one CMC would result in the one online CMC being used for all messages to and from the active CPU.

Figure 2-6
CMC normal mode



Central control complex frame

The CCC is housed in two standard DMS frames (Figure 2-7). The CCC0:00 frame contains CC 0 hardware and the CC1:00 contains CC 1 hardware. Each CCC frame is comprised of the following hardware:

Message and device controller

The message and device controller (MDC) shelf is located in shelf position 65. The MDC for CC 0 and CC 1 is located in the appropriate CCC frame. The MDC shelf houses the respective CMC module (that is, 0 or 1). Optionally, an MDC shelf may also house an Input/Output Controller (IOC) module in addition to a CMC module.

Central processor and memory

The central processor and memory (CPM) shelf is located in shelf position 51. The CPM for CC 0 and CC 1 is located in the appropriate CCC frame. The CPM shelf houses both the CPU and the PS modules.

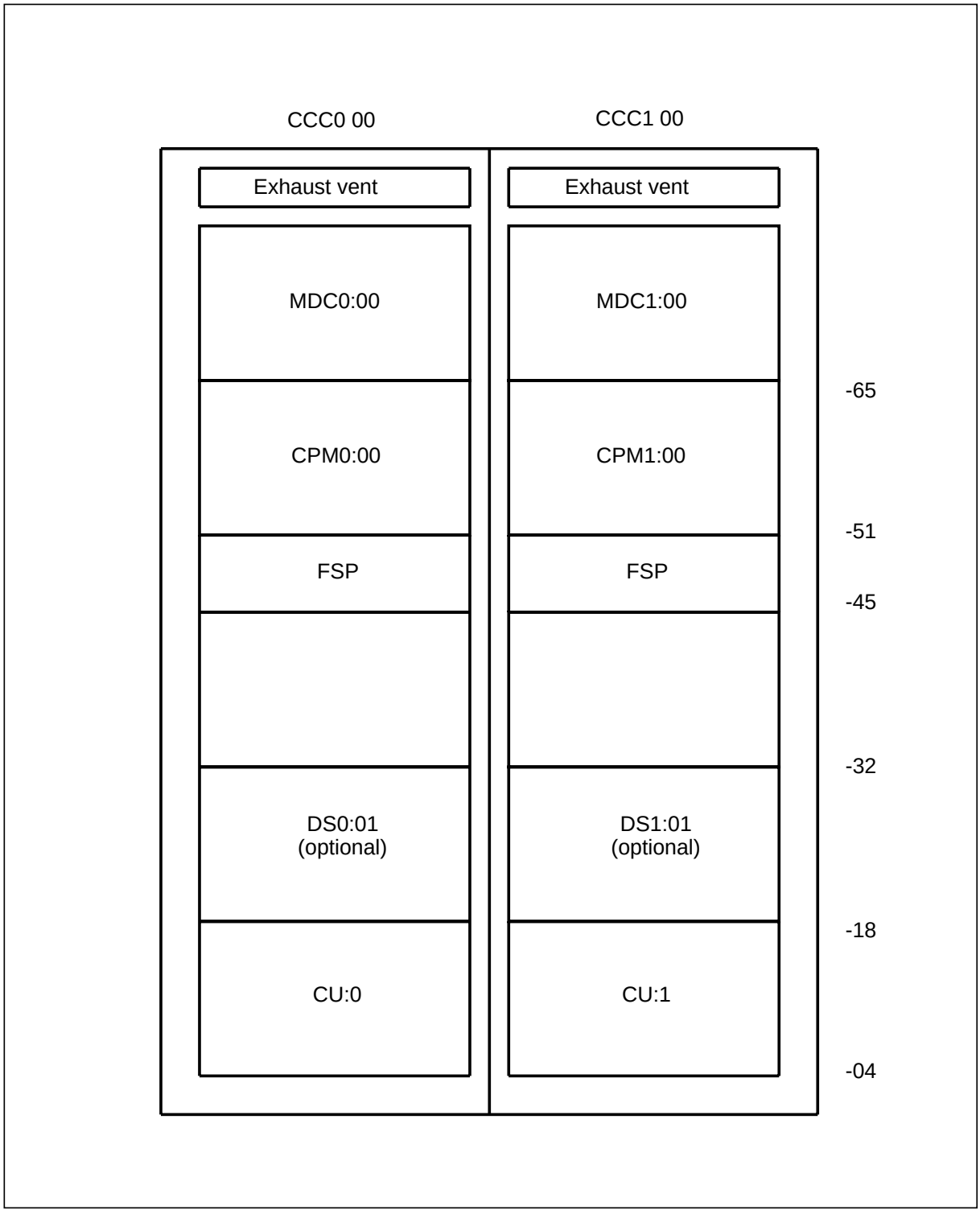
Frame supervisory panel

The frame supervisory panel (FSP) is located in shelf position 45 and provides power, control, and alarm circuits for the frame hardware.

Shelf positions 32 and 18 house DS modules. DS module 0 is located in shelf position 32 of the appropriate CCC frame. DS module 1, if required, is housed in shelf position 18.

A cooling unit, consisting of five ac powered fans, is located in shelf position 04 and provides the necessary air flow for cooling purposes.

Figure 2-7
Central control complex frame



Message device and controller shelf

The MDC shelf houses the CMC module (Figure 2-8). Optionally, an MDC shelf may also house an input/output (IOC) module in addition to a central message controller (CMC) module.

Central message controller

An MDC shelf housing only a CMC contains only CMC circuit packs. The CMC circuit packs and their functions are:

Synchronical master clock oscillator card

- generates the master 10.24 MHz frequency from which all of the DMS peripheral equipment will sync
- contains the time-of-day clock
- operates the clocks in an active/inactive configuration

Synchronizable master clock counter card

- used with the (NT3X15) card to form a synchronous clock pair. This is required when an office is deriving synchronization from an external clock or is configured in a Master/Slave office environment (derives sync from a clock in another office).

Processor interface card

- terminates the Data Port buses which are the interface between the CMC and each CPU

Common control card

- directs the operation of the outgoing and incoming Controller cards
- contains control registers which receive instructions from the CPU
- contains physical indicators which display the CMC status and a reset button which can force a CMC online

Incoming controller card

- scans the equipped message link ports for incoming messages
- handles and controls all incoming messages to the CPU from the peripheral equipment (Figure 2-9).

Outgoing controller card

- selects the addressed message link port over which the message will be sent
- handles and controls all outgoing messages to the peripheral equipment from the CPU (Figure 2-10).

Figure 2-8
Message device and controller shelf

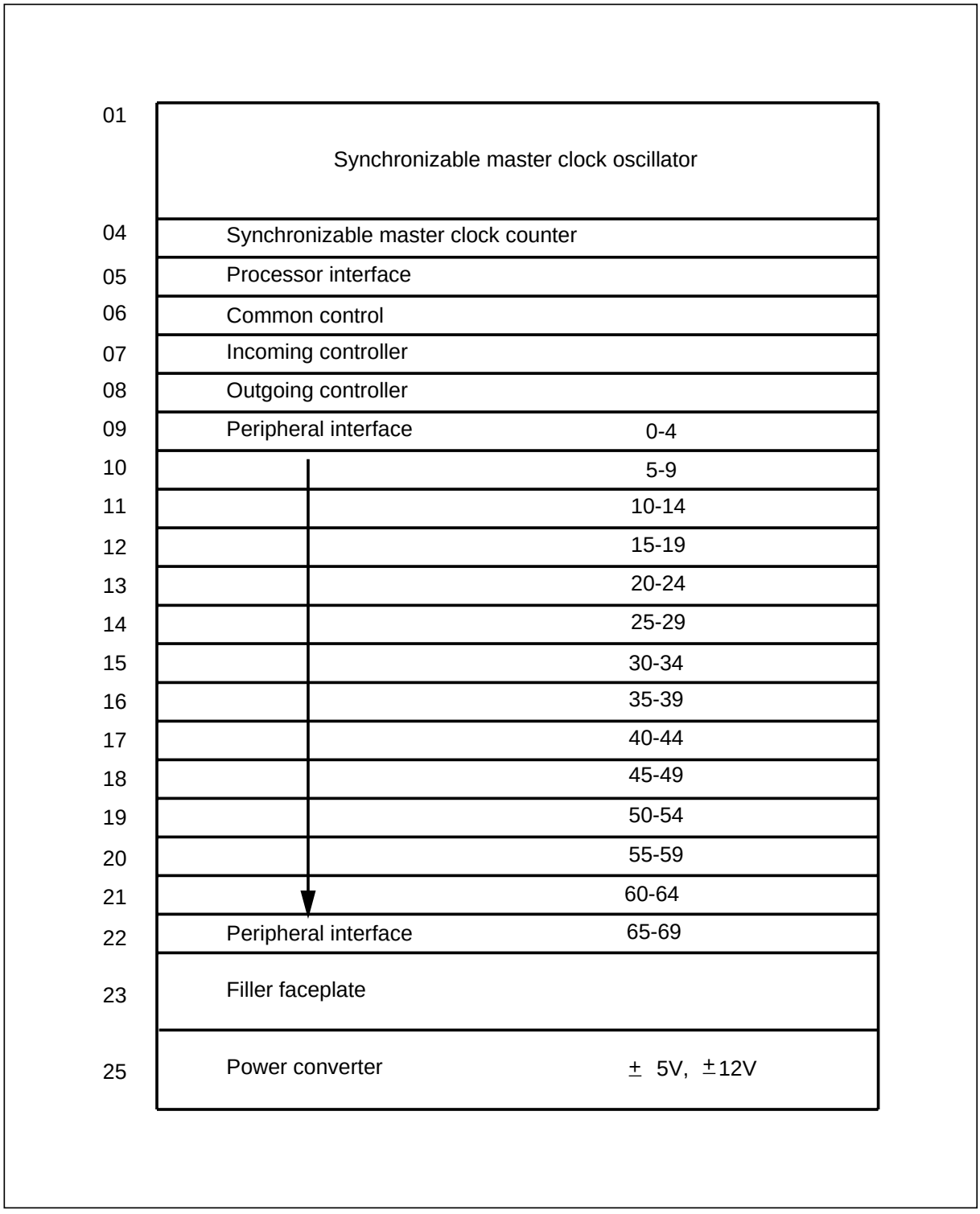


Figure 2-9
CMC incoming message

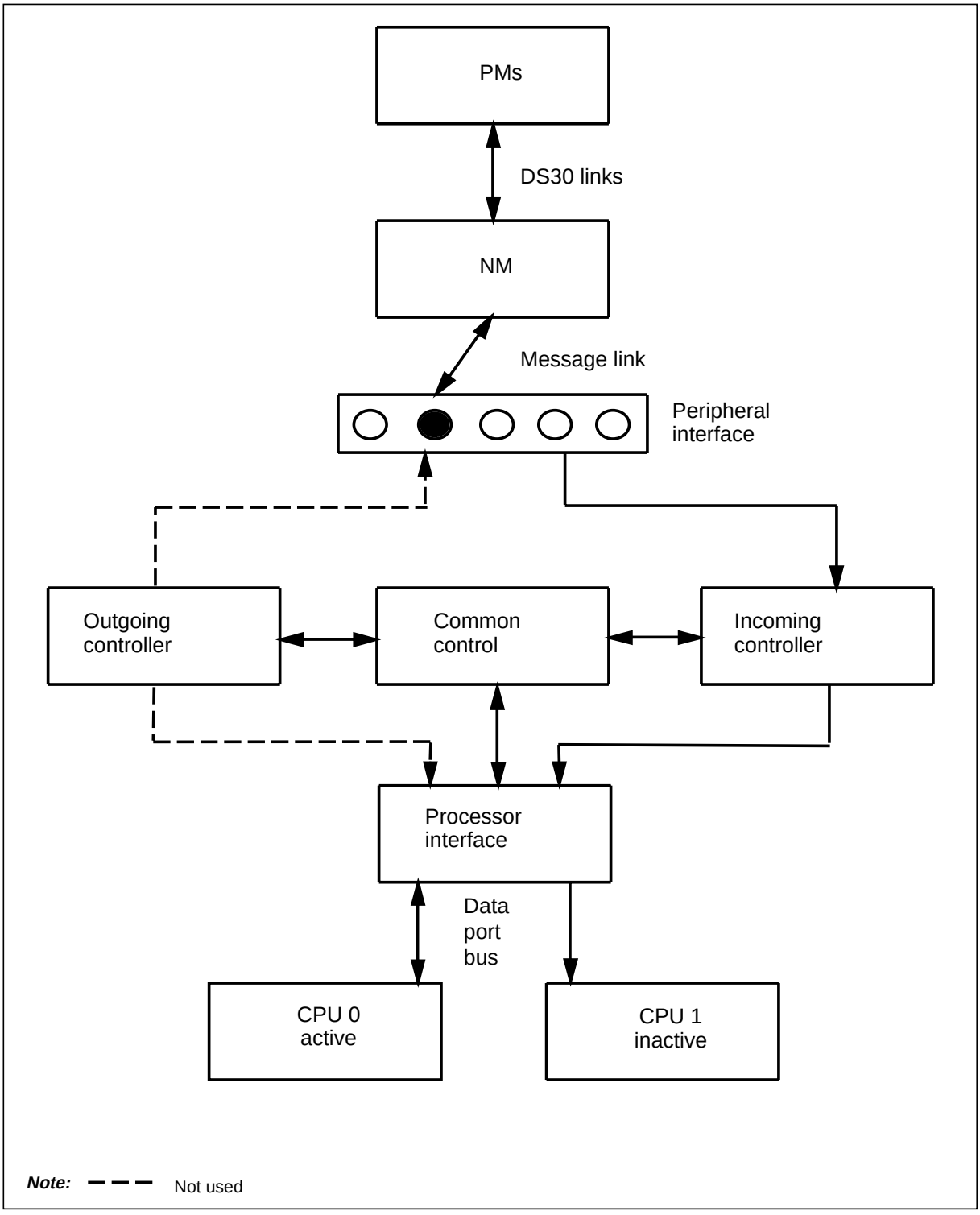
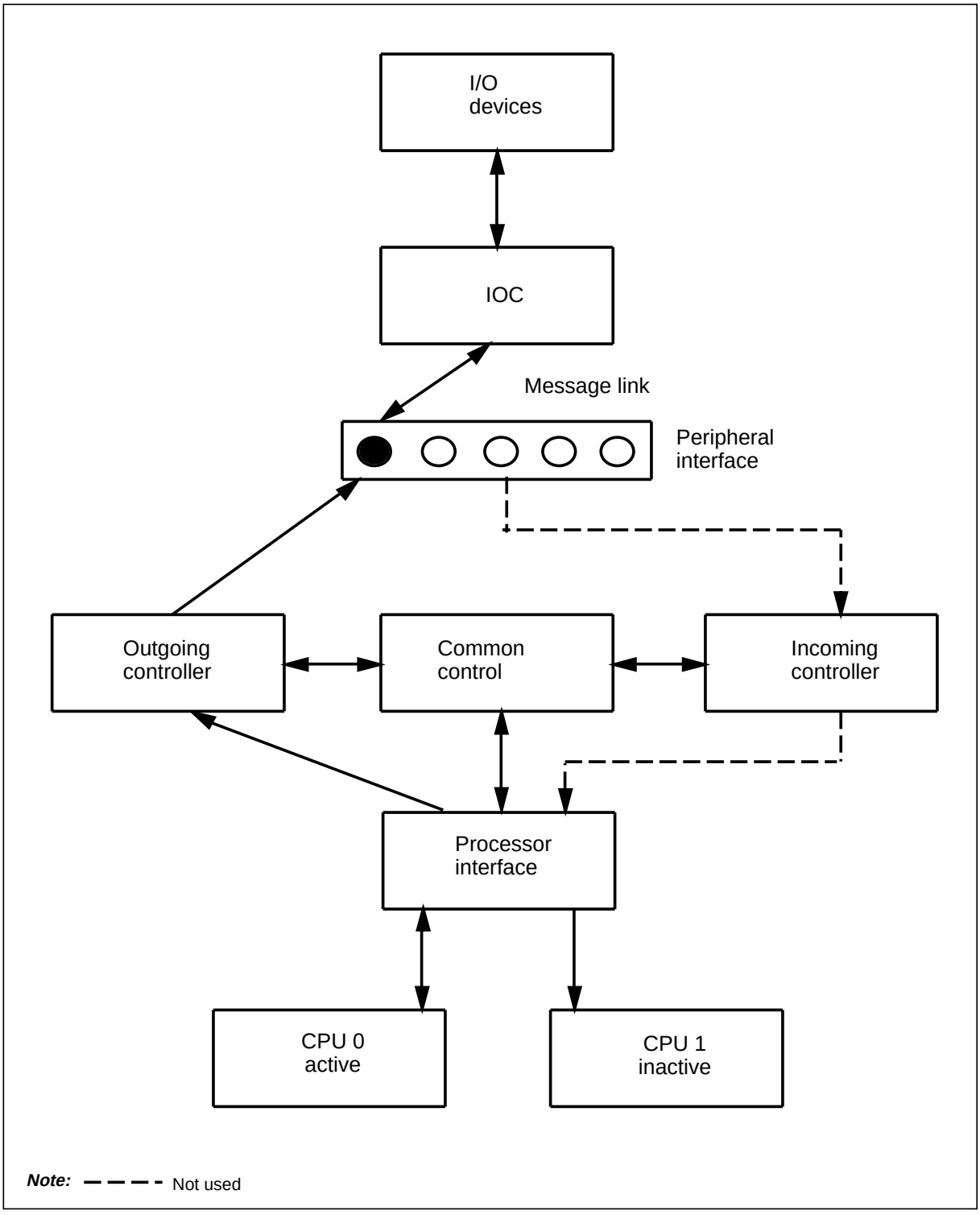


Figure 2-10
CMC outgoing message



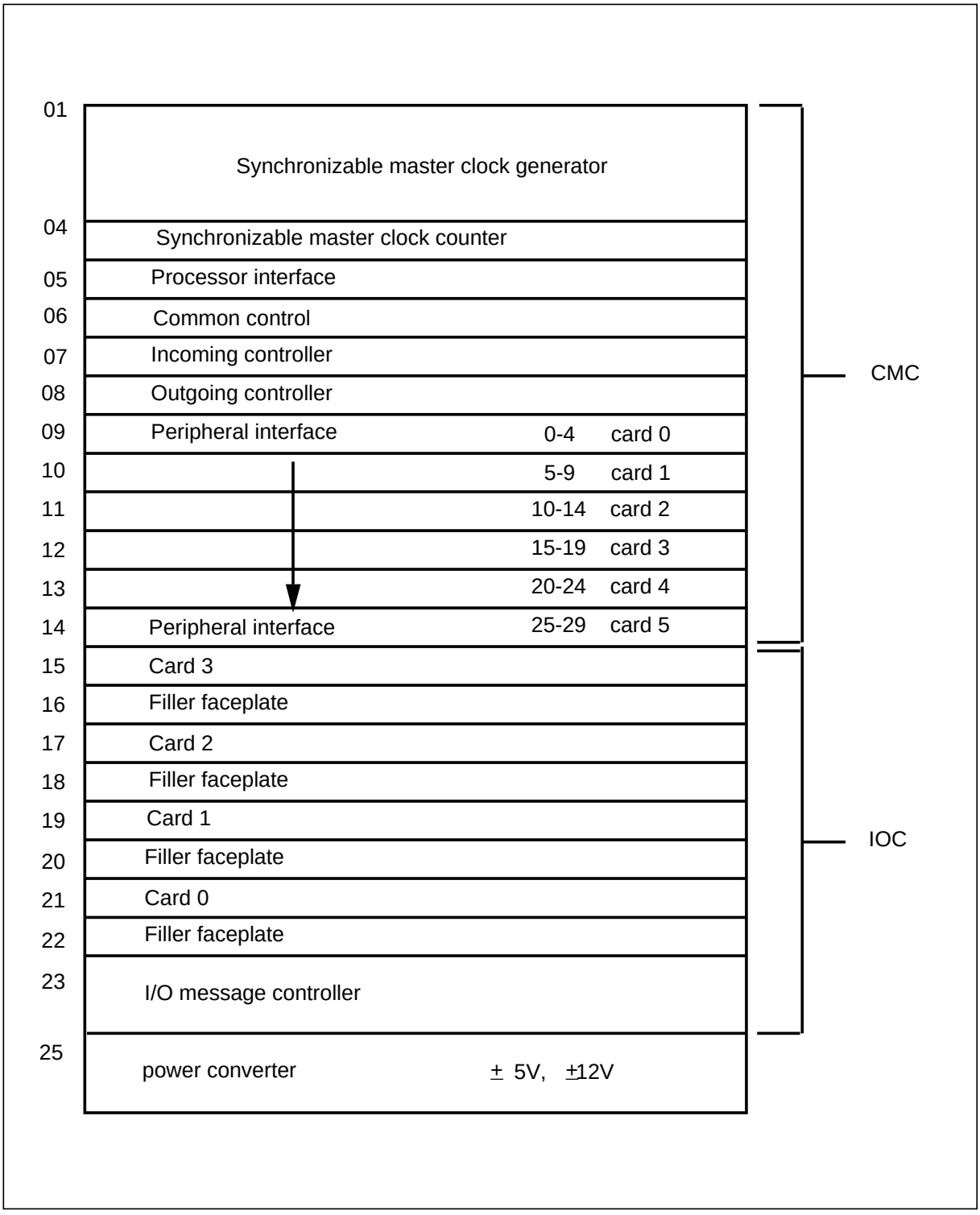
- The peripheral interface card provides the following:
  - a CMC interface for up to five message links
  - a MDC shelf containing only a CMC module which may house up to fourteen NT1X36. Therefore, a CMC can interface a maximum of seventy message links (14 x 5 = 70). There is one message link required for each NM and IOC.
  - a minimum of two NT1X36 cards are required. This is done to provide an enhanced reliability factor for the non-duplicated IOC modules.
- The power converter card:
  - converts -48V office battery to regulated +_5V and ±12V feeds for the circuit packs in the MDC shelf.

Central message controller and input/output controller

An message device and controller (MDC) shelf housing both a CMC and an IOC module contains both CMC and IOC type circuit packs (Figure 2-11). The following rules apply to this configuration:

- The switching office will never require more than 14 NM pairs (28 message links).
- The I/O device requirement will be no more than eight I/O cards (4 per CMC).

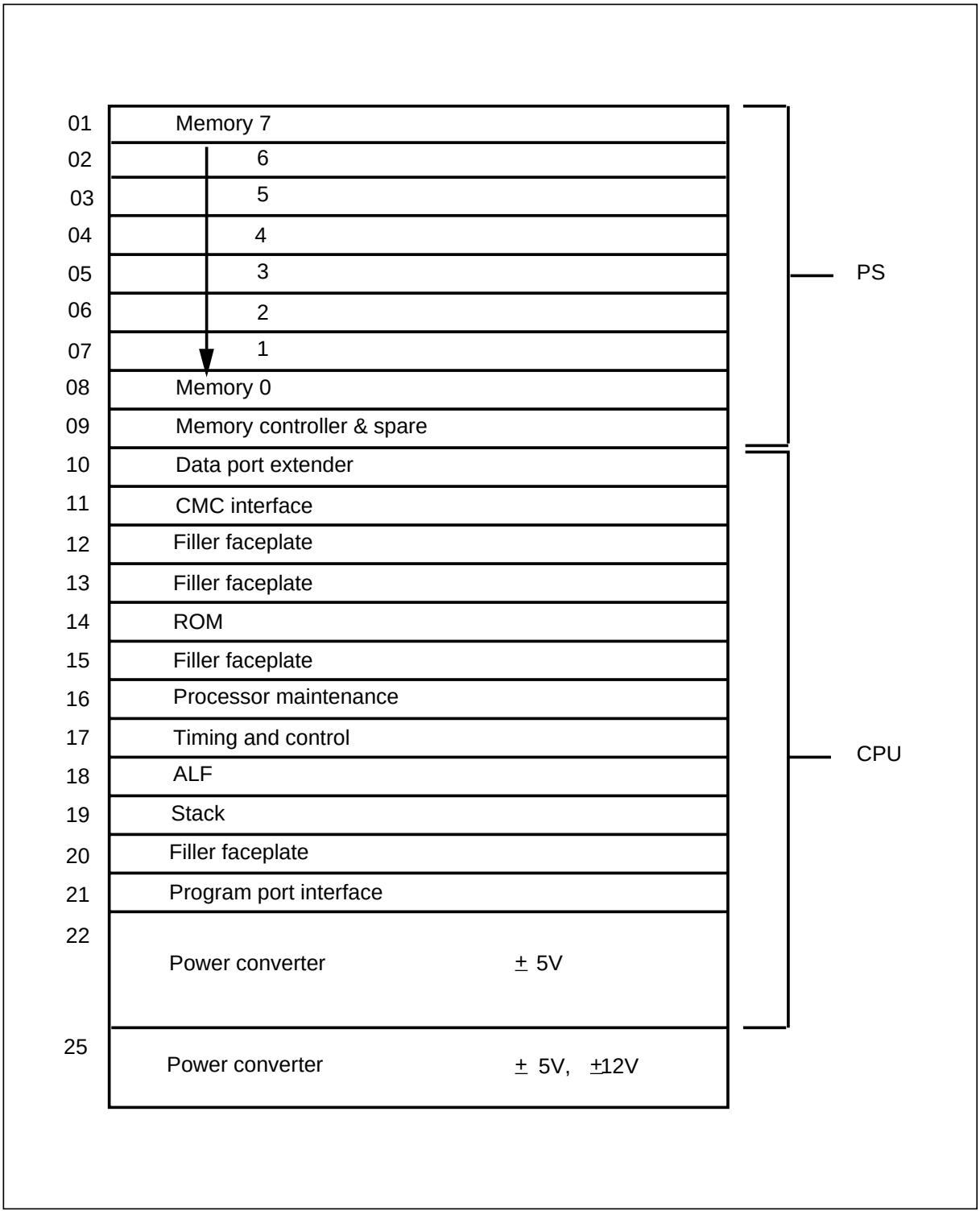
Figure 2-11
Message device and controller shelf



Central processor and memory shelf

The CPM shelf houses two separate modules; the PS module and the CPU module. The PS module is comprised of the circuit cards located in slot positions 01-09. The CPU module circuit cards are located in slot positions 10-25 (Figure 2-12).

Figure 2-12
Central processor and memory shelf



Central processor unit

The CPU circuit packs and their main functions are:

Data port extender card:

- terminate the Data Port bus which is the interface between the CPU and its DS memory
- uses balanced card when the DS memory is located within 30 meters of the CPU

CMC interface card:

- terminates the Data Port buses which are the interface between the CPU and each CMC.

ROM card:

- contains the micro-store and micro-sequencing logic necessary to execute the program instructions with the card capacity of 8K 40-bit words

Processor maintenance card:

- terminates the MEB which is used for the exchange of information between CPU
- contains CPU status indicators and manual controls

Timing and control card:

- provides the basic CPU timing with a 36 or 40 MHz clock source
- contains a two-digit hexadecimal maintenance display

Arithmetic and logic function card:

- provides all arithmetic and logic functions necessary for data manipulation

Stack card:

- contains 4K of 17-bit words (1 parity bit) of high-speed, bi-polar store, which, together with a few special registers, constitutes the system stack

Program port interface card:

- terminates the Program Port bus which is the interface between the CPU and its PS memory

Power converter card:

- converts -48V office battery to regulated $\pm$5V feeds for the circuit packs within the CPM shelf
- converts -48V office battery to regulated $\pm$5V and $\pm$12V feeds for the circuit packs within the CPM shelf.

Note: The CPU circuit packs described in this section are for the latest vintage of CCC hardware. It should be noted that there are several different vintages of CPU existing in the field today. Those CPU may have different card(s).

Program store

The PS module has a memory storage capacity of up to eight million 17-bit locations (words). Currently, the amount of addressable PS memory is 3.5 million words. As the demand for memory requirements increase, the amount of addressable PS memory will also increase (see Note 1). The PS module circuit packs and their main functions are:

Memory card:

- contains Random Access Memory (RAM) in which program instructions may be stored
- NT3X93 contains 256K of 17-bit words and is based on the 64K memory chips (see Note 2)
- NT4X80 contains 1 million 17-bit words and is based on the 256K memory chips.

Memory controller and spare card:

- contains the read, write, address, and control logic for its associated memory cards
- contains 64K 17-bit words of spare memory which is available for use by the CPU when a faulty section of memory is detected in one of the memory cards.

Notes: 1. The PS circuit cards described in this section are for the latest vintage of CCC hardware. It should be noted that there are switches existing in the field which have different cards and PS module configurations.

2. The PS module has a memory storage capacity of 2 million 17-bit words when using all 3X93 cards (256K x 8 = 2 million) and a capacity of 8 million 17-bit words when using all 4X80 cards (1 million x 8 = 8 million). It is possible to mix both types of cards in the PS module.

Data store shelf

The DS shelf contains the DS module which currently has a memory storage capacity of 4 million 17-bit locations (Figure 2-13). The DS limit for each CCC frame is 16 million 17-bit words. The DS circuit packs and their main functions are:

Bus interface and terminator card:

- terminates the data port bus and interfaces it to the memory controller card

Memory controller and spare card:

- contains the read, write, address and control logic for its associated memory cards
- contains 64K 17-bit words of spare memory which is available for use by the CPU when a faulty section of memory is detected in one of the memory cards

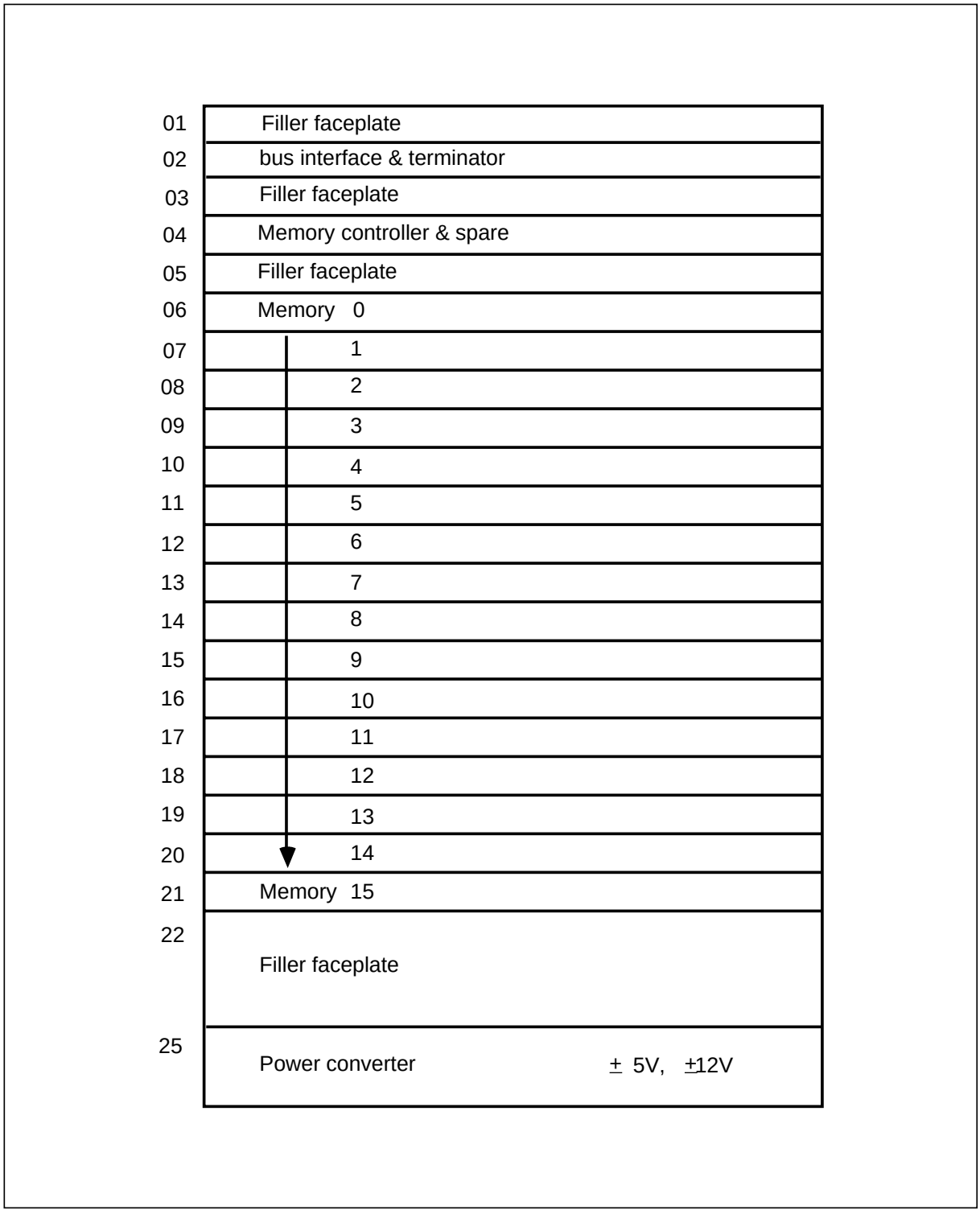
Memory card:

- contains 256K 17-bit words of RAM in which data base information may be stored. The Data Store shelf holds up to sixteen memory cards which equal four million words (16 x 256K = 4 million).

Power converter card:

- converts -48V office battery to regulated $\pm$5V and $\pm$12V feeds for the circuit packs in the DS shelf.

Figure 2-13
Data store shelf



Central control complex reliability

The central control complex (CCC) is a totally duplicated area of the DMS. It is comprised of two independent CCC frames. Each CCC frame contains all of the necessary hardware and software to operate and control the DMS system.

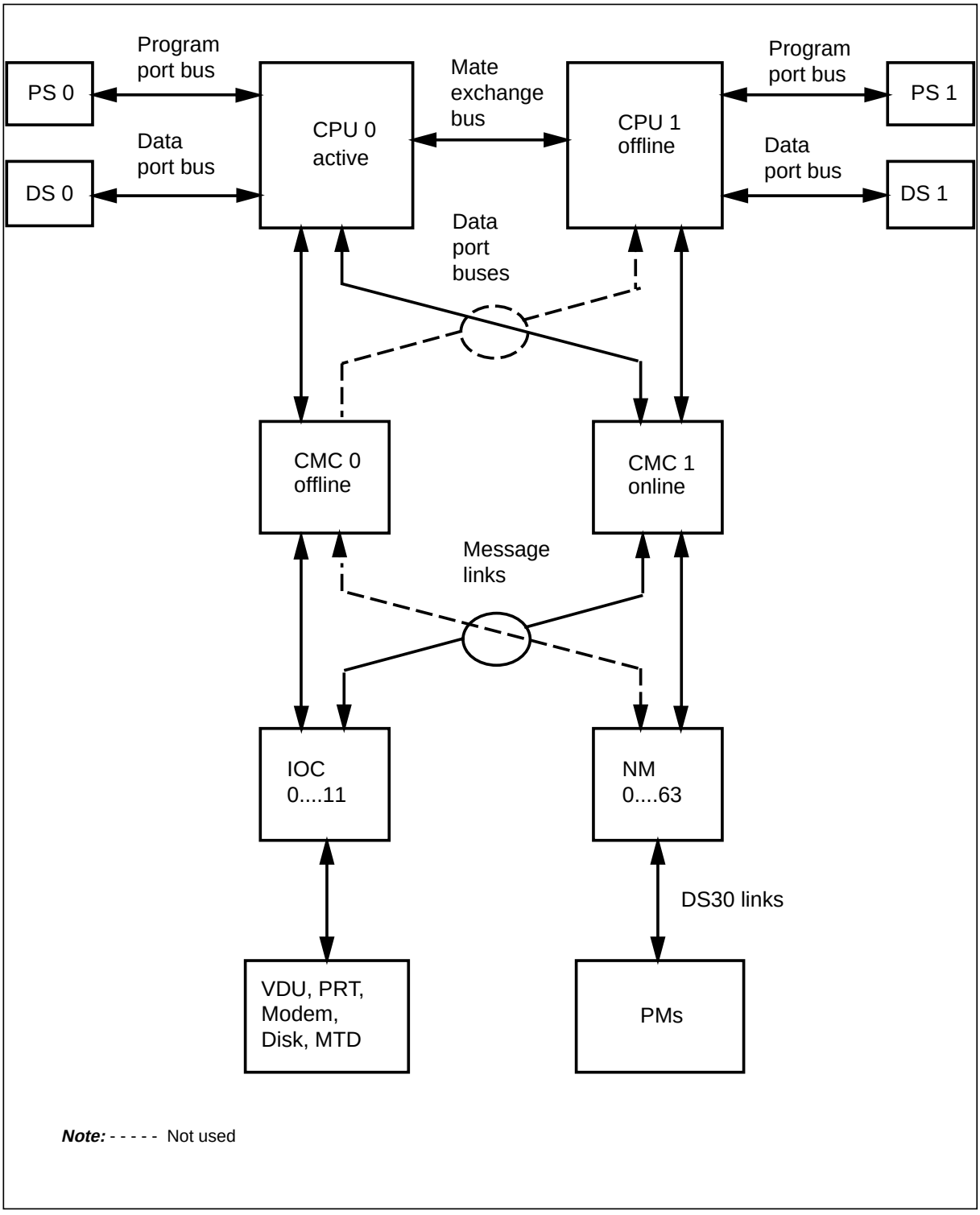
The reliability of the CCC is demonstrated in Figure 2-14. The CPU 1 and CMC 0 have failed and are offline. The reliability and architecture of the switch is such that CPU 0 is capable of operating and controlling the DMS. The CMC 1 is being used for all message flow to and from the CPU.

Each memory module of PS and DS has a 64K section of spare memory. If a 64K section of memory should fail, the DMS performs the following:

- isolates the faulty section of memory
- switches the activity of the system if the memory fault is in the active CPU
- offlines faulty CPU (no synchronization)
- activates spare for the faulty memory module
- active CPU updates spare with memory
- brings CPU back online (in sync).

These actions are accomplished without any loss of calls within the DMS. Multiple memory card sections within the same module must fail in order to keep a CPU offline.

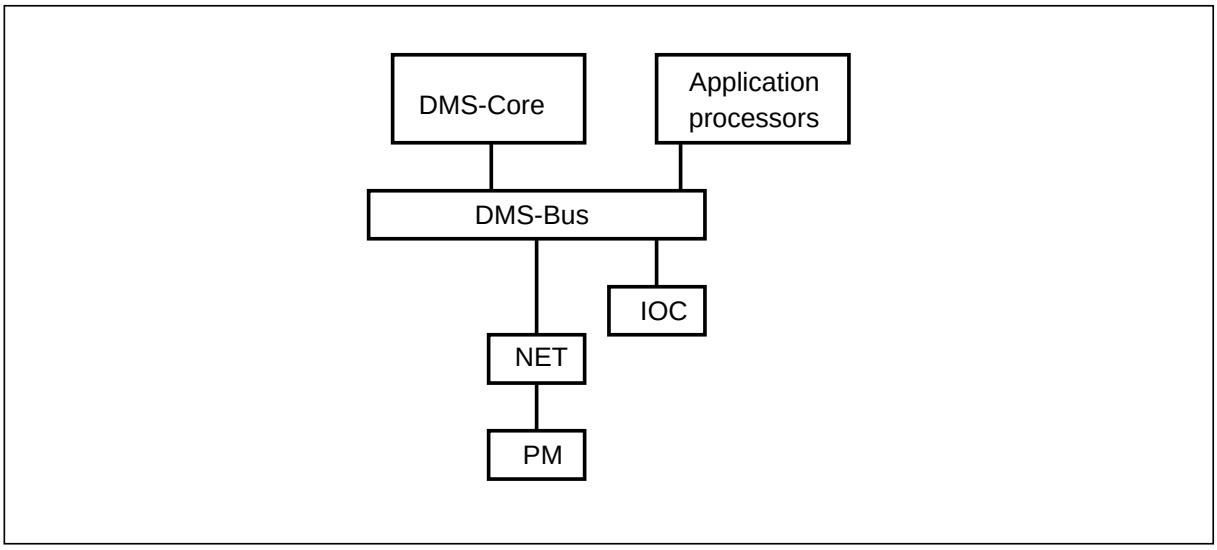
Figure 2-14
CCC reliability



DMS SuperNode

DMS SuperNode consists of the DMS-Core and the DMS-Bus (Figure 2-15). These hardware components are interconnected by DS512 links referred to as computing module interface links (CMIC). DMS-Bus is connected to the switching network by DS30 links.

Figure 2-15
DMS SuperNode architecture



DS512 links

The DS512 format is the standard for internal optical fiber links in DMS SuperNode. A DS512 link is equivalent to 16 DS30 links, multiplexed onto a single optical fiber. One channel is used for link synchronization. DS512 provides more bandwidth than DS30 and allows greater packaging density.

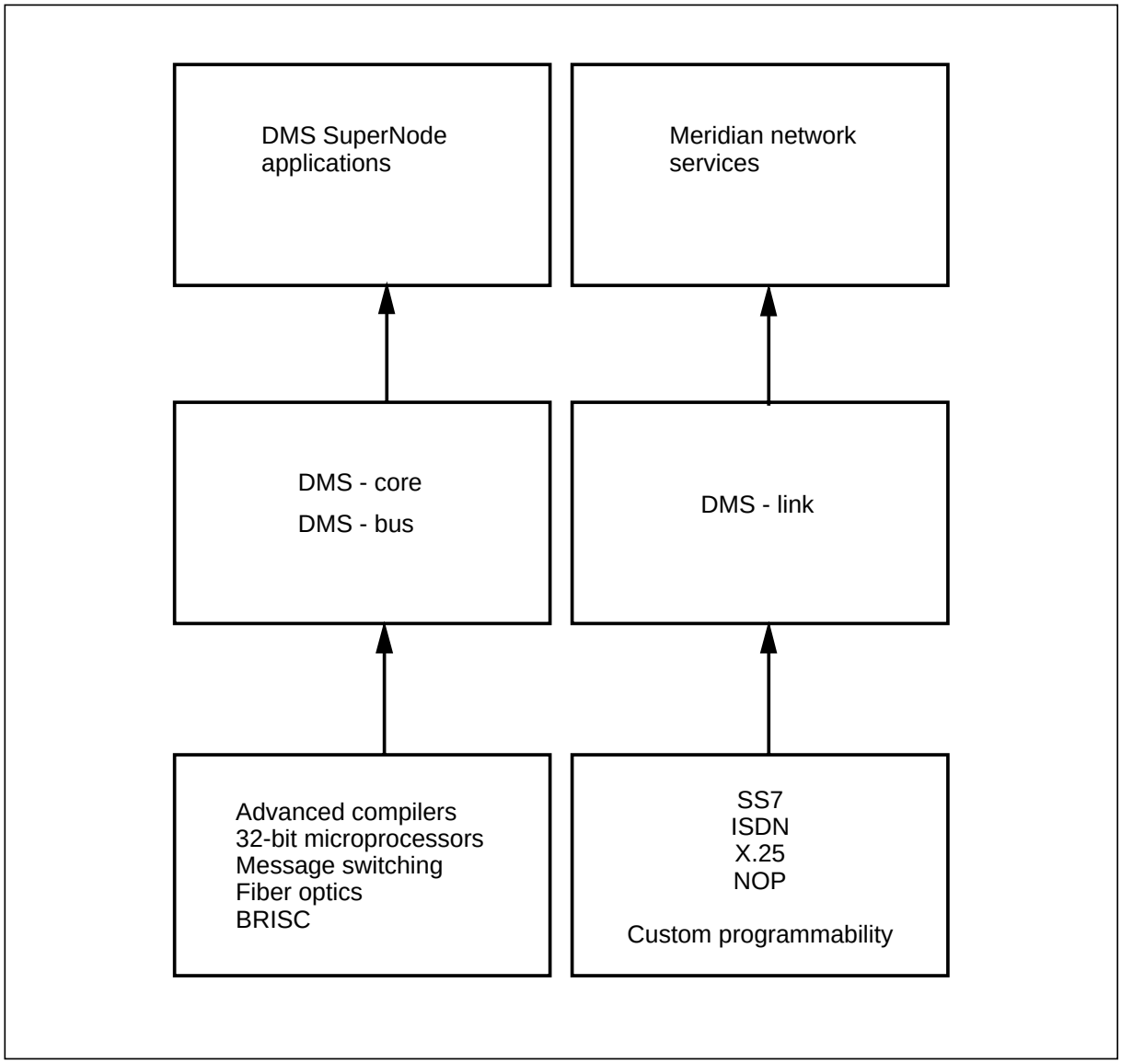
DS30 links

The common interface between components of the DMS-100 system is a serial data link with a bit-stream format. This format is termed “DS30” and is composed of thirty-two 10-bit channels within a 125 microsecond frame. The channels are numbered 0 to 31, with channel 0 coming first in time.

DMS SuperNode components

The fundamental components of DMS SuperNode include; DMS-Core, DMS-Bus, and DMS-link. These provide the enabling architecture for a series of DMS SuperNode applications and Meridian Network Services (Figure 2-16).

Figure 2-16
DMS SuperNode components



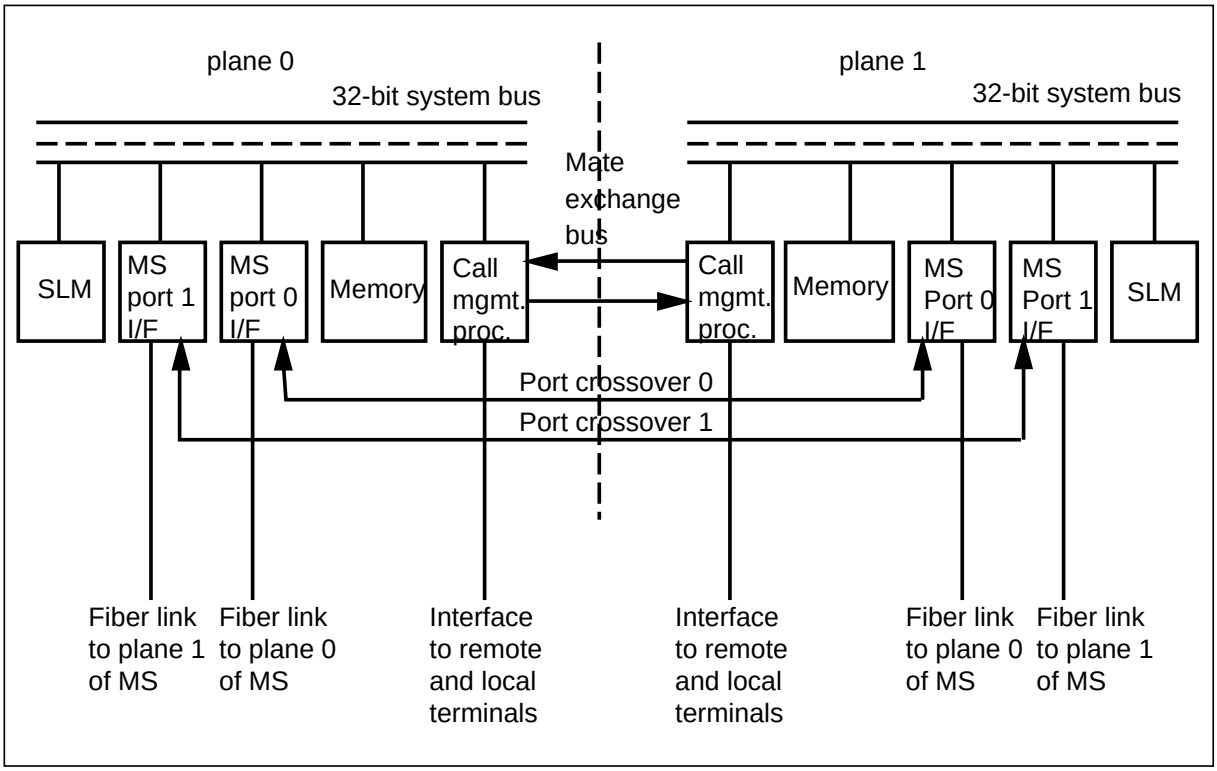
DMS-Core

DMS-Core is the computing and memory resource for the new architecture. DMS-Bus is a high-speed transaction switch acting as the hub joining all the system components connected to its ports (DMS-Core, DMS-STP, DMS-SCP, DMS-DNX modules, and customer-programmable processors) so that they may communicate freely with each other. DMS-link provides the software infrastructure upon which advanced Meridian Network Services and future network services are based.

The advantages of the new DMS SuperNode architecture are increased processing power and feature capacity, and its compatibility with components planned for future deployment, such as Enhanced Network. DMS SuperNode architecture is also compatible with existing Network Modules, Peripheral Modules, and Input/Output Controllers (IOCs). All available DMS-100 features will be transferred for use with DMS SuperNode.

In addition to call processing, DMS-Core is also responsible for switch sanity and maintenance, and loading and downloading programs. DMS-Core consists of a call management processor, system memory, a terminal interface, and it interfaces to both planes of DMS-Bus and the system load module (Figure 2-17).

Figure 2-17
DMS-Core duplex architecture



The call management processor of DMS-Core is the powerful Motorola 32-bit MC68020 microprocessor, which has over twice the processing power of the central processor that it displaced.

The call management processor of DMS-Core accesses the memory devices (either the tape or disk) by way of the system bus. It also manages the transfer of information between main memory and the system load module.

In addition to the use of a more powerful microprocessor, the increase in feature capacity is attributed to the following:

- increased band width for memory access
- implementation of a data cache
- use of a static random access memory (SRAM) for high runner code
- custom circuitry (gate arrays) for memory access
- optimization of software code for use with the MC68020

DMS-Core's architecture includes two planes for additional reliability. A mate exchange bus links the call management processors of the two planes and allows the processors to compare compilations and to check the sanity of each other.

Memory is composed of 10 cards per plane. Initially, each card contains 6 Mbytes of memory using 256 kilobyte memory devices. As DMS SuperNode evolves, 1 Mbyte memory devices will be available on 24 Mbyte cards. There is no physical separation of memory into data store and program store in DMS SuperNode as there currently is with the NT40 processor for the DMS-100 switch.

DMS-Core is connected to the rest of the DMS-100 architecture by the DMS-Bus interface. A DS-512 fiber optical link is used as the interface between DMS-Core and DMS-Bus. Each plane of DMS-Core interfaces each plane of DMS-Bus.

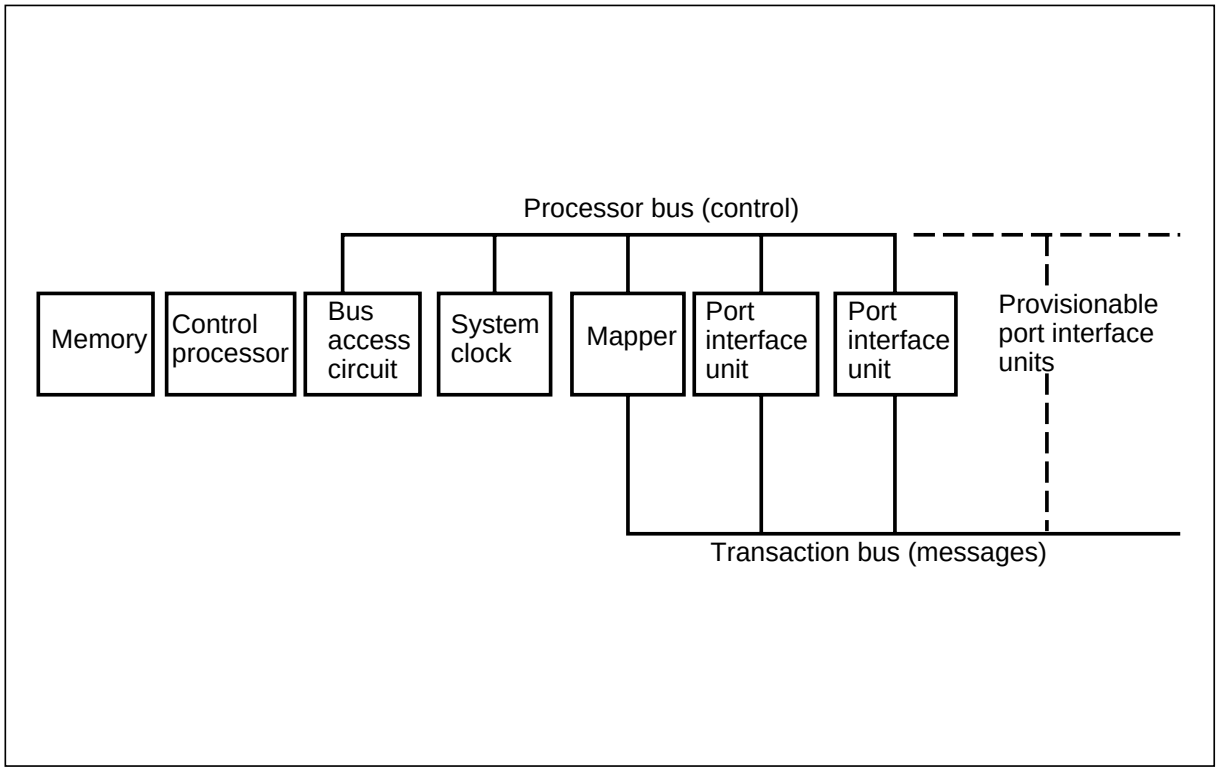
DMS-Bus

DMS-Bus is the messaging hub of DMS SuperNode. This messaging hub is established with a bus structure where DMS-Core, each input/output controller, and each network module is represented.

DMS-Bus actually consists of two buses: a processor bus for control of DMS-Bus components, and a transaction bus, on which messages are carried between the subsystems (for example, DMS-Core, network module, and input/output controllers that attach to DMS-Bus). The other components of DMS-Bus (Figure 2-18) include:

- control processor
- memory
- bus access circuit
- system clock
- mapper
- port interface unit

Figure 2-18
DMS-Bus architecture



The port interface units manage the interface to the DMS-Bus transaction bus for the different subsystems that connect to DMS-Bus. The port interface unit gains access to the transaction bus when it has been requested by the subsystem it serves. The port interface unit then acknowledges that it has been given control, places the message from the subsystem on the transaction bus, and confirms that the message has been received.

The port interface unit performs these functions in reverse order when receiving a message; that is, when being addressed, the port interface unit informs the subsystem of whether it is free or not, receives the message, and acknowledges that the message was received intact.

Four port interface units or ports exist on one card. A one-plane, single-shelf DMS-Bus can be provisioned with a maximum of twenty port cards. Two are dedicated to DMS-Core, and two are dedicated to a maximum of four input/output controllers (IOC). The remaining 16 cards (64 ports) are used to interface up to 32 network modules (64,000 channels).

The control processor manages the overall performance of DMS-Bus. It is supported by 4 Mbytes o memory and a bus access circuit. The processor

implemented with DMS-Bus is the MC68020, the same processor used with DMS-Core.

Messages received by and sent from the control processor transaction bus are managed by the bus access circuit. The control processor has full control of the processor bus and uses it to control the other components of DMS-Bus. The control processor receives from, and dispatches messages to other subsystems of the switch by way of the transaction bus.

The messages that travel on the transaction bus include an address header and a message body in their structure. The address header can either be a logical or physical address reference.

A physical address is the actual hard-wired address of a subsystem's interface managed by a specific port interface unit. A logical address is a non-specific reference for a subsystem; it must be translated into an actual physical address. The translation from logical to physical address is performed by the DMS-Bus mapper. The mapper contains the mapping of logical to physical address and reissues the message with a physical address.

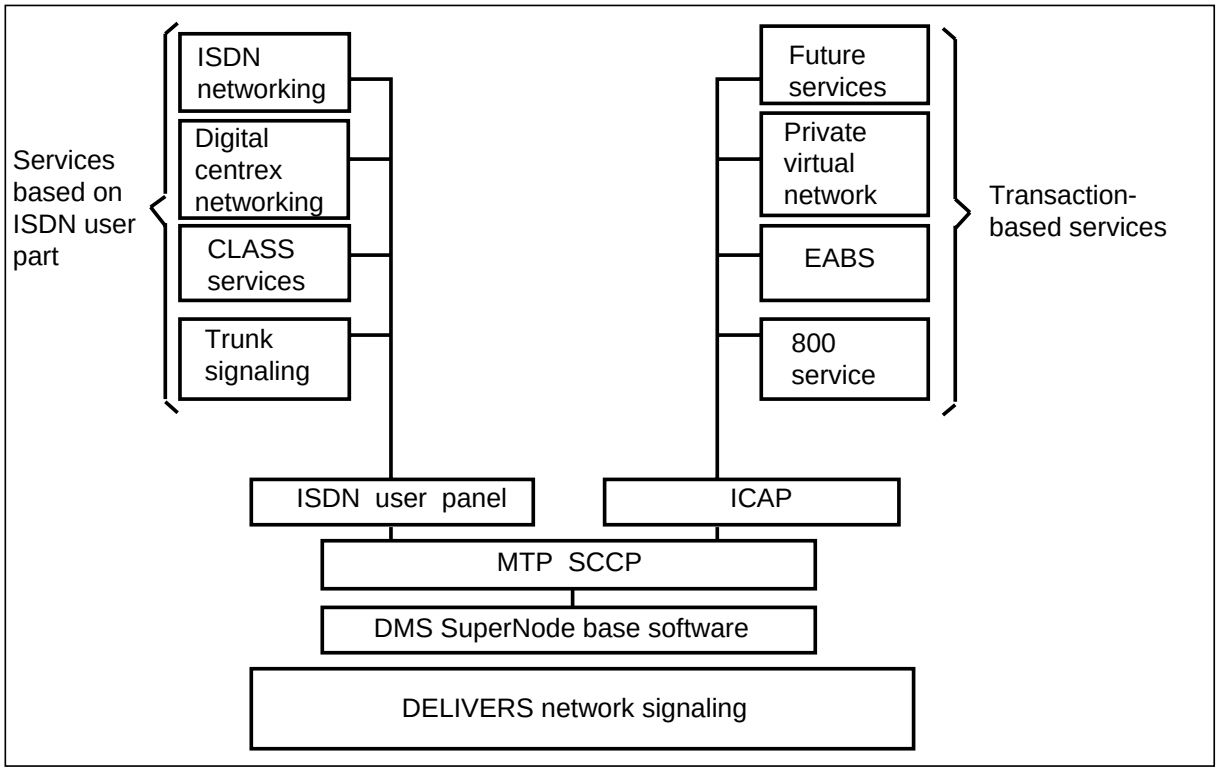
The system clock reference of DMS-Bus can be sourced either within DMS-Bus or as a separate external component interfacing to DMS-Bus. The built-in source is a synchronizable clock conforming to Stratum III. The external components can be either a non-synchronizable master reference or a synchronizable clock as follows:

- Stratum I: This clock requires the master reference frame (NT5X23AA).
- Stratum II: This clock requires the remote oscillator shelf (NT3X95AA) in an input/output equipment (IOE) frame equipped with the NT3X16AA Stratum II circuit packs.

DMS-link

The DMS-link (Figure 2-19) is the software and protocol structure which provides the signaling links among DMS SuperNode applications and among nodes in the telecommunication network. The DMS-link interfaces are implemented with public standard protocols.

Figure 2-19
DMS-link software structure



Protocol sets included within the DMS-link set include the signaling system No. 7 (SS7) set for both transaction and trunk switching, ISDN Access (Q.921 & Q.931), networks operations protocols (X.400), and X.25 for packet communications.

The DMS-link enables a set of services which represent major revenue opportunities for the telephone operating companies. The SS7 set provides excellent examples. There are two different protocols used in the top layer of the SS7 protocol set. These are the transaction capability application part and the ISDN user part.

Transaction capability application part (TCAP) is the protocol which a services switching point, the central office switching office handling the call, uses to query the services control point data base while processing 800 or automated credit card calls. Without a public standard protocol such as TCAP all of the central office switches and the entire SS7 network would have to be provided by the same vendor.

ISDN user part (ISUP) is the protocol used by central office switching systems for signaling while setting up calls, either voice or data, both ISDN, across a LATA network. ISUP contains provisions to routinely provide the calling number within the call setup procedure. It is this capability which is necessary to support the CLASS feature set. In addition, ISUP provides identification, for example, of the bearer capability which any call is using. This permits routing of digital data and voice calls over the same trunk group on digital transmission facilities.

Other services such as private virtual networking take advantage of similar capabilities of SS7.

The DMS-link commitment to the use of public standard protocols ensures that the telephone operating companies will have the ability to provide revenue earning services in a competitive multi-vendor network. This is an important setup in ensuring a successful transition into the Open Network Architecture and Intelligent Network II environments.

System load module (SLM)

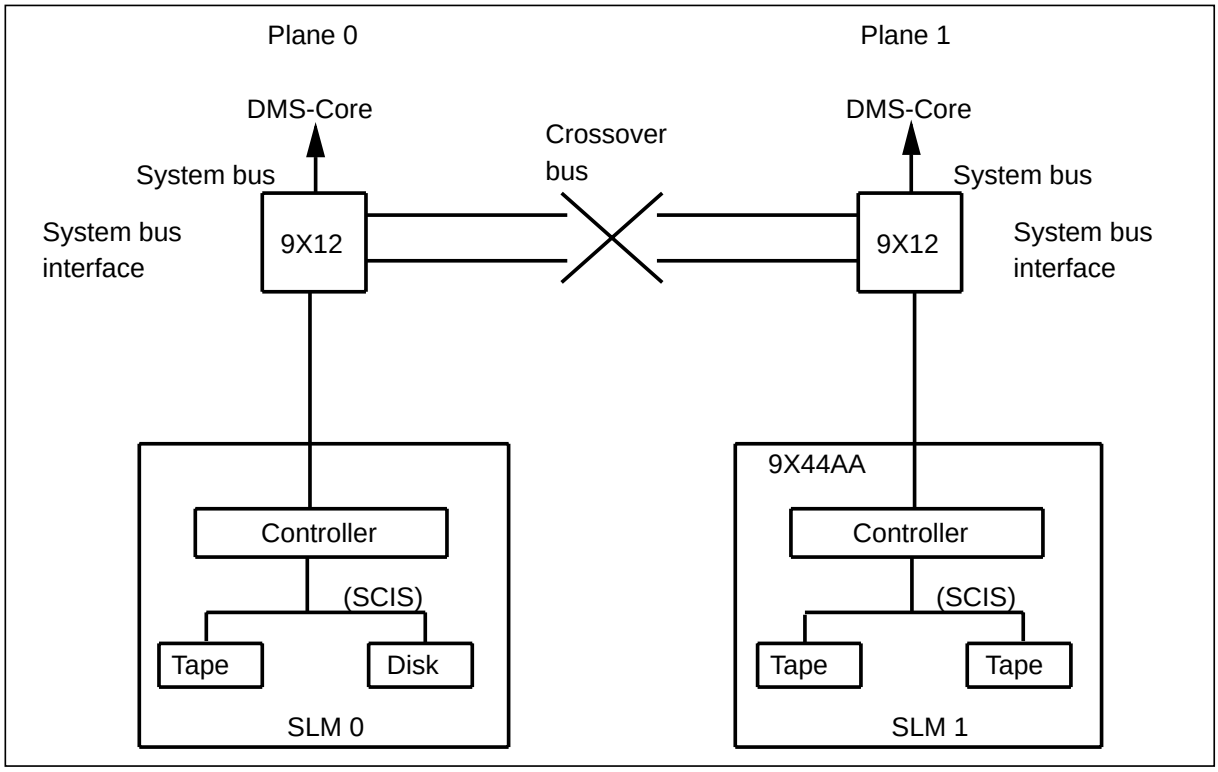
The SLM is a fully duplicated mass storage system that is dedicated to DMS-Core (Figure 2-20). New loads or stored office images can be booted into DMS-Core and DMS-Bus, and packed up using the SLM. The SLM is located in the DMS-Core extension shelf.

Each SLM is packaged into a single replaceable unit that consists of:

- 5 1/4-inch hard disk drive (140 Mbyte capacity formatted disk)
- 1/4-inch streaming cartridge tape drive (60 Mbyte capacity)
- controller central processor

Note: The hard disk drives in the existing DMS-100 have a 32 Mbyte limit. In DMS SuperNode offices with images greater than 32 Mbyte, SLM becomes a requirement because of unacceptable load times with only tape drives.

Figure 2-20
System load module architecture

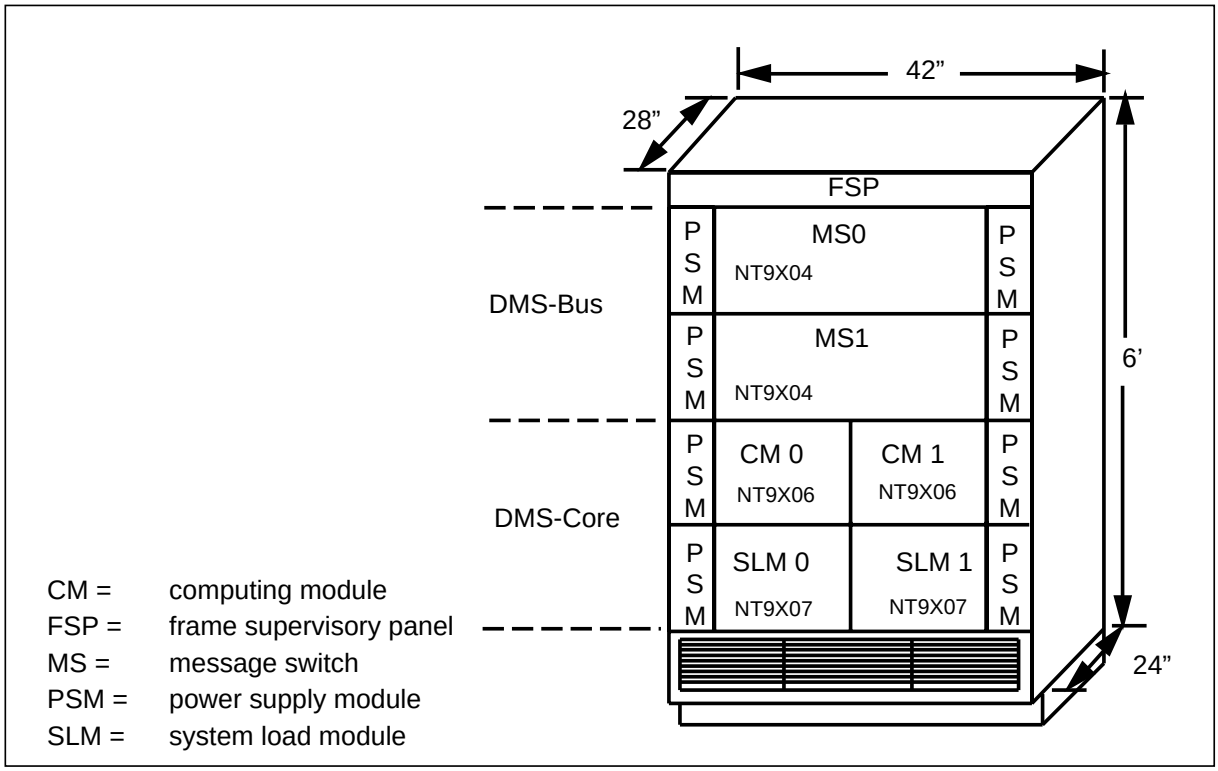


The control of the tape and hard disk is managed by the controller board. The system bus of DMS-Core is extended to the shelf where the two SLMs reside. A port access card (9X12) is used to interface the system bus.

Cabinet configurations

DMS SuperNode can be configured in two layouts: a single-cabinet layout and a two-cabinet configuration. The single-cabinet configuration of DMS SuperNode is illustrated in Figure 2-21.

Figure 2-21
DMS SuperNode single cabinet layout



This layout contains two planes of DMS-Bus on two shelves; and two planes of DMS-Core on two shelves.

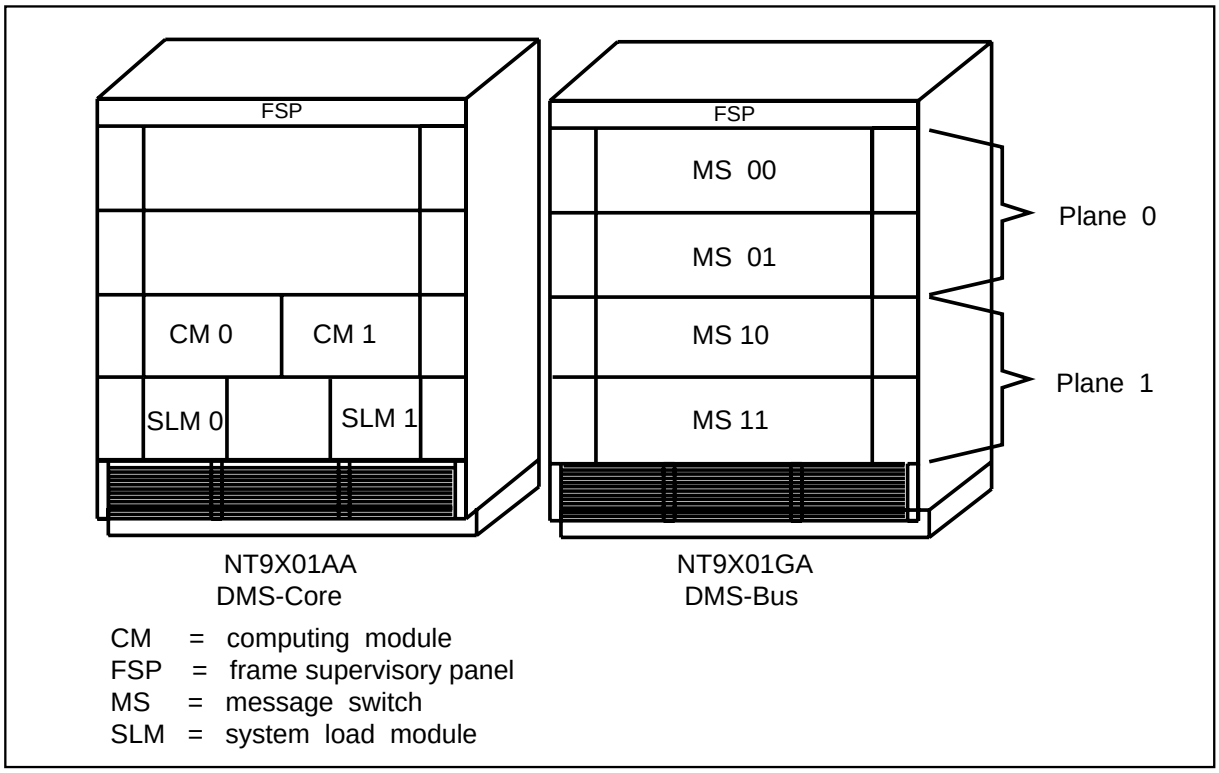
In the single-cabinet design, each plane of DMS-Bus has 20 slots for port cards. Two slots interface the two planes of DMS-Core and two are for use with the IOCs. The remaining 16 slots are used to interface the network modules.

Initially, four port interface units reside on each card, making a total of 64 ports (4 x 16 slots). The 64 ports support both planes of 32 network modules for 64K channel capacity. This is the maximum that the network modules can be configured. Therefore, a single-cabinet configuration is sufficient for existing DMS-100 Family switches.

There are planned developments that will require additional port capacity. These requirements will be provided by using a higher density of ports per card and/or expansion of the number of shelves that the DMS-Bus occupies. An example of a future development is the enhanced network. To address this expansion, a 16-port card is being developed and the DMS SuperNode architecture can be expanded to multiple cabinets.

Figure 2-22 illustrates the two-cabinet configuration of DMS SuperNode. Two cabinets are required to provide additional slots for DMS-Bus port cards. DMS-Bus is expanded by the addition of expansion shelves. An expansion shelf contains 24 slots for port cards and an extension of the Processor and Transaction buses to these cards. Control of these additional cards is exerted by the initial or processor shelf of DMS-Bus.

Figure 2-22
DMS SuperNode two-cabinet layout



A two-cabinet configuration can support up to 160 ports with the 4-port card. With the 16-port DMS-Bus interface card, the two-cabinet layout will support 640 ports.

DMS SuperNode memory

DMS SuperNode memory consists of memory circuit packs. Identical memory circuit packs are used in both the computing module and in the message switch.

Memory access protocol

Memory is partitioned into 64 Kbyte pages. The function of each page of memory is defined by memory protection attributes in the MAU. Four types of memory protection attributes are provided in the DMS SuperNode:

- write protection
- program only
- data only
- supervisor node

Combinations of these attributes determine the following characteristics of each page of memory:

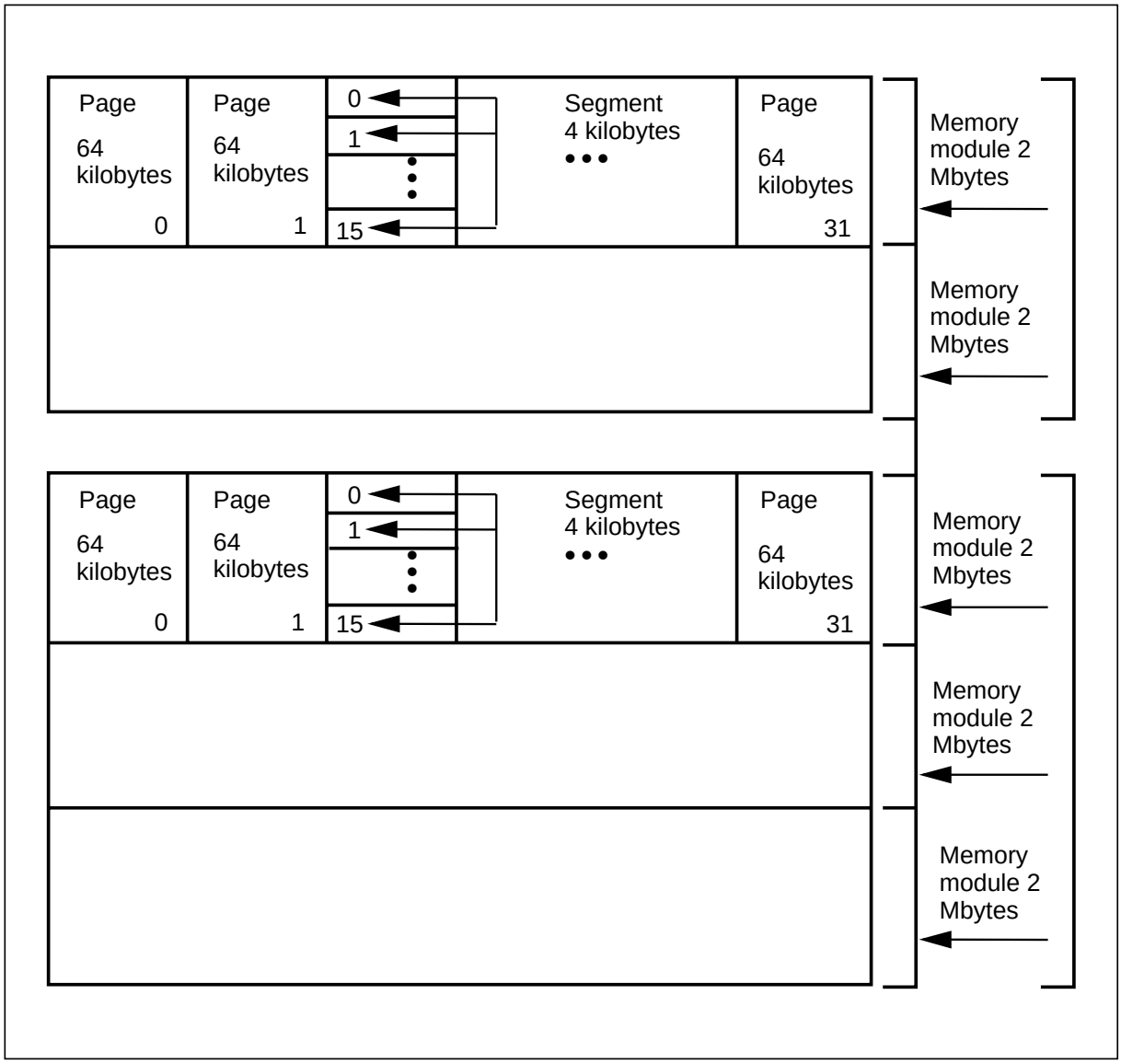
- Program store has the program only attribute. Write protection in program store is implemented by means of a counter. Only the program loader and some debugging tools modify program store.
- Protected data store (DSPROT) has the data only and write protection attributes. Write protection can be disabled temporarily for all of DSPROT.
- Data store or program store reserved for use by the support operating system (SOS) has the supervisor mode attribute, in addition to its other attributes. All other types of data store have the data only attribute.
- Memory not allocated has the combination of data store, program only, and write protection attributes.

Physically, memory is provided on memory circuit packs. There are two types of memory circuit packs:

- Six Mbytes of dynamic access random memory (DRAM) is divided into three 2 Mbyte modules (NT9X14BB).
- Twenty-four Mbytes of DRAM is divided into three 8 Mbyte memory modules (NT9X14DB).

Each memory module (Figure 2-23) has its own memory controller. Memory is organized into 40-bit words consisting of 32 data bits, seven error correcting bits, and one parity bit. The error correcting code bits provide the capability to correct single-bit errors and to detect multiple-bit errors. The error detecting and error correcting capacity are implemented in the memory controller hardware.

Figure 2-23
Memory modules, pages, and segments



Computing module operating modes

When the duplicated CPUs in the computing module are operating in synchronism, the controlling CPU is called “active” and the other is “inactive” (Figure 2-24). When operating in the syncmatch mode, both CPUs will be operating from one of the CPU’s clocks.

Figure 2-24
Computing module CPUs, message controllers, and message switches

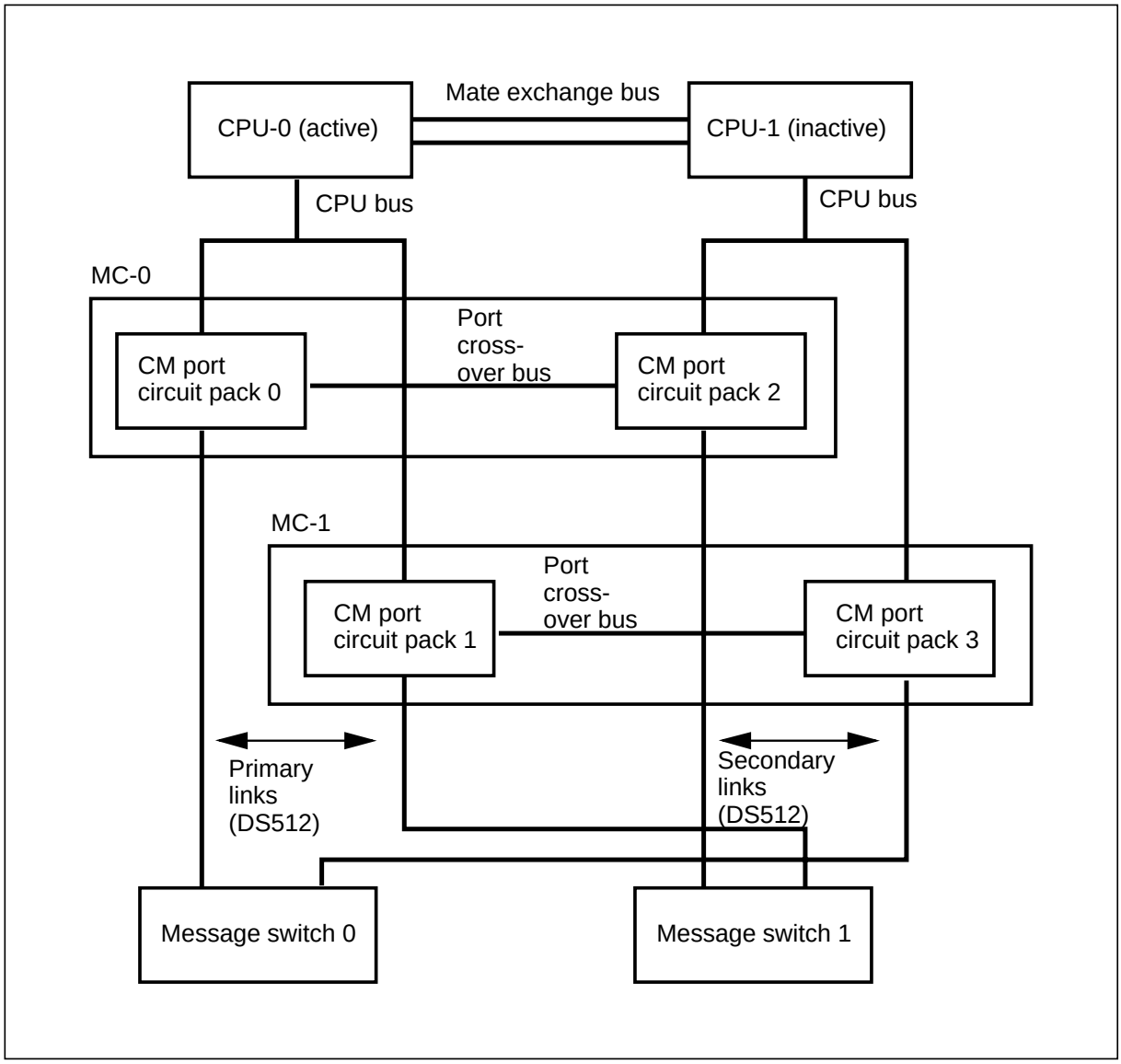


Table 2-1xxx
Computing module operating modes

Operating mode	Clock status
Operation in synchronism	The clock on the active CPU is used by both CPUs unless the active CPU clock is faulty
Scheduled SWAct are performed during low traffic periods to ensure that both units are functioning	Clock does not move
Operation in DP synchronism	Each CPU uses it's own clock

The version of the DMS SuperNode CPU circuit packs used in the computing module includes 256 kilobytes of semiconductor static RAM. Access to the static RAM is faster than access to memory on the memory circuit packs, and is used for purposes requiring fast memory.

Computing module memory

When the dual CPUs in the computing module are operating in synchronism, the memory is synchronized with the CPU and the error correcting capability is software disabled for faster operation. When the dual CPUs in the CM are not operating in synchronism, the memory is not synchronized with the other processor and the error correcting capability is enabled.

Each CM can be equipped with up to ten memory circuit pack for a total of 240 Mbytes. Each CPU can use any combination of 6 Mbyte and 24 Mbyte memory circuit packs.

Message controller

The message controller (MC) provides serial message links between the DMS-Core and the DMS-Bus. Each MC consists of two computing module port circuit packs, each with an associated DS512 interface paddleboard. Each CM port circuit pack, in conjunction with its associated DS512 paddleboard, provides the following functions:

- access to the CPU bus
- access to the mate CPU bus through the port cross-over bus
- generation of incoming message interrupts
- message buffering
- protocol handling supporting DS30, DMSX, and DMSY protocols
- parallel-to-serial and serial-to-parallel conversions

One of the two CM port circuit packs in each MC is located on the CPU-0 side of the CM shelf; the other on the CPU-1 side. Port cross-over buses between the CM port circuit packs allow the active CPU to have read/write

access to all four ports. The inactive CPU has read-only access to all four ports when the dual CPUs in the CM are operated in synchronism. Each MC is connected to both message switches by the way of two DS512 message links to each message switch.

The two DS512 links associated with the active CPU are called primary links; and the two associated with the inactive CPU are secondary links. If a primary link failure occurs, the MCs reroute messages over a secondary link by way of the port cross-over buses.

When the duplicated CPUs are operating in synchronism, the MCs route incoming messages to both CPUs by port cross-over buses. The MCs also synchronize the two incoming message interrupts to the CPUs.

Message controller synchronization

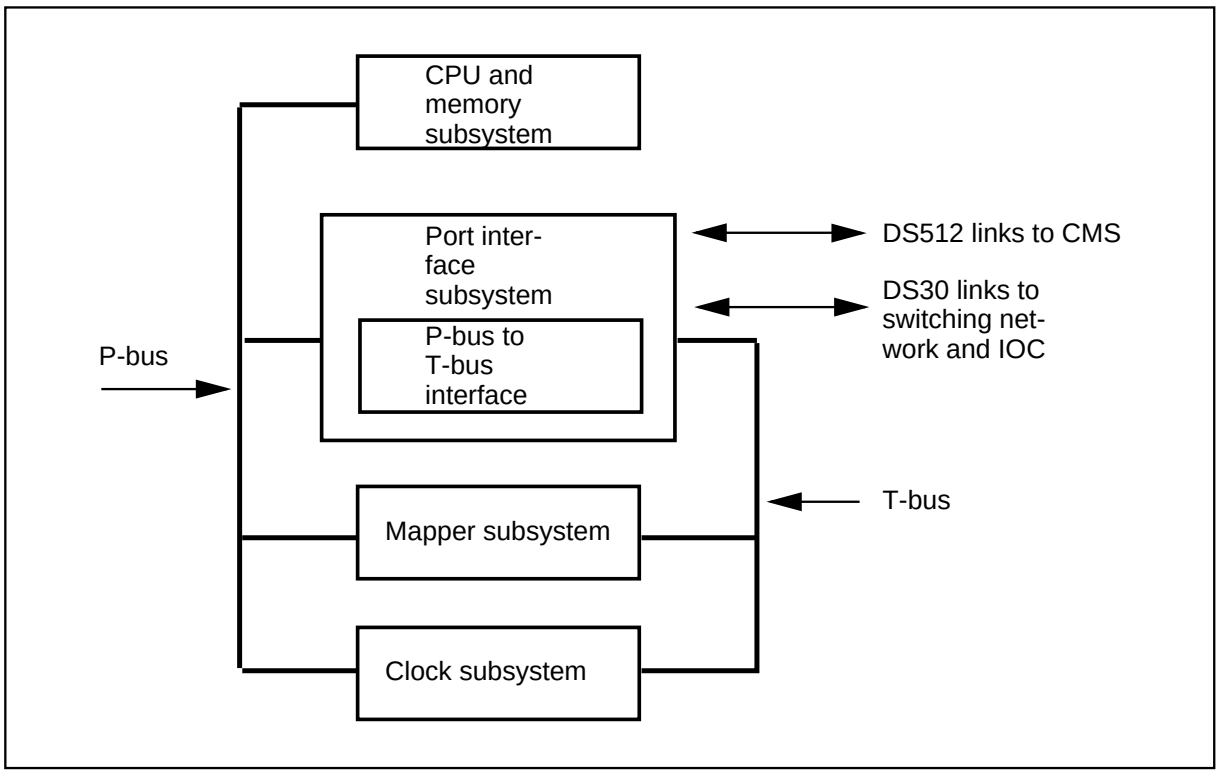
The CM subsystem clock paddleboard generates the transmit frame pulse required for CM port circuit pack synchronization. One CM subsystem clock is located on the CPU-0 side; the other on the CPU-1 side. Each CM subsystem clock paddleboard provides the master clock and transmit frame pulse to the two CM port circuit packs located on the same side of the CM shelf.

Message switch (MS)

The DMS-Bus is the messaging component of the DMS SuperNode and consists of duplicated message switches (MS) that operate in a load sharing mode. The MS concentrates and distributes messages in the DMS-100. The MS is designed to provide a greater message traffic capacity and longer message length than the central message controller (CMC). The MS also provides the central clock source for the DMS-100 office. Each MS resides on a separate MS shelf.

On the peripheral side, the MS can be connected to both the DS30 and DS512 links, and can support DS30, DMSX, and DSMY protocols. When connected to DS30 links, the MS converts between DS30 and encapsulated DS30 message formats (Figure 2-25).

Figure 2-25
Message switch functional block diagram



The MS can route messages using either a logical address or a physical address. Logical addresses are converted to physical addresses by a component of the MS called the Mapper Subsystem.

The MS is built around two major internal buses.

Processor bus (P-bus)

The message switch CPU uses the P-bus to communicate with all other components of the MS. The P-bus is used primarily for control and maintenance.

Transaction bus (T-bus)

Messages are transmitted from port to port over the T-bus. The T-bus is a synchronous bus operating at 4.096 megabits per second, and is composed of four components.

Address/data bus

The address/data bus is a 32-bit-wide bi-directional bus carrying multiplexed address and data information. The addresses are logical and physical destination addresses. The data consists of the messages to be rerouted. The net data rate is approximately 130 megabits per second (32 X 4.096

megabits per second). A 4-bit parity bus is associated with the address/data bus (one parity bit for each address/data byte).

Control/status bus

The control/status bus identifies the state of the address bus. Typical states include address cycle, data cycle, and end-of-message cycle.

Access control bus

The access control bus implements a distributed arbitration algorithm to resolve T-bus access problems.

Timing bus

The timing bus carries all clock signals necessary for the operation of the T-bus and the port interface subsystem.

CPU and memory subsystem

The processor and memory subsystem configures and maintains the other subsystems. One 6 megabit memory circuit pack is required in the message switch. All software used by the message switch resides in this memory circuit pack and on the processor circuit pack. Error detection and error correction are always enabled for the message switch memory.

Port interface subsystem

The port interface subsystem provides interfaces to DS30 and DS512 links; including protocol handling for DS30, DMSX, and DMSY protocols. The port interface subsystem includes universal port cards (MS 4-port circuit packs) with associated paddleboards for DS30 and DS512 links.

Each MS 4-port circuit pack serves one to four ports and provides the following functions:

T-bus interface

T-bus interface allows the port to receive and transmit messages over the T-bus.

Protocol handling

The port is programmed for one of three protocols for DS30 and DS512 links; DS30, DMSX, or DSMY.

Message store buffers

This function allows the temporary storage of messages in transit between a DS30 or DS512 link and the T-bus. These buffers are required because of the different speeds of the T-bus (130 megabits/sec), and the DS30 and DS512 links (2.56 to 32 megabits/sec).

Each DS30 link is associated with one MS port since all 32 channels on the link are associated with one Network Module (NM), or with one

Input/Output Controller (IOC). Each DS512 link connected to a CM is associated with one MS port since the link consists of one 32-megabit/second channel.

The port interface subsystem provides the interface between the P-bus and the T-bus by means of the T-bus access circuit pack.

Mapper subsystem

The mapper subsystem converts logical addresses to physical addresses and provides route status information. Message switching in the MS operates in one of two modes:

Mapper assist mode

Mapper assist mode is used when the physical address is set to default value (all ones).

Mapper bypass mode

Physical addresses are used to route messages. The mapper subsystem is not used.

Clock subsystem

The clock subsystem provides the system clock source for the DMS-100 office and the MS subsystem clock source for the MS.

The system clock is provided by the system clock circuit pack. One message switch provides the master clock source for the DMS-100 office; the other message switch clock is synchronized to this master clock source.

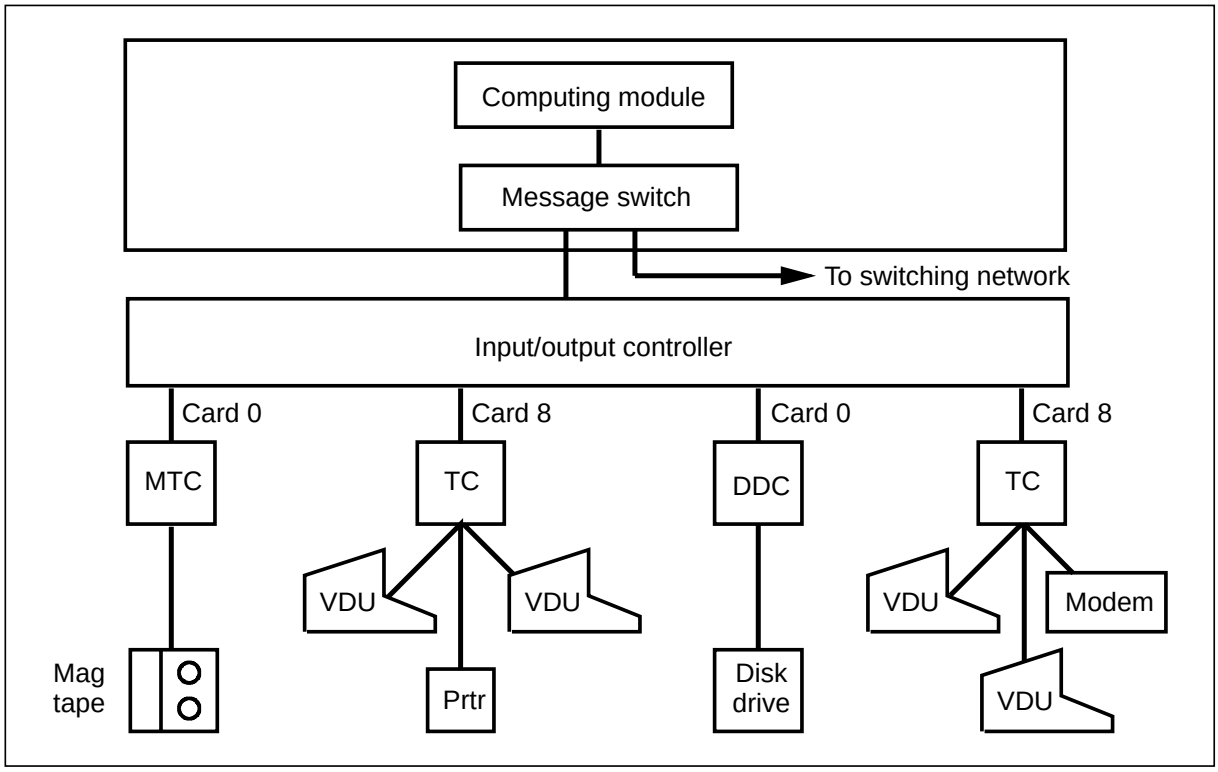
The system clock circuit pack may be synchronized to one of three sources:

- the mate message switch clock
- an external clock source within the DMS-100 office
- any of the DS1 links connected to a digital trunk controller (DTC), line trunk controller (LTC), or digital carrier module when the DMS-100 is operating in a digital network environment.

Input/output controller (IOC)

The input/output controller (IOC) connects a variety of input/output devices with the central control CPU by way of the message links to the messaging component (Figure 2-26). These devices include video display units (VDU), printers, magnetic tape drives, disk drives, and data links.

Figure 2-26
Input/output controlled devices



The IOC, together with the I/O device controller that connects with a particular device, performs the necessary conversion to DS30 format for communication with the control component by way of the message links. Two DS30 links connect to the IOC, one from each message component.

Input/output system

The peripheral modules and the control component communicate with each other by means of messages sent over DS30, DS1, and DS512 links. The messages can be PCM signals, or they can be control and information messages exchanged by the control component, the switching network, or the peripheral modules.

Nodes

Any unit that can accept messages, or originate them, or both, is termed a "node." The control and messaging components, network modules, peripheral modules, and the IOC are all nodes. In the DMS-100 switch, the side of a node (or link) facing toward the central control processor is referred to as the C-side; the side of a node (or link) facing towards the peripheral modules is referred to as the P-side.

In DMS SuperNode, the side of a node (or link) facing toward the DMS-Bus is referred to as the C-side; the side of a node (or link) facing away from the DMS-Bus is referred to as the P-side. In both switching systems, messages going from the C-side to the P-side are called outgoing messages. Those coming from the P-side to the C-side are called incoming messages.

When installed, each network module, peripheral module, and IOC is assigned a unique number on the node. Every terminal (for example, line and trunk) is identified internally by a unique terminal identifier consisting of the node number and the terminal number on the node. This identifier may be thought of as the address of a terminal. The central control processor software controls terminals by sending messages to the nodes on which they are located. These messages include the terminal identifier, as well as the data necessary for the particular action being performed.

Message link control is handled by the input/output (I/O) system. This function is distributed among the nodes since each node must receive and send messages over its C-side and P-side message links. The I/O system uses routing and error control information in a message to ensure successful message transmission in the presence of link noise, or in the event of transient or permanent hardware faults.

DMS SuperNode SE (SNSE)

The DMS SuperNode SE (SNSE) is designed to provide a cost-effective small-switch core platform based on DMS SuperNode/enhanced network (ENET) technology. The SNSE platform contains the following functions:

- computing module/system load module (CM/SLM)
- DMS-Bus
- link interface unit (LIU)
- Network

The SNSE provides a DMS SuperNode based switch configuration which is designed to address the needs of the small central office. It offers growth potential from an initial installation of less than 2,000 lines to 12,000 lines, with expansion to 20,000 lines, and includes POTS, business services, and ISDN.

SNSE switch core platforms are utilized in the following applications:

- Stand-alone
- Service switching point/signaling transfer point/service control point (SSP/STP/SCP)
- Small STP
- Cellular
- International

- IEC
- Toll
- PBX

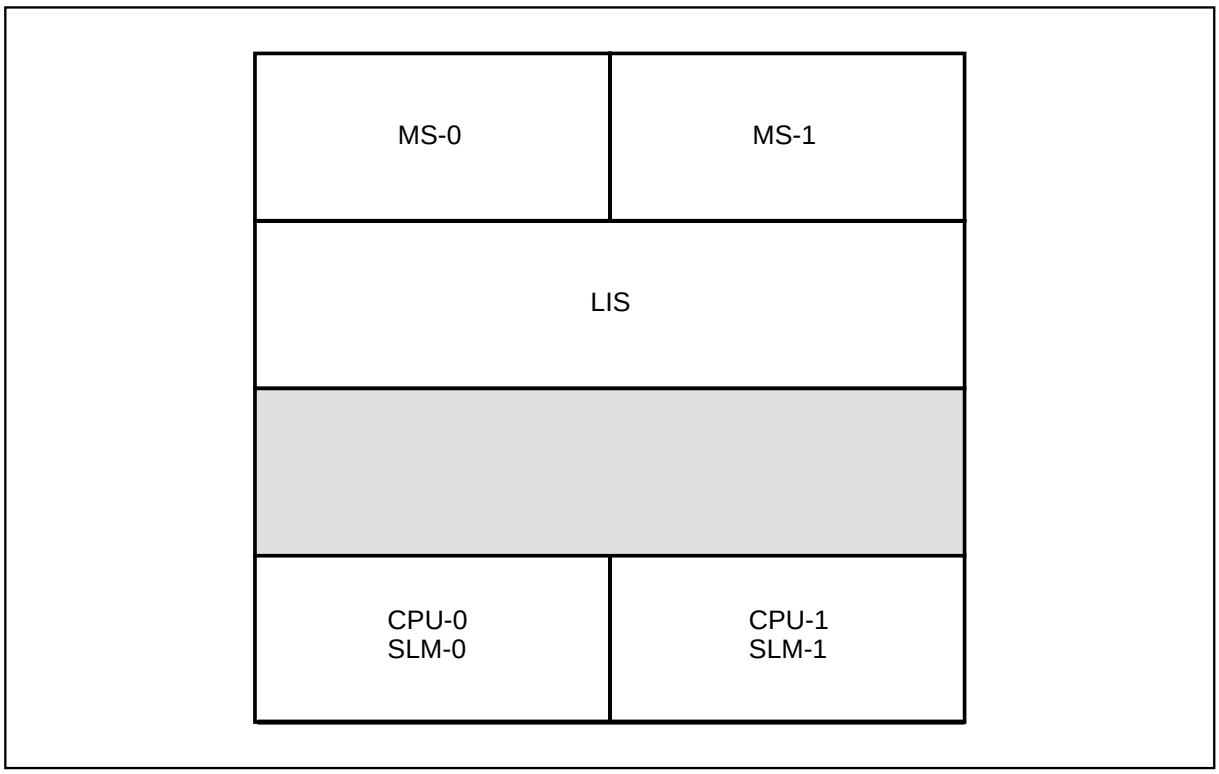
SNSE utilizes existing Series I/II peripheral modules for providing interfaces to lines and trunks, and is compatible with Series III peripheral modules. Series I peripheral modules are used for alarms, announcements, and test. The existing DMS IOC is used to provided connections to VDUs, modems, printers, and magnetic tape units (MTU) as required.

SNSE with external junctored network (JNET)

SNSE provides the capability to implement a cost reduced DMS SuperNode based switch. This is accomplished by providing a combined CM/SLM shelf, a single shelf message switch, and the capability to support a standard link interface shelf (LIS) (Figure 2-27).

An additional frame(s) (depending on line size, more than one frame may be needed) of existing junctor network/dual shelf network (JNET/DSN) can be supported as the network fabric if the internal SNSE 16K ENET is not provided.

Figure 2-27xxx
SNSE with JNET



SNSE with internal junctored network (JNET)

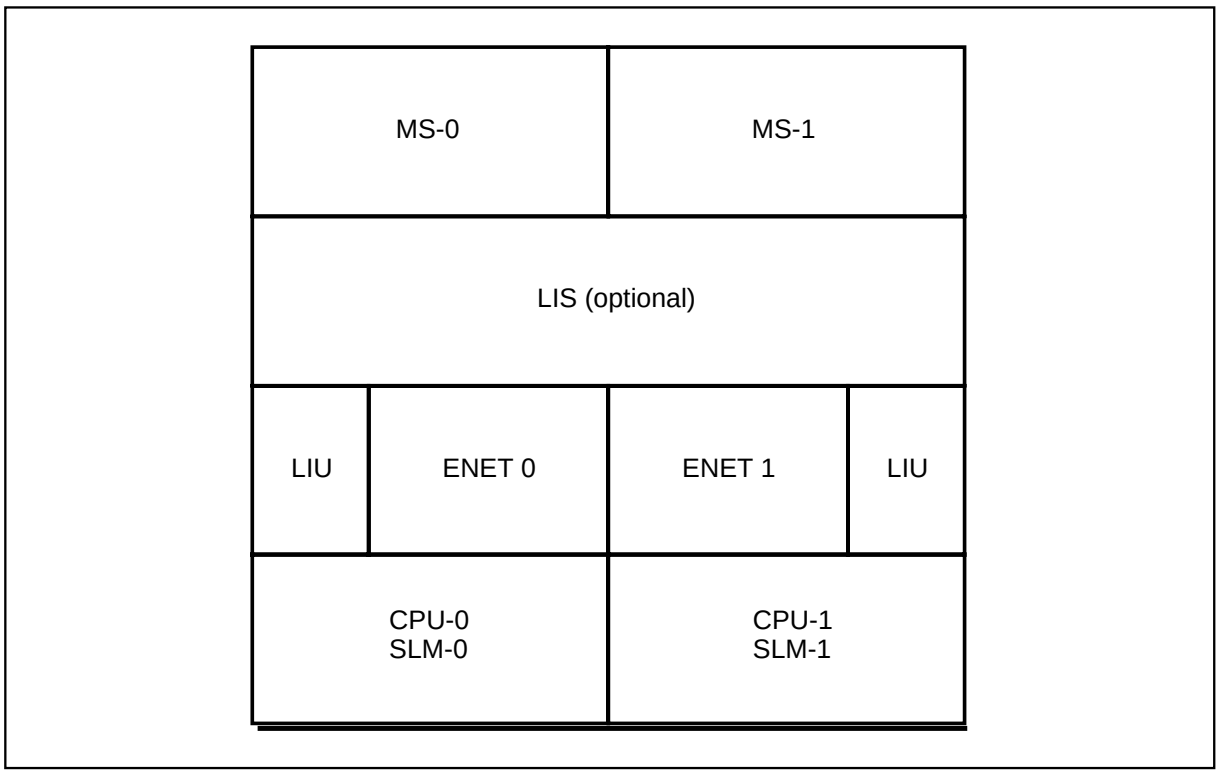
When equipped with the 16K ENET, SNSE merges the DMS SuperNode functions of the computing module (CM), system load module (SLM), link peripheral processor (LPP), enhanced network (ENET), and DMS-Bus functionality into a 3-shelf control complex (CC).

The single cabinet/three shelf configuration provides the following capability:

- duplicated computing modules with two SLMs
- two DMS-Bus units
- dual plane enhanced networks
- two LIU interfaces (such as CCS7)

An additional 12 LIUs can be provided by adding a link interface shelf (LIS) shelf to the 3 shelf SNSE configuration (Figure 2-28).

Figure 2-28xxx
SNSE with ENET



SNSE ENET has the capability of using optic fiber, copper, or a combination of the two interfaces to the peripheral modules.

By being fully compatible with DMS SuperNode, SNSE can provide the same feature sets, with reduced capacity, which are provided by DMS SuperNode. Also, when a new function is developed for DMS SuperNode, it is applicable to SNSE.

SNSE has also been designed so that future services or functions developed for synchronous optical network (SONET)/digital multiplex system (S/DMS) are applicable. This is accomplished by using standard interfaces defined for S/DMS.

Peripheral modules

SNSE connects to existing DMS-100 Family line and trunk peripherals either by optic fiber or copper interfaces.

Alarms, service circuits, announcements, and test access are provided to SNSE by utilizing the existing maintenance trunk module/trunk modules (MTM/TM) presently used in DMS SuperNode.

Input/output devices

Input/output devices such as MAP, X.25 links for AMATPS, and MTUs (if required) are provided by using existing IOC equipment.

System architecture

The SNSE has a DMS SuperNode based switching architecture configured for small switching applications. This is accomplished by using DMS SuperNode type CMs running in sync mode, providing dual SLMs, utilizing the MS in a load-sharing mode, utilizing a dual plane network, and providing system level interfaces. A functional block diagram is shown in Figure 2-29 and a system architecture block diagram is shown in Figure 2-30.

Figure 2-29xxx
SNSE functional block diagram

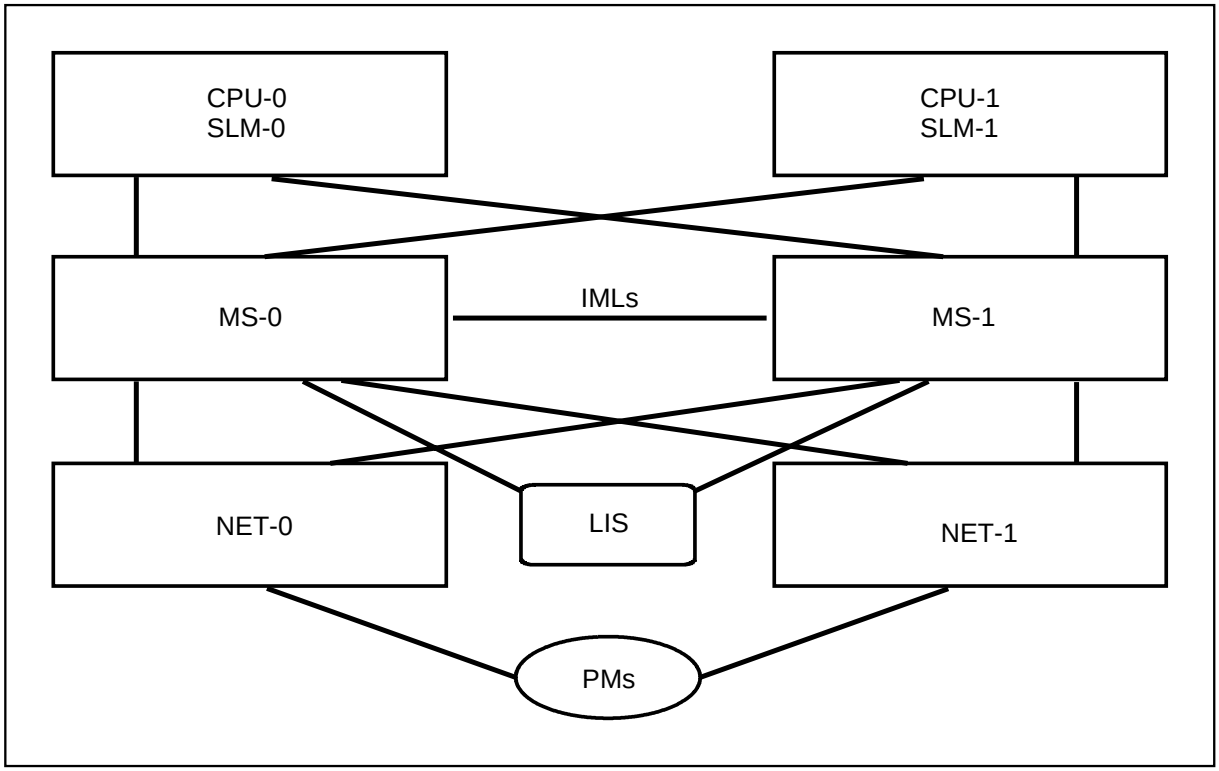
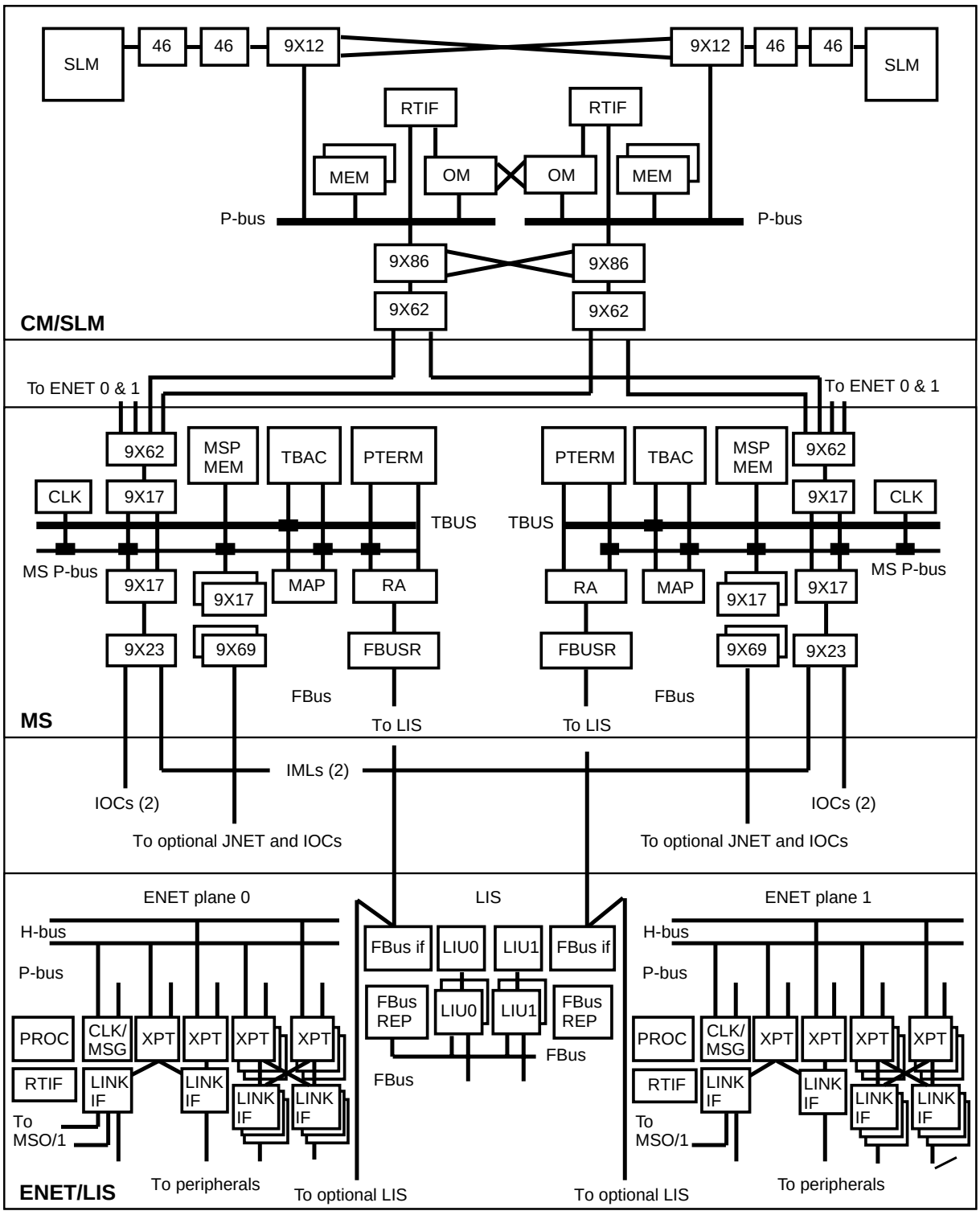


Figure 2-30xxx
SNSE system architecture (CM/SLM)



SNSE compute module/system load module (CM/SLM)

The CM/SLM functions are provided by combining a DMS SuperNode type CM and SLM on a single shelf.

The computing module in SNSE is based on the DMS SuperNode CM. Normally, the duplicated CPUs are running in synchronization match mode of operation. The controlling CPU is referred to as “active”, and the mate is “inactive”. SNSE makes minimal hardware and software changes in this area.

The CMs are connected to the message switches (MS) by optic fiber computing module inter-communication links (CMIC). Each CM connects to both MS directly through the CMIC.

SNSE utilizes the same memory boards that are used in the DMS SuperNode switch. These boards provide 24MByte of memory on each board. SNSE can provision up to five memory packs on each side. For the specified 24MByte memory CP, this amounts to a total of 120 megabytes, including an 8 megabyte spare memory module.

The SLMs provide the mass storage media for the SNSE in hard disk and streaming tape. The SLM used is the 5 slot SLM1A. This SLM1A is supplied with a 340 Mbyte 3-1/2 inch hard disk drive and a 150 Mbyte tape.

SNSE message switch (MS)

The message switch (MS) function extensively utilizes existing hardware in terms of circuit packs and paddle boards, but combines essentially two DMS SuperNode MS’s on one shelf. Since two MS’s are combined on one shelf, the port capacity is reduced from a standard DMS SuperNode MS in that SNSE provides seven port cards on each side. One port card slot is reserved for CMIC/ENET interfaces and one is reserved for IOC/IML interfaces, leaving five provisionable port card slots in each SNSE message switch.

Backplane functionality for the shelf is new, in that the capability of having the link interface shelf (LIS) interface directly to the MS is provided.

SNSE link interface unit (LIU)

The link interface unit (LIU) function is provided on the 16K ENET shelf and a minimum of two LIUs can be provisioned. The LIU’s are the two-slot version. If more LIUs are required, the optional link interface shelf (LIS) can be added to the cabinet, providing up to 12 additional LIUs. LIUs can be provided on SNSE both as CPs of the ENET shelf and as CPs on an LIS shelf for a total of 14 LIUs. SNSE supports the same LIU capability as the DMS SuperNode link peripheral processor (LPP), and does not preclude deployment of new LIU functionality that may be developed in the future. SNSE supports the provisioning of LPPs up to the full physical capacity of the MS.

This LIS shelf and the LIU CPs are DMS SuperNode CPs, and were not developed expressly for SNSE.

The SNSE MS supports external optic fiber LIS in addition to the internal copper connected LIS. When an external optic fiber LIS is provided, the number of CCS7 LIUs cannot exceed twenty-four.

SNSE lines/trunks

Line and trunk interfaces for SNSE are provided using the existing Series I and Series II peripherals. Interfaces will be via either DS30 or DS512 depending on the peripheral module used. Refer to *DMS-100 Family Peripheral Modules,* 297-1001-103 for further details.

Maintenance trunk module (MTM) related functions

The SNSE utilizes existing peripheral modules to provide functions related to service circuits (conference circuits and recorded announcements), test circuits, and alarms. These peripheral modules are connected to the JNET or ENET via DS30 interfaces.

Input/output (I/O) related functions

The SNSE uses the IOC presently used in NT-40 and DMS SuperNode switches, and the dual IOC used in the MSL series products, for I/O related functions. The IOC connects a variety of input/output devices with the CM by message links connected via the MS interface (DS30). These devices include video display units (VDU), printers, magnetic-tape units (MTU). disk drive units (DDU), and data links such as X.25.

The IOC, together with the I/O device controller that connects with that particular device, performs the necessary conversion to DS30 format for communication with the CM. Two DS30 links connect to the IOC.

Remote/stand-alone configuration

When serving as a host office for a group of remote offices, the SNSE provides the capability of supporting the following:

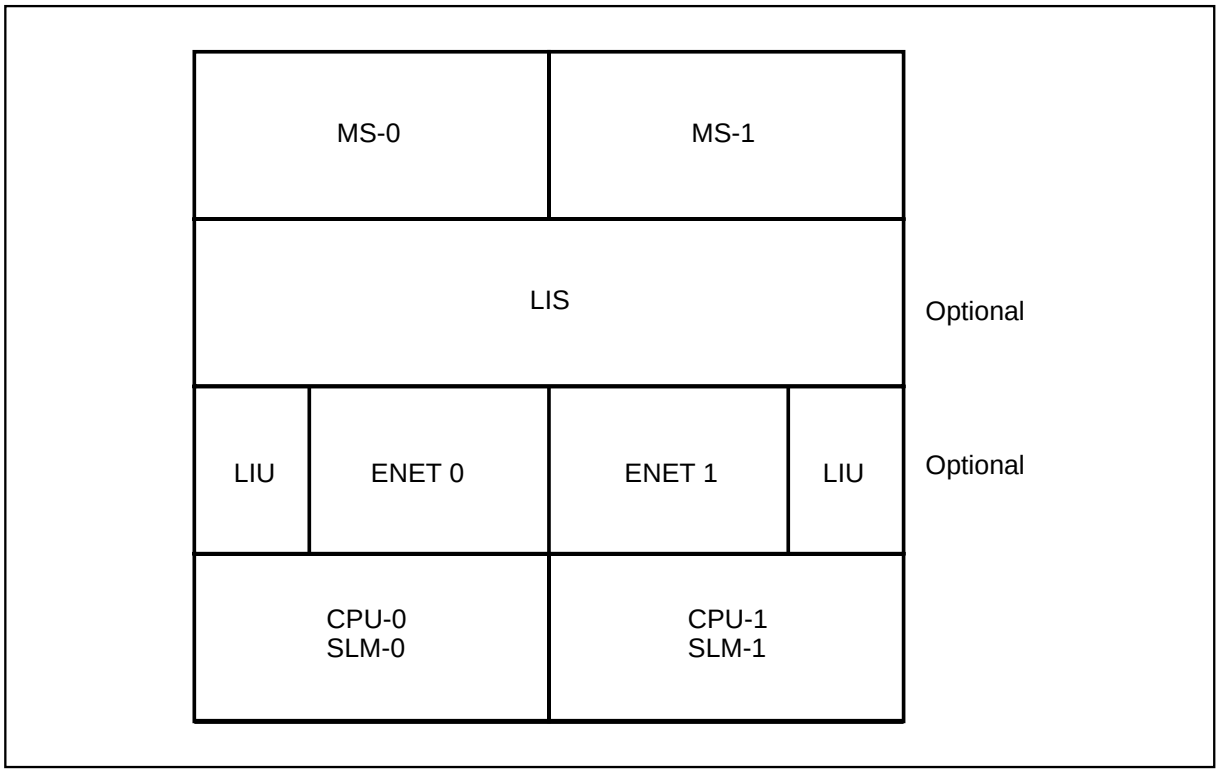
- SONET/remote switching center (S/RSC)
- Remote switching center (RSC)
- Remote line carrier module (RLCM)
- Outside plant module (OPM)
- DMS-1U
- DMS-1R
- Remote concentrator (SLC-96)
- Inter-message switch link (IDLC)
- Remote switching center (RSCI)

Packaging description

Cabinet layout

The SNSE is configured as shown in Figure 2-31. It packages the SNSE core system in the S/DMS cabinet while utilizing NT9X03AA shelf hardware. The ENET shelf and LIS shelves are optional.

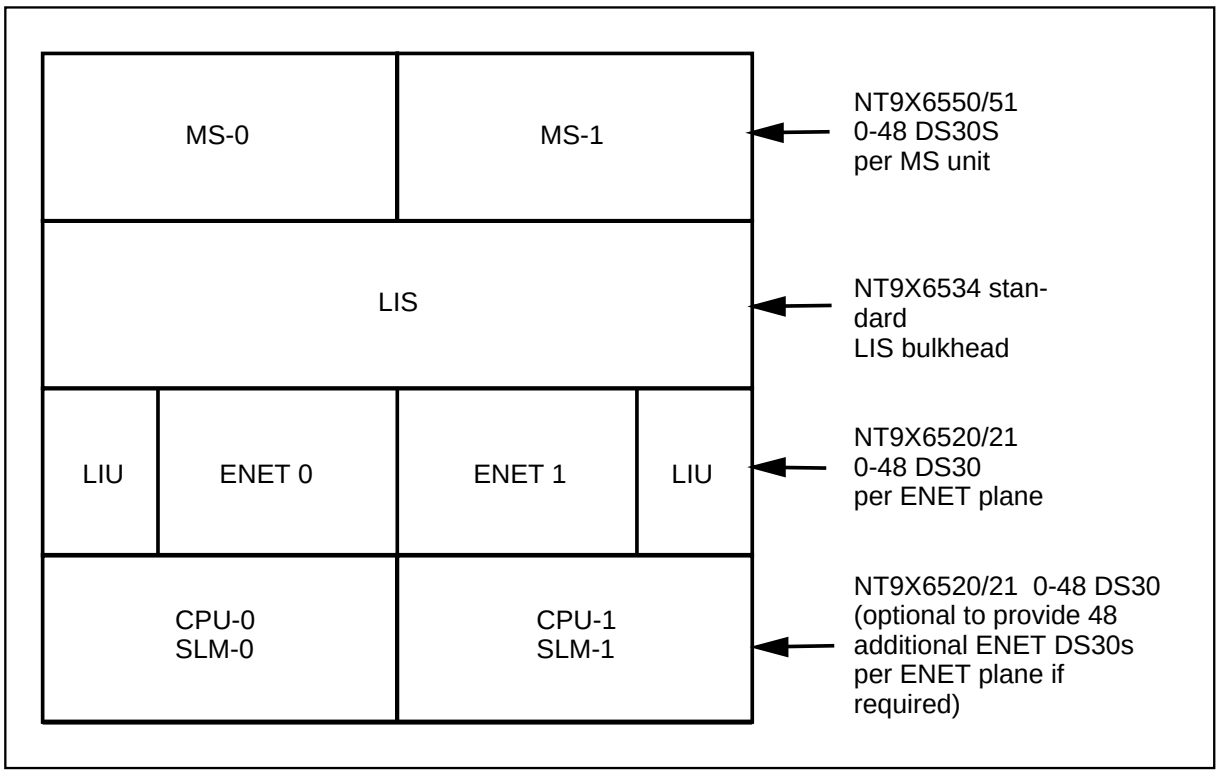
Figure 2-31xxx
SNSE cabinet



Cabling

The SNSE connections to external modules is by both optic fiber (DS512 or SR512) and copper (DS31) links. Interconnection to LIUs is via standard DMS SuperNode interfaces. As in DMS SuperNode, all SNSE optic fibers and cables exit the cabinet via shelf level bulkheads. The SNSE bulkhead types and cable capacities are show in Figure 2-32.

Figure 2-32xxx
SNSE cables and bulkhead types



The NT9X6520/21 bulkheads on the CM/SLM shelf are optional and are only provided if the 16K ENET DS30 requirements exceed 48 individual DS30 links for each plane.

No SLC function is necessary when using the 16K ENET as the bulkheads provided allow connection of up to 48 (96 with CM/SLM optional bulkhead) individual DS30 links for each ENET plane.

SNSE uses standard DMS SuperNode components in the following areas:

- circuit packs
- paddleboards
- logic backpanel
- power backpanel

Hardware description

SNSE hardware layout is shown in Figure 2-31, with the ENET and LIS shelves optional. The SNSE core supports up to 8 JNET network modules (16K channels), plus up to 6 IOCs when configured for the LEC/IEC market. When configured for the MSL market, SNSE supports up to 10 JNET network modules and IOCs.

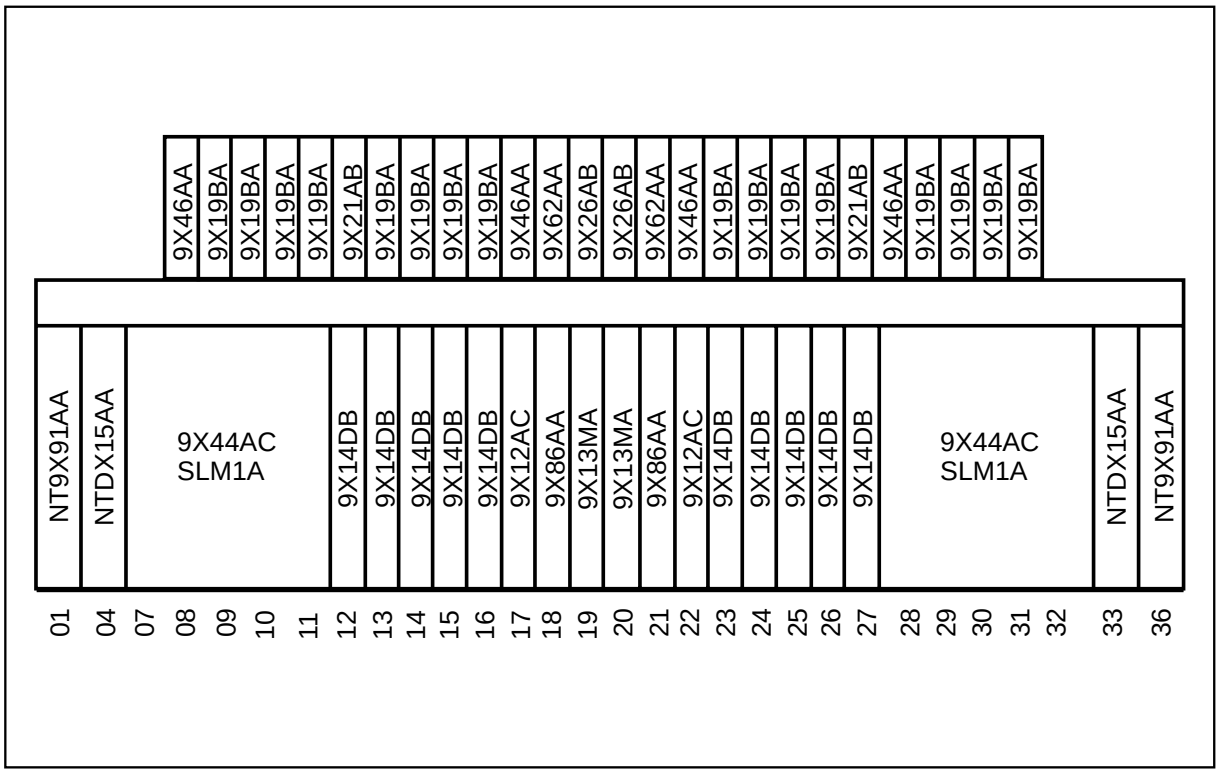
SNSE core

The core portion of SNSE consists of two shelves. One shelf contains the combined CPU and SLM1A functions, and the other contains the message switch functions.

Compute module/system load module 1A (CM/SLM1A) shelf assembly

A typical CM/SLM1A shelf configuration is shown in Figure 2-33.

Figure 2-33xxx
NT9X0610 CM/SLM1A shelf configuration



This is a new shelf and provides five memory circuit packs and one SLM1A on each side. Card positions 12-16 and 23-27 are reserved for memory circuit packs. Existing DMS SuperNode packs for the CM/SLM1A shelf are listed in Table 2-2, while new SNSE hardware is listed in Table 2-3.

Table 2-2xxx
DMS SuperNode packs for CM/SLM1A shelf

PEC	Description
NT9X14DB	24 megabyte memory circuit pack
NT9X26AB	Remote terminal interface (RTIF) paddle board
NT9X12AC	Message interface
NT9X19AA	Parallel interface paddle board
NT9X19AA	CP filler pack
NT9X19BA	PB filler pack

Table 2-3xxx
SNSE hardware for CM/SLM1A shelf

PEC	Description
NT9X13MA	Processor: This sync-matched processor is based on the DMS SuperNode NT9X13BC series processors and contains firmware specific to the operation of the SNSE core.
NT9X86AA	Dual port message controller: Allows termination of two separate message links, via the NT9X62AA paddle board, for communication between the CM and the MS.
NT9X62AA	Dual link subrate 512 paddle board: Interface between the two optic fiber links carrying messages between the CM and MS.
NT9X21AB	P-bus terminator paddle board: Terminates the CPU P-bus and allows access to the power converter ID PROMs.
NT9X44AC	SLM1A: Provides a 340M 3-1/2 inch disk drive and 150M tape unit.
NT9X0610	CM/SLM1A shelf assembly: Combines the CM and SLM functions on one shelf.
NT9X91AA	Power supply, +5V/+12V
NTDX15AA	Power supply, +5V/-5V

Message switch (MS) shelf

The message switch (MS) shelf utilizes DMS SuperNode mechanicals as shown in Figure 2-34. The shelf can be mounted in either the standard DMS SuperNode cabinet or in the SONET/digital multiplex system (S/DMS) cabinet. The MS shelf is always provided. Existing DMS SuperNode packs for the MS shelf are listed in Table 2-NO TAG, while new SNSE hardware is listed in Table 2-5.

Figure 2-34xxx
NT9X0470 combined MS shelf configuration

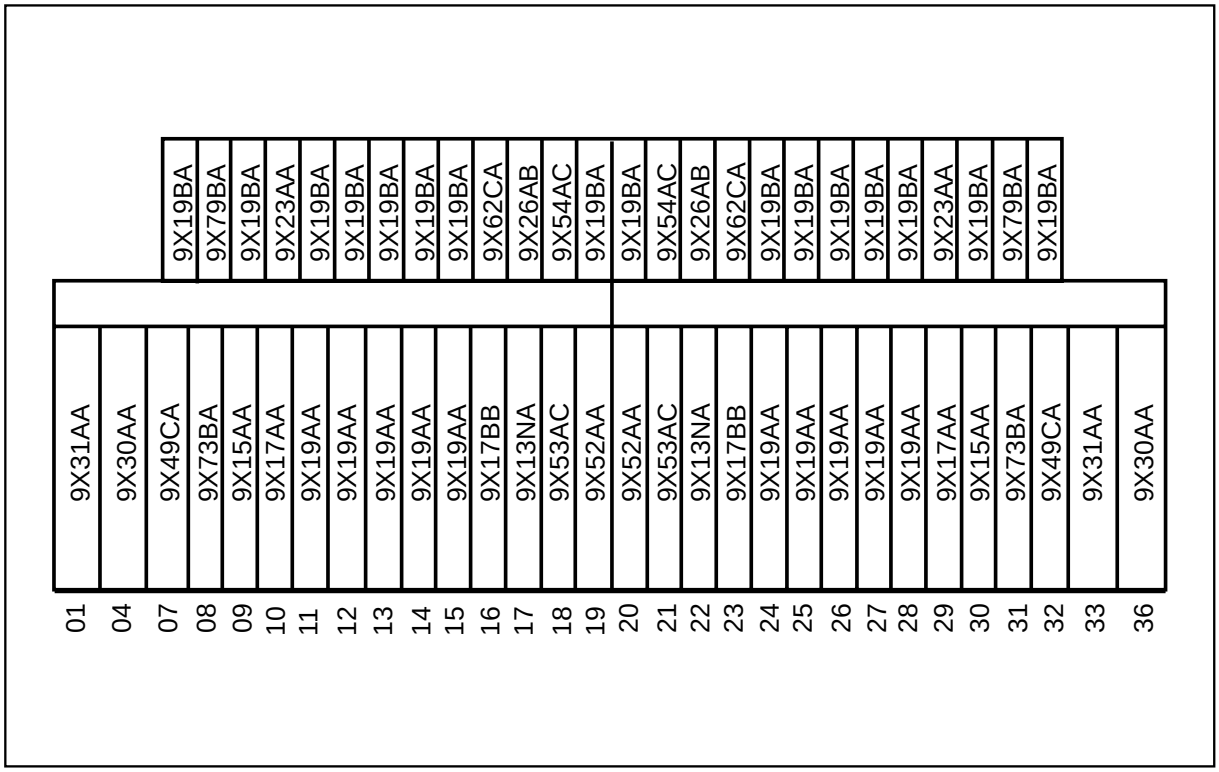


Table 2-4xxx
DMS SuperNode packs for MS shelf

PEC	Description
NT9X52AA	T-Bus access circuit pack
NT9X53AC	System clock circuit pack
NT9X73BA	Rate adapter circuit pack
NT9X15AA	Mapper circuit pack
NT9X49CA	T-Bus terminator circuit pack

-continued-

Table 2-4xxx
DMS SuperNode packs for MS shelf

PEC	Description
NT9X54AC	Clock interface paddle board
NT9X26AB	Remote terminal interface paddle board
NT9X79BA	F-Bus interface paddle board
NT9X23AA	DS30 4 link paddle board
NT9X17AA	4 port circuit pack
NT9X19AA	CP filler pack
NT9X19BA	PB filler pack

End

Table 2-5xxx
SNSE hardware for MS shelf

PEC	Description
NT9X0470	Message switch shelf assembly: Combines two message switch units on one shelf
NT9X13NA	Message switch processor: Equipped with 16M memory. This pack contains firmware specific to SNSE MS operation.
NT9X17BB	32 port circuit pack: Provides. termination for the 16 DS30 links on the NT9X69BA paddle board.
NT9X62CA	4 link SR512 paddle board: Provides dual out-of-band reset capability.
NT9X69BA	16 link DS30 paddle board.

Link interface shelf (LIS)

The link interface shelf (LIS) configuration is shown in Figure 2-35. The LIS shelf provides support for up to 12, two-slot link interface units (LIUs). Existing DMS SuperNode packs for the LIS shelf are listed in Table 2-6.

Figure 2-35xxx
NT9X7204 link interface shelf configuration

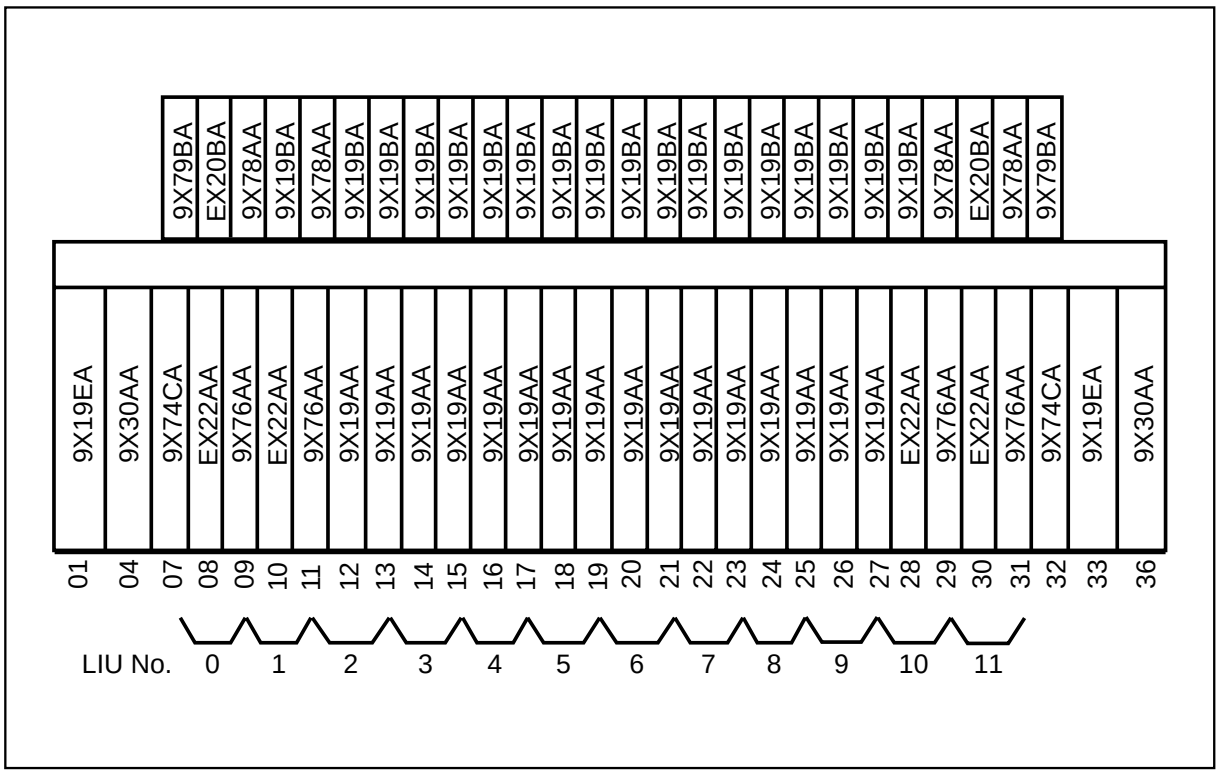


Table 2-6xxx
Existing DMS SuperNode packs for SNSE LIS shelf

PEC	Description
NT9X7204	Link interface shelf assembly and back panel
NT9X30AA	+ 5 V power converter
NT9X19EA	Power converter filler pack
NT9X79AA/BA	F-Bus interface paddle board
NT9X74CA	F-Bus repeater circuit pack
NT9X78BA	LIU link interface paddle board
NT9X76AA	LIU interface circuit pack
NTEX22AA	LIU processor circuit pack
NTEX20AA	F-Bus A-terminator paddle board
NTEX20BA	F-Bus B-terminator paddle board

-continued-

Table 2-6xxx
Existing DMS SuperNode packs for SNSE LIS shelf (continued)

PEC	Description
NT9X19AA	CP filler pack
NT9X19BA	PB filler pack

End

Peripheral section

SNSE interfaces with all Series I and II peripherals. As the SNSE is optimized for DS512 optic fiber interfaces, it is desirable to keep Series I applications at a minimum.

SNSE will also interface with the following Series III peripherals:

- Channel frame processor (CFP)
- High speed interface (HSI)
- Applications processor (AP)

Junctor network (JNET) section

SNSE interfaces to all JNET types; 0X--, 5X--, 7X--, and 8X--. SNSE also supports mixed JNET applications such as combined 5X-- and 8X-- networks

Due to the limited number of 0X-- networks remaining in operation and SNSE's targeted size range, it is anticipated that 0X-- applications will be minimal.

Note that SNSE does not support ENET and JNET simultaneously, except during JNET to ENET upgrade procedures.

Interfaces

The following paragraphs identify the high level interfaces that exist between the SNSE core and the rest of the DMS-100 system as well as the major interfaces within the SNSE core.

External interfaces

The following interfaces exist between the SNSE core and the remainder of the DMS-100 switch.

- DS30 links to the IOC, Series I, and Series II peripherals
- DS512 links to the optic fiber XPMs, future application processors, and Series III peripherals.

DS30 interface

The DS30 interface is a serial data link consisting of 32 channels within a 125 microsecond frame. Each of the 32 channels carries 10 bits of data. Eight of the bits form the primary data channel which is 64 Kbits/second and is used to encode the PCM or signaling information. There is one bit of parity and one bit of supervision data. The supervision bit is accumulated over 40 frames of DS30 to form the channel supervision message (CSM).

The CSM data stream is used to pass supervision information between peripherals. There are several applications for DS30 interfaces and they vary in the way that information is encoded on the primary data channel.

DS30 interface to XPM and MTM

The XPMs and MTM pass voice, signaling, and maintenance data on the DS30 link. The generalized case is that thirty channels are utilized for pulse code modulated (PCM) circuit switched voice or data, one channel is used for signaling between the XPM or MTM and the message switch, and one channel is used for maintenance and inter-peripheral message links (IPML).

DS30 interface to input/output controller

The input/output controller (IOC) uses the DS30 interface to provide a single high speed message interface. There is no circuit switched PCM data to the IOC, so the DS30 that connects it is not used in a channelized data stream; but rather as a single 2.048 Mbit/second data link dedicated to signaling.

DS512 interface

The DS512 interface is the standard format for optical links used to interconnect SNSE subsystems. A DS512 link is equivalent to 16 DS30 links, multiplexed onto a single optic fiber. DS512 links can be used to carry channelized PCM and signaling information so as to present 512 channels of 64 Kbit/second each, or can be used to carry a single high bandwidth signaling channel of 32 Mbit/second.

DS512 links are used to interface the CM to the MS and the MS to the ENET in the full size DMS SuperNode system. For SNSE, SR128 (subrate DS512, 128 channel bandwidth) is used.

DS512 links are also used to interface optic fiber XPM peripherals to the network. These DS512 links are essentially DS30 links that are multiplexed together. DS512 links for this application are used to carry 64 Kbit/second PCM data, and a message channel to the XPM that also rides on a 64 Kbit/second channel.

Sub-rate DS512 interface

Sub-rate DS512 interfaces are utilized in numerous applications in S/DMS. In SNSE, this type of optic fiber interface is utilized for the following functions:

- to realize the compute module inter-communications link (CMIC) function
- to provide the link from MS to ENET shelves
- as links from the MS to resource processors.

Sub-rate links can operate at the following rates, depending on application:

- SR128 (128 channels)
- SR256 (256 channels)
- full DS512 (512 channels)

Messaging protocols (DS30 and DS512 links)

Several protocols are used to carry signaling data on DS30 and DS512 data links.

The DS30 protocol is used on DS30 loops. This is a half-duplex message passing protocol that relies on checksum for message integrity.

DMSY protocol is the standard for use on DS512 links, and sub-rate DS512 links which interface to the message switch. DMSY is a full duplex protocol.

Internal interfaces

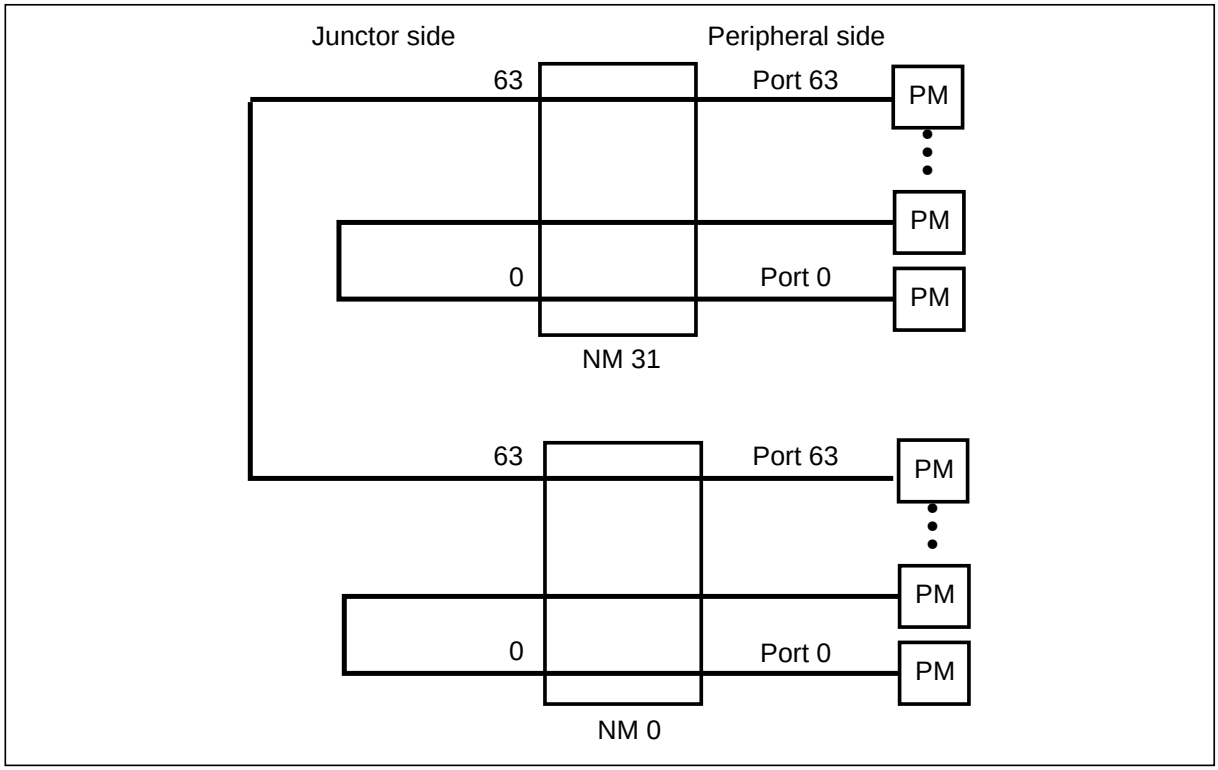
Internal interfaces in SNSE are as follows:

- SR128 optic fiber links are the main interfaces internal to the core.
- SR128 optic fiber links from ENET to MS.
- DS30 copper links connect the IOCs to MS
- DS30 copper links provide inter-MS links (IMLs): MS0 to MS1
- Copper F-Bus connects LIS to MS.

DMS SuperNode switching network

The switching network is connected to either messaging component by way of DS30 links as shown in Figure 2-36.

Figure 2-36xxx
Switching network configuration



The switching network switches pulse code modulation (PCM) signals using time-division multiplexing; and performs the following tasks:

- establishes a DS30 channel between incoming and outgoing ports under command of the central control processor
- provides signal processing (digital attenuation and gain) for PCM signals
- inserts outgoing control messages from the central control processor into the DS30 message channels to the peripheral modules
- extracts incoming messages from the peripheral module message links and forwards them to the control component

The switching network consists of up to 32 network modules (NM). Each NM has up to 64 DS30 incoming and 64 DS30 outgoing ports. The incoming side is the peripheral side, because this side connects to the PM links (speech links). The outgoing side is the junctor side, since this side is used to interconnect the NMs by way of speech links called junctors. Any

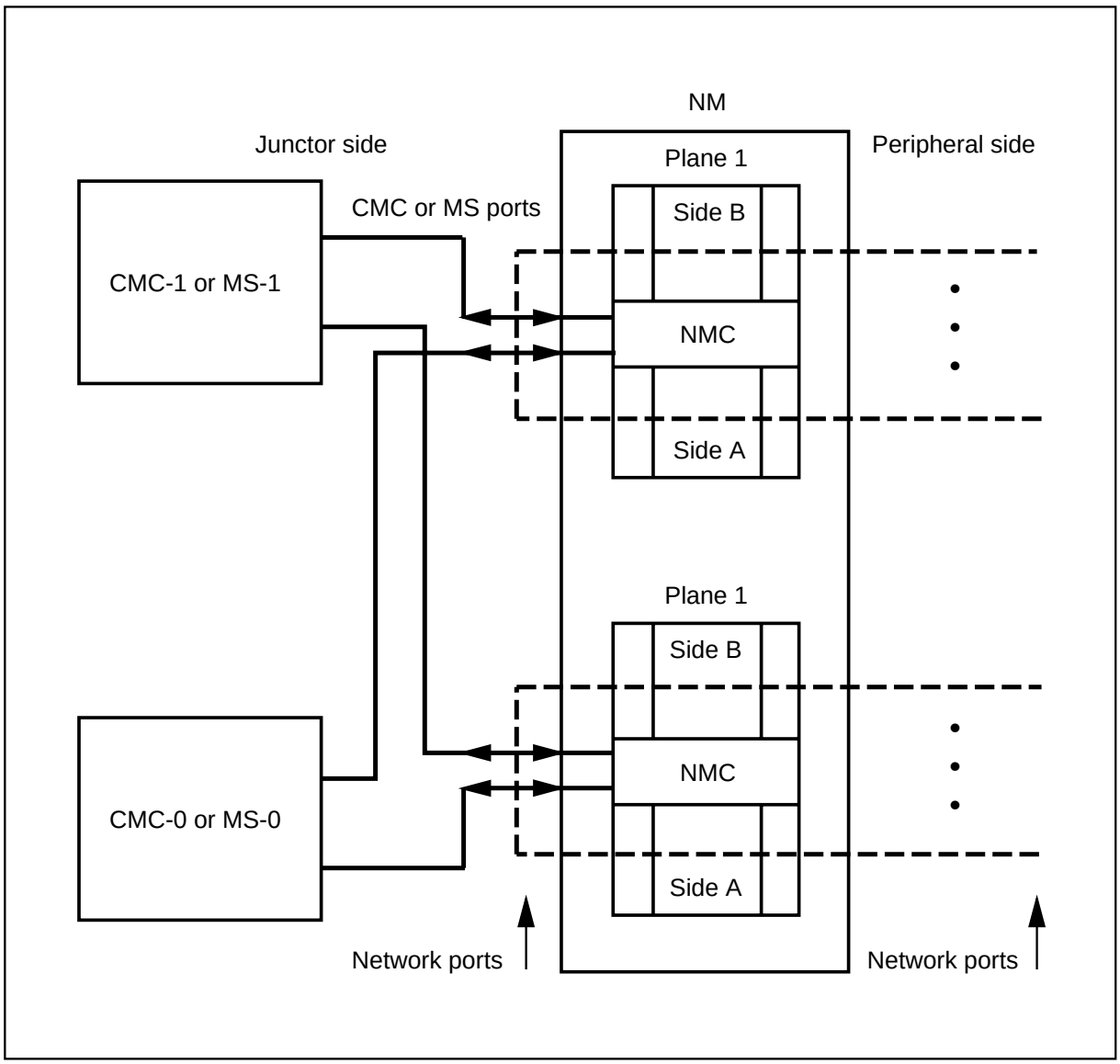
NM peripheral side port or channel may therefore be connected to any other NM peripheral side port or channel, thus establishing a DS30 connection.

A NM consists of a time-division multiplexed switching matrix controlled by a network module controller (NMC). The NMC connects with the messaging component by way of DS30 links. The NM determines which messages coming from the control component are switching network control messages; and which are messages destined for the connected peripheral modules. It takes action on switching network control messages and forwards the peripheral module control messages to the peripheral module. Messages from the peripheral module to the central control processor are forwarded by way of the messaging component.

Network module controller (NMC)

Network module controllers are duplicated and the mates are called “Plane 0” and “Plane 1.” The NMCs operate in duplex mode. Each CMC and each message switch has two ports assigned to each NM; one for messages assigned to Plane 0 and one for messages assigned to Plane 1. Switching network control messages are sent duplex from the control component to an NM. Thus, both planes receive a connection message and both establish a connection. Therefore, PMs connected through the switching network have a duplicated path to communicate with the central control processor (Figure 2-37).

Figure 2-37
Duplicated network module controllers



Messages sent to NMs are sent simplex; each message traverses the messaging component-to-NM links and the NM-to-PM message link as specified in the routing information carried in the message.

If a message link fails, the following actions occur:

- the link is taken out of service for maintenance
- all messages are routed through the remaining good link

Since a NM path is uni-directional, two paths are required to establish a bi-directional channel. Thus, there are two “sides” to a plane, designated

Side A and Side B. Side A switches PCM signals from the peripheral side to the junctor side; while Side B switches PCM signals from the junctor side to the peripheral side.

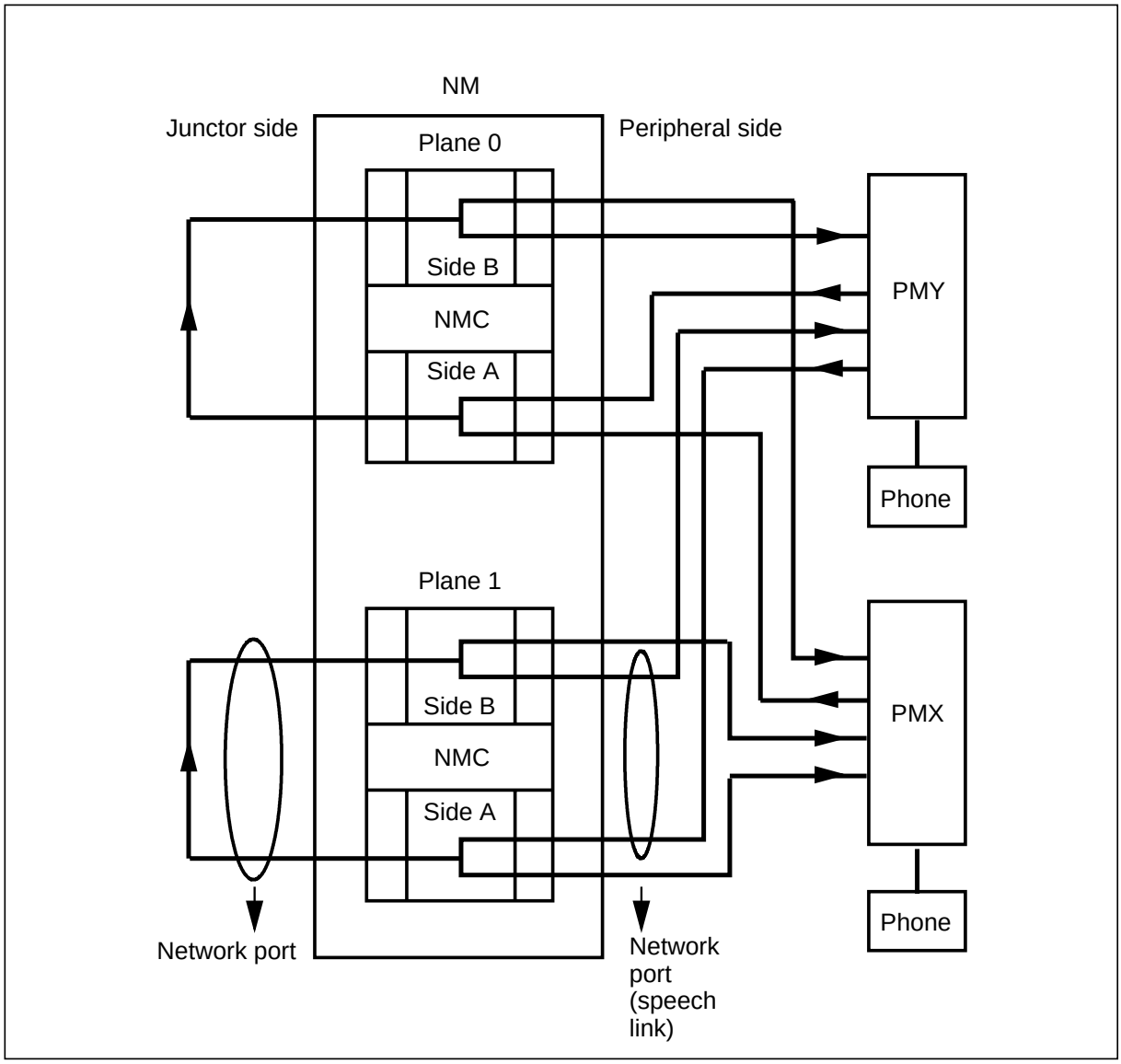
The junctors are DS30 links providing interconnection and intra-connection. Junctors carry 31 channels of speech, with channel 0 used for switching network DS30 synchronization.

The designated grade-of-service (probability of blocking) of the switching network is achieved with traffic offered by 30 channels of DS30 at the speech links. Thus, two channels of a speech link (channels 0 and 16) are available for other purposes. Channel 0 is made available for messaging and channel 16 for maintenance features. Channel 16 is also used by interperipheral message links (IPML).

Intra-network connection

Two PMs on the same NM are intra-connected by a single junctor. The PMs have one (duplicated) link connected to both planes of the NM. In this case, the link carries both speech and messaging as shown in Figure 2-38. The two PMs are connected by way of the switching network. Note that the illustrated connection represents both space and time since a link/channel on one PM is connected to a different link/channel on the other. In this case, only one physical junctor is necessary since it can carry up to 31 channels. PCM signals from each PM are carried on the single junctor, but in different time slots (channels).

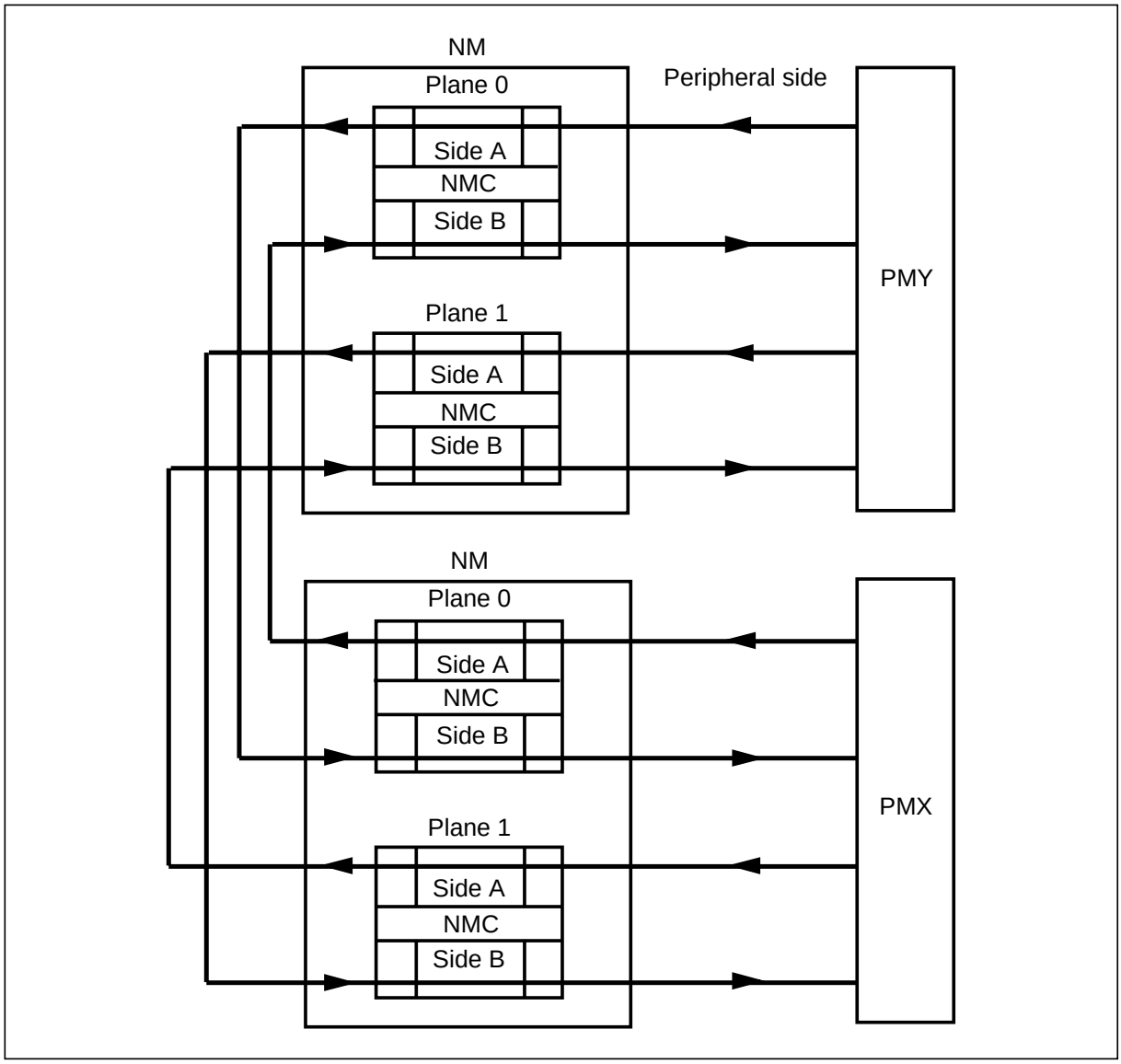
Figure 2-38
Intra-network connection



Inter-network connection

In inter-network connections, the peripheral module terminals to be connected are located on different network modules as shown in Figure 2-39.

Figure 2-39
Inter-network connection



Peripheral modules

The following paragraphs provide a basic description of each peripheral module in the DMS-100 Family digital switch. For further information on these components refer to Chapter 7, “Line peripheral capacity,” Chapter 8, “Trunk peripheral capacity,” and Chapter 10, “Integrated services digital network.”

The following peripheral modules (PM) are in the DMS-100 Family:

- Trunk module (TM)

- Digital carrier module (DCM)
- Digital trunk controller (DTC)
- ISDN digital trunk controller (DTCI)
- Message switch and buffer (MSB)
- Maintenance trunk module (MTM)
- Remote line module (RLM)
- Line concentrating module (LCM)
- ISDN line concentrating module (LCMI, LCME)
- Remote line concentrating module (RLCM)
- Line group controller (LGC)
- ISDN line group controller (LGCI)
- Line trunk controller (LTC)
- ISDN line trunk controller (LTCI)
- Outside plant module (OPM)
- Remote switching center (RSC)
- ISDN remote switching center (RSCI)
- Subscriber carrier module SCM-100R (DMS-1 Rural)
- Subscriber carrier module SCM-100U (DMS-1 Urban)
- Subscriber carrier module SCM-100S (DMS-1 SLC-96)

Trunk module (TM)

The trunk module (TM) provides an interface between external analog trunk facilities and the internal switching network. It converts incoming analog signals to digital signals and multiplexes them into a 2.56 Mb/s bit stream for transmission to the DMS-100 Family switching network. De-multiplexing and the digital-to-analog conversion are also provided for outgoing signals.

The TM interfaces a maximum of 30 analog trunk circuits to one 32 channel (30 VF, plus 1 signaling and 1 unused) speech link to each of the duplicate networks. The duplicate networks are referred to as Plane-0 and Plane-1. Many types of analog trunk circuit packs are available to interface to analog trunks. No blocking exists in the TM.

Digital carrier module (DCM)

The digital carrier module (DCM) provides an interface between the DMS-100 Family switching network and digital trunk facilities. The DCM presents a standard interface between the primary digital carrier stream, referred to as DS-1, which consists of 24 VF channels time-multiplexed onto a 1.544 Mb/s bit stream according to the DS-1 line signaling format. The DCM interfaces a maximum of five DS-1 links (5 X 24 = 120 VF channels)

equipped with four 32-channel (30 VF plus one signaling plus one unused) speech links to each of the duplicate networks. No blocking exists in the DCM.

Digital trunk controller (DTC)

The digital trunk controller (DTC) interfaces between digital trunks carried over DS-1 links and the DS-30 links used internally between the peripheral modules and each plane of the duplicate network. The DTC interfaces a maximum of 20 DS-1 links with 16 DS-30 links to each of the duplicate networks. No concentration exists in the DTC.

ISDN digital trunk controller (DTCI)

The ISDN digital trunk controller (DTCI) adds support for primary rate interface (PRI) trunks to enhance the functionality of the DTC. An ISDN signaling processor (ISP) card is used to terminate the D channel associated with the PRI trunks.

Message switch and buffer (MSB)

The message switch and buffer (MSB) provides the common channel interoffice signaling (CCIS) interface between the CCIS links and the DMS-100 Family switching network. Two versions of the MSB are available; the MSB6 for CCIS applications, and the MSB7 for signaling system #7 (SS7) applications.

Maintenance trunk module (MTM)

The maintenance trunk module (MTM) provides facilities for housing and controlling receivers, test circuits, transmission test lines, communication links, and jack-ended trunks.

Remote line module (RLM)

The remote line module (RLM) provides the capability to remote the interface between analog line facilities and the internal switching system. It converts analog signals to digital and digital signals to analog, and multiplexes the digital signals on DS-1 facilities to DCMs at the DMS-100 host office. The RLM provides concentration of 640 analog subscriber lines (20 terminal groups of 32 lines in each group) to up to four DS-1 links. Although 640 lines is used as the nominal capacity of a remote line module, the first RLM at a particular site has a capacity of 608 lines. Subscribers connected to an RLM have the same features available to them as subscribers in the host office.

Line concentrating module (LCM)

The line concentrating module (LCM) provides an interface between analog line facilities and the internal switching system. It converts analog to digital and digital to analog signals and multiplexes the digital signal into a 2.56 MBytes/sec rate for transmission to the LGC via DS-30A links. The LCM provides concentration of 640 analog subscriber lines to between 60 and 180

speech channels (2 to 6 DS-30A links) to the LGC. Six hundred thirty-nine (639) lines are available for subscriber use, and one line is used for testing.

ISDN line concentrating module (LCMI)

The ISDN line concentrating module (LCMI) replaces the Integrated services line module (ISLM) in providing housing to the ISDN 2B+D basic rate interface (BRI) line cards. Where the ISLM was a simplex unit capable of supporting 19 ISDN lines, The LCMI can support a variety of intelligent line types in a duplicated common control arrangement.

ISDN enhanced line concentrating module (LCME)

The enhanced line concentrating module (LCME) replaces the LCMI in housing the ISDN 2B+D BRI line cards. The primary reasons for replacement are:

- To comply with ANSI line coding standard 2B1Q (two binary to one quaternary) for the U loop interface.
- To increase the module's ISDN lines capacity and provide simpler mixing and provisioning rules.
- To satisfy the need for a single slot ISDN line card and a more flexible time division multiplexing (TDM) connection control for the D channels.

The LCME houses eight physical line drawers with two logical drawers per physical drawer, yielding a maximum of sixteen logical drawers per module. Each physical drawer however, has a capacity of sixty single slot line cards which gives the LCME the ability to house 480 line cards.

The following line types are not supported:

- POTS B Line Cards (NT6x18AA/AB) due to their analog noise
- ISDN-AMI U Line Cards (NTBx25AA/AB) due to their line coding

Remote line concentrating module (RLCM)

The remote line concentrating module (RLCM) is a remote LCM connected to a host LGC or RSC via a minimum of two, and a maximum of six, DS-1 links. During normal non-emergency stand-alone (ESA) operation, the RLCM will support all of the subscriber line features that are possible to assign to lines at a host LCM.

Line group controller (LGC)

The line group controller (LGC) is designed to support the LCM and the family of remotes based on the LCM. The LGC interfaces up to 16 DS-30 C-side ports spread over as many as 16 network modules. The 16 DS-30 C-side ports are accessible by 20 DS-30A P-side ports. Since the DTC and LGC employ a common architecture, it is possible to interface the 16 DS-30 C-side ports with a combination of DS-30A and DS-1 P-side ports up to a combined total of 20 P-side ports. When both DS-30A and DS-1 P-side ports are equipped, the module is designated as a line trunk controller (LTC).

ISDN line group controller (LGCI)

The ISDN line group controller (LGCI) adds support for the Basic Rate Interface (BRI) lines to the functionality of the the LGC. To accomplish this, two new cards were introduced:

- ISDN signaling processor (ISP)
- D-channel handler (DCH)

The DCH card terminates the D-channels from multiple ISDN loops. It provides the interface between the ISDN loops and both the packet handler (PH) and the ISDN signaling processor (ISP)

Line trunk controller (LTC)

The line trunk controller (LTC) is designed to support a subset of both LGC and DTC functions. The LTC interfaces to the DMS-100 network through a minimum of three, to a maximum of 16, DS-30 ports. These 16 DS-30 ports are accessible to a maximum of 20 DS-30A ports or 20 DS-1 ports. The DS-30A ports support LCMs; while the DS-1 ports support digital carrier facilities, RLCMs, and RSCs.

ISDN line trunk controller (LTCI)

The ISDN line trunk controller (LTCI) adds support for the basic rate interface (BRI) lines to the functionality of the LTC. It uses the same hardware as the LGCI; namely, the ISP and DCH cards.

Outside plant module (OPM)

The outside plant module (OPM) is an RLCM housed in an environmentally controlled cabinet. Features and configurations of the OPM are the same as those for the RLCM. The OPM also provides a commercial ac power inlet, rectifiers, batteries, and environmental control system, and equipment for the termination, protection, and powering of associated DS-1 pairs.

Remote switching center (RSC)

The remote switching center (RSC) is an LGC based peripheral that is remotely connected to an LGC when supporting lines only; and to an LTC when supporting lines and trunks. These connections are two to sixteen DS-1 C-side host links. A variable set of loopback channels are available for intra-calling. The RSC supports up to 20 links which may be configured to provide various combinations of DS-30A links (LCMs, RMMs) and DS-1 links (RLCMs, OPMs, CDO trunking, and PBX trunking). The RSC, when supporting lines only, has the ability to interface up to 5760 lines in low traffic applications (2.8 CCS/line).

ISDN remote switching center (RSCI)

The ISDN remote switching center (RSCI) adds support for basic rate interface (BRI) lines to the functionality of the RSC. The RSCI uses the

same new hardware as the LGCI; the ISP and DCH cards. It supports ESA for both ISDN and non-ISDN lines and does not support PRI trunking.

Subscriber carrier module-100R (SCM-100R)

The subscriber carrier module-100R (SCM-100R) provides an integrated interface for up to six DMS-1 remote concentrator terminals (RCT) to the DMS-100 switch. Each RCT can support up to 560 lines and will use from two to eight DS-1 links depending on protection switching provisioning.

Subscriber carrier module-100U (SCM-100U)

The subscriber carrier module-100U (SCM-100U) provides an integrated interface between the DMS-100 Family host and DMS-1 urban remote concentrator terminals. Each RCT can support up to 560 lines and will use from two to eight DS-1 links to the host DMS-100.

Subscriber carrier module-100S (SCM-100S)

The subscriber carrier module-100S (SCM-100S) provides an integrated interface between the DMS-100 Family host and AT&T SLC-96 digital loop carrier systems. SCM-100S supports Mode I, Mode II, and Mode III SLC-96 remote terminals (RT) and their protection switching span lines. Each SCM-100S has the capacity of 20 DS-1 links from RTs; thus will support up to four Mode I SLC RTs of five spans (four primary, one protection) each, or six Mode II or Mode III RTs of three spans (two primary, one protection) each.

Service circuits

Service circuits are those switch components that are provisioned on an office basis and are in a common pool to serve all subscribers. The circuits discussed in this chapter include the following:

- receivers (MF, DTMF, and UTR)
- three-port/six-port conference circuits
- special tones
- announcements

Multifrequency and Digitone receivers

The NT2X48 circuit card is supplied to meet two requirements, as a multifrequency(MF) receiver or as a Digitone receiver. The circuits used for the two applications are identical: only the firmware is different which allows them to perform different functions.

The purpose of the MF and Digitone receivers is to receive MF and Digitone tones respectively in pulse code modulation (PCM) format and produce a decoded 8-digit binary output. This method is used to pass signals and dialed digits necessary for call processing.

In addition to being used for regular call completion, Digitone receivers are used to support mechanized calling card service (MCCS). When used for this purpose, a separate group of Digitone receivers is engineered and dedicated for MCCS calls.

Universal tone receivers

The universal tone receiver (UTR) is an optional card in the PM. If the UTR is not included in a specific PM, the central control can establish a network connection between that PM and one that has a UTR.

The UTR is a 32-channel tone receiver. Thirty channels detect a variety of tones, including dual-tone multifrequency (DTMF) for lines and multifrequency (MF) for trunks. Tone samples are switched onto the parallel speech bus by the time switch and are collected by the UTR at the appropriate time slots. The UTR analyzes the samples and identifies the tones. The results are then sent to the signaling processor.

The UTR plugs into designated slots in any of the following configurations of the common peripheral controller shelves:

- LGC - line group controller
- LTC - line trunk controller
- DTC - digital trunk controller
- IDTC - international digital trunk controller

Announcement circuits

Announcement circuits for the DMS-100 are provided through the use of a special equipment shelf containing a digital recorded announcement machine (DRAM) located in a maintenance trunk module (MTM). The announcements are recorded on three different types of speech cards. The DRAM description and administration procedures are found in the *Digital Recorded Announcement Machine Administration Guide*, 297-1001-316.

Tone circuits

The DMS-100 provides a wide variety of tone treatments. These tones are typically provided in the peripheral modules (for example, the MTM). Tone generator circuit cards provide the tones as required; for example, the NT3X68 card provides tones for general purposes that include the following:

- permanent signal
- conference calling
- dual-tone multifrequency (DTMF) signaling
- call waiting

Each of the tone cards are provisioned based on calculations contained in *Provisioning, 297-1001-450*. In general, it is expected that if sufficient tone capacity is provided, then no shortage will exist and no overflows would be

encountered under normal circumstances. To determine which tones are provided, refer to the translations tables: TONES, STN (special tones), and SVRCKT (service circuits).

Conference circuits

Conference circuits in the DMS-100 include three-port and six-port configurations. The three-port circuits are used for three-party conference functions. The six-port circuits provide a conference facility on a single card. Up to five conference circuits can be connected in tandem to permit conference connections for 3 through 26 parties.

Features that use three-port conference circuits include the following:

- MDC features
  - Call transfer
  - Add-on
  - Three-way call chaining
- POTS features
  - Three-way calling
  - Local coin overtime
  - Three-way call chaining
- TOPS features
  - Automated alternate call billing (AABS)
  - Automatic coin toll services (ACTS)

There is also a requirement of one three-port conference circuit for each working TOPS position.

Basic capacity terms

System grade-of-service

To establish a standard basis of system evaluation, it is necessary to devise a measure of service to quantify the inconvenience suffered by the subscribers as a result of blocking or delay. The DMS-100 Family system applies a mixture of blocking (matching loss) and delay criteria.

Blocking criteria

Blocking occurs when a call arrives for service and all servicers (peripheral and network paths) or service circuits are busy. The call attempt may be delayed until a server is idle or aborted, depending on the service discipline. Blocking delay greater than zero is measured as the fraction of all calls attempted that are either lost or enter a queue.

There are four types of blocking or matching losses that occur in DMS-100 Family systems.

Tandem matching loss (TML)

Tandem matching loss (TML) is defined as the failure to find a path through the network from a given incoming trunk to an outgoing trunk group, assuming that idle trunks exist within the group. In DMS-100 Family systems, TML occurs if no connection can be made with two trials. Only the unavailability of a path through the network contributes to the tandem matching loss.

Intra-office matching loss (IAML)

Intra-office matching loss (IAML) is defined as the failure to find a path through the network from a given originating speech link (30 voice channels) to a given idle terminating line. The terminating line is assumed to be accessible by more than one speech link. The IAML depends on the channel availability of the terminating line peripheral, and on the availability of a path through the network.

Incoming matching loss (IML)

Incoming matching loss (IML) is defined as the failure to find a path through the network from a given incoming trunk to a given line, assuming that the line is idle. Access to the line via more than one speech link is implicitly assumed. The IML depends on the channel availability of the terminating line peripheral, and on the availability of a path through the network.

Outgoing matching loss (OML)

Outgoing matching loss is defined as the failure to find a path through the network from a given originating speech link (30 VF channels). or equivalent, to a given idle outgoing trunk. Only the unavailability of a path through the network contributes to the outgoing matching loss.

Matching loss grade-of-service

The overall DMS-100 Family grades of service are shown in Table 2-7.

Table 2-7
Matching loss grade-of-service

Matching loss criteria	DMS-100 (local)	
	ABSBH	HDBH
Intra-office matching loss (IAML)	2 percent	20 percent
Incoming matching loss (IML)	2 percent	20 percent
Outgoing matching loss (OML)	1 percent	20 percent
	DMS-200 (toll)	
	10 HDBH	HDBH
Tandem matching loss (TML)	0.5 percent	2 percent

Delay criteria

Delay occurs when a call finds all servers (typically service circuits) busy and the call is queued until it deflects or a server becomes idle. Delay is usually measured as the fraction of call attempts that are delayed. The overall DMS-100 Family grade-of-service criteria, based on delay, is shown in Table 2-8.

Table 2-8
Delay grades of service

Delay criteria	DMS-100 (local) ABSBH	HDBH	DMS-200 (toll) 10 HDBH	HDBH
Dial tone delay > 3 seconds	1.5 percent	20 percent	*	*
Incoming Start-to-dial > 3 seconds	1.5 percent	20 percent	8 percent	20 percent

There are two types of delay:

- dial tone delay
- incoming start-to-dial delay

Dial tone delay

Dial tone delay (DTD) is defined as the elapsed time from a request for service (off-hook) to the return of a start-to-dial. The requirements are stated in terms of the probability that a customer line requiring connection to a dial

pulse (DP) or dual tone multi-frequency receiver (DTMF) receiver experiences a delay of more than three seconds.

Incoming start-to-dial delay

Incoming start-to-dial delay (ISDD) is defined as the elapsed time from a "request-to-dial" from an incoming trunk to the return of a "start-to-dial." The requirements are stated in terms of the probability that an incoming trunk requiring connection to an MF receiver experiences a delay of more than three seconds.

CPU grade-of-service

There are traffic characteristics that affect the office grade-of-service at high processor occupancies. These characteristics can be categorized as traffic peaking and average work time for each call. Traffic peaking and average CPU work time do not affect maximum call processing occupancies. High traffic peaking and large average work times cause delays within the CPU which becomes larger at higher levels of call processing. Thus, more delays are experienced within the CPU as higher levels of call processing are reached. This extra amount of delay is not related to, and does not affect the operation of the DMS switch.

Class-of-service

Class-of-service is the categorization of telephone subscribers according to the specific types of service extended. Telephone service distinctions include such items as rate differences between individual and party lines, flat rate and message rate, and restricted and extended area service.

Service standards

The basic design philosophy of the DMS-100 Family is based upon delay criteria from the peripheral originator (line or trunk) up to the network. The network and all terminating paths are designed based upon blockage criteria. Blockage is defined as the failure to find an idle channel and is referred to as matching loss. The rates of delay and blockage are referred to as the grade-of-service (GOS). The higher these rates become the lower the grade-of-service that is experienced by the subscriber.

Delay in the DMS-100 Family occurs in the form of dial tone delay (DTD) for originating calls and incoming start-to-dial delay (ISDD) for incoming calls. The percentage of delays greater than three seconds is used to assess the grade-of-service for the overall switch design.

The criteria are 1.5 percent DTD and ISDD greater than 3 seconds for the average busy season busy hour (ABSBH) and 20 percent for the high day busy hour (HDBH)

Service criteria

Service criteria are those objective levels of call blocking and delay that are set for the measured busy hour. Effective capacity administration will ensure that these service objectives are met. Service criteria have been developed on the basis of judgment and experience. The overall objective is to provide the best possible service at a reasonable cost.

To establish a service standard, it is necessary to have a measurement that quantifies the customer's inconvenience experienced because of call blocking or call delay. When a call is blocked, a tone or message is delivered to the customer who then must hang up to try the call again. When a call is delayed, the customer is only considered to be inconvenienced if the delay exceeds some maximum tolerable value. The DMS-100 Family design applies a mixture of loss and delay criteria.

Loss criteria

All of the line modules are engineered to meet objective service levels during the worst case of incoming matching loss (IML) during either average busy season busy hour (ABSBH) or high day busy hour use (HDBH). Incoming matching loss is defined as that condition when a call cannot be completed because an idle path cannot be found between an incoming trunk and an idle line. Northern Telecom engineering tables are based on IML objectives.

The existing published matching loss criteria are stated for the entire office. They have two sources, peripheral matching loss and network matching loss. The peripheral portion is the predominant part of the HDBH criteria. The recommended incoming matching loss criteria for a DMS-100 are shown in Table 2-9.

Table 2-9
NTI recommended matching loss criteria

Busy hour	Overall	Peripheral	Network
ABSBH	2.0%	1.9%	.1%
HDBH	5.0%	4.0%	1.0%

Delay criteria

When subscribers and calls are served on a delay basis, the concern is usually more with the duration of the delay than the probability of delay. At the present time, delays of less than three seconds are considered acceptable to the subscriber, or at least they do not annoy the subscriber if it does not happen too frequently. The current recommended delay criteria are shown in Table 2-10. The delay criteria that are used for engineering purposes are as follows:

- Dial tone delay (DTD): The probability that a customer will experience a dial tone delay of more than three seconds.
- Incoming start-to-dial delay (ISDD): The probability that an incoming trunk to a multifrequency receiver will experience a delay of more than three seconds before the receiver becomes available.

Table 2-10
Recommended engineered delay criteria

	DMS-100		DMS-200	
Delay measurement	**ABSBH**	**HDBH**	**10HDBH**	**HDBH**
Dial tone delay	1.5%	20.00%	see note	see note
Incoming start-to-dial	1.5%	20.00%	8.0%	20.00%

Note: Not applicable to this office type.

With configurations that require a high penetration of Meridian Digital Centrex or multiple appearance directory number (MADN) features, a line peripheral can become limited by high day busy hour attempts. The load service relationship for an attempt limited line peripheral is dial tone delay (DTD). The attempt capacity can be obtained by using the Northern Telecom PRTCALC tool. Staying within this attempt limit maximizes throughput, minimizes any delay caused by the peripheral, and supports an overall DTD of 20 percent during the high day busy hour.

The traffic capacity tables, associated with line peripherals and the PRTCALC program, assume an even (balanced) flow of traffic across all line modules. This PRTCALC function is usually performed by the traffic engineer. The administrator may get the required information from the engineer that is responsible for the office in question.

Busy hour/busy season

Busy hours

The DMS-100 Family of switches are engineered based on empirical data or forecast data for the busiest hour for individual components or for the entire office (switch). These hours are referred to as busy hours. Listed below are the most commonly used busy hours and their definitions.

Call busy hour

This hour is the time-consistent 60-minute period having the most call originating plus incoming (O + I) attempts per main station or network access line (NAL). This hour is used primarily for the development of processor real time capacities.

Usage busy hour (office busy hour)

This hour is the time-consistent 60-minute period producing the most originating plus terminating (O + T) use per main station or network access line (NAL). This hour is used primarily for gathering data for load balancing and provisioning of switching hardware and software.

Service busy hour (dial tone busy hour)

This hour is the time-consistent 60-minute period when the highest percentage of customers originating a call must wait more than 3 seconds for dial tone.

Component busy hour

This hour is the time-consistent 60-minute period when call attempts or use are the highest for a particular switch component, for example, digitone receivers, tones and announcements.

> ***Note:*** These hours may coincide or each may be in a separate time period and administered separately.

Average busy hour (ABH)

The average busy hour (ABH) is an uninterrupted period of 60 minutes for which the average intensity of traffic is at a maximum. It is determined by taking the highest average traffic for the busiest hour of the busiest day of a normal week, excluding holidays, weekends, and special event days.

Average busy season busy hour (ABSBH)

The average busy season busy hour (ABSBH) is an uninterrupted period of 60 minutes for which the average intensity of traffic is at a maximum. The busy hour traffic averaged across the busy season is the basis for this time period

Average busy season (ABS)

The average busy season (ABS) is the three months having the highest average time-consistent busy hour hundred call seconds for each main station for the component in question.

High day busy hour (HDBH)

To determine the high day busy hour (HDBH), traffic data is processed to identify the ten highest traffic days of the year. The hour of the day that has the highest average traffic on these ten days is designated the "busy hour." The ten day average traffic level for this busy hour (the same hour for all ten days) is termed the "ten high day busy hour (10 HDBH). In the ten high day method, data is not included for extremely high traffic days which can be attributed to unusually severe weather or catastrophic events which are not expected to recur from year to year.

Capacity definitions

Typically, the capacities of the DMS-100 Family switches are addressed in accordance with terms used by the design engineers. These terms, which reflect the different capacity concepts that are employed in the provisioning process, have been adopted for use in the day-to-day monitoring activities. These terms include:

- physical (termination) capacity
- traffic capacity
- real-time capacity
- memory capacity

Physical capacity

Physical capacity is the total number of terminations that can be accommodated by a switch component or group of components, for example, the total number of terminations for lines in a line concentrating module (LCM) or group of LCMs.

Traffic capacity

Traffic capacity is the maximum number of terminations or requests for service that can be accommodated by a component or group of components while still meeting established delay and blocking service standards.

Real-time capacity

Real-time capacity, as applied to the DMS-100 Family central processing unit (NT40) or DMS-Core (SuperNode), is the maximum number of call attempts that the central processing unit (CPU) or DMS-Core can process while meeting the high day busy hour (HDBH) service objective of not exceeding 20 percent dial tone delay (delay greater than 3 seconds).

Memory configuration

NT-40 Central control complex

An NT-40 central processor and memory shelf has eight card slots available for active program store, plus one card slot used as a memory controller. This memory controller card has 256 K-Words of memory to be used to spare a detected memory fault in any one of the eight memory cards.

This shelf has a maximum capacity of eight M-Words (MWs) of program store. Of this, 7.75 MWs are addressable. The remaining 0.25 MWs are reserved for system use such as write protected registers.

An NT40 data store shelf has 16 card slots available for active data store plus one card slot used as a memory controller. This controller card has 256 K-Words of memory to be used to spare a detected fault in any one of the memory cards.

This shelf has a maximum capacity of 15.75 MWs of addressable data store dependant on CCC vintage. The remaining 0.25 MWs of memory is reserved for system use such as write protected registers.

There are two types of memory cards available for both program and data store.

- 256 K-Words (NT3X93)
- 1 M-Words (NT4X80)

Older vintage NT40 systems may have NT3X40 cards which contain 64 K-Words of memory. This card may exist in either program or data store shelves and can be mixed on the last addressable shelf with NT3X93 cards.

DMS SuperNode

A DMS SuperNode has 10 card slots available for memory on the DMS-Core shelf. Unlike the NT40, there is no hard partitioned separation of program and data store, as the memory is provisioned in a common pool. Also, there is no separate spare for fault detection built into a controller card.

The two types of memory cards available are listed below:

- 6 MByte (NT9X14BB
- 24 MByte (NT9X14DB

DMS SuperNode SE (SNSE)

A DMS SuperNode SE (SNSE) has 10 card slots available for memory on the DMS-Core shelf. The shelf configuration has 5 24 MByte memory CP (NTX9X14DB) slots on each side.

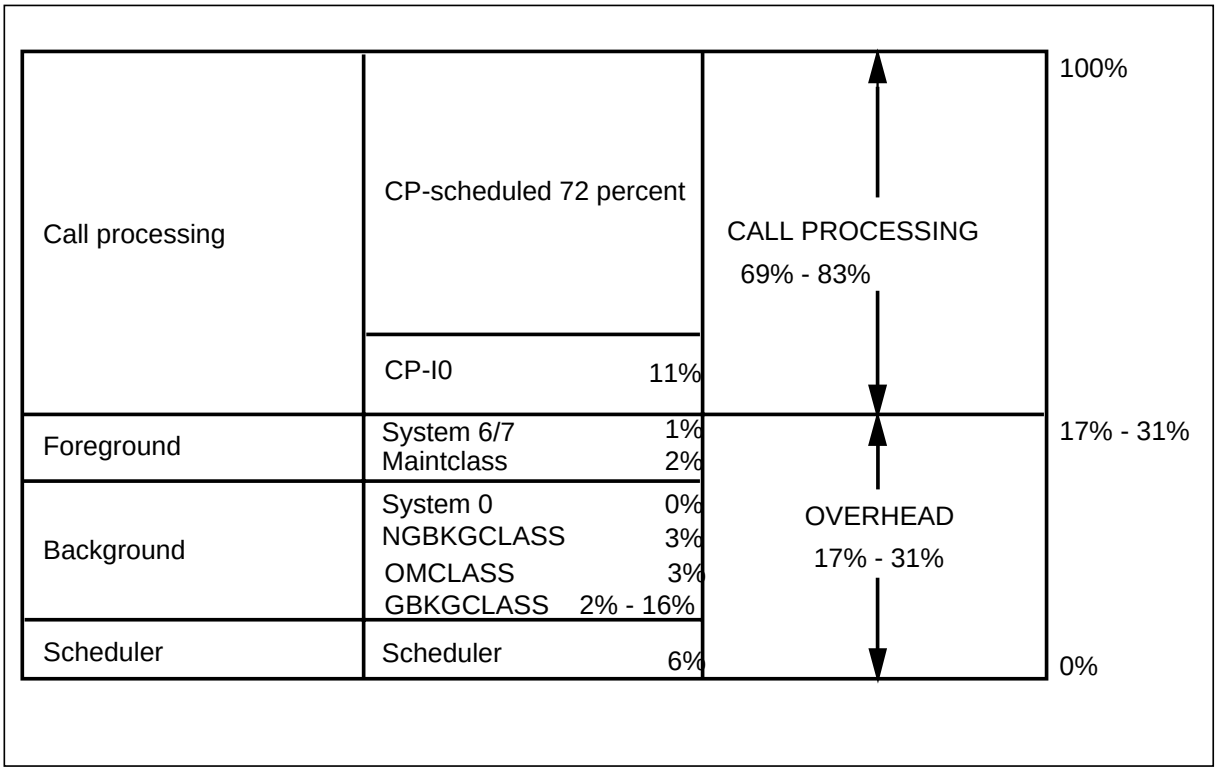
CPU capacity

Understanding CPU real time capacity

Real time is the actual time during which the central processing unit (NT40) or DMS-Core (SuperNode) performs its functions. The time is divided into two main categories: call processing time and non-call processing time (Figure 3-1). The call processing category includes both work time for the acceptance of call originations and call progression to completion or treatment. The CPU is active 100 percent of the time. Usually, the CPU is performing a combination of call processing and non-call processing activities. However, if no call requests are received during a period of time, the CPU remains active for 100 percent of the period, but uses the entire time on non-call activities.

The non-call processing category can be divided into subcategories of work that can be deferred and work that cannot be deferred. Work that can be deferred is postponed (if there are sufficient requests for call processing) until there is leftover call processing time in which to perform the work. Work that cannot be deferred is activity that the CPU must perform during each cycle of the system clock, referred to as overhead. The percentage of real time used for overhead depends on the type and number of features loaded, and the requirements for maintenance input/output devices. Theoretically, up to 31 percent of real time can be used by overhead if the switch is equipped for all features. In practice, switches do not contain all features available; therefore, the real time used for overhead is somewhere between the minimum and maximum values. Each switch configuration should be evaluated on its design and load to determine its overhead requirements.

Figure 3-1
Allocation of CPU classes



NT-40 CPU (CC) real time capacity

This section describes the central processor unit real time model, engineered office parameters, background engineering, and capacity prediction and verification. It also describes the Traffic Operator Position System real time allocations.

Central processing unit

The DMS-100 Family switch central processing unit (CPU) is designed to be active 100 percent of the time. The total amount of time available in one hour is 3,600,000 ms (60 min. x 60 sec. x 1000 = 3,600,000 ms). The CPU real time model shows the allocations of CPU processing tasks (Figure 3-1).

Two major divisions of the CPU work time are overhead and call processing. Overhead uses a minimum of 17 percent of CPU real time, leaving a maximum of 83 percent of CPU real time for call processing. These allocations are based on an ideal switch which is defined as fault free and possessing an unlimited supply of internal resources and external facilities.

Overhead consists of three primary areas; foreground, scheduler, and background. Foreground and scheduler processes are typical allocations,

while background processes are minimum allocations. With BCS21, the background allocation is operating company definable. Foreground and scheduler are higher priority processes than call processing.

As overhead requirements increase, the real time available for call processing will decrease. Therefore, if overhead requirements are higher than 17 percent of total CPU real time, the maximum call processing allocation will be less than 83 percent.

Real time allocation

Figure 3-1 shows typical allocation of the DMS 100 Family CPU classes at maximum call processing. This model represents the minimum overhead allocation of 17 percent and the maximum call processing allocation of 83 percent of CPU real time. Overhead processes have a complex interrelationship with each other and are application dependent. Real time allocation algorithm controls are implemented in the operating system scheduler to guarantee that each class of process receives a pre-defined minimum CPU allocation of real time across all call processing occupancies. These allocations, for a typical POTS office, were obtained from modeling as well as load and volume testing in existing offices.

Scheduler

The scheduler is interrupt driven and will maintain CPU allocation of work by scheduling call processing, maintenance, background, and foreground processes. The scheduler can range from 6 - 20 percent of total CPU real time based on call mix, call volume, and system critical maintenance. When call processing CPU requirements are low, the scheduler looks for additional activities to schedule into the CPU, thus the scheduler consumes more CPU time at these lower call processing loads. Conversely, as call processing CPU time increases, call processing gives up control of the CPU less often, which means less scheduling. The scheduler will run higher than 6 percent at maximum call processing occupancies in TOPS and MDC offices due to the complicated nature of that software. The scheduler in these applications can run up to 8 percent.

Background

Background is divided into three major classes: guaranteed background (GBKGCLASS), non-guaranteed background (NGBKGCLASS), and operational measurements (OMCLASS).

With BCS21, both OM and NGBKG classes have a minimum allocation of 3 percent of total CPU real time at maximum call processing occupancy.

Also with BCS21, the GBKG class has a minimum allocation of 2 percent of total CPU real time at maximum call processing occupancy. However, the amount of CPU real time allocated for GBKG is engineerable from 2 - 16 percent. This is accomplished by adjusting the parameter

Guaranteed_Terminal_CPU_Share in Table OFCENG. It should be noted that any value set for GBKG above 2 percent will be at the expense of call processing. Table OFCENG is write protected. This parameter, as well as all OFCENG parameters, should only be changed by qualified operating company personnel. Changes to this parameter will take effect immediately and a SOS106 LOG will be generated to show the parameter has been changed. Refer to DDOC BC1772 scheduler for High Priority Process Fixed CPU share for more complete details.

Background is mainly used for low priority maintenance, OM scanning, printing and manipulation, and terminal responses of Input/Output (I/O) devices. Areas within background and their allocations are:

- GBKGCLASS: Guaranteed background will range from 2 - 16 percent of total CPU real time as a minimum. Functions within this class are: Log and MAP devices defined as guaranteed in Tables TERMDEV and LOGDEV.
- NGBKGCLASS: Non-guaranteed background will be 3 percent of total CPU real time as a minimum. Functions within this class are: LOG message system, non-guaranteed LOG and MAP devices, maintenance auxiliary processes, system audits, and OM output.
- OMCLASS: Operational Measurement class will be a minimum of 3 percent of total CPU real time at maximum call processing occupancy. Functions within this class include OM scanning and OM transfer processes.
- SYSTEM O: System O is the lowest priority of all CPU classes. System O will be 0 percent of total CPU Real Time at maximum call processing. Functions within this class include idler, which simply checks to make sure no CPU work exists for the other CPU classes.

All background tasks will condense down to a minimum 8 - 22 percent of total CPU real time at maximum Call Processing occupancy. Tasks within GBKGCLASS, NGBKGCLASS and OMCLASS will receive slower response as their available processing time is reduced.

Foreground

Foreground is used for SYSTEM 7, SYSTEM 6, and MAINTCLASS processes. The foreground allocation is designed to be 3 percent of CPU real time in a well-maintained switching system. This allocation is a higher priority than call processing and background. Therefore the associated work of these classes should be managed to insure these allocations do not use more real time than typical allocations shown. When these classes exceed their allocations to the point where total overhead exceeds 17 percent, call processing is limited to the difference between total overhead and 100 percent.

Areas within foreground and their allocations are:

- SYSTEM 7: SYSTEM 7 will typically be 0.5 percent, but can go as high as 15 percent of the total CPU real time during periods of large maintenance activities such as total office PM reload. This is the overhead of communicating with devices for maintenance processes.
  - Functions within this class are: maintenance and complicated I/O interrupt handler, flashing A1, and system sanity checks.
- SYSTEM 6: SYSTEM 6 will typically be 0.5 percent, but does have the possibility of going as high as 85 percent of total CPU real time if System 6 level processes such as maintenance tool PMIST are misused. (This tool is to be used only by NTI TAS personnel and qualified operating company ESAC personnel). It will lock out call processing if PMIST is used for the entire office.
  - Functions within this class are: software operating system wake-ups, babbler recovery, and receiver audit.
- MAINTCLASS: MAINTCLASS is typically 2 percent; however, it may run up to 8 percent of total CPU real time at maximum call processing load if the maintenance processes are required to diagnose and return to service failed equipment. Therefore, at times of maximum call processing, maintenance processes residing within the MAINTCLASS should be run only as needed.
  - Functions within this class are dial tone speed recorder (DTSR), receiver attachment and delay recorder (RADR), network maintenance, reloading new peripheral, overhead for maintenance diagnostic processes, and device independent recording package (DIRP) audits.

Call processing

Call processing is divided into two functions: Call processing I/O and call processing scheduled.

Call processing I/O together with call processing scheduled comprises the total maximum CPU call processing allocation of 83 percent.

Call processing (I/O)

Call processing (I/O) is the CPU work used to handle interrupts from peripheral modules (PM). This includes changes of state (for example, on-hook, off-hook, digits, flash, key hits). The CP-I/O usually is 11 percent but varies depending on call mix.

Call processing (scheduled)

Call processing (scheduled) handles call processing, AMA, and feature requirements including call set up, translations, network connections, terminations, feature activations, AMA disk and I/O queue handling. call processing (scheduled) typically is 72 percent of CPU call processing, which is added to CP-I/O to provide the maximum CPU call processing allocation of 83 percent. The processes within CP-Scheduled are as follows:

- CALLP: This process provides the call processing functions that establish calls and features.
- GENQRM: This is a general queuing utility that is primarily used in the MDC environment.
- CPWAKEP: This process provides the “wake-up” queue and the periodic function that checks this queue.
- AMAPROC: This is a periodic process that formats AMA data for specific call types and combinations of call types and features.
- HDRT9: This process serves as a device driver for the tape drive. It puts information on or gets data from the tape.
- DSKIOQH: This process is similar in function to HDRT9 but serves as a device driver for the disk drive.

Call processing class is allowed to reduce background to its minimum of 8 - 22 percent. Call processing will constrain MAINTCLASS to less than 8 percent in a critical failure mode as long as traffic is sustained. If a critical maintenance action is performed at low call processing volume (for example, REXTST), MAINTCLASS can compress background to its minimum allocation. MAINTCLASS usage above the 8 percent level will reduce the shares for background and possibly impact call processing delay.

DMS-SuperNode CPU (CMC) real time capacity

Average CPU (CMC) work time

Average work time (AWT) is the average amount of central processor time spent processing each call. The level of messaging complexity associated with each call type will affect how much time is spent processing each call. Depending on call mix and type, different offices will have different average work times. Increased AWT will increase the amount of time the processor spends treating call attempts in progress versus accepting new originations. AWT factors are provided in the office models and call timings in Chapter 5, *BCS Call timings,* of this document.

Real time allocation

The processor has 100 percent of real time available to execute tasks. These tasks are defined as being related to overhead or call processing. Overhead processes handle overall system operation; while call processing deals with the handling of calls to the recording of billing information.

Overhead scheduling

Overhead processes that perform similar or related functions are grouped into scheduler classes. These classes are allocated a portion of processor real time based on their contribution to the overall switch performance.

Overhead tasks have a complex interrelationship with each other, and are application dependent. Real time allocation algorithm controls are implemented in the operating system scheduler to guarantee that each class receives a predetermined minimum processor allocation of real time across all call processing occupancies.

The classes associated with overhead processes are as follows:

- Scheduler class
- System class
- System tools class
- Maintenance class
- Guaranteed terminal class
- Guaranteed OM class
- Non-guaranteed OM class
- Background class
- Audit class
- Network operation system file transfer class
- Idle class

Scheduler class

The scheduler controls the allocation of processor real time after I/O, clock, and scheduler interrupts have taken their share. Remaining real time is divided between all other classes. The scheduler can range from 4 percent to 35 percent of real time in DMS-SuperNode, based on call mix, call volume, and system critical maintenance.

When real time requirements for call processing are low, the scheduler looks for additional activities to schedule into the processor, causing the scheduler to consume more processor real time. Conversely, as real time requirements for call processing increase, call processing classes give up control to the processor less often, which allows less scheduling. The scheduler will run higher than 4 percent at maximum call processing occupancies in TOPS and MDC offices due to the handling of complicated I/O messages. The scheduler in these applications car run as high as 8 percent.

System and system tool class

System and system tool class are used for critical system operations. Both of these classes use as much processor real time as required, therefore the processor real time used by these classes is not restricted by the scheduler. In

a typical office, these two classes combined use less than 1 percent of processor real time. This percentage is taken from a fixed component, and any required value above 1 percent is taken from an assignable component.

System class runs after the scheduler class and I/O interrupts have taken as much processor real time as they require. System tool class runs after system class has used as much time as it requires, and guaranteed terminal class has been scheduled.

Functions within system class include the following:

- complicated I/O interrupt handler
- flashing A1
- system sanity checks

Functions within system tools class include the following:

- software operating system
- wake-up
- babbler recovery
- receiver audit activity
- Analysis
- PMIST

Maintenance class

The scheduler allocates 1 percent of DMS-SuperNode processor real time to the maintenance class. Under normal operating conditions, this is sufficient but if requirements exceed the minimum guaranteed time, the additional time is taken from an assignable component.

Any portion of the real time allocation not used by maintenance class is available to other scheduler classes and is normally used by call processing classes.

Functions within this class include the following:

- dial tone speed recorder (DTSR)
- receiver attachment and delay recorder (RADR)
- network maintenance
- reloading new peripheral
- overhead for maintenance diagnostic processes
- device independent recording package (DIRP) audits

Guaranteed terminal class

The office parameter GUARANTEED_TERMINAL_CPU_SHARE controls the percentage of processor real time that the scheduler allocates to

guaranteed terminal class at capacity. This parameter has a range of 2 percent to 16 percent, with a default value of 2 percent. The first 2 percent is part of the fixed component, and the rest is from the assignable component.

Any portion of the assignable component not used by guaranteed terminal class is available to other classes and is normally used by call processing classes.

Functions within this class include log and MAP devices defined as guaranteed in Tables TERMDEV and LOGDEV.

Guaranteed terminal class runs before system tool class, thus guaranteed terminal cannot be locked out by system tool class.

Guaranteed and non-guaranteed operational measurements

Operational measurements (OM) data is gathered continually to monitor the performance of the switch. Examples of OM data include receiver and trunk usage and event counts. The OM system organizes the measurement data and manages data transfer to the display units and recording devices.

The scheduler guarantees 2 percent of processor real time at capacity to the guaranteed operational measurement (GOM) class and non-guaranteed operational measurement (NGOM) class. The GOM class uses as much of this time as required (usually less than 1 percent), and the remainder of the time goes to the NGOM class. If any portion of this time is left over, it is made available to the background class and audit class.

Operational measurement transfer process runs in GOM class, and the sampling process runs in NGOM class.

Background (BGK) and audit classes

The scheduler guarantees 4 percent processor real time at capacity for BGK and audit classes. BGK class is guaranteed 3.7 percent and audit class is guaranteed 0.3 percent. Any unused BGK time is given to audit class.

Any processor real time not used by the OM scheduler classes is made available first to these two classes.

Functions within BGK class include most terminals, OM accumulation, line and trunk maintenance, and critical audits.

Audit class is used for slow running audits and processes which do not require fast turn-around time.

Idle class

Idle class is provided time only if all other classes have nothing to do. Therefore, idle class receives 0 percent of processor real time at full load.

The idle process and call processing resource audit run in this class.

Network operating software file transfer (NOSFT) class

NOSFT class, used by the processes communicating with a dynamic network controller (DNC), is limited to 3 percent of processor real time (assignable time) at capacity. If a switch is not connected to a DNC, the 3 percent is provided to the call processing classes first.

Call processing classes

Call processing requirements are divided into four categories:

- High priority call processing (HPCP)
- Call processing (CP)
- Deferrable call processing (DEFCP)
- Call processing I/O interrupts (I/O)

Together, they comprise a total maximum CPU call processing allocation of 86 percent for DMS-SuperNode.

HPCP, CP, DEFCP classes

The scheduler will give these classes up to 75 percent of processor real time at full load in an ideal POTS office with no engineering factors.

Functions within these classes include the following:

- call processing
- AMA
- call set-up
- translations
- network connections
- terminations
- feature activations
- AMA disk and I/O queue handling

Call processing I/O interrupts

I/O interrupts handle interrupts from the peripheral modules, typically using 11 percent of processor real time.

Interrupts involve the following:

- on-hook
- off-hook
- digits
- flash

Monitoring via REAL::TIME

When planning an initial office, information such as line/trunk quantities, holding time for calls, traffic characteristics, features, and billing is entered into the REAL::TIME tool to predict switch capacity. Once an office is placed in service, the office characteristics are measured and compared to predicted characteristics. If any of the prediction numbers differ from the measured, the new verified numbers can be entered into the tool to increase the prediction accuracy of the tool.

In existing offices, the impact of future growth on processor capacity is predicted by entering measured information, equipment/feature enhancements, and predicted traffic conditions into the REAL::TIME tool. Once the enhancements are placed in service, system measures are taken and compared to the predicted values. If a difference exists, the measured numbers are then entered into the tool.

Engineered office parameters

Office parameters are critical parts that relate to engineered capacity. Unless the proper call processing resources are set aside, operations in the CPU cannot be completed, even though a large amount of real time may be available. Office parameters affect memory requirements and must be evaluated during initial system and extension provisioning. Critical call processing parameters are call condense blocks (NCCB), call processing letters (NUMCPLETTERS), and call processes (NUMCALLPROCESSES). Office parameters must be considered in three different time frames as follows:

Initial provisioning

Parameters must be engineered based on data provided by the operating company. Initial parameter settings are in accordance with the *Office Parameters Reference Manual*, 297-1001-455 and the L.S.S.G.R. standards.

Verification

Parameters can be monitored by the operating company using operational measurements (OMs). Any non-zero values shown in overflow registers will indicate under provisioning. For exact OM groups and fields, refer to *Office Parameters Reference Manual*, 297-1001-455.

Growth

Office parameters must be analyzed by operating company personnel on all types of growth in an office. Additional hardware and traffic data must be factored into parameter growth. Refer to *Office Parameters Reference Manual* 297-1001-455.

Background engineering

With BCS21, the background allocation of overhead condenses to a minimum of 8 to 22 percent of total CPU real time at maximum call processing occupancy. Out of this allocation, terminal devices (GBKGCLASS and NGBKGCLASS) and OM scanning/transfer functions compete for time for background work. It is possible to have five video display units (VDUs) and one teletypewriter (TTY) device defined as guaranteed for each office.

Each active device requires approximately 2 percent of total CPU real time for background work.

At times of maximum call processing the background allocation is at its minimum allocation of total CPU real time and all active devices compete for this time. If this condition occurs and many devices are simultaneously in use, terminal response time will be affected. In BCS21 loads, the operating company can allocate CPU time for priority I/O devices at the expense of call processing (2 to 16 percent) if required.

When the CPU is under high load, it is recommended to limit the number of active guaranteed devices to two simultaneous active devices and set the OM transfer time to 30 minutes to allow OM scanning processes and transfer to be completed. Disk and tape devices are recommended for large OM data output requirements to ensure storage of all data.

Capacity prediction and verification

The maximum occupancy of the CPU for call processing, feature functionality, and its associated grade of service determines how many call attempts a CPU can handle. A maximum call rate is dependent on many factors which must be understood. Different call types consume different amounts of real time. These factors can vary on a per hour, minute, or even second basis. Thus, the maximum call handling capacity of the DMS-100 Family is expressed as 83 percent of total of CPU real time. Note that this maximum occupancy can be less due to higher overhead requirements, and thus dictates what maximum call mix can be processed by that switch.

Capacity can be predicted for individual jobs using existing tools available to NTI Engineers and operating company Engineers. Call timings are used in the capacity prediction tools to determine percent of CPU occupancy based on office specific call mix and call volume.

CPU measurements

The CPU call timing process is comprised of three sub-processes; regression testing, load testing and documentation. All three processes are completed for each BCS. Below is a description of each.

The first category, regression testing, is a process which produces per call timings at three different stages of each BCS development cycle. As the name regression infers, these tests are made to compare results between each BCS.

To insure accurate measurements, call timings are completed in an environment with no other concurrent call processing. Call timings are measured in an idle lab on a single call basis, to determine the length of each process required to complete the call. For each measured call type, a measurement is completed twice every BCS (IS and RTM). These measurements are used as a consistency check within the BCS and are controlled by Northern Telecom's quality department. The last measurement (RTM) is done on the final BCS load and are the timings used in load testing and call timing documentation.

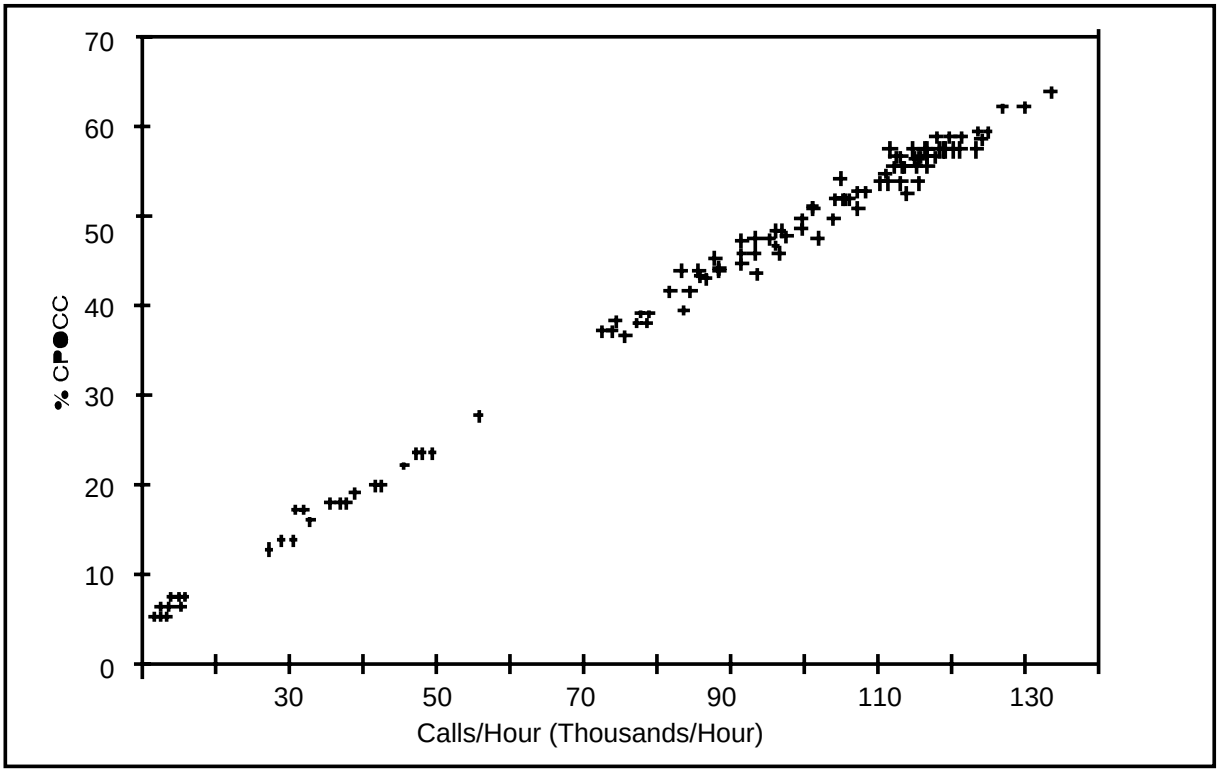
The second category, load testing, is completed for every BCS level in the FAST II switch. Load testing is a capacity verification to test call timings under various CPU load levels. Currently, load testing is conducted on a POTS configuration with plans for two additional configurations, MDC (Meridian Digital Centrex) and TOPS.

Tests are conducted at various CPU call processing occupancies as well as overload (as indicated by the CPU measurement tool ACTIVITY). The verification consists of using the actual calling rates and call mix for the different call processing occupancies applied to RTM call timings to determine the call processing occupancy. A comparison of this determination and the actual FAST II call processing occupancy from ACTIVITY is used to verify call timings under various call processing loads.

The third category, documentation, is the process that provides current BCS RTM call timings for the marketplace, and is completed every BCS. These call timing values are incorporated into the capacity prediction tool REAL::TIME.

Call measurements have been verified to stay constant at high load. This has been proven for inservice as well as load and volume test sites. A linear response for call processing occupancy in relation to call volume has been measured in these sites. Refer to Figure 3-2 for an example of CPOCC versus calls per hour. Note that the number of calls per hour and CPOCC is for a particular office. The number of calls at an occupancy will vary with the call mix.

Figure 3-2
CPOCC versus calls with 40 MHz clock



Prediction tools

There are two capacity prediction tools available; CPU call timings and REAL::TIME.

CPU call timings

The capacity prediction calculated from this planning section is based on the call type mix, feature assignments, and feature activation. This information can predict office capacities to within five percent accuracy for non-TOPS applications and to within ten percent accuracy for TOPS applications with accurate input data.

REAL::TIME

The PC based program REAL::TIME is also used to predict CPU capacity. It is a computer-based spreadsheet that is available on floppy disk that can be used on an IBM PC. This program can predict CPU capacity to within ten percent accuracy for non-TOPS offices and fifteen percent accuracy for TOPS offices with accurate input data. Documentation is provided with the tool, and on-line help screens are included.

Verification tools

Measurements within the DMS can be used to verify actual office traffic. They are operational measurements (OM) and traffic separation measurements system (TSMS) These measurements are used with CPU capacity tools ACTIVITY or ANALYSIS to validate CPU predictions for each office configuration.

Operational measurements (OM)

Operational measurements are used to determine system call mix, feature activations, and trouble conditions. All of the OMs must be gathered for analyzing system capacity and overload situations. The OM referenced measure call characteristics including overflows and blocked calls. This provides a delineation of capacity and trouble concerns. OM, when used in conjunction with ACTIVITY, allows the capability to project system call capacity. Refer to *Operational Measurements Manual* 297-1001-814 for more complete information.

Traffic separations measurement system (TSMS)

Traffic separations measurement system (TSMS) is used to collect traffic data based on call types using source to destination grids. TSMS provides a means by which switched traffic may be separated on a point-to-point basis, therefore allowing for detailed traffic information based on specific call types such as 1FR POTS call to a local trunk. This data, combined with OM data, provides detailed call attempts that can be applied to REAL::TIME (refer to *Traffic Separation Reference Manual* 297-1001-321 for greater detail).

ACTIVITY/ANALYSIS

The ACTIVITY/ANALYSIS software provides an on-line real time indicator tool that monitors a system's traffic count, CPU occupancy and call queuing time.

The ACTIVITY/ANALYSIS feature assists with the following:

- evaluation of the current system configuration to assist in capacity planning.
- as a maintenance tool to determine if call processing is efficiently handled.

The measurements of call processing occupancy and grade of service from these tools verify the expected real time requirements. Since ACTIVITY/ANALYSIS takes direct measurements from the CPU scheduled and interrupt processes, it is the most comprehensive real time indicator.

Traffic Operator Position (TOPS) real time allocation

Scheduler (TOPS stand-alone and OC)

The scheduler time is increased typically 3 percent over the CPU real time tools ACTIVITY and ANALYSIS due to complex interactive processes. These processes are attributed to Traffic Operator Position System (TOPS) call processing. TOPS call types have complex interactive processes that require the scheduler to schedule in and schedule out the CPU activities involved in call processing. This call processing work is performed in overhead. Call timings do include this time.

A more detailed calculation of the additional scheduler requirements for a TOPS office using TOPS operational measurements for the hour is shown below.

Call Processing in Overhead Calculations

TOPS STAND-ALONE

$$\% \text{ Points for SCHED} = \frac{(C)}{3{,}600{,}000 \text{ ms}} \times 100\%$$

TOPS REMOTE OC

$$\% \text{ Points for SCHED} = \frac{(D)}{3{,}600{,}000 \text{ ms}} \times 100\%$$

TOPS HOST OC

$$\% \text{ Points for SCHED} = \frac{(E)}{3{,}600{,}000 \text{ ms}} \times 100\%$$

(A) = CDACTS_ACTSINI X 0.6ms

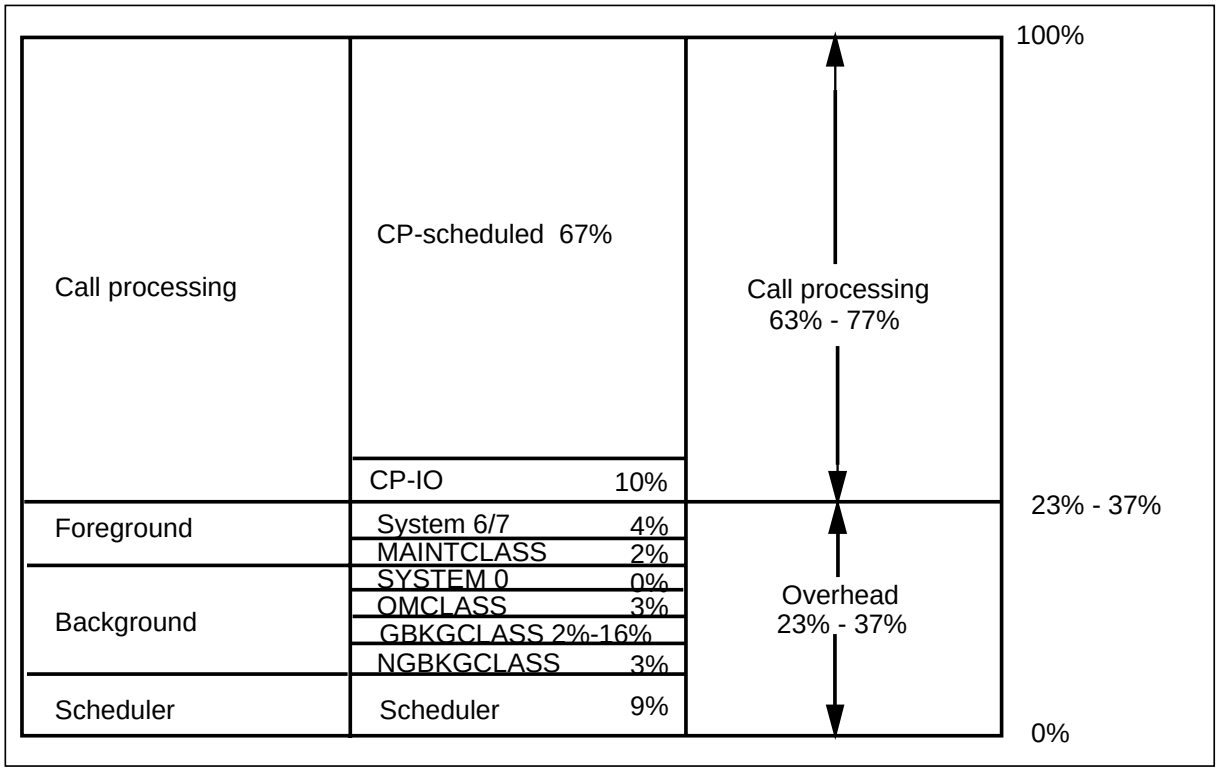
(B) = CDMCCS_MCCSATT X 0.6 ms

(C) = (CF3P_TOPSZRS X 2.4ms) + A + B

(D) = (CF3P_TOPSZRS X 2.7ms) + A + B

(E) = C + (TOPSOC_OCINI X 2.4ms) + (TOPSOC_OCMCCS X 0.6ms)

Figure 3-3xxx
Allocation of CPU classes (TOPS office with call processing reaching 77 percent)



Foreground (TOPS OC)

The foreground time is increased over the CPU real time model typically 3 percentage points due to the complicated I/0 on OC data link handling. Calls coming in and going out over the OC links cannot be completed during the I/O interrupt and must be scheduled into the foreground process (Figure 3). Once foreground work for the I/O interrupt is completed, the normal call processing work is scheduled and completed as call processing. This is call processing work performed in overhead.

A more detailed calculation of the additional foreground requirements for a TOPS office using hourly TOPS operational measurements is shown below.

Call Processing in Overhead Calculations

TOPS STAND-ALONE

$$\text{\% Points for FOREGROUND} = \frac{(Z)}{3{,}600{,}000 \text{ ms}} \times 100\%$$

TOPS REMOTE OC

$$\text{\% Points for FOREGROUND} = \frac{(Z) + (Y)}{3{,}600{,}000 \text{ ms}} \times 100\%$$

TOPS HOST OC

$$\text{\% Points for FOREGROUND} = \frac{(Z) + (X)}{3{,}600{,}000 \text{ ms}} \times 100\%$$

(Z) = (CDMCCS_MCCSATT x 1.6 ms)

(Y) = (CF3P_TOPSZRS x 4.8 ms)

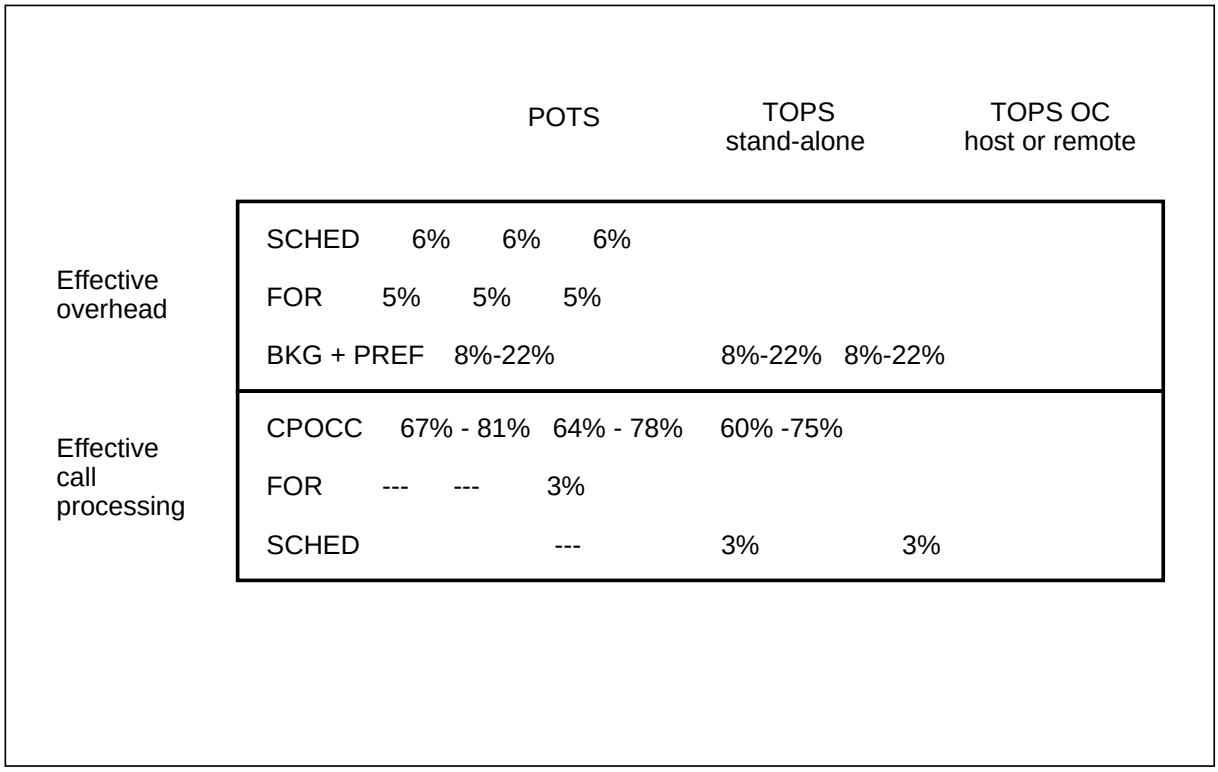
(X) = (TOPSOC_OCINI X 6.4 ms) + (TOPSOC_OCMCCS x 1.6 ms)

TOPS stand-alone offices typically require 3 percent to be added to ACTIVITY CPOCC reading to reflect scheduling used by TOPS for call processing time. A more exact value can be used instead of the typical 3 percent. The calculations for this value are shown above.

TOPS OC typically requires 6 percent to be added to ACTIVITY CPOCC readings to reflect this extra call processing scheduling and foreground time. A more exact value can be used instead of the typical 6 percent. The calculations for this value are shown above.

Figure 3-3 represents a typical CPU allocation in a TOPS OC office. See Figure 3-4 for allocations with ACTIVITY turned on.

Figure 3-4
Typical CPU allocations at maximum call processing occupancy with ACTIVITY on



TOPS operational measurements enhancement

Improved operational measurements for TOPS was available in BCS21 with the introduction of the feature TOPS operational measurement enhancement (refer to DDOC AF0075). This feature provides two major enhancements to TOPS operational measurements:

- A consistent approach to the pegging of the office traffic summary (OFZ) OM. The registers OFZ_NIN and OFZ_INOUT have been modified to provide improved measurements. The OFZ_NIN register will now peg once for each incoming TOPS call attempt, whereas in the past multiple pegs could occur on a single call. The OFZ_INOUT register will now peg once per trunk originated call, whereas in the past under certain conditions multiple pegs could occur for a single call.
- Improves the quantification details of operator traffic measured by the TOPS OM groups. To provide further enhancements, the following registers have been added:

Register	OM Grp	Description (Measurement)
TOPSNIN	TOPSTRAF	Total number of incoming TOPS calls
TOPSTRK	TOPSTRAF	TOPS calls that go out over a trunk
TOPSTON	TOPSTRAF	TOPS calls routed to tone

- TOPSANN	TOPSTRAF	TOPS calls routed to announcement
- TOPSCAN	TOPSTRAF	TOPS calls that are cancelled by the operator
- TOPSREQ	TOPSQ	Customer who requests an operator
- OCINI TO	PSOC*	Total number of OC calls
- OCQABN	TOPSOC*	OC call abandons
- OCMCCS	TOPSOC*	Total number of OC MCCS queries
- RONA TT	TOPSRON*	RONI operator attempts
- RONRECL	TOPSRON*	RONI recalls
- RONQABN	TOPSRON*	RONI abandons
- ACTSABN	CDACTS	Customer abandons (ACTS)
- ACTSSUCC	CDACTS	Call completions (ACTS)
- MCCSUCC	CDMCCS	Call completions (MCCS)
- MCCSABN	CDMCCS	Customer abandons (MCCS)
- MCCSOPR	CDMCCS	MCCS calls that transfer to an operator

*Note that TOPSOC and TOPSRON are new OM groups.

TOPs enhancements

TOPS deferred BC AMA formatting feature: Included in BCS23, this feature provides a real time enhancement by allowing raw TOPS AMA data to be written directly to an output file (tape, disk, DPP, etc.). This raw information is reformatted by the DMS-100F switch in an off-traffic period or is processed by the DPP, thereby deferring or removing the real time load to process AMA.

Call timings

CPU call timings are measured by BNR in a lab environment. Every call type is not measured with each new BCS, therefore, the following categories exist:

- Measured: Measured call timings are measured in the present BCS or in past BCSs. These call timings are within $\pm$ 5 percent accuracy.
- Derived: Call timings are derived in the following ways:
  - The call timing was measured in a past BCS and was updated to reflect the current BCS general trend.
  - A call timing is derived from other call types that were measured in the present BCS.

These call timings have a lesser degree of accuracy but are typically $\pm$ 10 percent accurate.

- Estimates - These call timings do not exist today and are used as planning estimates for new features. These estimated call timings have a ± 15 percent accuracy assessed to them.

Universal tone receiver

The universal tone receiver (UTR) collects, decodes and translates tones into digits at the peripheral module and reports the information to the CPU. The UTR relieves the CPU of having to establish a network connection to a common pool of receiver circuits, providing an increase in call processing capacity.

The real time savings is measured at 2.5 ms for each DTMF and MF attempt using the UTR. Depending on call mix and new PM penetration, the expected real time savings range from 5 percent to 13 percent. An analysis on an in-service switch will be compiled using the same test procedure used in the 40 MHz CPU analysis.

Optional features

The following describes the estimated CPU usage for optional features:

- Engineering administration data acquisition system/data collection (EADAS/DC)
  The EADAS/DC is an operational support system which collects operational measurement (OM) data from a DMS-100 switch via data links. Basically, the EADAS computer submits a poll or request for data and the switch responds with either the data requested or a message indicating why the data is not being sent. The estimated CPU overhead requirement for this function is 2 percent of total CPU time.
- Engineering administration data acquisition system/network management (EADAS/NM)
  EADAS/NM is an Operational Support system which provides network managers with traffic measurements and control capabilities for its network of telephone switches. Based on data collected every 5 minutes, the EADAS/NM system can:
  - Keep the network of telephone switches operating near maximum efficiency.
  - Help the network maintain network integrity during overloads or facility failures.

  The estimated CPU overhead requirement for this function is 3 percent of total CPU time, which will decrease maximum call processing occupancy by 3 percent.

- Network operation systems/customer network management (NOS/CNM) provides the DMS with the capability to transfer operating company and customer data over a communications link concurrently with the generation of the data on the DMS-100. Network operations protocol (NOP) is the protocol by which the DMS-100 will be able to communicate with the network operation system. The estimated CPU overhead requirement for this function is 5 percent per 9,600 baud link if equipped with a 1X67 I/O card; and the maximum call processing occupancy is decreased by 5 percent. The estimated requirement for this function is 2.5 percent per 9,600 baud link if equipped with a 1X89 MPC card; and the maximum call processing occupancy is decreased by 2.5 percent if using a 1X89 MPC card.

Monitoring CPU real time capacity factors

There are real time capacity factors that can be monitored to determine the amount of CPU capacity that is being used, how it is being used, and how much remains available. This section describes those factors and how they can be used to learn more about the status of real time capacity for a particular time period.

Each of the following descriptions of real time factors includes a table that lists the related OMs and associated log reports.

Overhead

Call processing occupancy

Call processing occupancy is a measurement of the average percentage of CPU real time allotted to call processing that is used during the study period. A study period is usually the office call busy hour, although it can be during any other period of the day.

Table 3-1 lists the OM groups and registers that are associated with call processing occupancy.

Table 3-1
Performance indicators for CPU real time capacity

Operational measurements		Log reports
Group	**Register**	
CPUSTAT	CPSCPOCC	None
CPUSTAT	CCPAVAIL	None
OFZ	NORIG	None
OFZ	NIN	None

Evaluating call processing occupancy

Call processing occupancy can be evaluated for different purposes. These purposes may include: determining why occupancy is high or low for a particular short period of time, verifying estimated average work time, verifying predicted real time use derived from the REAL::TIME tool, and monitoring the effect of new services or features.

Evaluating abnormally high or low occupancy

If the percentage of call processing occupancy for a given number of call attempts continues to remain lower that expected, it may be due to a lower average work time than forecast. The reverse may be true if the percentage of occupancy remains higher than forecast. The average work time can be calculated by the following formula:

$$AWT = \frac{\text{3,600,000 ms x recorded \% occupancy}}{\text{OFZ_NORIG + OFZ_NIN}}$$

In this calculation, 3,600,000 ms represents the total number of milliseconds in an hour. This value is then multiplied by the recorded percent occupancy from CPUSTAT_CPSCPOCC. The result is divided by the sum of the number of originations (OFZ_NORIG) and number of incoming attempts (OFZ_NIN) recognized by the CPU. The value derived is the average work time for calls processed by the CPU during the study period.

Evaluating the CPU call rate

The purpose of monitoring the call rate is to see if it is tracking the projected call rate for the engineered period. This factor becomes more important as an NT40 CPU nears capacity and an upgrade to SuperNode (DMS-Core) is required, especially if the switch is processor limited.

Total call attempts = OFZ_NORIGATT + OFZ_NIN

CPU call types

Introduction

This chapter provides DMS-100 switch call types which are described in the chapter listing CPU call times for individual BCS cycles. BCS29 through BCS34 CPU call time values are provided in the following chapter. The BCS sections include CPU call times and office models containing call types that are representative of typical operating company offices.

Call type description

The following listing provides a detailed description of each call type as measured by BNR and tracked by NTI systems engineering. The call times for each call type are measured and published at each BCS interval. These call time types should be reviewed when examining the office models given in the individual BCS sections.

The call types within this section are listed in numeric order according to their test case numbers. The listing is further divided into two sections; local/toll (Table 4-1) and TOPS (Table 4-2). These call types are current through BCS31 and will be updated as new call types are added.

Local/toll call types

Table 4-1xxx
Local/toll call types

Call type	**005**
Description	POTS DP 1FR line - LAMA trunk
Options/features	PIC and DGT
Billing	yes
Scenario	POTS DP 1FR line dials 1+10 digits IT line goes off-hook for answer POTS DP 1FR line goes on-hook LAMA trunk goes on-hook

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**011**
Description	POTS DTMF1FR line - LAMA trunk
Options/features	PIC and DGT
Billing	yes
Scenario	POTS DTMF1FR line dials 1+10 digits IT line goes off-hook for answer POTS DTMF 1FR line goes on-hook LAMA trunk goes on-hook
Call type	**014**
Description	POTS 1FR line - false start
Options/features	PIC and DGT
Billing	no
Scenario	POTS 1FR line goes off-hook POTS 1FR line goes on-hook, no digits
Call type	**015**
Description	POTS DTMF 1MR line - POTS 1FR line
Options/features	PIC and DGT - PIC and DGT
Billing	yes
Scenario	POTS 1MR line dials 7 digits TO trunk goes off-hook for answer POTS 1MR line goes on-hook TO line goes on-hook
Call type	**016**
Description	POTS DTMF 1MR line - EAS trunk
Options/features	PIC and DGT
Billing	yes
Scenario	POTS DTMF 1MR line dials 7 digits EAS trunk goes off-hook for answer POTS DTMF 1MR line goes on-hook EAS trunk goes on-hook
Call type	**018**
Description	Coin DTMF line - busy line

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**018**
Options/features	PIC and DGT - PIC and DGT
Billing	no
Scenario	coin line goes off-hook and deposits coin coin line receives 7 digits coin line receives busy signal coin line goes on-hook coin is returned
Call type	**019**
Description	Coin DTMF line - POTS 1FR line
Options/features	PIC and DGT - PIC and DGT
Signaling	DT
Billing	yes
Scenario	coin line goes off-hook and deposits coin coin line dials 7 digits POTS 1FR line goes off-hook for answer POTS 1FR line goes on-hook coin is collected
Call type	**020**
Description	Coin DTMF line - EAS trunk
Options/features	PIC and DGT
Billing	yes
Scenario	coin line goes off-hook and deposits coin coin line dials 7 digits TO trunk goes off-hook for answer coin is collected TO trunk goes on-hook
Call type	**031**
Description	MF trunk - INWATS line
Options/features	PIC and DGT
Billing	yes

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**031**
Scenario	IT trunk goes off-hook and dials 7 digits INWATS line goes off-hook for answer IT trunk goes on-hook INWATS line goes on-hook
Call type	**046**
Description	MF INCAMA trunk - POTS 1FR line
Options/features	PIC and DGT
Billing	yes
Scenario	SC trunk goes off-hook and dials 7 digits POTS 1FR line goes off-hook for answer SC trunk goes on-hook POTS 1FR line goes on-hook
Call type	**048**
Description	MF INCAMA trunk - trunk
Options/features	
Billing	yes
Scenario	SC trunk goes off-hook and dials 10 digits IT trunk goes off-hook for answer SC trunk goes on-hook IT trunk goes on-hook
Call type	**052**
Description	OUTWATS line - LAMA trunk
Options/features	PIC and DGT
Billing	yes
Scenario	OUTWATS line goes off-hook and dials 10 digits IT trunk goes off-hook for answer OUTWATS line goes on-hook IT trunk goes on-hook
Call type	**054**
Description	PBX DOD trunk - POTS 1FR line
Options/features	PIC and DGT
Billing	no

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**054**
Scenario	PX trunk goes off-hook and dials 7 digits POTS 1FR line goes off-hook for answer PX trunk goes on-hook POTS 1FR line goes on-hook
Call type	**055**
Description	PBX DOD trunk - LAMA trunk
Options/features	
Billing	yes
Scenario	PX trunk goes off-hook and dials 1+10 digits IT trunk goes off-hook for answer PX trunk goes on-hook IT trunk goes on-hook
Call type	**308**
Description	POTS DTMF 1MR line - busy line
Options/features	PIC and DGT - PIC and DGT
Billing	no
Scenario	POTS 1MR line goes off-hook and dials 7 digits POTS 1MR line receives busy signal POTS 1MR line goes on-hook
Call type	**309**
Description	Enhanced OUTWATS - ATC trunk
Options/features	PIC and DGT
Billing	yes
Scenario	enhanced OUTWATS DT line goes off-hook and dials 1+10 digits ATC trunk receives ANI digits ATC trunk goes off-hook for answer enhanced OUTWATS line goes on-hook ATC trunk goes on-hook
Call type	**360**
Description	FGC 1+10D - IC (PIC)
Options/features	PIC and DGT

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**360**
Billing	yes
Scenario	enhanced OUTWATS DT line goes off-hook and dials 1+10 digits ATC trunk receives ANI digits ATC trunk goes off-hook for answer enhanced OUTWATS line goes on-hook ATC trunk goes on-hook
Call type	**378**
Description	FGC 1+10D - AT (PIC)
Options/features	PIC and DGT
Billing	yes
Scenario	POTS 1FR line goes off-hook and dials 1+10 digits IT trunk goes off-hook for answer POTS 1FR line goes on-hook IT trunk goes on-hook
Call type	**401**
Description	FGD 1+7D - IC (OCS on, PIC)
Options/features	PIC and DGT
Billing	yes
Scenario	POTS 1FR line goes off-hook and dials 1+7 digits ATC trunk goes off-hook for answer POTS 1FR line goes on-hook ATC trunk goes on-hook
Call type	**402**
Description	FGD 1+10D - AT (OCS on, PIC)
Options/features	PIC and DGT
Billing	yes
Scenario	POTS 1FR line goes off-hook and dials 1+10 digits IT trunk goes off-hook for answer POTS 1FR line goes on-hook IT trunk goes on-hook

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**453**
Description	IC trunk - POTS 1FR line
Options/features	PIC and DGT
Billing	yes
Scenario	ATC trunk goes off-hook and dials 7 digits POTS 1FR line goes off-hook for answer POTS 1FR line goes on-hook IT trunk goes on-hook
Call type	**455**
Description	IT trunk - IC carrier trunk
Options/features	
Billing	no
Scenario	IT trunk goes off-hook and dials 6 digit code for ATC trunk ATC trunk goes off-hook for answer IT trunk goes on-hook ATC trunk goes on-hook
Call type	**456**
Description	IC carrier trunk - IT trunk
Options/features	
Billing	yes
Scenario	ATC trunk goes off-hook and dials 10 digits IT trunk goes off-hook for answer IT trunk goes on-hook ATC trunk goes on-hook
Call type	**577**
Description	POTS DTMF line - ISUP trunk
Options/features	PIC and DGT
Billing	no
Scenario	POTS 1FR line goes off-hook and dials 7 digits ISUP trunk goes off-hook for answer POTS 1FR line goes on-hook

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**578**
Description	MDC DTMF line - ISUP trunk
Options/features	PIC and DGT
Billing	no
Scenario	MDC line goes off-hook and dials 9+7 digits ISUP trunk goes off-hook for answer MDC line goes on-hook
Call type	**579**
Description	POTS DTMF line - ISUP trunk
Options/features	PIC and DGT
Billing	yes
Scenario	POTS 1MR line goes off-hook and dials 7 digits ISUP trunk goes off-hook for answer POTS 1MR line goes on-hook
Call type	**580**
Description	ISUP trunk - POTS DTMF line
Options/features	PIC and DGT
Billing	no
Scenario	ISUP trunk goes off-hook and dials 7 digits POTS 1FR line goes off-hook for answer ISUP trunk goes on-hook POTS 1FR line goes on-hook
Call type	**581**
Description	ISUP trunk - MDC DTMF line
Options/features	PIC and DGT
Billing	no
Scenario	ISUP trunk goes off-hook and dials 9+7 digits MDC line goes off-hook for answer ISUP trunk goes on-hook MDC line goes on-hook
Call type	**582/585**
Description	MDC line - ISUP trunk - EBS with display

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**582/585**
Options/features	PIC and DGT - PIC and DGT; network name and number display
Billing	no
Scenario	MDC line goes off-hook and dials 9+7 digit call via ISUP trunk EBS with display displays name and number of MDC line EBS with display goes off-hook for answer MDC line goes on-hook EBS with display goes on-hook
Call type	**583/598**
Description	MDC line - ISUP trunk - EBS with display
Options/features	PIC and DGT and network ring again - PIC and DGT
Billing	no
Scenario	EBS with display goes off-hook and dials 9+7 digits EBS with display detects busy MDC line EBS with display presses ring again key EBS with display goes on-hook MDC line goes on-hook EBS with display notified busy line is idle EBS with display goes off-hook and presses RA key MDC line goes off-hook for answer EBS with display goes on-hook MDC line goes on-hook
Call type	**584/599**
Description	MDC line - ISUP trunk - EBS with display
Options/features	PIC and DGT - PIC and DGT; network name and number display
Billing	no
Scenario	MDC line goes off-hook and dials 9+7 digits call via ISUP trunk EBS with display displays number of MDC line EBS with display goes off-hook for answer MDC line goes on-hook EBS with display goes on-hook

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**805**
Description	MDC line - false start
Options/features	PIC and DGT
Billing	no
Scenario	MDC line goes off-hook MDC line goes on-hook, no digits dialed
Call type	**850**
Description	Attendant - MDC DTMF line (SCG)
Options/features	PIC and DGT
Billing	no
Scenario	attendant presses console key and dials 3 digits MDC line goes off-hook for answer console releases MDC line goes on-hook
Call type	**854**
Description	MF POTS trunk - MDC DTMF line
Options/features	PIC and DGT
Billing	no
Scenario	IT trunk goes off-hook and dials 7 digits MDC line goes off-hook for answer IT line goes on-hook MDC line goes on-hook
Call type	**855**
Description	MDC MF trunk - MDC DTMF line (SCG)
Options/features	PIC and DGT
Billing	no
Scenario	IBNT2 trunk goes off-hook and dials 3 digits MDC line goes off-hook for answer IBNT2 line goes on-hook
Call type	**856**
Description	MDC DTMF FX trunk - MDC DTMF line (SCG)

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**856**
Options/features	PIC and DGT
Billing	no
Scenario	FX trunk goes off-hook and dials 7 digits MDC line goes off-hook for answer FX trunk goes on-hook MDC line goes on-hook
Call type	**857**
Description	MDC DTMF line - POTS 1FR 2nd dial tone
Options/features	PIC and DGT - PIC and DGT
Billing	no
Scenario	MDC line goes off-hook and dials 9 digits MDC line gets second dial tone MDC line dials 7 digits POTS 1FR line goes off-hook for answer POTS 1FR line goes on-hook MDC line goes on-hook
Call type	**858**
Description	MDC DTMF line - abandon after 2 digits
Options/features	PIC and DGT
Billing	no
Scenario	MDC line goes off-hook and dials 2 digits MDC line abandons call and goes on-hook
Call type	**859**
Description	POTS DTMF 1FR line - MDC DTMF line
Options/features	PIC and DGT - PIC and DGT
Billing	no
Scenario	POTS 1FR line goes off-hook and dials 7 digits MDC line goes off-hook for answer POTS 1FR line goes on-hook MDC line goes on-hook
Call type	**861**
Description	EBS without display - attendant

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**861**
Options/features	PIC and DGT
Billing	no
Scenario	EBS without display goes off-hook and dials 0 attendant console connects speech path complete attendant console releases EBS without display goes on-hook
Call type	**862**
Description	EBS without display - MDC DTMF line (SCG)
Options/features	PIC and DGT - PIC and DGT
Billing	no
Scenario	EBS without display goes off-hook and dials 3 digits MDC line goes off-hook for answer MDC line goes on-hook EBS without display goes on-hook
Call type	**863**
Description	EBS without display - EBS without display
Options/features	PIC and DGT - PIC and DGT
Billing	no
Scenario	EBS without display goes off-hook and dials 3 digits called EBS without display goes off-hook for answer called EBS without display goes on-hook calling EBS without display goes on-hook
Call type	**864**
Description	EBS without display - 1FR 2nd dial tone
Options/features	PIC and DGT - PIC and DGT
Billing	no
Scenario	EBS without display goes off-hook and dials 9 EBS without display detects 2nd dial tone EBS without display dials 7 digits POTS 1FR line goes off-hook for answer POTS 1FR line goes on-hook EBS without display goes on-hook

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**868**
Description	MDC MF trunk - Attendant
Options/features	
Billing	no
Scenario	IBNT2 trunk goes off-hook and dials 0 attendant console connects speech path is complete attendant console releases IBNT2 trunk goes on-hook
Call type	**873**
Description	MDC DTMF line - EBS without display
Options/features	PIC and DGT - PIC and DGT
Billing	no
Scenario	MDC line goes off-hook and dials 3 digits EBS without display goes off-hook for answer EBS without display goes on-hook MDC line goes on-hook
Call type	**874**
Description	MDC DTMF line - MDC MF trunk
Options/features	PIC and DGT
Billing	yes
Scenario	MDC line goes off-hook and dials 7+10 digits IBNT2 trunk goes off-hook for answer IBNT2 trunk goes on-hook MDC line goes on-hook
Call type	**875**
Description	EBS without display - FX DTMF trunk
Options/features	PIC and DGT
Billing	no
Scenario	EBS without display goes off-hook and dials 9+7 digits FX trunk goes off-hook for answer EBS without display goes on-hook FX trunk goes on-hook

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**876**
Description	EBS without display - MDC MF trunk
Options/features	PIC and DGT
Billing	yes
Scenario	EBS without display goes off-hook and dials 7+10 digits IBNT2 trunk goes off-hook for answer IBNT2 trunk goes on-hook EBS without display goes on-hook
Call type	**879**
Description	POTS MF trunk - EBS without display
Options/features	PIC and DGT
Billing	no
Scenario	IF trunk goes off-hook and dials 7 digits EBS without display goes off-hook for answer EBS without display goes on-hook IT trunk goes on-hook
Call type	**881**
Description	FGB DP MDC line - AT MF
Options/features	PIC and DGT
Billing	no
Scenario	MDC line goes off-hook and dials 9+7 digits OC trunk goes off-hook for answer MDC line goes on-hook OC trunk goes on-hook
Call type	**882**
Description	FGC DTMF MDC line - AT MF
Options/features	PIC and DGT
Billing	yes

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**882**
Scenario	MDC line goes off-hook and dials 9 for outside access MDC line dials 10XXX to select carrier MDC line dials 1+10 digits IT trunk goes off-hook for answer MDC line goes on-hook IT trunk goes on-hook
Call type	**883**
Description	FGD DTMF MDC line - AT MF
Options/features	PIC and DGT
Billing	yes
Scenario	MDC line goes off-hook and dials 9 for outside access MDC line dials 10XXX to select carrier MDC line dials 1+10 digits IT trunk goes off-hook for answer MDC line goes on-hook IT trunk goes on-hook
Call type	**884**
Description	MDC DTMF intraLATA - TOLL (MF trunk)
Options/features	PIC and DGT
Billing	yes
Scenario	MDC line goes off-hook and dials 9+10 digits IT trunk goes off-hook for answer MDC line goes on-hook IT line goes on-hook
Call type	**885**
Description	EBS with display FGD - AT MF
Options/features	PIC and DGT
Billing	yes

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**885**
Scenario	EBS with display goes off-hook and dials 9 for outside access EBS with display dials 10XXX to select carrier EBS with display dials 1+10 digits IT trunk goes off-hook for answer EBS with display goes on-hook IT trunk goes on-hook
Call type	**886**
Description	E800 EAEO DTMF MDC line - IC trunk
Options/features	PIC and DGT
Billing	yes
Scenario	MDC line goes off-hook and dials 9 for outside access MDC line dials 1+800+7 digits database is accessed for terminating number ATC trunk goes off-hook for answer MDC line goes on-hook ATC line goes on-hook
Call type	**888**
Description	MDC DTMF line - MDC line
Options/features	PIC and DGT - PIC and DGT
Billing	yes
Scenario	MDC line goes off-hook and dials 3 digits called MDC line goes off-hook for answer called MDC line goes on-hook calling MDC line goes on-hook
Call type	**889**
Description	MDC DTMF line - EAS trunk
Options/features	PIC and DGT
Billing	no
Scenario	MDC line goes off-hook and dials 9+7 digits TO trunk goes off-hook for answer TO trunk goes on-hook MDC line goes on-hook

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**890**
Description	EBS with display - Partial dial (2 digits)
Options/features	PIC and DGT
Billing	no
Scenario	EBS with display goes off-hook and dials 2 digits EBS with display goes on-hook to abandon
Call type	**891**
Description	EBS with display - EBS with display
Options/features	PIC and DGT - PIC and DGT
Billing	no
Scenario	EBS with display goes off-hook and dials 3 digits called EBS with display goes off-hook for answer called EBS with display goes on-hook calling EBS with display goes on-hook
Call type	**892**
Description	EBS with display - EAS trunk
Options/features	PIC and DGT
Billing	no
Scenario	EBS with display goes off-hook and dials 9+7 digits TO trunk goes off-hook for answer TO trunk goes on-hook EBS with display goes on-hook
Call type	**893**
Description	EBS with display - LAMA trunk
Options/features	PIC and DGT
Billing	yes
Scenario	EBS with display goes off-hook and dials 9+10 digits IT trunk goes off-hook for answer EBS with display goes on-hook IT trunk goes on-hook

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**894**
Description	EBS with display - EBS without display
Options/features	PIC and DGT - PIC and DGT
Billing	no
Scenario	EBS with display goes off-hook and dials 3 digits EBS without display goes off-hook for answer EBS without display goes on-hook EBS with display goes on-hook
Call type	**908**
Description	Coin DTMF line - (1+800) trunk
Options/features	PIC and DGT
Billing	yes
Scenario	coin line goes off-hook and deposits coin coin line dials 1+800+7 digits database is checked for terminating number IT trunk goes off-hook coin line goes on-hook IT trunk goes on-hook coin collected
Call type	**910**
Description	FGB DTMF coin line - MF AT
Options/features	PIC and DGT
Billing	no
Scenario	coin line goes off-hook, deposits coin and dials 9501XXX for carrier OC trunk goes off-hook for answer coin line goes on-hook OC trunk goes on-hook coin is collected
Call type	**914**
Description	PBX DOD DTMF line - non-LAMA MF EAS
Options/features	PIC and DGT
Billing	no

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**914**
Scenario	POTS 1FR line goes off-hook and dials 7 digits TO trunk goes off-hook for answer POTS line goes on-hook OC trunk goes on-hook
Call type	**916**
Description	FGB PBX DOD DTMF line - MF AT
Options/features	PIC and DGT
Billing	yes
Scenario	POTS 1FR line goes off-hook and dials 1+10 digits IT trunk goes off-hook for answer POTS 1FR line goes on-hook IT trunk goes on-hook
Call type	**917**
Description	FGB PBX DOD DTMF line - MF AT
Options/features	PIC and DGT
Billing	yes
Scenario	POTS 1FR line goes off-hook and dials 10XXX for carrier, then dials 1+10 digits IT trunk goes off-hook for answer POTS 1FR line goes on-hook IT trunk goes on-hook
Call type	**918**
Description	FGC OUTWATS DTMF line - MF AT
Options/features	PIC and DGT
Billing	yes
Scenario	OUTWATS line goes off-hook and dials 1+10 digits IT trunk goes off-hook for answer OUTWATS line goes on-hook IT trunk goes on-hook
Call type	**919**
Description	FGC LEAS MF INC trunk - IC trunk
Options/features	

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**919**
Billing	yes
Scenario	SC trunk goes off-hook and dials carrier, then 1+10 digits ATC trunk goes off-hook for answer SC trunk goes on-hook ATC trunk goes on-hook
Call type	**920**
Description	FGD LEAS MF INC trunk - IC trunk
Options/features	
Billing	yes
Scenario	SC trunk goes off-hook and dials carrier, then 1+10 digits ATC trunk goes off-hook for answer ATC trunk goes on-hook SC trunk goes on-hook
Call type	**921**
Description	FGD LEAS MF INC trunk - tandem MF IT
Options/features	
Billing	yes
Scenario	SC trunk goes off-hook and dials carrier, then 1+10 digits IT trunk goes off-hook for answer IT trunk goes on-hook SC trunk goes on-hook
Call type	**922**
Description	POTS DTMF 1FR (E800) - IC (database query)
Options/features	PIC and DGT
Billing	yes
Scenario	POTS 1FR line goes off-hook and dials 1+800+7 digits database is queried ATC trunk goes off-hook for answer POTS 1FR line goes on-hook ATC trunk goes on-hook

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**924**
Description	AT (E800) - IC trunk (database query)
Options/features	
Billing	yes
Scenario	IT trunk goes off-hook and dials FGD access code and 800+7 digits database is queried called IT trunk goes off-hook for answer calling IT trunk goes on-hook called IT trunk goes on-hook
Call type	**927**
Description	POTS 1FR (E800) - reorder (database query)
Options/features	PIC and DGT
Billing	no
Scenario	POTS 1FR line goes off-hook and dials 1+800+7 digits database is queried there is no response from database POTS 1FR line goes on-hook
Call type	**928**
Description	POTS 1FR (E800) - AT (database query)
Options/features	PIC and DGT
Billing	yes
Scenario	POTS 1FR line goes off-hook and dials 1+800+7 digits database is queried IT trunk goes off-hook for answer POTS 1FR line goes on-hook IT trunk goes on-hook
Call type	**929**
Description	AT (E800) - IT trunk (database query)
Options/features	
Billing	yes

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**929**
Scenario	IT trunk goes off-hook and dials carrier, then dials 800+7 digits database is queried IT trunk goes off-hook for answer calling IT trunk goes on-hook called IT trunk goes on-hook
Call type	**943**
Description	AT (E800) - reorder (database query)
Options/features	
Billing	no
Scenario	IT trunk goes off-hook and dials carrier, then dials 800+7 digits database is queried, but no response IT trunk goes on-hook
Call type	**946**
Description	MF trunk - abandon (no start signal)
Options/features	
Billing	no
Scenario	ATC trunk goes off-hook and dials 5 digits ATC trunk goes on-hook to abandon
Call type	**947**
Description	POTS DP 1FR line - POTS 1FR line
Options/features	PIC and DGT - PIC and DGT
Billing	no
Scenario	POTS 1FR line goes off-hook and dials 7 digits called 1FR line goes off-hook for answer calling 1FR line goes on-hook called 1FR line goes on-hook
Call type	**948**
Description	POTS 1FR DTMF line - busy 1FR
Options/features	PIC and DGT - PIC and DGT
Billing	no

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**948**
Scenario	POTS 1FR line goes off-hook and dials 7 digits POTS 1FR line receives busy signal POTS 1FR line goes on-hook
Call type	**949**
Description	POTS 1FR line - operator trunk
Options/features	PIC and DGT
Billing	no
Scenario	POTS 1FR line goes off-hook and dials 0+10 digits RC trunk goes off-hook for answer POTS 1FR line goes on-hook RC trunk goes on-hook
Call type	**950**
Description	POTS 1MR DTMF line - POTS 1MR line
Options/features	PIC and DGT - PIC and DGT
Billing	yes
Scenario	POTS 1MR line goes off-hook and dials 7 digits called 1MR line goes off-hook for answer calling 1MR line goes on-hook called 1MR line goes on-hook
Call type	**951**
Description	POTS 1FR line - abandon after 5 digits
Options/features	PIC and DGT
Billing	no
Scenario	POTS 1FR line goes off-hook and dials 5 digits POTS 1FR line goes on-hook and abandons
Call type	**952**
Description	Coin line - direct to IC FGC trunk
Options/features	PIC and DGT
Billing	yes

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**952**
Scenario	coin line goes off-hook and deposits coin coin line dials 1+10 digits ATC trunk goes off-hook for answer coin line goes on-hook ATC trunk goes on-hook coin is collected
Call type	**953**
Description	Coin line - Via AT to IC FGC trunk
Options/features	PIC and DGT
Billing	yes
Scenario	coin line goes off-hook and deposits coin coin line dials 1+10 digits IT trunk goes off-hook for answer coin line goes on-hook IT trunk goes on-hook coin is collected
Call type	**954**
Description	Coin line - direct to IC FGD trunk
Options/features	PIC and DGT
Billing	yes
Scenario	coin line goes off-hook and deposits coin coin line dials 1+10 digits ATC trunk goes off-hook for answer coin line goes on-hook ATC trunk goes on-hook coin is collected
Call type	**955**
Description	Coin line - Via AT to IC FGD trunk
Options/features	PIC and DGT
Billing	yes

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**955**
Scenario	coin line goes off-hook and deposits coin coin line dials 1+10 digits IT trunk goes off-hook for answer coin line goes on-hook IT line goes on-hook coin is collected
Call type	**958**
Description	MF PX DOD trunk - Direct to IC trunk
Options/features	
Billing	yes
Scenario	PX trunk goes off-hook and dials carrier code and 1+10 digits ATC trunk goes off-hook for answer PX trunk goes on-hook ATC trunk goes on-hook
Call type	**959**
Description	MF PX DOD trunk - Via AT trunk to IC trunk
Options/features	
Billing	yes
Scenario	PX trunk goes off-hook and dials carrier code +10 digits ATC trunk goes off-hook for answer PX trunk goes on-hook ATC trunk goes on-hook
Call type	**961**
Description	MF PX DOD trunk - EAS MF trunk
Options/features	
Billing	no
Scenario	PX trunk goes off-hook and dials 7 digits TO trunk goes off-hook for answer PX trunk goes on-hook TO trunk goes on-hook

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**962**
Description	POTS DTMF 1FR line - POTS 1MR line
Options/features	PIC and DGT - PIC and DGT
Billing	no
Scenario	POTS 1FR line goes off-hook and dials 7 digits POTS 1MR line goes off-hook for answer POTS 1FR line goes on-hook POTS 1MR line goes on-hook
Call type	**963**
Description	POTS DTMF 1FR line - MF PBX DID trunk
Options/features	PIC and DGT
Billing	no
Scenario	POTS 1FR line goes off-hook and dials 7 digits PX trunk goes off-hook for answer POTS 1FR line goes on-hook PX trunk goes on-hook
Call type	**966**
Description	POTS DTMF 1FR line - BLDN treatment
Options/features	PIC and DGT
Billing	no
Scenario	POTS 1FR line goes off-hook and dials 7 digits POTS 1FR line receives announcement that the line does not exist POTS 1FR line goes on-hook
Call type	**967**
Description	POTS DTMF 1FR line - MF operator trunk
Options/features	PIC and DGT
Billing	no
Scenario	POTS 1FR line goes off-hook and dials carrier code +0 for operator OP trunk goes off-hook for answer POTS 1FR line goes on-hook OP trunk goes on-hook

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**974**
Description	POTS DTMF 1MR line - via AT to IC FGD
Options/features	PIC and DGT
Billing	yes
Scenario	POTS 1MR line goes off-hook and dials 1+10 digits IT trunk goes off-hook for answer POTS 1MR line goes on-hook
Call type	**979**
Description	POTS DP 2FR line - POTS 1FR line
Options/features	PIC - PIC and DGT
Billing	no
Scenario	POTS 2FR line goes off-hook and dials 7 digits POTS 1FR line goes off-hook for answer POTS 2FR line goes on-hook POTS 1FR line goes on-hook
Call type	**982**
Description	Coin line - operator trunk
Options/features	PIC and DGT
Billing	yes
Scenario	coin line goes off-hook, deposits coin and dials 00 OP trunk goes off-hook for answer coin line goes on-hook OP trunk goes on-hook coin is collected
Call type	**986**
Description	DTMF PBX DOD (FX) - operator trunk
Options/features	
Billing	no
Scenario	PX trunk goes off-hook and dials carrier code +0 for operator OP trunk send ANI digits OP trunk goes off-hook for digits PX trunk goes on-hook OP trunk goes on-hook

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**987**
Description	PBX DOD trunk - operator trunk
Options/features	
Billing	no
Scenario	PX trunk goes off-hook and dials carrier code +0 for operator OP trunk goes off-hook for answer PX trunk goes on-hook OP trunk goes on-hook
Call type	**988**
Description	OUTWATS line - direct to IC FGB trunk
Options/features	PIC and DGT
Billing	yes
Scenario	OUTWATS line goes off-hook and dials 9501XXX ATC trunk goes off-hook for answer OUTWATS line goes on-hook ATC trunk goes on-hook
Call type	**989**
Description	OUTWATS line - direct to IC FGD trunk
Options/features	PIC and DGT
Billing	yes
Scenario	OUTWATS line goes off-hook and dials carrier code +10 digits ATC trunk goes off-hook for answer OUTWATS line goes on-hook ATC trunk goes on-hook
Call type	**990**
Description	IC trunk - POTS 1FR line
Options/features	PIC and DGT
Billing	yes
Scenario	ATC trunk goes off-hook and dials 7 digits POTS 1FR line goes off-hook for answer ATC trunk goes on-hook POTS 1FR line goes on-hook

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**991**
Description	IC trunk - MF PBX DID trunk (PX)
Options/features	
Billing	yes
Scenario	ATC trunk goes off-hook and dials 7 digits PX trunk goes off-hook for answer ATC trunk goes on-hook PX trunk goes on-hook
Call type	**993**
Description	POTS 1FR DTMF line - abandon after 6 digits
Options/features	PIC and DGT
Billing	no
Scenario	POTS 1FR line goes off-hook and dials 6 digits POTS 1FR line goes on-hook abandoning the call
Call type	**994**
Description	POTS 1FR DTMF line - POTS 1FR line
Options/features	PIC and DGT - PIC and DGT
Billing	no
Scenario	POTS 1FR line goes off-hook and dials 7 digits called POTS 1FR line goes off-hook for answer calling POTS 1FR line goes on-hook called POTS 1FR line goes on-hook
Call type	**995**
Description	POTS 1FR DTMF line - EAS trunk
Options/features	PIC and DGT
Billing	no
Scenario	POTS 1FR line goes off-hook and dials 7 digits TO trunk goes off-hook for answer POTS 1FR line goes on-hook TO trunk goes on-hook
Call type	**996**
Description	MF IT trunk - POTS 1FR line

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**996**
Options/features	PIC and DGT
Billing	no
Scenario	MF IT trunk goes off-hook and dials 7 digits POTS 1FR line goes off-hook for answer MF IT trunk goes on-hook POTS 1FR line goes on-hook
Call type	**997**
Description	MF tandem INCAMA trunk - MF tandem trunk
Options/features	
Billing	no
Scenario	TO trunk goes off-hook and dials 7 digits called TO trunk goes off-hook to answer calling TO trunk goes on-hook called TO trunk goes on-hook
Call type	**998**
Description	MF IT trunk - IT trunk
Options/features	
Billing	no
Scenario	IT trunk goes off-hook and dials 7 digits called IT trunk goes off-hook for answer calling IT trunk goes on-hook called IT goes on-hook
Call type	**999**
Description	ATC trunk - busy
Options/features	
Billing	yes
Scenario	ATC trunk goes off-hook and dials 7 digits ATC trunk receives busy signal ATC trunk goes on-hook
Call type	**1059**
Description	POTS DTMF 1FR line - EBS with display

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Table 4-1xxx
Local/toll call types (continued)

Call type	**1059**
Options/features	PIC and DGT - PIC and DGT
Billing	no
Scenario	POTS 1FR line off-hook, dials 7 digits EBS with display off-hook for answer POTS 1FR line on-hook EBS with display on-hook
Call type	**1065**
Description	1FR line (all CCF assigned) - 1FR line
Options/features	PIC, DGT, 3WC, SC1, CWT, CFW - PIC, DGT
Billing	no
Scenario	1FR line with CCF assigned, goes off-hook and dials 7 digits called 1FR line goes off-hook for answer calling 1FR line goes on-hook called 1FR line goes on-hook
Call type	**1066**
Description	1FR line (3WC activated) - 1FR line
Options/features	PIC, DGT, 3WC, SC1, CWT, CFW - PIC, DGT
Billing	yes
Scenario	1FR line (A) with CCF assigned goes off-hook and dials 7 digits 1FR line (B) goes off-hook for answer 1FR line (A) flashes and dials 7 digits for 3WC 1FR line (C) goes off-hook for answer 1FR line (A) flashes to get all three lines active 1FR line (C) goes on-hook 1FR line (B) goes on-hook 1FR line (A) goes on-hook
Call type	**1067**
Description	1FR line (SC1 activated) - 1FR line
Options/features	PIC, DGT, 3WC, SC1, CWT, CFW - PIC, DGT
Billing	no

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**1067**
Scenario	1FR line with CCF goes off-hook and dials 8# for speed call 1 called 1FR line goes off-hook for answer calling 1FR line goes on-hook called 1FR line goes on-hook
Call type	**1070**
Description	1FR line - 1FR line (CFU assigned)
Options/features	PIC, DGT - PIC, DGT, CFW
Billing	no
Scenario	1FR line goes off-hook and dials 7 digits called 1FR line with CFU goes off-hook for answer calling 1FR line goes on-hook called 1FR line goes on-hook
Call type	**1072**
Description	1FR line - 1FR line (all CFU assigned)
Options/features	PIC, DGT - PIC, DGT, 3WC, SC1, CWT, CFW
Billing	no
Scenario	1FR line goes off-hook and dials 7 digits called 1FR line (CCF assigned) goes off-hook for answer calling 1FR line goes on-hook called 1FR line goes on-hook
Call type	**1073**
Description	1FR line - 1FR line (CFU activated)
Options/features	PIC, DGT - PIC, DGT, 3WC, SC1, CWT, CFW
Billing	no
Scenario	POTS 1FR line goes off-hook and dials 7 digits POTS 1FR line with POTS CCF assigned has ring splash for call forwarding to 1FR line (C) 1FR line (C) goes off-hook for answer calling 1FR line goes on-hook 1FR line (C) goes on-hook

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Table 4-1xxx
Local/toll call types (continued)

Call type	**1074**
Description	1FR line - 1FR line (CWT activated)
Options/features	PIC, DGT - PIC, DGT, 3WC, SC1, CWT, CFW
Billing	no
Scenario	POTS 1FR line (A) goes off-hook and dials 7 digits POTS 1FR line (B) with POTS CCF assigned goes off-hook for answer POTS 1FR line (C) goes off-hook and dials POTS 1FR line (B) POTS 1FR line (B) receives CWT tone POTS 1FR line (B) flashes to answer call waiting POTS 1FR line (C) goes on-hook POTS 1FR line (B) flashes to return to original call POTS 1FR line (A) goes on-hook POTS 1FR line (B) goes on-hook
Call type	**1075**
Description	MDC line - MDC line
Options/features	PIC and DGT - PIC and DGT
Billing	no
Scenario	MDC line goes off-hook and dials 3 digits called MDC line goes off-hook for answer calling MDC line goes on-hook called MDC line goes on-hook
Call type	**1085**
Description	MDC line (all CCF assigned) - MDC line
Options/features	PIC, DGT, 3WC, SC1, CWT, SC2, CFB, CFD, CFU, CXR, CH - PIC, DGT
Billing	no
Scenario	MDC line with CCF assigned goes off-hook and dials 3 digits called MDC line goes off-hook for answer calling MDC line goes on-hook called MDC line goes on-hook
Call type	**1086**
Description	MDC line (3WC activated) - MDC line

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**1086**
Options/features	PIC, DGT, 3WC, SC1, CWT, SC2, CFB, CFD, CFU, CXR, CH - PIC, DGT
Billing	yes
Scenario	MDC line (A) with CCF assigned goes off-hook and dials 3 digits MDC line (B) goes off-hook for answer MDC line (A) flashes and dials 3 digits for 3WC MDC line (C) goes off-hook for answer MDC line (A) flashes to get all three active MDC line (C) goes on-hook MDC line (B) goes on-hook MDC line (A) goes on-hook
Call type	**1087**
Description	MDC line (SC1 activated) - MDC line
Options/features	PIC, DGT, 3WC, SC1, CWT, SC2, CFB, CFD, CFU, CXR, CH - PIC, DGT
Billing	no
Scenario	MDC line with CCF assigned goes off-hook and dials *8# for SC1 called MDC line goes off-hook for answer calling MDC line goes on-hook called MDC line goes on-hook
Call type	**1088**
Description	MDC line (SC2 activated) - MDC line
Options/features	PIC, DGT, 3WC, SC1, CWT, SC2, CFB, CFD, CFU, CXR, CH - PIC, DGT
Billing	no
Scenario	MDC line with CCF assigned goes off-hook and dials *29# for SC2 called MDC line goes off-hook for answer calling MDC line goes on-hook called MDC line goes on-hook
Call type	**1089**
Description	MDC line (CH activated) - MDC line

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**1089**
Options/features	PIC, DGT, 3WC, SC1, CWT, SC2, CFB, CFD, CFU, CXR, CH - PIC, DGT
Billing	no
Scenario	MDC line (A) with CCF assigned goes off-hook and dials 3 digits MDC line (B) line goes off-hook for answer MDC line (A) flashes and dials 447 for call hold MDC line (A) dials 447 to release call hold MDC line (B) goes on-hook MDC line (A) goes on-hook
Call type	**1092**
Description	MDC line - MDC line (CFU assigned)
Options/features	PIC, DGT - PIC, DGT, CFU
Billing	no
Scenario	MDC line goes off-hook and dials 3 digits called MDC line with CFU assigned goes off-hook for answer calling MDC line goes on-hook called MDC line goes on-hook
Call type	**1095**
Description	MDC line - MDC line (CFB assigned)
Options/features	PIC, DGT - PIC, DGT, CFB
Billing	no
Scenario	MDC line goes off-hook and dials 3 digits called MDC line with CFB assigned goes off-hook for answer calling MDC line goes on-hook called MDC line goes on-hook
Call type	**1096**
Description	MDC line - MDC line (CFD assigned)
Options/features	PIC, DGT - PIC, DGT, CFD
Billing	no

-continued-

Table 4-1xxx **Local/toll call types (continued)**	
Call type	**1096**
Scenario	MDC line goes off-hook and dials 3 digits called MDC line with CFD assigned goes off-hook for answer calling MDC line goes on-hook called MDC line goes on-hook
Call type	**1099**
Description	MDC line - MDC line (all CCF assigned)
Options/features	PIC, DGT - PIC, DGT, 3WC, SC1, CWT, CWI, SC2, CFB, CFD, CFU. CXR. CH
Billing	no
Scenario	MDC line goes off-hook and dials 3 digits called MDC line with CCF assigned goes off-hook for answer calling MDC line goes on-hook called MDC line goes on-hook
Call type	**1100**
Description	MDC line - MDC line (CFU activated)
Options/features	PIC, DGT - PIC, DGT, 3WC, SC1, CWT, CWI, SC2, CFB, CFD, CFU. CXR. CH
Billing	no
Scenario	MDC line goes off-hook and dials 3 digits called MDC line with CCF assigned has CFU activated to MDC line (C) MDC line (C) goes off-hook for answer calling MDC line goes on-hook MDC line (C) goes on-hook
Call type	**1101**
Description	MDC line - MDC line (CWT activated)
Options/features	PIC, DGT - PIC, DGT, 3WC, SC1, CWT, CWI, SC2, CFB, CFD, CFU. CXR. CH
Billing	no
-continued-	

Table 4-1xxx
Local/toll call types (continued)

Call type	**1101**
Scenario	MDC line (A) goes off-hook and dials 3 digits called MDC line (B) with CCF assigned goes off-hook for answer MDC line (C) goes off-hook and dials MDC line (B) MDC line (B) receives tone for CWT and flashes to answer MDC line (C) MDC line (C) goes on-hook MDC line (B) flashes to return to original call MDC line (A) goes on-hook MDC line (B) goes on-hook
Call type	**1102**
Description	MDC line - MDC line (CFB activated)
Options/features	PIC, DGT - PIC, DGT, 3WC, SC1, CWT, CWI, SC2, CFB, CFD, CFU. CXR. CH
Billing	no
Scenario	MDC line goes off-hook and dials 3 digits called MDC line (B) with CCF assigned has CFB activated to MDC line (C) MDC line (C) goes off-hook for answer calling MDC line goes on-hook MDC line (C) goes on-hook
Call type	**1103**
Description	MDC line - MDC line (CFD activated)
Options/features	PIC, DGT - PIC, DGT, 3WC, SC1, CWT, CWI, SC2, CFB, CFD, CFU. CXR. CH
Billing	no
Scenario	MDC line goes off-hook and dials 3 digits called MDC line (B) with CCF assigned has CFD activated to MDC line (C) MDC line (C) goes off-hook for answer calling MDC line goes on-hook MDC line (C) goes on-hook
Call type	**1104**
Description	MDC line - MDC line (CXR activated)
Options/features	PIC, DGT - PIC, DGT, 3WC, SC1, CWT, CWI, SC2, CFB, CFD, CFU. CXR. CH

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**1104**
Billing	yes
Scenario	MDC line (A) goes off-hook and dials 3 digits MDC line (B) with CCF assigned goes off-hook for answer MDC line (B) flashes and dials 3 digits to CXR to another line MDC line (C) goes off-hook for answer MDC line (B) goes on-hook connecting MDC line (A) and MDC line (C) MDC line (C) goes on-hook MDC line (A) goes on-hook
Call type	**1105**
Description	1FR line - 1FR line (3WC, SC1, CWT assigned)
Options/features	PIC, DGT - PIC, DGT, 3WC, SC1, CWT
Billing	no
Scenario	POTS 1FR line goes off-hook and dials 7 digits called POTS 1FR line with CCF goes off-hook for answer calling POTS 1FR line goes on-hook called POTS 1FR line goes on-hook
Call type	**1106**
Description	MDC line - MDC line (3WC, SC1, CWT, SC2, CH, CXR assigned)
Options/features	PIC, DGT - PIC, DGT, 3WC, SC1, SC2, CWT, CWI, CHD, CXR
Billing	no
Scenario	MDC line goes off-hook and dials 3 digits called MDC line with CCF goes off-hook for answer calling MDC line goes on-hook calling MDC line goes on-hook
Call type	**1107**
Description	MDC line (ring again activated) - MDC line
Options/features	PIC, DGT, 3WC, SC1, SC2, CWT, CWI, CH, CXR, RA, CF - PIC, DGT
Billing	no

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**1107**
Scenario	MDC line goes off-hook and dials 3 digits MDC detects busy signal MDC line flashes and dials RAG activation # MDC line goes on-hook busy line goes idle MDC line gets special ring and goes off-hook feature rings idle line and goes off-hook MDC line goes on-hook
Call type	**1108**
Description	MDC line - MDC line (call pickup activated)
Options/features	PIC, DGT - PIC, DGT, 3WC, SC1, SC2, CWT, CWI, CH, CXR, CPU, CF
Billing	no
Scenario	MDC line (A) goes off-hook and dials 3 digits MDC line (B) no answer MDC line (C) goes off-hook, dials CPU # MDC line (A) and MDC line (C) connected MDC line (C) on-hook MDC line (A) on-hook
Call type	**1200**
Description	E911 trunk - E911 tandem
Options/features	DGT
Billing	no
Scenario	E911 trunk goes off-hook and dials 911 default routing to the 1FR PSAP line POTS 1FR line goes off-hook for answer POTS 1FR line goes on-hook E911 trunk goes on-hook
Call type	**1201**
Description	FX trunk - E911 tandem
Options/features	PIC and DGT
Billing	no

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Table 4-1xxx
Local/toll call types (continued)

Call type	**1201**
Scenario	PX trunk goes off-hook and dials 911 default routing to the PSAP MDC line MDC line goes off-hook for answer MDC line goes on-hook PX trunk goes on-hook
Call type	**1202**
Description	E911 trunk - LDT PSAP via tandem
Options/features	DGT
Billing	no
Scenario	E911 trunk goes off-hook and dials 911 ANI digits are received from originator database for the PSAP line is queried MDC PSAP line goes off-hook for answer MDC line on-hook E911 trunk on-hook
Call type	**1203**
Description	E911 trunk - PSAP EBS line with originator hold
Options/features	DGT
Billing	no
Scenario	E911 trunk goes off-hook and dials 911 ANI digits are received from originator P-phone with display PSAP off-hook for answer E911 trunk goes on-hook, agents remain connected E911 trunk goes off-hook, reconnecting call E911 trunk goes on-hook P-phone goes on-hook
Call type	**1205**
Description	RES - RES (ACB, CND, COT, AR assigned to both)
Options/features	PIC, DGT, ACB, AR, CND, COT - PIC, DGT, ACB, AR, CND, COT
Billing	no

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**1205**
Scenario	RES line with CLASS features assigned goes off-hook and dials 7 digits called RES line with CLASS features assigned goes off-hook for answer calling RES line goes on-hook called RES line goes on-hook
Call type	**1206**
Description	RES line (ACB NODAL activated) - RES line
Options/features	PIC, DGT, ACB - PIC, DGT
Billing	no
Scenario	RES line (A) with ACB assigned goes off-hook and dials 7 digits RES line (A) detects busy signal RES line (A) flashes and dials 66# to activate ACB RES line (A) receives confirmation announcement RES line (A) goes on-hook RES line (B) goes on-hook RES line (A) receives ring splash RES line (A) goes off-hook RES line (B) receives ringing RES line (B) goes off-hook for answer RES line (A) goes on-hook RES line (B) goes on-hook
Call type	**1207**
Description	RES line - RES line (AR NODAL activated)
Options/features	PIC, DGT - PIC, DGT, AR
Billing	no
Scenario	RES line (A) dials RES line (B) no answer, RES line (A) goes on-hook (previous call setup not included in published call times) RES line (B) with AR feature goes off-hook and dials 69# RES line (A) goes off-hook for answer RES line (B) goes on-hook RES line (A) goes on-hook

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**1208**
Description	RES line (network ACB activated) - RES line
Options/features	PIC, DGT, ACB - PIC, DGT
Billing	yes
Scenario	RES line (A) with ACB feature goes off-hook and dials 1+10 digits call goes out over an ISUP trunk RES line (A) receives a busy signal RES line (A) flashes and dials 66# to activate ACB RES line (A) receives confirmation announcement RES line (A) goes on-hook RES line (B) goes on-hook RES line (A) receives ring splash and goes off-hook RES line (B) receives ringing and goes off-hook for answer RES line (A) goes on-hook RES line (B) goes on-hook
Call type	**1209**
Description	RES line - RES line (network AR activated)
Options/features	PIC, DGT - PIC, DGT, AR
Billing	no
Scenario	RES line (A) dials RES line (B) over an ISUP trunk no answer; RES line (A) goes on-hook previous call setup not included in published call times RES line (B) with AR feature goes off-hook and dials 69# RES line (A) goes off-hook for answer RES line (B) goes on-hook RES line (B) goes on-hook
Call type	**1210**
Description	RES line - RES line (SCRJ activated)
Options/features	PIC, DGT - PIC, DGT, SCRJ
Billing	yes
Scenario	RES line goes off-hook and dials 1+10 digits called RES line blocks the call calling RES line receives announcement calling RES line goes on-hook

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Table 4-1xxx
Local/toll call types (continued)

Call type	**1211**
Description	RES line - RES line (network SCF activated)
Options/features	PIC, DGT - PIC, DGT, SCF
Billing	yes
Scenario	RES line goes off-hook and dials 1+10 digits call goes out over SS7 trunk called RES line has SCF; call forwards to 1FR line called 1FR line goes off-hook for answer calling RES line goes on-hook called 1FR line goes on-hook
Call type	**1212**
Description	RES line - RES line (network SCA activated)
Options/features	PIC, DGT - PIC, DGT, SCA
Billing	yes
Scenario	RES line goes off-hook and dials 1+10 digits call goes out over SS7 trunk called RES line has SCA calling RES line passes SCA criteria called RES line goes off-hook for answer calling RES line goes on-hook called RES line goes on-hook
Call type	**1213**
Description	RES line - RES line (network DRCW activated)
Options/features	PIC, DGT - PIC, DGT, DRCW
Billing	yes
Scenario	RES line goes off-hook and dials 1+10 digits call goes out over SS7 trunk called RES line has SCA calling RES line passes SCA criteria called RES line goes off-hook for answer calling RES line goes on-hook called RES line goes on-hook
Call type	**1214**
Description	RES line - RES line (DRCW activated)
Options/features	PIC, DGT - PIC, DGT, COT

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**1214**
Billing	no
Scenario	base RES line-RES line call not included in timing called RES line with COT goes off-hook and dials feature activation 57# log is sent to central office RES line goes on-hook
Call type	**1215**
Description	RES line (CNDB activated) - RES line
Options/features	PIC, DGT, CNDB - PIC, DGT
Billing	no
Scenario	RES line off-hook, dials 67# to activate calling number displays blocking calling line detects special dial tone and dials 7 digits called RES line does not receive calling digits, goes off-hook for answer calling RES line goes on-hook called RES line goes on-hook
Call type	**1216**
Description	RES line (CNDB activated) - RES line
Options/features	PIC, DGT, CNDB with SUSP on - PIC, DGT
Billing	yes
Scenario	RES line off-hook, dials 67# to activate calling number displays blocking calling line detects special dial tone and dials 7 digits called RES line does not receive calling digits, goes off-hook for answer calling RES line goes on-hook called RES line goes on-hook AMA record is produced with SUSP = on
Call type	**1217**
Description	POTS 1FR line - RES line CNAMD activated
Options/features	PIC, DGT - PIC, DGT, CNAMD
Billing	yes

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**1217**
Scenario	POTS 1FR line goes off-hook, dials 1+10 digits call goes over SS7 trunk RES line receives calling name, then goes off-hook for answer POTS 1FR line goes on-hook RES line goes on-hook
Call type	**1218**
Description	POTS 1FR line - RES line CND activated
Options/features	PIC, DGT - PIC, DGT, CND
Billing	yes
Scenario	POTS 1FR line goes off-hook, dials 1+10 digits RES line receives calling number, then goes off-hook for answer POTS 1FR line goes on-hook RES line goes on-hook
Call type	**1220**
Description	RES line - SMDI direct
Options/features	PIC and DGT - SMDI
Billing	no
Scenario	RES line goes off-hook, dials 7 digits to SMDI SMDI line goes off-hook for answer RES line goes on-hook SMDI goes on-hook
Call type	**1221**
Description	POTS line - RES line (SMDI call forward busy)
Options/features	PIC and DGT - SMDI
Billing	no
Scenario	POTS line goes off-hook, dials 7 digits to RES line RES line is busy, call forwards to SMDI SMDI goes off-hook for answer POTS line goes on-hook SMDI goes on-hook

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**1222**
Description	POTS line - RES line (SMDI call forward no answer)
Options/features	PIC and DGT - SMDI
Billing	no
Scenario	POTS line goes off-hook, dials 7 digits to RES line RES line doesn't answer, call forwards to SMDI SMDI goes off-hook for answer POTS line goes on-hook SMDI goes on-hook
Call type	**1223**
Description	POTS line - RES line (SMDI call forward always)
Options/features	PIC and DGT - SMDI
Billing	no
Scenario	POTS line goes off-hook, dials 7 digits to RES line RES line call forwards to SMDI SMDI goes off-hook for answer POTS line goes on-hook SMDI goes on-hook
Call type	**1225**
Description	POTS 1FR line - POTS 1FR line (teen service)
Options/features	PIC, DGT - PIC, DGT, teen service
Billing	no
Scenario	POTS 1FR line goes off-hook, dials 7 digits called POTS 1FR line with teen service rings on secondary DN called POTS 1FR line goes off-hook for answer calling POTS 1FR line goes on-hook called POTS 1FR line goes on-hook
Call type	**1230**
Description	MF IT trunk - SS7 ATC trunk
Options/features	FGD
Billing	no
Scenario	MF trunk - SS7 trunk tandem call

-continued-

Table 4-1xxx
Local/toll call types (continued)

Call type	**1231**
Description	SS7 IT trunk - MF ATC trunk
Options/features	FGD
Billing	no
Scenario	SS7 IT trunk - MF ATC trunk tandem call
Call type	**1232**
Description	SS7 IT trunk - SS7 ATC trunk
Options/features	FGD
Billing	no
Scenario	SS7 IT trunk - SS7 ATC trunk tandem call
Call type	**1233**
Description	SS7 E800 IT trunk - MF ATC trunk
Options/features	FGD
Billing	no
Scenario	SS7 E800 IT trunk - MF ATC trunk tandem call E800 database query done at the tandem
Call type	**1234**
Description	SS7 E800 IT trunk - SS7 ATC trunk
Options/features	FGD
Billing	no
Scenario	SS7 E800 IT trunk - SS7 ATC trunk tandem call E800 database query done at the tandem
Call type	**1235**
Description	SS7 IT TRUNK - MF ATC trunk
Options/features	FGB
Billing	no
Scenario	SS7 IT trunk - MF ATC trunk tandem call

-continued-

Table 4-1xxx **Local/toll call types**	
Call type	**1236**
Description	POTS 1FR line - MADN primary
Options/features	PIC and DGT - PIC and DGT
Billing	no
Scenario	POTS 1FR line goes off-hook, dials 7 digits MADN primary is only member in MADN group MADN primary goes off-hook for answer POTS 1FR line goes on-hook MADN primary goes on-hook
End	

TOPS call types

Table 4-2xxx
TOPS call types

Call type	**314 (Stand-alone)** **333 (Host OC)** **490 (Remote OC)**
Description	O-; OH; NCN; IC
Billing	yes
Scenario	calling part dials 0 on non-coin phone operator requests digits operator keys 10 digit number IC prompt received on screen, operator requests carrier operator keys IC call transfers to IC operator because operating company doesn't serve IC called party goes off-hook conversation calling party goes on-hook called party goes on-hook
Call type	**315 (Stand-alone)** **334 (Host OC)** **491 (Remote OC)**
Description	O-; OH; NCN; PER_PD; EO
Billing	yes
Scenario	calling party dials 0 on non-coin phone operator requests digits operator keys 7 digit number operator requests pay class called party goes off-hook speech path between called party and operator operator requests party operator keys pay class operator releases call conversation calling party goes on-hook called party goes on-hook
Call type	**316 (Stand-alone)** **335 (Host OC)** **492 (Remote OC)**
Description	O-; OH; non-coin; info only, no outpulsing
Billing	no

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**316 (Stand-alone)** **335 (Host OC)** **492 (Remote OC)**
Scenario	calling party dials 0 on non-coin phone operator replies calling party requests information calling party goes on-hook operator releases call
Call type	**317 (Stand-alone)** **337 (Host OC)** **494 (Remote OC)**
Description	O-; OH; NCN; STA_SPL; BNS=Y
Billing	yes
Scenario	calling party dials 0 on non-coin phone operator requests digits operator keys digits operator determines pay class operator keys pay class 10 digit special number operator releases call called party goes off-hook conversation calling party goes on-hook called party goes on-hook
Call type	**320 (Stand-alone)** **336 (Host OC)** **493 (Remote OC)**
Description	0+; MCCS; OH; NO_X_DB; with timeout
Billing	yes
Scenario	calling party dial 0+10 digits on non-coin phone after receiving MCCS announcement, calling party elects not to dial calling card number operator assists after timeout operator keys calling card number operator keys pay class operator releases call called party goes off-hook conversation called party goes on-hook calling party goes on hook

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**321 (Stand-alone)** **341 (Host OC)** **498 (Remote OC)**
Description	1+; CAMA; ONI; non-coin
Billing	yes
Scenario	calling party with multiparty line dial 10 digits from non-coin phone (requires ONI) call advances to operator position with CAMA prompt operator requests calling parties phone number operator keys 7 digit number call releases from position automatically called party goes off-hook conversation calling party goes on-hook called party goes on-hook
Call type	**322 (Stand-alone)** **342 (Host OC)** **499 (Remote OC)**
Description	1+; ONI; successful validation
Billing	no
Scenario	calling party with multiparty line dials on non-coin phone (requires ONI) call advances to operator position with RCAMA prompt operator requests number operator keys number call releases from position automatically as number is validated in end office no billing is required at TOPS office
Call type	**326 (Stand-alone)** **346 (Host OC)** **503 (Remote OC)**
Description	1+; ACTS; coin
Billing	yes

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**326 (Stand-alone)** **346 (Host OC)** **503 (Remote OC)**
Scenario	calling party dials 1+10 digits on coin phone calling party receives ACTS announcement for coin deposit calling party deposits coins coin tones detected; enough for initial period called party goes off-hook conversation calling party goes on-hook called party goes on-hook
Call type	**327 (Stand-alone)** **340 (Host OC)** **497 (Remote OC)**
Description	0+; MCCS; NO_X_DB
Billing	yes
Scenario	calling party dials 0+10 digits on non-coin phone calling party receives MCCS announcement or alert tone calling party dials calling card number verification is attempted via BVC (CCITT #6) called party goes off-hook conversation called party goes on-hook calling party goes on-hook
Call type	**328 (Stand-alone)** **347 (Host OC)** **504 (Remote OC)**
Description	1+; DD; HTL; PER_PD
Billing	yes
Scenario	calling party dials 1+ digits from non-coin hotel phone operator requests room number operator requests pay class called party goes off-hook operator requests party operator releases call conversation calling party goes on-hook called party goes on-hook

-continued-

Table 4-2xxx **TOPS call types (continued)**	
Call type	**329 (Stand-alone)** **486 (Host OC)** **505 (Remote OC)**
Description	0+; OA; non-coin; STA_PD; EO
Billing	yes
Scenario	calling party dials 0+ digits from non-coin phone operator receives call called party goes off-hook operator requests pay class operator releases call conversation calling party goes on-hook called party goes on-hook
Call type	**330 (Stand-alone)** **487 (Host OC)** **506 (Remote OC)**
Description	0+; OA; non-coin; PER_PD; EO
Billing	yes
Scenario	calling party dials 0+ digits from non-coin phone operator requests party operator initiates outpulsing operator requests pay class called party goes off-hook operator requests called party operator keys pay class operator releases call conversation calling party goes on-hook called party goes on-hook
Call type	**331 (Stand-alone)** **488 (Host OC)** **507 (Remote OC)**
Description	0+; OA; non-coin; STA_COL; EO
Billing	yes
-continued-	

Table 4-2xxx
TOPS call types (continued)

Call type	**331 (Stand-alone)** **488 (Host OC)** **507 (Remote OC)**
Scenario	calling party dials 0+ digits from non-coin phone operator requests party operator allows outpulsing to start operator requests pay class called party goes off-hook operator asks if charges will be accepted operator keys pay class operator releases call conversation calling party goes on-hook called party goes on-hook
Call type	**332 (Stand-alone)** **489 (Host OC)** **508 (Remote OC)**
Description	0+; OA; non-coin; PER_COL; EO
Billing	yes
Scenario	calling party dials 0+ digits from non-coin phone operator requests party operator allows outpulsing to start operator requests pay class called party goes off-hook operator asks if person to which calling party wishes to speak to is available and if charges will be accepted operator keys pay class operator releases call conversation calling party goes on-hook called party goes on-hook
Call type	**509 (Stand-alone)** **527 (Host OC)** **545 (Remote OC)**
Description	0+; non-coin; inter-LATA carrier
Billing	yes

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**509 (Stand-alone)** **527 (Host OC)** **545 (Remote OC)**
Scenario	calling party dials 0+10 digits from non-coin phone inter-LATA carrier is not served by operating company call transfers to inter-LATA carrier called party goes off-hook conversation calling party goes on-hook called party goes on-hook
Call type	**513 (Stand-alone)** **531 (Host OC)** **549 (Remote OC)**
Description	0-; OH; non-coin; OVS; XFR_IC inter-LATA carrier
Billing	yes
Scenario	calling party dials 0 from non-coin phone operator responds calling party requests carrier operator keys carrier carrier not served by operating company operator releases call called party goes off-hook conversation calling party goes on-hook called party goes on-hook
Call type	**515 (Stand-alone)** **533 (Host OC)** **551 (Remote OC)**
Description	0+; coin phone; OVS; inter-LATA carrier
Billing	yes
Scenario	calling party dials 0+ digits from coin phone call transfers to international operator called party goes off-hook conversation calling party goes on-hook called party goes on-hook

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**518 (Stand-alone)** **536 (Host OC)** **554 (Remote OC)**
Description	Queue search for CAMA calls
Billing	yes
Scenario	a call (0+) is in progress at the operator position a +1 call is placed from a multi-party line requiring ONI operator gets a visual prompt on screen that there is a CAMA call waiting operator requests CAMA call operator keys calling party number CAMA call leaves position operator continues handling original 0+ call called party goes off-hook (CAMA call proceeds) conversation calling party goes on-hook called party goes on-hook
Call type	**520 (Stand-alone)** **538 (Host OC)** **556 (Remote OC)**
Description	Verify and connect
Billing	yes

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**520 (Stand-alone)** **538 (Host OC)** **556 (Remote OC)**
Scenario	a call is in progress between party (A) and (B) calling party (C) calls (B) since (B) is busy, the calling party dials operator requesting emergency verification and connection operator receives 0- call from calling party on non-coin phone operator requests number, determines that the line is to be verified and emergency connect made operator requests pay class operator verifies conversation operator tells (A) and (B) that emergency call is waiting parties (A) and (B) go on-hook operator takes down forwarding connection operator allows outpulsing of called number operator keys pay class operator releases the call called party goes off-hook conversation calling party goes on-hook called party goes on-hook
Call type	**526 (Stand-alone)** **544 (Host OC)** **562 (Remote OC)**
Description	Verify with scrambler
Billing	no
Scenario	a call is in progress between party (A) and (B) calling party (C) calls busy party (B) operator receives 0- call from calling party on non-coin phone operator asks number, determines that the line is to be verified operator requests pay class operator verifies conversation operator releases the call calling party goes on-hook

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**802 (Stand-alone)** **602 (Host OC)** **702 (Remote OC)**
Description	0+; MCCS; hook flash to operator
Billing	yes
Scenario	calling party dials 0+10 digits on non-coin phone calling party receives MCCS announcement calling party elects not to use MCCS equipment and hook flashes to reach operator operator requests pay class operator keys in calling card number operator releases call verification is attempted via BVC (CCITT#6) called party goes off-hook conversation called party goes on-hook calling party goes on-hook
Call type	**807 (Stand-alone)** **607 (Host OC)** **707 (Remote OC)**
Description	1+; ACTS; coin; T/O initial deposit
Billing	no
Scenario	calling party dials 1+10 digits on coin phone calling party receives ACTS announcement for coin deposit calling party deposits coins less than required for initial period call transfers to operator operator keys for coin details operator requests additional coins calling party decides to go on-hook operator releases call
Call type	**809 (Stand-alone)** **609 (Host OC)** **709 (Remote OC)**
Description	1+; OH; hotel; bill to room
Billing	yes

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**809 (Stand-alone)** **609 (Host OC)** **709 (Remote OC)**
Scenario	calling party dials 1+10 digits on non-coin hotel phone called party goes off-hook operator requests room number operator releases call conversation calling party goes on-hook called party goes on-hook
Call type	**813 (Stand-alone)** **613 (Host OC)** **713 (Remote OC)**
Description	0-; OH; coin; PER_PD; EO
Billing	yes
Scenario	calling party dials 0- coin phone operator requests digits operator keys 7 digit number operator keys pay class called party goes off-hook speech path between called party and operator operator requests party to speak with operator releases call conversation calling party goes on-hook called party goes on-hook
Call type	**814 (Stand-alone)** **614 (Host OC)** **714 (Remote OC)**
Description	0+; OA; coin; PER_PD; EO
Billing	yes

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**814 (Stand-alone)** **614 (Host OC)** **714 (Remote OC)**
Scenario	calling party dials 0+7 digits on coin phone operator initiates call operator requests pay class called party goes off-hook speech path between called party and operator operator requests party to speak with operator keys pay class operator releases call conversation calling party goes on-hook called party goes on-hook
Call type	**815 (Stand-alone)** **615 (Host OC)** **715 (Remote OC)**
Description	1+; DD; coin; STA_PD; EO
Billing	yes
Scenario	calling party dials 1+7 digits on coin phone call proceeds to operator because ACTS is turned off in office operator receives call called party goes off-hook operator requests pay class operator informs subscriber of cost coins collected operator releases call conversation calling party goes on-hook called party goes on-hook
Call type	**818 (Stand-alone)** **618 (Host OC)** **718 (Remote OC)**
Description	0+; OA; non-coin; PER_PD; EO; TICS
Billing	yes

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**818 (Stand-alone)** **618 (Host OC)** **718 (Remote OC)**
Scenario	calling party dials 0+10 digits on non-coin phone inter-LATA number lookup from PIC BOC provides service for carrier operator requests pay class called party goes off-hook speech path between called party and operator operator requests party to speak with operator keys pay class operator releases call conversation called party goes on-hook calling party goes on-hook
Call type	**819 (Stand-alone)** **619 (Host OC)** **719 (Remote OC)**
Description	0+; OH; coin; PER_PD; EO; TICS
Billing	yes
Scenario	calling party dials 0- on non-coin phone operator requests digits inter-LATA number lookup from PIC BOC provides service for carrier operator requests pay class called party goes off-hook speech path between called party and operator operator requests party to speak with operator keys pay class operator releases call conversation called party goes on-hook calling party goes on-hook
Call type	**824 (Stand-alone)** **624 (Host OC)** **724 (Remote OC)**
Description	0+; MCCS; SS7DB; successful
Billing	yes

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**824 (Stand-alone)** **624 (Host OC)** **724 (Remote OC)**
Scenario	calling party dials 0+10 digits on non-coin phone calling party receives MCCS announcement calling party dials calling card number verification made via SS7 link LIDB verification is successful called party goes off-hook conversation called party goes on-hook calling party goes on-hook
Call type	**825 (Stand-alone)** **625 (Host OC)** **725 (Remote OC)**
Description	0+; OA; CCN; SS7DB: service deny 1st; successful 2nd
Billing	yes
Scenario	calling party dials 0+10 digits on non-coin phone operator requests pay class operator keys calling card number verification made via SS7 link to LIDB operator release forward connection operator informs calling party that the calling card number is invalid calling party gives operator another calling card number operator keys in second calling card number verification made via SS7 link to LIDB verification is successful operator initiates called party connection called party goes off-hook conversation calling party goes on-hook called party goes on-hook
Call type	**826 (Stand-alone)** **626 (Host OC)** **726 (Remote OC)**
Description	0+; OA; CCN; SS7DB; service deny no payment
Billing	yes

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**826 (Stand-alone)** **626 (Host OC)** **726 (Remote OC)**
Scenario	calling party dials 0+10 digits on non-coin phone operator requests pay class operator keys calling card number verification made via SS7 link to LIDB calling card number service denied by LIDB operator informs calling party that calling card number is invalid operator cancels call calling party goes on-hook
Call type	**827 (Stand-alone)** **627 (Host OC)** **727 (Remote OC)**
Description	0+; OA; CCN; SS7DB; successful
Billing	yes
Scenario	calling party dials 0+10 digits on non-coin phone operator requests pay class operator keys calling card number verification made via SS7 link to LIDB verification is successful operator releases call called party goes off-hook conversation calling party goes on-hook called party goes on-hook
Call type	**828 (Stand-alone)** **628 (Host OC)** **728 (Remote OC)**
Description	0+; OA; BNS; SS7DB; verify collect
Billing	yes

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**828 (Stand-alone)** **628 (Host OC)** **728 (Remote OC)**
Scenario	calling party dials 0+10 digits on non-coin phone operator requests pay class verification made via SS7 link to LIDB verification requires that calling party be contacted called party goes off-hook operator asks if collect call will be accepted called party agrees to accept charges operator releases call conversation calling party on-hook called party on-hook
Call type	**830 (Stand-alone)** **630 (Host OC)** **730 (Remote OC)**
Description	0+; OA; BNS; SS7DB; verify third number
Billing	yes
Scenario	calling party dials 0+10 digits on non-coin phone operator requests pay class pay class is third party billing operator releases forward connection operator keys pay class verification is made via SS7 link to LIDB verification requires third party be contacted operator initiates outpulsing of third party number third party goes off-hook third party agrees to pay for the call operator releases forward connection third party goes on-hook operator releases call called number is outpulsed called party goes off-hook conversation calling party goes on-hook called party goes on-hook
Call type	**1112 (Stand-alone)** **1110 (Host OC)** **1111 (Remote OC)**
Description	EAOSS; intraLATA; DTMF; 0+; non-coin; PER_PD
Billing	YES

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**1112 (Stand-alone)** **1110 (Host OC)** **1111 (Remote OC)**
Scenario	calling party dials 0+ digits on non-coin phone operator requests pay class operator initiates outpulsing called party goes off-hook speech path between called party and operator operator requests party to speak with operator keys pay class operator releases call conversation calling party goes on-hook called party goes on-hook
Call type	**1115 (Stand-alone)** **1113 (Host OC)** **1114 (Remote OC)**
Description	EAOSS; intraLATA; DP; 0-; non-coin; PER_PD
Billing	yes
Scenario	calling party dials 0 on non-coin DP phone operator requests digits operator keys digits called party goes off-hook operator requests pay class speech path between called party and operator operator requests party to speak with operator keys pay class operator releases call conversation calling party goes on-hook called party goes on-hook
Call type	**1118 (Stand-alone)** **1116 (Host OC)** **1117 (Remote OC)**
Description	EAOSS; inter-LATA; DTMF; PRE_SUB; 0+; non-coin; PER_PD
Billing	yes

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**1118 (Stand-alone)** **1116 (Host OC)** **1117 (Remote OC)**
Scenario	calling party dials 0+10 digits on non-coin DTMF pre-subscribed phone inter-LATA number lookup from PIC BOC provides service for carrier operator requests pay class called party goes off-hook speech path between called party and operator operator requests party to speak with operator keys pay class operator releases call conversation called party goes on-hook calling party goes on-hook
Call type	**1121 (Stand-alone)** **1119 (Host OC)** **1120 (Remote OC)**
Description	EAOSS; inter-LATA; DTMF; 10XXX; 0+; non-coin; PER_PD
Billing	yes
Scenario	calling party dials 10XXX, 0+10 digits on non-coin DTMF phone BOC provides service for carrier operator requests pay class called party goes off-hook speech path between called party and operator operator requests party to speak with operator keys pay class operator releases call conversation called party goes on-hook calling party goes on-hook
Call type	**1124 (Stand-alone)** **1122 (Host OC)** **1123 (Remote OC)**
Description	EAOSS; inter-LATA; DTMF; PRE_SUB; 0-; non-coin; PER_PD
Billing	yes

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**1124 (Stand-alone)** **1122 (Host OC)** **1123 (Remote OC)**
Scenario	calling party dials 0- on non-coin phone operator keys digits inter-LATA number lookup from PIC BOC provides service for carrier called party goes off-hook operator requests pay class speech path between called party and operator operator requests party to speak with operator keys pay class operator releases call conversation called party goes on-hook calling party goes on-hook
Call type	**1127 (Stand-alone)** **1125 (Host OC)** **1126 (Remote OC)**
Description	EAOSS; inter-LATA; DP; 10XXX; 1+; CAMA; ANI_FAIL
Billing	yes
Scenario	calling party dials 10XXX, 1+ digits on non-coin DP phone ANI failure, so call is received by operator operator keys digits called party goes off-hook operator releases call conversation called party goes on-hook calling party goes on-hook
Call type	**1130 (Stand-alone)** **1128 (Host OC)** **1129 (Remote OC)**
Description	TOPS_MP; 0-; OH; non-coin; PER_PD; EO
Billing	yes

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**1130 (Stand-alone)** **1128 (Host OC)** **1129 (Remote OC)**
Scenario	calling party dials 0 on non-coin phone operator requests digits operator keys 7 digit number operator requests pay class called party goes off-hook speech path between called party and operator operator requests party to speak with operator keys pay class operator releases call conversation calling party goes on-hook called party goes on-hook
Call type	**1133 (Stand-alone)** **1131 (Host OC)** **1132 (Remote OC)**
Description	TOPS_MP; 0+; OA; non-coin; PER_PD; EO
Billing	yes
Scenario	calling party dials 0+ digits from non-coin phone operator requests party to speak with operator initiates outpulsing operator requests pay class called party goes off-hook operator requests called party operator keys pay class operator releases call conversation calling party goes on-hook called party goes on-hook
Call type	**1136 (Stand-alone)** **1134 (Host OC)** **1135 (Remote OC)**
Description	TOPS_MP; 0-; OH; coin; PER_PD; EO
Billing	yes

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**1136 (Stand-alone)** **1134 (Host OC)** **1135 (Remote OC)**
Scenario	calling party dials 0- coin phone operator requests digits operator keys 7 digit number operator keys pay class called party goes off-hook speech path between called party and operator operator requests party to speak with operator releases call conversation calling party goes on-hook called party goes on-hook
Call type	**1139 (Stand-alone)** **1137 (Host OC)** **1138 (Remote OC)**
Description	TOPS_MP; 0+; OA; coin; PER_PD; EO
Billing	yes
Scenario	calling party dials 0+7 digits on coin phone operator initiates call operator requests pay class called party goes off-hook speech path between called party and operator operator requests party to speak with operator keys pay class operator releases call conversation calling party goes on-hook called party goes on-hook
Call type	**1142 (Stand-alone)** **1140 (Host OC)** **1141 (Remote OC)**
Description	0-; OH; non-coin; PER_PD; GEN_AMA; ANS
Billing	yes (two billings)

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**1142 (Stand-alone)** **1140 (Host OC)** **1141 (Remote OC)**
Scenario	calling party dials 0 on non-coin phone operator keys number called party goes off-hook operator keys pay class speech path between called party and operator operator requests party to speak with called party is not available operator generates first AMA record operator releases forward connection called party goes on-hook calling party requests second number operator keys called number second called party goes off-hook speech path between called party and operator operator requests party to speak with operator releases call conversation calling party goes on-hook called party goes on-hook
Call type	**1145 (Stand-alone)** **1143 (Host OC)** **1144 (Remote OC)**
Description	0-; OH; coin; STA_PD; GEN_AMA; UNANS
Billing	yes (two billings)
Scenario	calling party dials 0 on coin phone operator keys number operator keys pay class called party doesn't answer operator generates first AMA record operator releases forward connection called party goes on-hook calling party requests second number operator keys called number second called party goes off-hook operator releases call conversation calling party goes on-hook called party goes on-hook

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**1148 (Stand-alone)** **1146 (Host OC)** **1147 (Remote OC)**
Description	Directory assistance; 411; voice quote
Billing	yes
Scenario	calling party dials 411 from non-coin phone directory assistance operator presses location softkey directory assistance operator keys name directory assistance operator keys street directory assistance operator keys street name directory assistance operator keys for residential listing listing appears on the screen directory assistance operator selects correct listing directory assistance operator quotes number directory assistance operator releases call calling party goes on-hook
Call type	**1151 (Stand-alone)** **1149 (Host OC)** **1150 (Remote OC)**
Description	Directory assistance; 411; external ARU
Billing	yes
Scenario	calling party dials 411 from non-coin phone directory assistance operator presses location softkey directory assistance operator keys name directory assistance operator keys street directory assistance operator keys street name directory assistance operator keys for residential listing listing appears on the screen directory assistance operator selects correct listing directory assistance operator releases call to ARU ARU goes off-hook ARU announcement is played once ARU goes on-hook calling party goes on-hook

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**1154 (Stand-alone)** **1152 (Host OC)** **1153 (Remote OC)**
Description	Directory assistance; 411; external ARU; no ANI
Billing	yes
Scenario	directory assistance trunk (dedicated) goes off-hook directory assistance operator keys ANI digits directory assistance operator keys softkey, transfers from billing screen to directory assistance screen directory assistance operator presses location softkey directory assistance operator keys name directory assistance operator keys street directory assistance operator keys street name directory assistance operator keys for residential listing listing appears on screen directory assistance operator selects correct listing directory assistance operator releases call to ARU ARU goes off-hook ARU announcement is played once ARU goes on-hook calling party goes on-hook
Call type	**1163 (Stand-alone)** **1161 (Host OC)** **1162 (Remote OC)**
Description	Intercept external ARU; intercept trunk
Billing	yes
Scenario	calling party dials number directory number is no longer a working number call routed to new database for new directory number new directory number found ARU announcement played once ARU goes on-hook calling party goes on-hook
Call type	**1166 (Stand-alone)** **1164 (Host OC)** **1165 (Remote OC)**
Description	Intercept database lookup unsuccessful

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**1166 (Stand-alone)** **1164 (Host OC)** **1165 (Remote OC)**
Billing	yes
Scenario	calling party dials number directory number is no longer a working number call routed to database for new directory number new directory number is not found in database call is routed to operator operator informs calling party that no new number exists operator releases call calling party goes on-hook
Call type	**1169 (Stand-alone)** **1167 (Host OC)** **1168 (Remote OC)**
Description	Intercept ONI external ARU
Billing	yes
Scenario	calling party dials number ONI failure transfers to directory assistance operator directory assistance operator keys softkey for appropriate numbering plan area directory assistance operator keys directory number directory assistance operator keys INT, causing database search call is routed to database for new directory number new directory number is found ARU goes off-hook ARU announcement played once ARU goes on-hook calling party goes on-hook
Call type	**1172 (Stand-alone)** **1170 (Host OC)** **1171 (Remote OC)**
Description	AABS; 0+; collect; non-coin; LIDB database verify
Billing	yes

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**1172 (Stand-alone)** **1170 (Host OC)** **1171 (Remote OC)**
Scenario	calling party dials 0+ number incoming trunk marked for AABS AABS prompts customer for billing options customer selects collect call verification via LIDB completed called party goes off-hook for answer AABS informs called party of collect call called party accepts charges and is connected calling party goes on-hook called party goes on-hook
Call type	**1175 (Stand-alone)** **1173 (Host OC)** **1174 (Remote OC)**
Description	AABS; 0+; bill third party; non-coin; LIDB database verify
Billing	yes
Scenario	calling party dials 0+ number incoming trunk is marked for AABS AABS prompts customer for billing options customer dials third party number for billing verification via LIDB completed third party is called and goes off-hook AABS informs third party of charges third party accepts charges and goes on-hook called party is connected and goes off-hook for answer calling party goes on-hook called party goes on-hook
Call type	**1178 (Stand-alone)** **1176 (Host OC)** **1177 (Remote OC)**
Description	AABS; 0+; calling card; non-coin; LIDB database verify
Billing	yes

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**1178 (Stand-alone)** **1176 (Host OC)** **1177 (Remote OC)**
Scenario	calling party dials 0+ number incoming trunk marked for AABS AABS prompts customer for billing options customer dials calling card number for billing verification via LIDB completed called party goes off-hook for answer calling party goes on-hook called party goes on-hook
Call type	**1242 (Stand-alone)** **1240 (Host OC)** **1241 (Remote OC)**
Description	Directory assistance 411 call completion station paid
Billing	yes (two records)
Scenario	Directory assistance calling party dials 411 on non-coin phone directory assistance operator presses location softkey directory assistance operator keys name directory assistance operator keys street directory assistance operator keys street name directory assistance operator keys RES for residential listing listing appears on screen directory assistance operator selects correct listing directory assistance operator releases call to ARU ARU off-hook ARU announcement played once calling party offered call completion calling party accepts and continues station paid ARU on-hook Toll and assistance call is outpulsed to requested number called party goes off-hook conversation calling party goes on-hook called party goes on-hook

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Table 4-2xxx
TOPS call types (continued)

Call type	**1245 (Stand-alone)** **1243 (Host OC)** **1244 (Remote OC)**
Description	Directory assistance 411 call completion alternate billing calling card number
Billing	yes (two records)
Scenario	calling party dials 411 on non-coin phone directory assistance operator presses location softkey directory assistance operator keys name directory assistance operator keys street directory assistance operator keys street name directory assistance operator keys RES for residential listing listing appears on screen directory assistance operator selects correct listing directory assistance operator releases call to ARU ARU off-hook ARU announcement played once calling party offered call completion calling party accepts with alternate billing ARU on-hook calling party connected to AABS announcement calling party elects to use calling card calling card number is entered and verified at LIDB call is outpulsed to requested number on IT trunk called party off-hook conversation calling party on-hook called party on-hook
Call type	**1248 (Stand-alone)** **1246 (Host OC)** **1247 (Remote OC)**
Description	Directory assistance 411 call completion alternate billing collect
Billing	yes (two records)

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**1248 (Stand-alone)** **1246 (Host OC)** **1247 (Remote OC)**
Scenario	calling party dials 411 on non-coin phone directory assistance operator presses location softkey directory assistance operator keys name directory assistance operator keys street directory assistance operator keys street name directory assistance operator keys RES for residential listing listing appears on screen directory assistance operator selects correct listing directory assistance operator releases call to ARU ARU off-hook ARU announcement played once calling party offered call completion calling party accepts with alternate billing ARU on-hook calling party connected to AABS announcement calling party elects to call collect calling party enters 11, called number verified at LIDB call is outpulsed to requested number on IT trunk called party goes off-hook AABS announces collect call from calling party called party accepts call (dials digit 1) conversation calling party on-hook called party on-hook
Call type	**1251 (Stand-alone)** **1249 (Host OC)** **1250 (Remote OC)**
Description	Directory assistance 411 call completion alternate billing third party
Billing	yes (two records)

-continued-

Table 4-2xxx
TOPS call types (continued)

Call type	**1251 (Stand-alone)** **1249 (Host OC)** **1250 (Remote OC)**
Scenario	calling party dials 411 on non-coin phone directory assistance operator presses location softkey directory assistance operator keys name directory assistance operator keys street directory assistance operator keys street name directory assistance operator keys RES for residential listing listing appears on screen directory assistance operator selects correct listing directory assistance operator releases call to ARU ARU off-hook ARU announcement played once calling party offered call completion calling party accepts with alternate billing ARU on-hook calling party connected to AABS announcement calling party elects third number billing calling party enters third number third number verified at LIDB third number is outpulsed on IT trunk third party off-hook AABS announces a call is being charged to this number third party accepts charge and dials digit 1 third party on-hook requested number outpulsed on IT trunk called party off-hook conversation calling party on-hook called party on-hook
Call type	**1254 (Stand-alone)** **1252 (Host OC)** **1253 (Remote OC)**
Description	0 handoff via VSN, billed collect
Billing	yes

-continued-

Table 4-2xxx **TOPS call types**	
Call type	**1254 (Stand-alone)** **1252 (Host OC)** **1253 (Remote OC)**
Scenario	calling party dials 0 incoming trunk marked for AABS calling party connected to operator calling party selects collect billing calling party gives the called number number is verified via LIDB operator presses Function+Number+Start keys call goes to AABS calling party is connected to VSN VSN is connected to called party VSN asks called party if they will accept charges called party accepts charges and dials digit 1 conversation calling party on-hook called party on-hook
Call type	**1257 (Stand-alone)** **1255 (Host OC)** **1256 (Remote OC)**
Description	0 handoff via VSN, billed third party
Billing	yes
Scenario	calling party dials 0 incoming trunk marked for AABS calling party connected to operator calling party selects third party billing calling party gives the called number and third party number number is verified via LIDB operator presses Function+Number+Start keys call goes to AABS calling party is connected to VSN VSN is connected to third party VSN asks third party if they will accept charges third party accepts charges and dials digit 1 conversation calling party on-hook called party on-hook
End	

BCS 30 call times

BCS30 (NT40 and DMS-Core) call time values

Introduction

This section contains NT40 and DMS-Core call time values for real time planning purposes as well as a series of office models that are representative of general office configurations.

NT40 and DMS-Core call times are measured in a laboratory environment. The hardware and software in the laboratory is configured to emulate realistic switch parameters, and the call times have been measured in the following configuration:

NT40

- 40 Mhz clock — in sync
- DTSR — unbound
- AMA format — Bellcore format (BCFMT)
- LOGAMA — off
- AMA tape mounted — yes
- data billed to — tape
- UTR — no
- SMDR — off

DMS-Core

- CC — SuperNode 68020
- 20 Mhz clock — in sync
- DTSR — unbound
- LOGAMA — off
- AMA tape mounted — yes
- data billed to — tape
- UTR — no
- data cache — on
- data cache parity — on

All PVN call types are configured with AMA; SMDR; and UTR. Database queries are via SS7 to the service control point (SCP).

The call time values in this section are always reported in milliseconds and are considered to be within plus or minus 5 percent accuracy unless otherwise noted.

The call times are categorized as follows:

- actual
- derived
- estimated

Actual call times

Actual call times are those measured in the current BCS. times with no symbol indicate actual call times.

Derived call times

Derived call times are determined by using the two following methods:

- The call type was measured in a past BCS and was updated to reflect the current BCS general trend.
- A call time can be derived from similar call types that were measured in the current BCS.

times followed by the letter “D” indicate derived call times.

Estimated call times

Estimated call times are determined by using current base measured call times along with design estimates. These estimated call times are considered to be accurate within plus or minus 15 percent accuracy. times followed by the letter “E” indicate estimated call times.

A series of call type models representative of general office configurations are provided as well as a complete list of all call times measured at each BCS interval.

A “*” next to each call time indicates an AMA record is included in the time. A “**” next to the call type or time indicates that the call type is included in the REAL::TIME capacity planning tool.

Finally, a listing of estimated call times for various features and call types is provided. These features and call types have been included in the REAL::TIME tool for estimating future CPU capacity requirements.

The REAL::TIME capacity planning tool or times provided should be used to estimate the CPU real time impact for various offices.

BCS30 CPU call time models

The following tables contain a series of office models that are representative of general office configurations. Tables 5-3 through 5-8 illustrate offices configured with NT40; while Tables 5-9 through 5-14 illustrate offices configured with DMS-Core. The models are intended to show possible CPU capacity changes between BCS releases within general office types. Since each individual office will differ somewhat from these models, actual office capacity changes are office dependent.

The NT40 has a maximum call processing capacity of 83 percent. This percentage has been adjusted when necessary to allow for average work time (AWT). Table 5-1 illustrates the percentage adjustment needed at various levels of AWT for the NT40. For example, in the TOPS host model (BCS29), an AWT of 46.915 ms equates to a 3.0 percent adjustment to the maximum call processing of 83 percent.

Table 5-1
NT40 average work time (AWT) adjustments

AWT (average ms)	Call processing adjustments
< 15 ms	0 percent
15.0 ms to 25.9 ms	1 percent
26.0 ms to 40.0 ms	2 percent
> 40.0 ms	3 percent

The DMS-Core has a maximum call processing capacity of 86 percent. This percentage has been adjusted when necessary to allow for average work time (AWT). Table 5-2 illustrates the percentage adjustment needed at various levels of AWT for the DMS-Core. For example, in the TOPS host model (BCS29), an AWT of 23.829 ms equates to a 1.5 percent adjustment to the maximum call processing of 86 percent.

Table 5-2
DMS-Core average work time (AWT) adjustments

AWT (average ms)	Call processing adjustments
< 12.5 ms	0 percent
12.5 ms to 20.0 ms	1 percent
> 20.0 ms	1.5 percent

Actual office BCS impact can be estimated by using the capacity prediction tool REAL::TIME.

Adjustments related to TOPS call time models

Three features were introduced in BCS 28 and BCS29 that have an impact on certain TOPS call times when compared to previous releases. The

following is a brief discussion of their effect on these call times. A brief explanation of TOPS position queuing is also included.

Extended Bellcore AMA format (EBAF)

All TOPS stand-alone and remote OC calls are affected by the introduction of this feature in BCS28. The real time associated with this feature is optional in BCS28 and BCS29. The following call time models do not include the real time associated with this feature. For NT40, the approximate real time increase associated with this feature is 0.9 ms for each call. For DMS-Core, the approximate real time associated with this feature is 0.4 ms for each call. Additional information on this feature can be found in SEA 89-05-002.

International telephone credit card (ICCN)

This feature was introduced in BCS28 and affects all stand-alone and remote OC MCCS type calls. The real time associated with this feature is non-optional in BCS28 and optional in BCS29. The following call time models include the real time associated with this feature for BCS28 times and do not include the additional time for BCS29 times. For NT40, the approximate real time increase associated with this feature is 1.7 ms for each call in BCS28, and 2.1 ms for each call in BCS29. For DMS-Core, the approximate real time increase associated with this feature is 1.0 ms for each call in BCS28 and 1.2 ms for each call in BCS29 and BCS30.

Directory assistance - toll branding

This feature was introduced in BCS29 and affects all operator handled stand-alone and remote OC call types, excluding MCCS and ACTS. The real time associated with this feature is optional in BCS29. The following call time models do not include the real time associated with this feature. For NT40, the approximate real time increase associated with this feature is 0.13 ms for each call. For DMS-Core, the approximate real time associated with this feature is 0.1 ms for each call.

TOPS operator position queues

TOPS calls requiring operator assistance are placed in a calls-waiting queue when no operators are immediately available. The additional time associated with this queue is 1.4 ms in NT40 and 0.7 ms in DMS-Core. This queuing adjustment is not included in the TOPS call times found in this section.

Table 5-3
POTS EAEO suburban model NT40 @ 40 Mhz

			BCS29 RTM Weighted ms/CA		BCS30 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
994	DTMF 1FR line - line	5.0%	17.6	.880	17.9	.895
995	DTMF 1FR line - EAS trunk	3.0%	14.9	.447	14.9	.447
950	DTMF 1MR line - line	15.0%	25.9	3.885	26.2	3.930
016	DTMF 1MR line - EAS trunk	7.0%	24.4	1.708	24.5	1.715
011	DTMF 1FR line - LAMA trunk	10.0%	23.3	2.330	23.4	2.340
360	FGC 1+10 digits - IC trunk	5.0%	29.1	1.445	29.3	1.465
401	FGD 1+7 digits - IC trunk	5.0%	32.8	1.640	33.1	1.655
993	DTMF 1FR line - abandon	4.0%	8.0	.320	8.1	.324
308	DTMF 1MR line - busy	6.0%	15.2	.912	15.4	.924
996	MF trunk - line	30.0%	12.6	3.780	12.8	3.840
453	IC trunk - line	10.0%	24.3	2.430	24.1	2.410
Totals		100 %	AWT = 19.787		AWT = 19.945	
Maximum call attempts at 82% CPOCC				149,189		148,007

CPOCC adjusted by 1.0 percent for average work time

BCS30 maximum call attempts at 82 percent CPOCC	148,007
BCS29 maximum call attempts at 82 percent CPOCC	149,189
Difference	- 1,182
% change from BCS29 to BCS30	- .8%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 5-4
POTS EAEO urban model NT40 @ 40 Mhz

			BCS29 RTM Weighted ms/CA		BCS30 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
974	DTMF 1MR AT to FGD IC	5.0%	33.3	1.665	33.6	1.680
950	DTMF 1MR line - line	18.0%	25.9	4.662	26.2	4.716
016	DTMF 1MR line - EAS trunk	7.0%	24.4	1.708	24.5	1.715
308	DTMF 1MR line - busy	3.0%	15.2	.456	15.4	.462
018	DTMF coin line - busy	1.0%	17.8	.178	18.2	.182
996	MF trunk - line	7.0%	12.6	.882	12.8	.896
990	IC trunk - line	14.0%	24.3	3.402	24.1	3.374
019	DTMF coin line - line	2.0%	27.9	.558	28.5	.570
954	DTMF coin line - IC/FGD	1.0%	37.8	.378	37.7	.377
054	PBX DOD trunk - line	11.0%	17.1	1.881	17.3	1.903
958	MF PX DOD trunk - IC trunk	3.0%	32.5	.975	32.6	.978
961	MF PX DOD trunk - EAS trunk	4.0%	15.8	.632	15.9	.636
888	DTMF MDC line - MDC line	10.0%	16.8	1.680	17.3	1.730
889	DTMF MDC line - EAS trunk	4.0%	17.6	.704	17.9	.716
858	DTMF MDC line - abandon	2.0%	14.6	.292	14.7	.294
854	MF POTS trunk - MDC line	5.0%	12.7	.635	13.0	.650
883	FGD DTMF MDC line - AT	3.0%	35.5	1.065	35.4	1.062
Totals		100 %	AWT = 21.753		AWT = 21.941	
Maximum call attempts at 82% CPOCC				135,705		134,543

CPOCC adjusted by 1.0 percent for average work time

BCS30 maximum call attempts at 82 percent CPOCC	135,543
BCS29 maximum call attempts at 82 percent CPOCC	135,705
Difference	- 1162
% change from BCS29 to BCS30	- 0.9%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 5-5
Access tandem model NT40 @ 40 Mhz

			BCS29 RTM Weighted ms/CA		BCS30 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
998	MF IT trunk - IT trunk	27.5%	11.9	3.190	11.9	3.273
048	MF INCAMA trunk - trunk	5.5%	18.0	.990	18.0	.990
455	IT trunk - IC carrier trunk	22.0%	11.8	2.596	11.9	2.618
456	IC carrier trunk - IT trunk	33.0%	19.5	6.435	19.6	6.468
997	Tandem INCAMA - tandem	12.0%	8.8	1.056	8.9	1.068
Totals		100 %	AWT = 14.350		AWT = 14.417	
Maximum call attempts at 83% CPOCC				208,223		207,255

BCS30 maximum call attempts at 83 percent CPOCC	207255
BCS29 maximum call attempts at 83 percent CPOCC	208,223
Difference	- 968
% change from BCS29 to BCS30	-0.5%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 5-6
Meridian Digital Centrex (MDC) model NT40 @ 40 Mhz

			BCS29 RTM Weighted ms/CA		BCS30 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
888	DTMF MDC line - MDC line	8.0%	16.8	1.344	17.3	1.384
889	DTMF MDC line - EAS trunk	3.0%	17.6	.528	17.9	.537
858	DTMF MDC line - abandon	5.0%	14.6	.730	14.7	.735
884	MDC intraLATA - toll trunk	7.0%	26.7	1.869	26.5	1.855
883	FGD DTMF MDC line - AT	9.0%	35.5	3.195	35.4	3.186
873	DTMF MDC line - EBS without display	5.0%	19.4	.970	19.5	.975
891	EBS with display - EBS with display	5.0%	27.2	1.360	27.2	1.360
890	EBS with display - abandon	3.0%	17.2	.516	17.4	.522
892	EBS with display - EAS trunk	3.0%	21.9	.657	22.0	.660
885	EBS with display FGD - AT MF	8.0%	39.8	3.184	39.6	3.168
893	EBS with display - LAMA trunk	5.0%	30.4	1.520	30.1	1.505
862	EBS without display - MDC line	4.0%	19.9	.796	20.1	.804
854	MF POTS trunk - MDC line	19.0%	12.7	2.413	13.0	2.470
879	MF POTS trunk - EBS without display	16.0%	14.6	2.336	14.9	2.384
Totals		100 %	AWT = 21.418		AWT = 21.545	
Maximum call attempts at 82% CPOCC				137,828		137,016

CPOCC adjusted by 1.0 percent for average work time

BCS30 maximum call attempts at 82 percent CPOCC	137,016
BCS29 maximum call attempts at 82 percent CPOCC	137,828
Difference	- 812
% change from BCS29 to BCS30	-0.6%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 5-7
TOPS host OC/stand-alone model NT40 @ 40 Mhz

			BCS29 RTM Weighted ms/CA		BCS30 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
340	Host OC MCCS	15.0%	4.4	.660	4.4	.660
327	stand-alone MCCS	21.0%	58.0	12.184	57.9	12.163
326	ACTS coin	14.0%	63.8	8.935	64.4	9.019
487	Host OC non-coin 0+	4.5%	41.5	1.868	42.3	1.904
334	Host OC non-coin 0-	6.0%	42.2	2.532	42.9	2.574
614	Host OC coin 0+	2.3%	46.3	1.065	47.2	1.086
613	Host OC coin-	2.3%	46.9	1.079	47.7	1.097
330	stand-alone non-coin 0+	6.3%	70.3	4.428	70.9	4.466
315	stand-alone non-coin 0-	8.4%	67.5	5.669	67.9	5.703
814	stand-alone coin 0+	3.1%	90.6	2.808	88.2	2.734
813	stand-alone coin 0-	3.1%	89.4	2.771	89.8	2.783
048	MF INCAMA trunk - trunk	14.0%	18.0	2.520	18.0	2.520
Totals		100 %	AWT = 46.519		AWT = 46.723	
Maximum call attempts at 80% CPOCC				61,910		61,639

CPOCC adjusted by 3.0 percent for average work time

BCS30 maximum call attempts at 80 percent CPOCC	61,639
BCS29 maximum call attempts at 80 percent CPOCC	61,910
Difference	- 271
% change from BCS29 to BCS30	-0.4%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 5-8
TOPS remote OC/AT model NT40 @ 40 Mhz

			BCS29 RTM Weighted ms/CA		BCS30 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
998	MF IT trunk - IT trunk	12.5%	11.9	1.488	11.9	1.488
048	MF INCAMA trunk - trunk	12.5%	18.0	2.250	18.0	2.250
455	IT trunk - IC carrier trunk	10.0%	11.8	1.180	11.9	1.190
456	IC carrier trunk - IT trunk	15.0%	19.5	2.925	19.6	2.940
997	Tandem INCAMA trunk - tandem	5.0%	8.8	.440	8.9	.445
924	E800 AT - IC trunk database query	5.0%	45.1	2.255	45.1	2.255
497	Remote OC MCCS	15.0%	61.7	9.258	61.8	9.273
503	Remote OC ACTS	10.0%	63.8	6.382	64.4	6.442
506	Remote OC non-coin 0+	4.5%	79.9	3.596	80.4	3.618
491	Remote OC non-coin 0-	6.0%	76.4	4.583	76.7	4.601
714	Remote OC coin 0+	2.3%	99.5	2.288	96.9	2.228
713	Remote OC coin 0-	2.2%	99.1	2.180	97.5	2.145
Totals		100.0%	AWT = 38.825		AWT = 38.875	
Maximum call attempts at 81 percent CPOCC				75,106		75,010

CPOCC adjusted by 2.0 percent for average work time

BCS30 maximum call attempts at 81 percent CPOCC	75,010
BCS29 maximum call attempts at 81 percent CPOCC	75,106
Difference	- 96
% change from BCS29 to BCS30	- 0.1%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 5-9
POTS EAEO suburban model DMS-Core

			BCS29 RTM Weighted ms/CA		BCS30 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
994	DTMF 1FR line - line	5.0%	9.6	.480	9.8	.490
995	DTMF 1FR line - EAS trunk	3.0%	8.2	.246	8.2	.246
950	DTMF 1MR line - line	15.0%	13.2	1.980	13.3	1.995
016	DTMF 1MR line - EAS trunk	7.0%	12.6	.882	12.4	.868
011	DTMF 1FR line - LAMA trunk	10.0%	12.4	1.240	12.4	1.240
360	FGC 1+10 digits - IC trunk	5.0%	15.1	.755	15.1	.755
401	FGD 1+7 digits - IC trunk	5.0%	17.3	.865	17.5	.875
993	DTMF 1FR line - abandon	4.0%	4.5	.180	4.5	.180
308	DTMF 1MR line - busy	6.0%	8.2	.492	8.1	.486
996	MF trunk - line	30.0%	7.1	2.130	7.2	2.160
453	IC trunk - line	10.0%	12.0	1.200	11.8	1.180
Totals		100 %	AWT = 10.450		AWT = 10.475	
Maximum call attempts at 86% CPOCC				296,268		295,561

No CPOCC adjustment necessary for average work time

BCS30 maximum call attempts at 86 percent CPOCC	295,561
BCS29 maximum call attempts at 86 percent CPOCC	296,268
Difference	- 707
% change from BCS29 to BCS30	- .2%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 5-10
POTS EAEO urban model DMS-Core

			BCS29 RTM Weighted ms/CA		BCS30 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
974	DTMF 1MR AT to FGD IC	5.0%	17.4	.870	17.6	.880
950	DTMF 1MR line - line	18.0%	13.2	2.376	13.3	2.394
016	DTMF 1MR line - EAS trunk	7.0%	12.6	.882	12.4	.868
308	DTMF 1MR line - busy	3.0%	8.2	.246	8.1	.243
018	DTMF coin line - busy	1.0%	10.1	.101	10.2	.102
996	MF trunk - line	7.0%	7.1	.497	7.2	.504
990	IC trunk - line	14.0%	12.0	1.680	11.9	1.666
019	DTMF coin line - line	2.0%	15.8	.316	16.1	.322
954	DTMF coin line - IC/FGD	1.0%	21.0	.210	20.8	.208
054	PBX DOD trunk - line	11.0%	9.8	1.078	9.9	1.089
958	MF PX DOD trunk - IC trunk	3.0%	17.8	.534	18.0	.540
961	MF PX DOD trunk - EAS trunk	4.0%	9.1	.364	9.3	.372
888	DTMF MDC line - MDC line	10.0%	9.2	.920	9.4	.940
889	DTMF MDC line - EAS trunk	4.0%	9.6	.384	9.9	.396
858	DTMF MDC line - abandon	2.0%	7.9	.158	7.9	.158
854	MF POTS trunk - MDC line	5.0%	7.1	.355	7.3	.365
883	FGD DTMF MDC line - AT	3.0%	17.9	.537	18.0	.540
Totals		100 %	AWT = 11.508		AWT = 11.587	
Maximum call attempts at 86% CPOCC				269,030		267,196

No CPOCC adjustment necessary for average work time

BCS30 maximum call attempts at 86 percent CPOCC	267,196
BCS29 maximum call attempts at 86 percent CPOCC	269,030
Difference	- 1834
% change from BCS29 to BCS30	- 0.7%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 5-11
Access tandem model DMS-Core

Call type	Call description	Mix	BCS29 RTM Weighted ms/CA Call	BCS29 RTM Weighted ms/CA Time	BCS30 RTM Weighted ms/CA Call	BCS30 RTM Weighted ms/CA Time
998	MF IT trunk - IT trunk	27.5%	6.8	1.870	6.9	1.898
048	MF INCAMA trunk - trunk	5.5%	9.8	.539	9.9	.545
455	IT trunk - IC carrier trunk	22.0%	6.8	1.496	6.8	1.496
456	IC carrier trunk - IT trunk	33.0%	10.1	3.333	10.2	3.366
997	Tandem INCAMA - tandem	12.0%	5.1	.612	5.2	.624
Totals		100 %		AWT = 7.850		AWT = 7.928
Maximum call attempts at 86% CPOCC				394,395		390,515

No CPOCC adjustment necessary for average work time

BCS30 maximum call attempts at 86 percent CPOCC	390,515
BCS29 maximum call attempts at 86 percent CPOCC	394,395
Difference	- 3,880
% change from BCS29 to BCS30	-1.0%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 5-12
Meridian Digital Centrex (MDC) model DMS-Core

			BCS29 RTM Weighted ms/CA		BCS30 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
888	DTMF MDC line - MDC line	8.0%	9.2	.736	9.4	.752
889	DTMF MDC line - EAS trunk	3.0%	9.6	.288	9.9	.297
858	DTMF MDC line - abandon	5.0%	7.9	.395	7.9	.395
884	MDC intraLATA - toll trunk	7.0%	13.8	.966	13.7	.959
883	FGD DTMF MDC line - AT	9.0%	17.9	1.611	18.0	1.620
873	DTMF MDC line - EBS without display	5.0%	10.0	.500	10.3	.515
891	EBS with display - EBS with display	5.0%	11.9	.595	12.1	.605
890	EBS with display - abandon	3.0%	8.1	.243	7.9	.237
892	EBS with display - EAS trunk	3.0%	9.7	.291	10.0	.300
885	EBS with display FGD - AT MF	8.0%	18.1	1.448	18.0	1.440
893	EBS with display - LAMA trunk	5.0%	13.9	.695	13.5	.675
862	EBS without display - MDC line	4.0%	9.1	.364	9.2	.368
854	MF POTS trunk - MDC line	19.0%	7.1	1.349	7.3	1.387
879	MF POTS trunk - EBS without display	16.0%	7.6	1.216	7.8	1.248
Totals		100 %	AWT = 10.697		AWT = 10.798	
Maximum call attempts at 86% CPOCC				289,427		286,720

No CPOCC adjustment necessary for average work time

BCS30 maximum call attempts at 86 percent CPOCC	286,720
BCS29 maximum call attempts at 86 percent CPOCC	289,427
Difference	- 2,707
% change from BCS29 to BCS30	- 0.9%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 5-13
TOPS host OC/stand-alone model DMS-Core

Call type	Call description	Mix	BCS29 RTM Weighted ms/CA Call	BCS29 RTM Weighted ms/CA Time	BCS30 RTM Weighted ms/CA Call	BCS30 RTM Weighted ms/CA Time
340	Host OC MCCS	15.0%	2.4	.360	2.1	.315
327	stand-alone MCCS	21.0%	29.8	6.248	29.8	6.248
326	ACTS coin	14.0%	33.5	4.683	33.5	4.683
487	Host OC non-coin 0+	4.5%	19.3	.869	19.0	.855
334	Host OC non-coin 0-	6.0%	19.5	1.170	19.3	1.158
614	Host OC coin 0+	2.3%	20.9	.481	20.7	.476
613	Host OC coin-	2.3%	21.4	.492	21.3	.490
330	stand-alone non-coin 0+	6.3%	36.5	2.296	36.3	2.284
315	stand-alone non-coin 0-	8.4%	34.7	2.911	34.3	2.877
814	stand-alone coin 0+	3.1%	47.9	1.483	45.6	1.412
813	stand-alone coin 0-	3.1%	47.3	1.465	47.8	1.480
048	MF INCAMA trunk - trunk	14.0%	9.8	1.372	9.9	1.386
Totals		100 %	AWT = 23.829		AWT = 23.664	
Maximum call attempts at 84.5% CPOCC				127,660		128,552

CPOCC adjusted by 1.5 percent for average work time

BCS30 maximum call attempts at 84.5 percent CPOCC	128,552
BCS29 maximum call attempts at 84.5 percent CPOCC	127,660
Difference	- 892
% change from BCS29 to BCS30	-0.7%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 5-14
TOPS remote OC/AT model DMS-Core

Call type	Call description	Mix	BCS29 RTM Weighted ms/CA Call	BCS29 RTM Weighted ms/CA Time	BCS30 RTM Weighted ms/CA Call	BCS30 RTM Weighted ms/CA Time
998	MF IT trunk - IT trunk	12.5%	6.8	.850	6.9	.863
048	MF INCAMA trunk - trunk	12.5%	9.8	1.225	9.9	1.238
455	IT trunk - IC carrier trunk	10.0%	6.8	.680	6.8	.680
456	IC carrier trunk - IT trunk	15.0%	10.1	1.515	10.2	1.530
997	Tandem INCAMA trunk - tandem	5.0%	5.1	.255	5.2	.260
924	E800 AT - IC trunk database query	5.0%	21.8	1.090	22.1	1.105
497	Remote OC MCCS	15.0%	32.0	4.793	32.0	4.793
503	Remote OC ACTS	10.0%	33.5	3.345	33.5	3.345
506	Remote OC non-coin 0+	4.5%	39.4	1.771	39.8	1.789
491	Remote OC non-coin 0-	6.0%	37.9	2.271	37.5	2.247
714	Remote OC coin 0+	2.3%	50.5	1.160	49.8	1.144
713	Remote OC coin 0-	2.2%	50.6	1.112	49.3	1.084
Totals		100.0%	AWT = 20.067		AWT = 20.076	
Maximum call attempts at 84.5 percent CPOCC				151,592		151,524
CPOCC adjusted by 1.5 percent for average work time						
BCS30 maximum call attempts at 84.5 percent CPOCC			151,524			
BCS29 maximum call attempts at 84.5 percent CPOCC			151,592			
Difference			- 68			
% change from BCS29 to BCS30			0.0%			
(- sign indicates a decrease in capacity)						
(+ sign indicates an increase in capacity)						

Table 5-15
CPU call times-line origination

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
947	POTS DP 1FR - POTS DTMF 1FR line	17.1	8.6
005	POTS DP 1FR - LAMA trunk	22.3	11.2 *
979	POTS DP 2FR - POTS 1FR line	21.9	11.0
014	POTS DTMF 1FR - false start	6.8	3.4
994 **	POTS DTMF 1FR line - POTS 1FR line	17.9	9.8
015 **	POTS DTMF 1MR line - POTS 1FR line	26.3	13.2 *
962	POTS DTMF 1FR line - POTS 1MR line	19.3	9.7
950	POTS DTMF 1MR line - POTS 1MR line	26.2	13.3 *
859	POTS DTMF 1FR line - MDC DTMF line	18.9	9.5
995 **	POTS DTMF 1FR line - EAS trunk	14.9	8.2
016 **	POTS DTMF 1MR line - EAS trunk	24.5	12.4 *
360 **	FGC 1+10 digits - IC (PIC)	29.3	15.1 *
378 **	FGC 1+10 digits - AT (PIC)	30.2	15.2 *
401 **	FGD 1+7 digits - IC (OCS on, PIC)	33.1	17.5 *
402	FGD 1+10 digits - AT (OCS on, PIC)	34.6	17.4 *
974	POTS DTMF 1MR line - via AT TO IC FGD trunk	33.6	17.6 *
011 **	POTS DTMF 1FR line - LAMA trunk	23.4	12.4 *
949	POTS DTMF 1FR line - operator trunk	23.5	11.8
308	POTS DTMF 1MR line - busy	15.4	8.1
951	POTS DTMF 1MR line - abandon after 5 digits	9.2	4.6
993 **	POTS DTMF 1FR line - abandon after 6 digits	8.1	4.5
948	POTS DTMF 1FR line - busy DTMF 1FR	15.5	7.8
967	POTS DTMF 1FR line - MF operator trunk	21.5	10.8
963	POTS DTMF 1FR line - MF PBX DID trunk	17.3	8.7
966	POTS DTMF 1FR line - announcement BLDN treatment	18.1	9.1
019 **	Coin DTMF - POTS 1FR line	28.5	16.1 *
020 **	Coin DTMF - EAS trunk	29.1	14.6 *

-continued-

Table 5-15
CPU call times-line origination (continued)

Call type	Call description	NT40	DMS-Core
910 **	FGB coin DTMF - AT MF	28.1	14.1
952	Coin DTMF - direct to IC FGC trunk	38.4	19.3 *
953 **	Coin DTMF - via AT to IC FGC trunk	38.4	19.3 *
954	Coin DTMF - direct to IC FGD	37.7	20.8 *
955 **	Coin DTMF - via AT to IC FGD trunk	41.8	21.8 *
982	Coin DTMF - operator trunk	30.4	15.3
908	Coin DTMF - trunk (1+800)	34.4	17.3 *
018	Coin DTMF - busy	18.2	10.2
054 **	PBX DOD trunk - POTS 1FR line	17.3	9.9
055 **	PBX DOD trunk - LAMA trunk	26.9	13.5 *
914 **	PBX DTMF DOD - non-LAMA MF EAS	16.1	8.1
915 **	FGB DTMF PBX DOD - AT MF trunk	20.1	10.1
916 **	FGC DTMF PBX DOD - AT MF trunk	30.0	15.1 *
917 **	FGD DTMF PBX DOD - AT MF trunk	33.0	16.6 *
988 **	OUTWATS - direct to IC FGB trunk	30.0	15.1 *
918 **	FGC DTMF OUTWATS - AT MF trunk	30.8	15.5 *
989 **	OUTWATS - direct to IC FGD	33.4	16.8 *
052 **	OUTWATS - LAMA trunk	24.5	12.3 *
309	OUTWATS (enhanced) - ATC trunk	34.4	17.3 *
805	MDC DTMF - false start	7.4	3.7
888 **	MDC DTMF - MDC line	17.3	9.4
889 **	MDC DTMF - EAS trunk	17.9	9.9
881 **	FGB DP MDC - AT MF	20.5	10.3
882 **	FGC DTMF MDC - AT MF	32.4	16.3 *
883 **	FGD DTMF MDS - AT MF	35.4	18.0 *
884 **	DTMF MDC intraLATA - MF toll trunk	26.5	13.7 *
886	E800 EAEO DTMF MDC - IC trunk	49.8	25.0 *
873	MDC DTMF - EBS without display	19.5	10.3

-continued-

Table 5-15
CPU call times-line origination (continued)

Call type	Call description	NT40	DMS-Core
874	MDC DTMF - MDC MF trunk	28.5	14.3 *
857	MDC DTMF second DT - POTS 1FR	21.1	10.6
858	MDC DTMF - abandon after two digits	14.7	7.9
891	EBS with display - EBS with display	27.2	12.1
892	EBS with display - EAS trunk	22.0	10.0
893	EBS with display - LAMA trunk	30.1	13.5 *
863	EBS without display - EBS without display	20.3	10.2
894	EBS with display - EBS without display	20.7	10.4
885	EBS with display FGD - AT MF	39.6	18.0 *
876	EBS without display - MDC MF trunk	28.1	14.1 *
875	EBS without display DTMF FX trunk	19.1	9.6
890	EBS with display - abandon after two digits	17.4	7.9
862	EBS without display - MDC DTMF line (SCG)	20.1	9.2
861	EBS without display - attendant	21.1	10.6
864	EBS without display second DT - POTS 1FR	21.3	10.7
	Data path - line	31.8 D	16.0 D
	Data path - non-LAMA (EAS)	33.0 D	16.6 D
	Data path - LAMA	49.2 D	24.7 D

End

Table 5-16xxx
Call types with custom calling/CLASS/SMDI features

POTS custom calling features (CCF)

3 - way calling (3WC)
Call waiting (CWT)
Speed calling (SC1)
Call forward (CFW)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1065	1FR line (all CCF assigned) - 1FR line	19.1	9.6
1066	1FR line (3WC activated) - 1FR line	142.9	71.8 *
1067	1FR line (SC1 activated) - 1FR line	18.5	9.3
1070	1FR line - 1FR line (CFU assigned)	19.9	10.0
1072	1FR line - 1FR line (all CCF assigned)	19.9	10.0
1073	1FR line - 1FR line (CFU activated)	23.5	12.6
1074	1FR line - 1FR line (CWT activated)	115.4	58.0 *
1105	1FR line - 1FR line (3WC, SC1, CWT assigned)	18.5	9.3
1225	1FR line - 1FR line (teen service activated)	18.0	9.7

MDC custom calling features (CCF)

3 - way calling (3WC)
Call waiting (CWT)
Speed calling short list (SC1)
Speed calling long list (SC2)
Call forward busy (CFB)
Call forward universal (CFU)
Call forward don’t answer CFD)
Call transfer (CXR)
Call hold (CH)
Ring again (RA)
Call pick-up (CPU)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1075	MDC line - MDC line	18.5	9.3
1085	MDC line (all CCF assigned) - MDC line	18.7	9.4
1086	MDC line (3WC activated) - MDC line	120.6	60.6 *
1087	MDC line (SC1 activated) - MDC line	22.3	11.2

-continued-

Table 5-16xxx
Call types with custom calling/CLASS/SMDI features (continued)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1088	MDC line (SC2 activated) - MDC line	22.3	11.2
1089	MDC line (CH activated) - MDC line	108.1	54.3 *
1107	MDC line (RA activated) - MDC line	83.2	41.8
1092	MDC line - MDC line (CFU assigned)	19.3	9.7
1095	MDC line - MDC line (CFB assigned)	19.3	9.7
1096	MDC line - MDC line (CFD assigned)	27.1	13.6
1099	MDC line - MDC line (all CCF assigned)	27.1	13.6
1100	MDC line - MDC line (CFU activated)	26.3	13.2
1101	MDC line - MDC line (CWT activated)	130.3	65.5 *
1102	MDC line - MDC line (CFB activated)	26.3	13.2
1103	MDC line - MDC line (CFD activated)	48.6	24.4
1104	MDC line - MDC line (CXR activated)	95.7	48.1 *
1106	MDC line - MDC line (3WC, SC1, SC2, CWT, CH, CXR assigned)	18.7	9.4
1108	MDC line - MDC line (CPU activated)	36.2	18.2
RES custom local area signaling services (CLASS)			
Automatic call back (ACB) Automatic recall (AR) Calling number delivery blocking (CNDB) Selective call rejection (SCRJ) Customer originated trace (COT) Usage sensitive billing (USB)			
Call type	**Call description**	**ms per C/A NT40**	**ms per C/A DMS-Core**
1205	RES - RES (ACB, AR, CND, COT assigned originating and terminating	26.1	13.1
1206	RES (ACB intraNODAL activated) - RES	115.6	58.1
1207	RES - RES (AR intraNODAL activated	38.4	19.3
1208	RES (ACB network activated - SS7 - RES	219.5	110.3 *
1209	RES (AR network activated) - SS7 - RES	62.1	31.2

-continued-

Table 5-16xxx
Call types with custom calling/CLASS/SMDI features (continued)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1210	RES - RES (SCRJ activated)	46.0	23.1 *
1214	RES - RES (COT activated)	22.7	12.1
1215	RES (CNDB activated) - RES	28.0	15.3
1216	RES (CNDB activated and USB on) - RES	34.9	18.2
RES simplified message desk interface (SMDI)			
SMDI call forward busy (CFB) SMDI call forward don't answer (CFD) SMDI call forward always (CFA)			
Call type	**Call description**	**ms per C/A NT40**	**ms per C/A DMS-Core**
1220	RES - SMDI (direct)	49.4	30.8
1221	POTS 1FR - RES SMDI (CFR)	58.5	35.0
1222	POTS 1FR - RES SMDI (CFD)	74.6	43.3
1223	POTS 1FR - RES SMDI (CFA)	58.7	34.9
End			

Table 5-17
Incoming trunk origination

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
997	MF tandem INCAMA trunk - MF tandem trunk	8.9	5.2
996 **	MF trunk - POTS 1FR line	12.8	7.2
998 **	MF IT trunk - IT trunk	11.9	6.9
453	MF IC trunk - POTS 1FR line	24.1	11.8 *
999	MF trunk - busy	19.3	9.7 *
031 **	MF trunk - INWATS line	24.5	12.3 *
879	MF trunk - EBS without display	14.9	7.8
946	MF trunk - abandon (no start signal)	7.2	3.6
854	MF POTS trunk - MDC DTMF line	13.0	7.3
046	MF INCAMA trunk - POTS 1FR line	22.9	11.5 *
048 **	MF INCAMA trunk - trunk	18.0	9.9 *
990	IC trunk - POTS 1FR line (LCM)	24.1	11.9 *
456 **	IC carrier trunk - IT trunk	19.6	10.2 *
991	IC trunk - MF PBX DID (PX)	22.7	11.4 *
455	IT trunk - IC carrier trunk	11.9	6.8
919 **	FGC MF incoming trunk - IC trunk	29.9	15.0 *
920 **	FGD MF incoming trunk - IC trunk	32.0	16.1 *
921 **	MF incoming trunk - tandem MF IT trunk	32.8	16.5 *
855	MDC MF trunk - MDC DTMF line	16.3	8.2
856	MDC DTMF FX trunk - MDC DTMF line (SCG)	21.7	10.9
868	MDC MF trunk - attendant	19.3	9.7
850	Attendant - MDC DTMF line (SCG)	24.3	12.2
958	MF PX DOD trunk DIG (PX) - direct to IC trunk	32.6	18.0 *
959	MF PX DOD trunk DIG - via AT to IC trunk	33.6	16.9 *
961	MF PX DOD trunk DIG - MF EAS trunk	15.9	9.3
986	DTMF PBX DOD (FX) trunk - operator trunk	21.7	10.9
987	MF PBX DOD trunk - operator trunk	22.5	11.3

Table 5-18
E911 trunking

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1201	FX trunk - E911 tandem	21.7	10.9
1202	E911 trunk - E911 tandem PSAP QRY	19.3	9.7
1203	E911 trunk - PSAP line with ORIGHOLD	27.9	13.5

Table 5-19
SS7 trunking

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
577	DTMF POTS line - SS7 trunk	22.6	12.1
578 **	DTMF MDC line - SS7 trunk	25.5	13.4
579 **	DTMF POTS line - SS7 trunk	30.1	15.8 *
580	SS7 trunk - DTMF POTS line	14.8	7.8
581	SS7 trunk - DTMF MDC line	16.5	8.3
582	SS7 trunk - EBS with display (network name display)	26.1	13.1
583	EBS with display - SS7 trunk (network ring again)	96.1	48.3
584	SS7 trunk - EBS with display (network number display)	20.9	10.5
585	EBS with display - SS7 trunk (network name display)	31.2	15.7
598	SS7 trunk - EBS with display (network ring again)	17.7	8.9
599	EBS with display - SS7 trunk (network number display)	27.2	14.8
1230	FGD MF trunk - SS7 trunk	19.5	9.8
1231	FGD SS7 trunk - MF trunk	17.3	8.7
1232 **	FGD SS7 trunk - SS7 trunk	16.7	8.4
1233	FGD E800 SS7 trunk - MF trunk (DB query)	34.8	17.5 *
1234	FGD E800 SS7 trunk - SS7 trunk (DB query)	34.2	17.2 *
1235	FGB SS7 trunk - MF trunk	12.1	6.8

Table 5-20
800 service

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
922	E800 DTMF 1FR - IC (DB query)	47.8	24.0 *
924 **	E800 DTMF 1FR - IC (DB query)	45.1	22.1 *
927	E800 EAEO DTMF 1FR - reorder (DB query)	40.4	20.3
928	E800 EAEO DTMF 1FR - AT (DB query)	49.2	24.7 *
929	E800 AT - IT (DB query)	40.6	20.4 *
943	E800 AT - reorder (DB query)	25.9	13.0

Table 5-21
Call time adjustments

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
A19 **	Incoming dial pulse	-2.4	-1.4
A6 **	Incoming AMA	9.1D	4.9D
A7 **	Originating dial pulse	-1.5D	-1.1D
	Originating MADN	.6 plus number of secondary members x .5 ms D	.3 plus number of secondary members x .5 ms D
	Terminating MADN	11.8 plus ringing secondary members x 2.5 ms D	6.4 plus ringing secondary members x 2.5 ms D
A1 **	MDC SMDR	5.3D	2.8D
A4 **	MDC attendant console	24.0D	12.9D
	UTR	-2.0D	-1.1D
	Alternate routing	1.1D	.6D
	Virtual facility group	1.5D	.8D
	Hunt group	2.4D	1.3D

Table 5-22
POTS feature activation

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
A31 **	Call waiting	66.5	33.1
A13 **	Three-way calling	95.6	47.7
A32 **	Call forward	3.6	2.6
A33 **	Speed calling	-0.6	-0.3

Table 5-23
MDC feature activation

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
A12 **	Call waiting	67.0	33.4
A13M **	Three-way calling	74.1	36.9
A16 **	Ring again	64.7	32.5
A17 **	Call transfer	40.8	20.2
A18 **	Call pick-up	17.7	8.9
A14 **	Call forward, no answer	30.1	15.1
A20 **	Call forward, universal	7.8	3.9
A34 **	Call forward, busy	7.8	3.9
A15 **	Speed calling	3.6	1.8

Table 5-24
CLASS feature activation

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
R001 **	ACB intra-NODAL	89.5	45.0
R002 **	ACB - SS7 network	122.7	61.5
R007 **	SS7 network - ACB	61.4	30.7
R004 **	AR intra-NODAL	12.3	6.2
R005 **	AR - SS7 network	24.0	12.1

-continued-

Table 5-24
CLASS feature activation (continued)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
R008 **	SS7 network - AR	12.0	6.0
R006 **	CDNB	4.4	2.2
R003 **	COT	22.7	12.1
R010 **	Selective call rejection (SCRJ)	10.8	5.1
R011 **	Selective call forward (SCFWD)	12.0	3.2
R012 **	Distinctive ring, call forward	12.0E	6.0E
R013 **	Selective call acceptance	10.8E	5.1E
R014 **	Usage sensitive billing	6.9	2.9E

End

Table 5-25
CLASS feature assignment

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
	Automatic recall (AR) terminating	3.2	1.6
	Automatic callback (ACB) originating	2.3	1.1
	Customer originated trace (COT) terminating	3.2	1.6
	Calling number delivery (CND) terminating	3.9	1.9

Table 5-26xxx
TOPS Extended Bellcore AMA format phase 0/DA phase 1-stand-alone TOPS configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
316 **	0-; OH; non-coin; information only, no outpulsing	43.2	21.6
314	0-; OH; non-coin; inter exchange carrier	81.0	40.5
315 **	0-; OH; non-coin; person paid; end office	68.9	34.7
317	0-; OH; non-coin; station special; BNS = yes	79.2	39.6
513	0-; OH; non-coin; OVS; transfer IC; interLATA carrier	63.8	31.9
813 **	0-; OH; coin; person paid; end office; without rate step	90.8	48.2
819	0-; OH; person paid; end office; TICS	97.2	48.6
1142	0-; OH; non-coin; person paid; AMA; answer	112.6	56.3
824 **	0+; MCCS; SS7 database; successful	79.4	39.7
802	0+; MCCS; hook flash to operator	94.0	47.0
327	0+; MCCS; no query database	60.9	31.3
320	0+; MCCS; OH; no query database; with timeout	93.4	46.7
331	0+; OA; non-coin; station collect; end office	74.2	37.1
329	0+; OA; non-coin; station paid; end office	73.4	36.7
332	0+; OA; non-coin; person collect; end office	74.0	37.0
330 **	0+; OA; non-coin; person paid; end office	71.9	36.7
509	0+; non coin, interLATA carrier	35.2	17.6
515	0+; coin; OVS; interLATA carrier	34.6	17.3
814 **	0+; OH; coin; person paid; end office; without rate step	89.2	46.0
818	0+; OA; non-coin; person paid; end office; TICS	76.4	38.2
825	0+; OA; CCN; SS7 database; deny first number; complete second number	161.2	80.6
826	0+; OA; CCN; SS7 database; service deny, no payment	95.6	47.8
827	0+; OA; CCN; SS7 database; successful	106.1	54.3
828	0+; OA; BNS; SS7 database; verify collect	98.0	49.0

-continued-

Table 5-26xxx
TOPS Extended Bellcore AMA format phase 0/DA phase 1-stand-alone TOPS configuration
(continued)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
830	0+; OA; BNS; SS7 database; verify third number	141.2	70.6
807	1+; ACTS; coin; initial deposit	128.9	67.1
326	1+; ACTS; coin	65.3	33.8
321	1+; CAMA; ONI; non-coin	48.0	24.0
322	1+; ONI; successful validation	35.1	18.3
328	1+; direct dialed; hotel; person paid	81.4	40.7
809	1+; OH; hotel; bill to room	96.4	48.2
815	1+; direct dialed; coin; station paid; end office; without rate step	92.7	47.6
518	Queue search for CAMA calls	48.6	24.3
520	Verify and connect	98.0	49.0
526	Verify with scrambler	59.0	29.5

End

Table 5-27xxx
Host OC TOPS configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
335 **	0-; OH; non-coin; information only, no outpulsing	27.4	13.7
333	0-; OH; non-coin; interconnect carrier	42.4	21.2
334 **	0-; OH; non-coin; person paid; end office	42.9	19.3
337	0-; OH; non-coin; station special	50.4	25.2
531	0-; OH; non-coin, OVS; transfer IC; interLATA carrier	29.8	14.9
613 **	0-; OH; coin; person paid; end office without step rate	47.9	21.3
619	0-; OH; coin; person paid; end office; TICS	50.5	20.8
1140	0-; OH; non-coin; person paid; AMA, answer	64.6	32.3
602	0+; MCCS; hook flash to operator	47.6	23.8
340	0+; MCCS; no query database	4.5	2.1
336	0+; MCCS; OH; no query database; with timeout	55.2	27.6
488	0+; OA; non-coin; station collect; end office	38.6	19.3
486	0+; OA; non-coin; station paid; end office	38.0	19.0
489	0+; OA; non-coin; person collect; end office	38.8	19.4
487 **	0+; OA; non-coin; person paid; end office	42.3	19.0
614 **	0+; OH; coin; person paid; end office; without rate step	42.5	19.3
618	0+; OA; non-coin; person paid; end office; TICS	35.4	17.7
625	0+; OA; CCN; SS7 database; deny first number; complete second number	78.4	39.2
626	0+; OA; CCN; SS7 database; service deny no payment	53.4	26.7
627	0+; OA; CCN; SS7 database; successful	54.2	23.9
628	0+; OA; BNS; SS7 database; verify collect	38.6	19.3
630	0+; OA; BNS; SS7 database; verify third number	69.0	34.5
607	1+; ACTS; coin; T/O initial deposit	61.2	30.6
341 **	1+; CAMA; ONI; non-coin	22.6	11.3
342 **	1+; ONI; successful validation	22.6	11.3

-continued-

Table 5-27xxx
Host OC TOPS configuration (continued)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
347 **	1+; direct dial; hotel; person paid	42.2	21.1
609	1+; OH; hotel; bill to room	42.6	21.3
615 **	1+; direct dial; coin; station paid; end office; without step rate	46.8	20.7
536	Queue search for CAMA calls	26.8	13.4
538	Verify and connect	67.0	33.5
544 **	Verify with scrambler	42.0	21.0

End

Table 5-28xxx
Remote OC TOPS configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
492 **	0-; OH; non-coin; information only, no outpulsing	47.8	23.9
490	0-; OH; non-coin; interconnect carrier	87.8	43.9
491 **	0-; OH; non-coin; person paid; end office	77.7	37.9
494	0-; OH; non-coin; station special BNS = yes	92.4	46.2
549	0-; OH; non-coin, OVS; transfer IC; interLATA carrier	70.2	35.1
713	0-; OH; coin; person paid; end office without step rate	98.6	49.7
719	0-; OH; coin; person paid; end office; TICS	106.9	51.4
1141	0-; OH; non-coin; person paid; AMA, answer	113.2	56.6
724 **	0+; MCCS; SS7 database; successful	78.8	39.4
702	0+; MCCS; hook flash to operator	110.8	55.1
497	0+; MCCS; no query database	64.8	33.5
493	0+; MCCS; OH; no query database; with timeout	111.8	55.9
507	0+; OA; non-coin; station collect; end office	81.6	40.8
505	0+; OA; non-coin; station paid; end office	79.6	39.8
508	0+; OA; non-coin; person collect; end office	80.0	40.2
506 **	0+; OA; non-coin; person paid; end office	81.4	41.5
545	0+; non-coin; interLATA carrier	35.8	17.9
551	0+; coin; OVS; interLATA carrier	35.0	17.5
714 **	0+; non-coin; person paid; end office; without rate step	97.9	50.2
718	0+; OA; non-coin; person paid; end office; TICS	85.4	42.7
725	0+; OA; CCN; SS7 database; deny first number; complete second number	169.2	84.6
726	0+; OA; CCN; SS7 database; service deny no payment	100.4	50.2
727	0+; OA; CCN; SS7 database; successful	113.8	56.4
728	0+; OA; BNS; SS7 database; verify collect	101.6	50.8
730	0+; OA; BNS; SS7 database; verify third number	142.4	71.2

-continued-

Table 5-28xxx
Remote OC TOPS configuration (continued)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
707	1+; ACTS; coin; T/O initial deposit	147.8	73.9
503 **	1+; ACTS; coin;	65.3	33.8
498 **	1+; CAMA; ONI; non-coin	52.4	26.2
499 **	1+; ONI; successful validation	37.2	18.6
504 **	1+; direct dial; hotel; person paid	86.8	43.4
709	1+; OH; hotel; bill to room	99.4	49.7
715 **	1+; direct dial; coin; station paid; end office; without step rate	102.6	51.7
554	Queue search for CAMA calls	52.0	26.0
556	Verify and connect	105.2	52.6
562 **	Verify with scrambler	64.4	32.2

End

Table 5-29
TOPS multi-purpose-stand-alone TOPS MP configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1130	0-; OH; non-coin; person paid; end office	73.2	36.6
1136	0-; OH; coin; person paid; end office	87.2	43.6
1133	0+; OA; non-coin; person paid; end office	73.0	36.5
1139	0+; OA; coin; person paid; end office	90.6	45.3

Table 5-30
TOPS multi-purpose-host OC TOPS MP configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1128	0-; OH; non-coin; person paid; end office	39.4	19.7
1134	0-; OH; coin; person paid; end office	39.6	19.7
1131	0+; OA; non-coin; person paid; end office	38.8	19.4
1137	0+; OA; coin; person paid; end office	39.0	19.5

Table 5-31
TOPS multi-purpose-remote OC TOPS MP configuration

		ms per C/A	
Call type	**Call description**	**NT40**	**DMS-Core**
1129	0-; OH; non-coin; person paid; end office	76.4	38.2
1135	0-; OH; coin; person paid; end office	92.0	46.0
1132	0+; OA; non-coin; person paid; end office	80.0	40.0
1138	0+; OA; coin; person paid; end office	96 .0	48.0

Table 5-32
Stand-alone AABS configuration

		ms per C/A	
Call type	**Call description**	**NT40**	**DMS-Core**
1172 **	AABS; 0+; collect; non-coin; LIDB database; verify	100.7	50.9
1175 **	AABS; 0+; bill third party; non-coin; LIDB database; verify;	121.1	61.7
1178 **	AABS; 0+; calling card number; non-coin; LIDB verify	80.5	40.7
1254	Operator handoff via VSN billed collect	129.4	69.8
1257	Operator handoff via VSN billed third party	127.8	75.7

Table 5-33
Host OC AABS configuration

		ms per C/A	
Call type	**Call description**	**NT40**	**DMS-Core**
1170	AABS; 0+; collect; non-coin; LIDB database; verify	0.0	0.0
1173	AABS; 0+; bill third party; non-coin; LIDB database; verify;	0.0	0.0
1176	AABS; 0+; calling card number; non-coin; LIDB verify	0.0	0.0
1252	Operator handoff via VSN billed collect	64.2	31.7
1255	Operator handoff via VSN billed third party	58.1	30.8

Table 5-34
Remote OC AABS configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1171 **	AABS; 0+; collect; non-coin; LIDB database; verify	100.7	50.8
1174 **	AABS; 0+; bill third party; non-coin; LIDB database; verify;	121.1	61.9
1177 **	AABS; 0+; calling card number; non-coin; LIDB verify	80.5	40.7
1253	Operator handoff via VSN billed collect	139.7	64.8
1256	Operator handoff via VSN billed third party	148.7	73.7

Table 5-35
Stand-alone TOPS MP configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1148	411; combined trunk and voice quote	65.4	32.7
1151	411; combined trunk and external ARU	72.2	36.1 **
1154	411; DA trunk; external ARU; no ANI	64.4	32.2
1163	Intercept; intercept trunk; external ARU	44.0	22.0
1166	Intercept; intercept trunk; number not in database; voice quote	52.6	26.3
1169	Intercept; intercept trunk; ONI; external ARU	73.6	36.8
1242	411; combined trunk; call completion; station paid	99.9	48.9
1242	411; call completion; AABS calling card	148.4	73.7
1242	411; call completion; AABS collect	188.1	84.3
1242	411; call completion; AABS bill third party	178.9	94.3

Table 5-36
Host OC TOPS MP configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1146	411; combined trunk and voice quote	33.4	16.7
1149	411; combined trunk and external ARU	28.8	14.4 **
1152	411; DA trunk; external ARU; no ANI	32.4	16.2
1161	Intercept; intercept trunk; external ARU	0.0	0.0
1164	Intercept; intercept trunk; number not in database; voice quote	24.8	12.4
1167	Intercept; intercept trunk; ONI; external ARU	27.2	13.6
1240	411; combined trunk; call completion; station paid	32.1	14.4
1243	411; call completion; AABS calling card	35.7	16.3
1246	411; call completion; AABS collect	39.6	18.2
1249	411; call completion; AABS bill third party	41.9	19.6

Table 5-37
Remote OC TOPS MP configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1147	411; combined trunk and voice quote	67.6	33.8
1150	411; combined trunk and external ARU	72.8	36.4 **
1153	411; DA trunk; external ARU; no ANI	64.8	32.4
1162	Intercept; intercept trunk; external ARU	44.0	22.0
1165	Intercept; intercept trunk; number not in database; voice quote	57.6	28.8
1168	Intercept; intercept trunk; ONI; external ARU	71.8	35.9
1241	411; combined trunk; call completion; station paid	101.6	49.9
1242	411; call completion; AABS calling card	145.8	72.6
1242	411; call completion; AABS collect	163.1	80.5
1242	411; call completion; AABS bill third party	179.3	89.7

Table 5-38
Stand-alone EAOSS

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1115	0-; interLATA; dial pulse; non-coin; person paid	69.0	34.5
1124	0-; interLATA; DTMF; pre-subscription; coin; person paid	100.0	50.0
1112	0+; interLATA; DTMF; non-coin; person paid	72.2	36.1
1118	0+; interLATA; DTMF; pre-subscription; non-coin; person paid	78.9	39.9
1121	0+; interLATA; DTMF; 10XXX; non-coin; person paid	80.0	40.0
1127	1+; interLATA; dial pulse; 10XXX; CAMA; ANI failure	54.0	27.0

Table 5-39
Host OC EAOSS

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1113	0-; interLATA; dial pulse; non-coin; person paid	38.8	19.4
1122	0-; interLATA; DTMF; pre-subscription; coin; person paid	44.2	22.1
1110	0+; interLATA; DTMF; non-coin; person paid	38.0	19.0
1116	0+; interLATA; DTMF; pre-subscription; non-coin; person paid	40.0	16.2
1119	0+; interLATA; DTMF; 10XXX; non-coin; person paid	35.4	17.7
1125	1+; interLATA; dial pulse; 10XXX; CAMA; ANI failure	24.5	11.4

Table 5-40
Remote OC EAOSS

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1114	0-; interLATA; dial pulse; non-coin; person paid	75.8	37.9
1123	0-; interLATA; DTMF; pre-subscription; coin; person paid	108.4	54.2
1111	0+; interLATA; DTMF; non-coin; person paid	77.8	38.9
1117	0+; interLATA; DTMF; pre-subscription; non-coin; person paid	87.9	43.4
1120	0+; interLATA; DTMF; 10XXX; non-coin; person paid	87.8	43.9
1126	1+; interLATA; dial pulse; 10XXX; CAMA; ANI failure	56.9	29.0

Table 5-41
PVN call times

Call description	ms per C/A NT40	ms per C/A DMS-Core
PVN trunk (DTMF) - PVN trunk; trunks available in primary trunk group	35.4	18.6
PVN trunk (DTMF) - PVN trunk; primary trunk group busy and alternate trunk group used	41.3	21.7
PVN trunk (DTMF) - PVN trunk; primary and alternate trunk groups busy; second alternate trunk group used	42.9	22.5
PVN trunk (DTMF) - POTS trunk	35.0	18.4
PVN trunk (DTMF) - POTS line	37.6	19.7
PVN trunk (DTMF) - IC; trunks available for primary carrier	40.1	21.1
PVN trunk (DTMF) - IC; primary and alternate carrier groups busy, second alternate carrier group used	47.2	24.7
PVN trunk (FGD) - PVN trunk; trunks available in primary trunk group	34.9	18.4
PVN trunk (FGD) - POTS trunk; trunks available in primary trunk group	32.1	16.9
PVN line (DTMF) - IC; trunks available for primary carrier	38.8	20.4
PVN line (DTMF) - POTS line	36.3	19.1
PVN line (DTMF) - PVN trunk; trunks available in primary trunk group	34.4	18.1
PVN trunk (DTMF) - PVN trunk; trunks available in primary trunk group; announcement and AUTHCODE collection	67.3	35.4
PVN trunk (DTMF) - PVN trunk; trunks available in primary trunk group; special dial tone and AUTHCODE collection	67.3	35.4
PVN trunk (FGD) - PVN trunk; trunks available in primary trunk group; announcement and AUTHCODE collection	66.8	35.0
POTS line (DTMF) - POTS line; PVN remote access from POTS line	53.2	28.0

Table 5-42
ISDN call times

Call description	ms per C/A NT40	ms per C/A DMS-Core
Basic rate interface (stimulus signaling) - basic rate interface (stimulus signaling)	38.6E	19.4E
Basic rate interface (stimulus signaling) - POTS 1FR	27.9E	14.0E
Basic rate interface (stimulus signaling) - EBS with display	34.2E	17.2E
EBS with display - basic rate interface (stimulus signaling)	28.1E	14.1E
Basic rate interface (stimulus signaling) - Basic rate interface (functional signaling)	44.8E	22.5E
Basic rate interface (stimulus signaling) - primary rate interface	29.1E	14.6E
Basic rate interface (functional signaling) - basic rate interface (functional signaling)	50.5E	25.4E
Basic rate interface (functional signaling) - POTS 1FR	31.6E	15.9E
Basic rate interface (functional signaling) - EBS with display	38.0E	19.1E
EBS with display - basic rate interface (functional signaling)	33.9E	17.0E
Basic rate interface (functional signaling) - basic rate interface (stimulus signaling)	42.2E	21.2E
Basic rate interface (functional signaling) - primary rate interface	37.0E	18.6E
Primary rate interface - primary rate interface	15.5E	7.8E
Primary rate interface - POTS 1FR	15.3E	7.7E
Primary rate interface - EBS with display	21.3E	10.7E
EBS with display - primary rate interface	31.2E	15.7E
Primary rate interface - basic rate interface (stimulus signaling)	24.9E	12.5E
Primary rate interface - basic rate interface (functional signaling)	30.0E	15.1E

BCS 31 call times

BCS31 (NT40 and DMS-Core) call time values

Introduction

This section contains NT40 and DMS-Core call time values for real time planning purposes as well as a series of office models that are representative of general office configurations.

NT40 and DMS-Core call times are measured in a laboratory environment. The hardware and software in the laboratory is configured to emulate realistic switch parameters, and the call times have been measured in the following configuration:

NT40

- 40 Mhz clock — in sync
- DTSR — unbound
- AMA format — Bellcore format (BCFMT)
- LOGAMA — off
- AMA tape mounted — yes
- data billed to — tape
- UTR — no
- SMDR — off

DMS-Core

- CC — DMS-Core Series 20
- 20 Mhz clock — in sync
- DTSR — unbound
- LOGAMA — off
- AMA tape mounted — yes
- data billed to — tape
- UTR — no
- data cache — on
- data cache parity — on

All PVN call types are configured with AMA; SMDR; and UTR. Database queries are via SS7 to the service control point (SCP).

The call time values in this section are always reported in milliseconds and are considered to be within plus or minus 5 percent accuracy unless otherwise noted.

The call times are categorized as follows:

- actual
- derived
- estimated

Actual call times

Actual call times are those measured in the current BCS. times with no symbol indicate actual call times.

Derived call times

Derived call times are determined by using the two following methods:

- The call type was measured in a past BCS and was updated to reflect the current BCS general trend.
- A call time can be derived from similar call types that were measured in the current BCS.

times followed by the letter “D” indicate derived call times.

Estimated call times

Estimated call times are determined by using current base measured call times along with design estimates. These estimated call times are considered to be accurate within plus or minus 15 percent accuracy. times followed by the letter “E” indicate estimated call times.

A series of call type models representative of general office configurations are provided as well as a complete list of all call times measured at each BCS interval.

A “*” next to each call time indicates an AMA record is included in the time. A “**” next to the call type or time indicates that the call type is included in the REAL::TIME capacity planning tool.

Finally, a listing of estimated call times for various features and call types is provided. These features and call types have been included in the REAL::TIME tool for estimating future CPU capacity requirements. The REAL::TIME capacity planning tool or times provided should be used to estimate the CPU real time impact for various offices.

BCS31 CPU call time models

The following tables contain a series of office models that are representative of general office configurations. Tables 6-3 through 6-8 illustrate offices configured with NT40; while Tables 6-9 through 6-14 illustrate offices configured with DMS-Core. The models are intended to show possible CPU capacity changes between BCS releases within general office types. Since each individual office will differ somewhat from these models, actual office capacity changes are office dependent.

The NT40 has a maximum call processing capacity of 83 percent. This percentage has been adjusted when necessary to allow for average work time (AWT). Table 6-1 illustrates the percentage adjustment needed at various levels of AWT for the NT40. For example, in the TOPS host model (BCS31), an AWT of 47.144 ms equates to a 3.0 percent adjustment to the maximum call processing of 83 percent.

Table 6-1
NT40 average work time (AWT) adjustments

AWT (average ms)	Call processing adjustments
< 15 ms	0 percent
15.0 ms to 25.9 ms	1 percent
26.0 ms to 40.0 ms	2 percent
> 40.0 ms	3 percent

The DMS-Core has a maximum call processing capacity of 86 percent. This percentage has been adjusted when necessary to allow for average work time (AWT). Table 6-2 illustrates the percentage adjustment needed at various levels of AWT for the DMS-Core. For example, in the TOPS host model (BCS31), an AWT of 23.994 ms equates to a 1.5 percent adjustment to the maximum call processing of 86 percent.

Table 6-2
DMS-Core average work time (AWT) adjustments

AWT (average ms)	Call processing adjustments
< 12.5 ms	0 percent
12.5 ms to 20.0 ms	1 percent
> 20.0 ms	1.5 percent

Actual office BCS impact can be estimated by using the capacity prediction tool REAL::TIME.

Issues affecting BCS31 TOPS call time models

Three features were introduced in BCS28 and BCS29 that have an impact on certain TOPS call times when compared to previous releases. The following

is a brief discussion of their effect on these call times. A brief description of TOPS position queuing is also included.

Extended Bellcore AMA format (EBAF)

All TOPS stand-alone and remote OC calls are affected by the introduction of this feature in BCS28. The real time associated with this feature is optional in BCS28 and BCS29. The following call time models do not include the real time associated with this feature. For NT40, the approximate real time increase associated with this feature is 0.9 ms for each call. For DMS-Core, the approximate real time associated with this feature is 0.4 ms for each call. Additional information on this feature can be found in SEA 89-05-002.

International telephone credit card (ICCN)

This feature was introduced in BCS28 and affects all stand-alone and remote OC MCCS type calls. The real time associated with this feature is non-optional in BCS28 and optional in BCS29. The following call time models include the real time associated with this feature for BCS28 times and do not include the additional time for BCS29 times. For NT40, the approximate real time increase associated with this feature is 1.7 ms for each call in BCS28, and 2.1 ms for each call in BCS29. For DMS-Core, the approximate real time increase associated with this feature is 1.0 ms for each call in BCS28 and 1.2 ms for each call in BCS29.

Directory assistance - toll branding

This feature was introduced in BCS29 and affects all operator handled stand-alone and remote OC call types, excluding MCCS and ACTS. The real time associated with this feature is optional in BCS29. The following call time models do not include the real time associated with this feature. For NT40, the approximate real time increase associated with this feature is 0.13 ms for each call. For DMS-Core, the approximate real time associated with this feature is 0.1 ms for each call.

TOPS operator position queues

TOPS calls requiring operator assistance are placed in a calls-waiting queue when no operators are immediately available. The additional time associated with this queue is 1.4 ms for NT40, and 0.7 ms for DMS-Core. This queuing adjustment is not included in the TOPS call times found in this section.

Call time adjustments related to enhanced DMS-Core processors

The call times listed in this section are measured on a Series 20 processor. In order to determine capacity for the Series 30/40/50 processors, it is necessary to apply factors to the call times listed.

Factors to be applied are as follows:

- Series 30 1.5

- Series 40 1.7
- Series 50 2.5

For example, to determine call time for call type 994 with a Series 40 processor, divide the Series 20 call time by 1.7. The Series 20 call type 994 time of 9.8 ms divided by 1.5 gives a Series 40 call time of 5.8 ms.

Another example is to determine the maximum call per hour (CPH) for the Access tandem model switch with a Series 50 processor. Multiply the Series 20 CPH value by 2.5. A Series 20 maximum CPH of 379,668 multiplied by 2.5 gives a Series 50 maximum CPH of 949,170.

Table 6-3
POTS EAEO suburban model NT40 @ 40 Mhz

			BCS30 RTM Weighted ms/CA		BCS31 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
994	DTMF 1FR line - line	5.0%	17.9	.895	18.2	.910
995	DTMF 1FR line - EAS trunk	3.0%	14.9	.447	15.2	.456
950	DTMF 1MR line - line	15.0%	26.2	3.930	26.8	4.020
016	DTMF 1MR line - EAS trunk	7.0%	24.5	1.715	25.1	1.757
011	DTMF 1FR line - LAMA trunk	10.0%	23.4	2.340	24.0	2.400
360	FGC 1+10 digits - IC trunk	5.0%	29.3	1.465	29.7	1.485
401	FGD 1+7 digits - IC trunk	5.0%	33.1	1.655	33.7	1.685
993	DTMF 1FR line - abandon	4.0%	8.1	.324	8.1	.324
308	DTMF 1MR line - busy	6.0%	15.4	.924	15.6	.936
996	MF trunk - line	30.0%	12.8	3.840	13.1	3.390
453	IC trunk - line	10.0%	24.1	2.410	24.6	2.460
Totals		100 %	AWT = 19.945		AWT = 20.363	
Maximum call attempts at 82% CPOCC				148,007		144,969

CPOCC adjusted by 1.0 percent for average work time

BCS31 maximum call attempts at 82 percent CPOCC	144,969
BCS30 maximum call attempts at 82 percent CPOCC	148,007
Difference	- 3,038
% change from BCS30 to BCS31	- 2.1%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 6-4
POTS EAEO urban model NT40 @ 40 Mhz

			BCS30 RTM Weighted ms/CA		BCS31 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
974	DTMF 1MR AT to FGD IC	5.0%	33.6	1.680	34.0	1.700
950	DTMF 1MR line - line	18.0%	26.2	4.716	26.8	4.824
016	DTMF 1MR line - EAS trunk	7.0%	24.5	1.715	25.1	1.757
308	DTMF 1MR line - busy	3.0%	15.4	.462	15.6	.468
018	DTMF coin line - busy	1.0%	18.2	.182	18.7	.187
996	MF trunk - line	7.0%	12.8	.896	13.1	.917
990	IC trunk - line	14.0%	24.1	3.374	24.6	3.444
019	DTMF coin line - line	2.0%	28.5	.570	29.3	.586
954	DTMF coin line - IC/FGD	1.0%	37.7	.377	38.6	.386
054	PBX DOD trunk - line	11.0%	17.3	1.903	17.7	1.947
958	MF PX DOD trunk - IC trunk	3.0%	32.6	.978	33.0	.990
961	MF PX DOD trunk - EAS trunk	4.0%	15.9	.636	16.0	.640
888	DTMF MDC line - MDC line	10.0%	17.3	1.730	17.7	1.770
889	DTMF MDC line - EAS trunk	4.0%	17.9	.716	18.4	.736
858	DTMF MDC line - abandon	2.0%	14.7	.294	15.0	.300
854	MF POTS trunk - MDC line	5.0%	13.0	.650	13.3	.665
883	FGD DTMF MDC line - AT	3.0%	35.4	1.062	36.1	1.083
Totals		100 %	AWT = 21.941		AWT = 22.400	
Maximum call attempts at 82% CPOCC				134,543		131,786

CPOCC adjusted by 1.0 percent for average work time

BCS31 maximum call attempts at 82 percent CPOCC	131,786
BCS30 maximum call attempts at 82 percent CPOCC	134,543
Difference	- 2757
% change from BCS30 to BCS31	- 2.0%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 6-5
Access tandem model NT40 @ 40 Mhz

			BCS30 RTM Weighted ms/CA		BCS31 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
998	MF IT trunk - IT trunk	27.5%	11.9	3.273	12.0	3.300
048	MF INCAMA trunk - trunk	5.5%	18.0	.990	18.4	1.012
455	IT trunk - IC carrier trunk	22.0%	11.9	2.618	12.0	2.640
456	IC carrier trunk - IT trunk	33.0%	19.6	6.468	20.0	6.600
997	Tandem INCAMA - tandem	12.0%	8.9	1.068	9.0	1.080
Totals		100 %	AWT = 14.417		AWT = 14.632	
Maximum call attempts at 83% CPOCC				207,255		204,210

No CPOCC adjustment necessary for average work time

BCS31 maximum call attempts at 83 percent CPOCC	204,210
BCS30 maximum call attempts at 83 percent CPOCC	207,255
Difference	- 3,045
% change from BCS30 to BCS31	-1.5%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 6-6
Meridian Digital Centrex (MDC) model NT40 @ 40 Mhz

			BCS30 RTM Weighted ms/CA		BCS31 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
888	DTMF MDC line - MDC line	8.0%	17.3	1.384	17.7	1.416
889	DTMF MDC line - EAS trunk	3.0%	17.9	.537	18.4	.552
858	DTMF MDC line - abandon	5.0%	14.7	.735	15.0	.750
884	MDC intraLATA - toll trunk	7.0%	26.5	1.855	27.1	1.897
883	FGD DTMF MDC line - AT	9.0%	35.4	3.186	36.1	3.249
873	DTMF MDC line - EBS without display	5.0%	19.9	.995	20.4	1.020
891	EBS with display - EBS with display	5.0%	27.2	1.360	28.3	1.415
890	EBS with display - abandon	3.0%	17.4	.522	17.4	.522
892	EBS with display - EAS trunk	3.0%	22.0	.660	22.5	.675
885	EBS with display FGD - AT MF	8.0%	39.6	3.168	40.5	3.240
893	EBS with display - LAMA trunk	5.0%	30.1	1.505	30.8	1.540
862	EBS without display - MDC line	4.0%	20.1	.804	20.6	.824
854	MF POTS trunk - MDC line	19.0%	13.0	2.470	13.3	2.527
879	MF POTS trunk - EBS without display	16.0%	14.9	2.384	15.2	2.432
Totals		100 %	AWT = 21.565		AWT = 22.059	
Maximum call attempts at 82% CPOCC				136,888		133,823

CPOCC adjusted by 1.0 percent for average work time

BCS31 maximum call attempts at 82 percent CPOCC	133,823
BCS30 maximum call attempts at 82 percent CPOCC	136,888
Difference	- 3,065
% change from BCS30 to BCS31	-2.2%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 6-7
TOPS host OC/stand-alone model NT40 @ 40 Mhz

			BCS30 RTM Weighted ms/CA		BCS31 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
340	Host OC MCCS	15.0%	4.5	.675	4.4	.660
327	stand-alone MCCS	21.0%	57.9	12.163	58.5	12.289
326	ACTS coin	14.0%	64.4	9.019	64.9	9.089
487	Host OC non-coin 0+	4.5%	42.3	1.904	42.6	1.917
334	Host OC non-coin 0-	6.0%	42.9	2.574	44.0	2.640
614	Host OC coin 0+	2.3%	47.2	1.086	43.5	1.001
613	Host OC coin-	2.3%	47.7	1.097	48.7	1.120
330	stand-alone non-coin 0+	6.3%	70.9	4.466	71.5	4.504
315	stand-alone non-coin 0-	8.4%	67.9	5.703	68.8	5.778
814	stand-alone coin 0+	3.1%	88.2	2.734	88.9	2.756
813	stand-alone coin 0-	3.1%	89.8	2.783	90.8	2.815
048	MF INCAMA trunk - trunk	14.0%	18.0	2.520	18.4	2.576
Totals		100 %		AWT = 46.723		AWT = 47.144
Maximum call attempts at 80% CPOCC				61,639		61,090

CPOCC adjusted by 3.0 percent for average work time

BCS31 maximum call attempts at 80 percent CPOCC	61,090
BCS30 maximum call attempts at 80 percent CPOCC	61,639
Difference	- 549
% change from BCS30 to BCS31	-0.9%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 6-8
TOPS remote OC/AT model NT40 @ 40 Mhz

			BCS30 RTM Weighted ms/CA		BCS31 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
998	MF IT trunk - IT trunk	12.5%	11.9	1.488	12.0	1.500
048	MF INCAMA trunk - trunk	12.5%	18.0	2.250	18.4	2.300
455	IT trunk - IC carrier trunk	10.0%	11.9	1.190	12.0	1.200
456	IC carrier trunk - IT trunk	15.0%	19.6	2.940	20.0	3.000
997	Tandem INCAMA trunk - tandem	5.0%	8.9	.445	9.0	.450
924	E800 AT - IC trunk database query	5.0%	45.1	2.255	45.6	2.280
497	Remote OC MCCS	15.0%	61.8	9.273	62.4	9.363
503	Remote OC ACTS	10.0%	64.4	6.442	64.9	6.492
506	Remote OC non-coin 0+	4.5%	80.4	3.618	80.6	3.627
491	Remote OC non-coin 0-	6.0%	76.7	4.601	76.2	4.571
714	Remote OC coin 0+	2.3%	96.9	2.228	98.2	2.258
713	Remote OC coin 0-	2.2%	97.5	2.145	97.1	2.136
Totals		100.0%	AWT = 38.875		AWT = 39.177	
Maximum call attempts at 81 percent CPOCC				75,010		74,431

CPOCC adjusted by 2.0 percent for average work time

BCS31 maximum call attempts at 81 percent CPOCC	74,431
BCS30 maximum call attempts at 81 percent CPOCC	75,010
Difference	- 579
% change from BCS30 to BCS31	- 0.8%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 6-9
POTS EAEO suburban model DMS-Core Series 20 processor

			BCS30 RTM Weighted ms/CA		BCS31 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
994	DTMF 1FR line - line	5.0%	9.8	.490	9.8	.490
995	DTMF 1FR line - EAS trunk	3.0%	8.2	.246	8.4	.252
950	DTMF 1MR line - line	15.0%	13.3	1.995	13.7	2.055
016	DTMF 1MR line - EAS trunk	7.0%	12.4	.867	13.0	.910
011	DTMF 1FR line - LAMA trunk	10.0%	12.4	1.240	12.7	1.270
360	FGC 1+10 digits - IC trunk	5.0%	15.1	.755	15.5	.775
401	FGD 1+7 digits - IC trunk	5.0%	17.5	.875	17.8	.890
993	DTMF 1FR line - abandon	4.0%	4.5	.180	4.5	.180
308	DTMF 1MR line - busy	6.0%	8.1	.486	8.3	.498
996	MF trunk - line	30.0%	7.2	2.160	7.3	2.190
453	IC trunk - line	10.0%	11.8	1.180	12.1	1.210
Totals		100 %	AWT = 10.475		AWT = 10.720	
Maximum call attempts at 86% CPOCC				295,561		288,806

No CPOCC adjustment necessary for average work time

BCS31 maximum call attempts at 86 percent CPOCC	288,806
BCS30 maximum call attempts at 86 percent CPOCC	295,561
Difference	- 6,755
% change from BCS30 to BCS31	- 2.3%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 6-10
POTS EAEO urban model DMS-Core Series 20 processor

			BCS30 RTM Weighted ms/CA		BCS31 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
974	DTMF 1MR AT to FGD IC	5.0%	17.6	.880	17.9	.895
950	DTMF 1MR line - line	18.0%	13.3	2.394	13.7	2.466
016	DTMF 1MR line - EAS trunk	7.0%	12.4	.868	13.0	.910
308	DTMF 1MR line - busy	3.0%	8.1	.243	8.3	.249
018	DTMF coin line - busy	1.0%	10.2	.102	10.6	.106
996	MF trunk - line	7.0%	7.2	.504	7.3	.511
990	IC trunk - line	14.0%	11.9	1.666	12.1	1.694
019	DTMF coin line - line	2.0%	16.1	.322	16.3	.326
954	DTMF coin line - IC/FGD	1.0%	20.8	.208	21.4	.214
054	PBX DOD trunk - line	11.0%	9.9	1.089	10.1	1.111
958	MF PX DOD trunk - IC trunk	3.0%	18.0	.540	18.2	.546
961	MF PX DOD trunk - EAS trunk	4.0%	9.3	.372	9.4	.376
888	DTMF MDC line - MDC line	10.0%	9.4	.940	9.4	.940
889	DTMF MDC line - EAS trunk	4.0%	9.9	.396	10.1	.404
858	DTMF MDC line - abandon	2.0%	7.9	.158	8.1	.162
854	MF POTS trunk - MDC line	5.0%	7.3	.365	7.4	.370
883	FGD DTMF MDC line - AT	3.0%	18.0	.540	18.2	.546
Totals		100 %	AWT = 11.587		AWT = 11.826	
Maximum call attempts at 86% CPOCC				267,196		261,796

No CPOCC adjustment necessary for average work time

BCS31 maximum call attempts at 86 percent CPOCC	261,796
BCS30 maximum call attempts at 86 percent CPOCC	267,196
Difference	- 5400
% change from BCS30 to BCS31	- 2.0%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 6-11
Access tandem model DMS-Core Series 20 processor

			BCS30 RTM Weighted ms/CA		BCS31 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
998	MF IT trunk - IT trunk	27.5%	6.9	1.898	7.1	1.953
048	MF INCAMA trunk - trunk	5.5%	9.9	.545	10.2	.561
455	IT trunk - IC carrier trunk	22.0%	6.8	1.496	7.0	1.540
456	IC carrier trunk - IT trunk	33.0%	10.2	3.366	10.5	3.465
997	Tandem INCAMA - tandem	12.0%	5.2	.624	5.3	.636
Totals		100 %		AWT = 7.928		AWT = 8.155
Maximum call attempts at 86% CPOCC				390,515		379,668

No CPOCC adjustment necessary for average work time

BCS31 maximum call attempts at 86 percent CPOCC	379,668
BCS30 maximum call attempts at 86 percent CPOCC	390,515
Difference	- 10,847
% change from BCS30 to BCS31	-2.8%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 6-12
Meridian Digital Centrex (MDC) model DMS-Core Series 20 processor

			BCS30 RTM Weighted ms/CA		BCS31 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
888	DTMF MDC line - MDC line	8.0%	9.4	.752	9.4	.752
889	DTMF MDC line - EAS trunk	3.0%	9.9	.297	10.1	.303
858	DTMF MDC line - abandon	5.0%	7.9	.395	8.1	.405
884	MDC intraLATA - toll trunk	7.0%	13.7	.959	13.9	.973
883	FGD DTMF MDC line - AT	9.0%	18.0	1.620	18.2	1.638
873	DTMF MDC line - EBS without display	5.0%	10.3	.515	10.4	.520
891	EBS with display - EBS with display	5.0%	12.1	.605	11.9	.595
890	EBS with display - abandon	3.0%	7.9	.237	7.9	.237
892	EBS with display - EAS trunk	3.0%	10.0	.300	10.1	.303
885	EBS with display FGD - AT MF	8.0%	18.0	1.440	18.2	1.456
893	EBS with display - LAMA trunk	5.0%	13.5	.675	13.8	.690
862	EBS without display - MDC line	4.0%	9.2	.368	9.1	.364
854	MF POTS trunk - MDC line	19.0%	7.3	1.387	7.4	1.406
879	MF POTS trunk - EBS without display	16.0%	7.8	1.248	7.8	1.248
Totals		100 %	AWT = 10.798		AWT = 10.890	
Maximum call attempts at 86% CPOCC				286,720		284,298

No CPOCC adjustment necessary for average work time

BCS31 maximum call attempts at 86 percent CPOCC	284,298
BCS30 maximum call attempts at 86 percent CPOCC	286,720
Difference	- 2,422
% change from BCS30 to BCS31	-0.8%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 6-13
TOPS host OC/stand-alone model DMS-Core Series 20 processor

			BCS30 RTM Weighted ms/CA		BCS31 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
340	Host OC MCCS	15.0%	2.1	.315	2.1	.315
327	stand-alone MCCS	21.0%	29.8	6.248	30.0	6.290
326	ACTS coin	14.0%	33.5	4.683	34.4	4.809
487	Host OC non-coin 0+	4.5%	19.0	.855	19.4	.873
334	Host OC non-coin 0-	6.0%	19.3	1.158	19.6	1.176
614	Host OC coin 0+	2.3%	20.7	.476	19.8	.455
613	Host OC coin-	2.3%	21.3	.490	21.5	.495
330	stand-alone non-coin 0+	6.3%	36.3	2.284	36.5	2.296
315	stand-alone non-coin 0-	8.4%	34.3	2.877	34.9	2.927
814	stand-alone coin 0+	3.1%	45.6	1.412	46.6	1.446
813	stand-alone coin 0-	3.1%	47.8	1.480	47.9	1.483
048	MF INCAMA trunk - trunk	14.0%	9.9	1.386	10.2	1.428
Totals		100 %	AWT = 23.664		AWT = 23.994	
Maximum call attempts at 84.5% CPOCC				128,552		126,784

CPOCC adjusted by 1.5 percent for average work time

BCS31 maximum call attempts at 84.5 percent CPOCC	126,784
BCS30 maximum call attempts at 84.5 percent CPOCC	128,552
Difference	- 1768
% change from BCS30 to BCS31	-1.4%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 6-14
TOPS remote OC/AT model DMS-Core Series 20 processor

			BCS30 RTM Weighted ms/CA		BCS31 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**	**Call**	**Time**
998	MF IT trunk - IT trunk	12.5%	6.9	.863	7.1	.888
048	MF INCAMA trunk - trunk	12.5%	9.9	1.238	10.2	1.275
455	IT trunk - IC carrier trunk	10.0%	6.8	.680	7.0	.700
456	IC carrier trunk - IT trunk	15.0%	10.2	1.530	10.5	1.575
997	Tandem INCAMA trunk - tandem	5.0%	5.2	.260	5.3	.265
924	E800 AT - IC trunk database query	5.0%	22.1	1.105	22.5	1.125
497	Remote OC MCCS	15.0%	32.0	4.793	32.4	4.853
503	Remote OC ACTS	10.0%	33.5	3.345	34.4	3.435
506	Remote OC non-coin 0+	4.5%	39.8	1.789	39.9	1.793
491	Remote OC non-coin 0-	6.0%	37.5	2.247	38.1	2.289
714	Remote OC coin 0+	2.3%	49.8	1.144	49.6	1.140
713	Remote OC coin 0-	2.2%	49.3	1.084	50.1	1.101
Totals		100.0%	AWT = 20.076		AWT = 20.438	
Maximum call attempts at 84.5 percent CPOCC				151,524		148,840

CPOCC adjusted by 1.5 percent for average work time

BCS31 maximum call attempts at 84.5 percent CPOCC	148,840
BCS30 maximum call attempts at 84.5 percent CPOCC	151,524
Difference	- 2684
% change from BCS30 to BCS31	- 1.8%

(- sign indicates a decrease in capacity)
(+ sign indicates an increase in capacity)

Table 6-15
CPU call times-line origination

Call type	Call description	ms perC/A NT40	ms per C/A DMS-Core
947	POTS DP 1FR - POTS DTMF 1FR line	17.5	8.7
005	POTS DP 1FR - LAMA trunk	23.1	11.6 *
979	POTS DP 2FR - POTS 1FR line	23.8	12.0
014	POTS DTMF 1FR - false start	6.3	3.4
994 **	POTS DTMF 1FR line - POTS 1FR line	18.2	9.8
015 **	POTS DTMF 1MR line - POTS 1FR line	26.8	13.5 *
962	POTS DTMF 1FR line - POTS 1MR line	19.6	9.8
950	POTS DTMF 1MR line - POTS 1MR line	26.8	13.7 *
859	POTS DTMF 1FR line - MDC DTMF line	19.5	9.8
1059	POTS DTMF 1FR line - EBS with display	21.5	13.0
1236	POTS DTMF 1FR line - MADN primary	29.9	15.7
995 **	POTS DTMF 1FR line - EAS trunk	15.2	8.4
016 **	POTS DTMF 1MR line - EAS trunk	25.1	13.0 *
360 **	FGC 1+10 digits - IC (PIC)	29.7	15.5 *
378 **	FGC 1+10 digits - AT (PIC)	30.4	15.3 *
401 **	FGD 1+7 digits - IC (OCS on, PIC)	33.7	17.8 *
402	FGD 1+10 digits - AT (OCS on, PIC)	33.6	17.7 *
974	POTS DTMF 1MR line - via AT TO IC FGD trunk	34.0	17.9 *
011 **	POTS DTMF 1FR line - LAMA trunk	24.0	12.7 *
949	POTS DTMF 1FR line - operator trunk	24.6	12.3
308	POTS DTMF 1MR line - busy	15.6	8.3
951	POTS DTMF 1MR line - abandon after 5 digits	9.2	4.6
993 **	POTS DTMF 1FR line - abandon after 6 digits	8.1	4.5
948	POTS DTMF 1FR line - busy DTMF 1FR	15.8	8.0
967	POTS DTMF 1FR line - MF operator trunk	23.2	11.7
963	POTS DTMF 1FR line - MF PBX DID trunk	17.8	8.9
966	POTS DTMF 1FR line - announcement BLDN treatment	17.5	9.3

-continued-

Table 6-15
CPU call times-line origination (continued)

Call type	Call description	ms perC/A NT40	ms per C/A DMS-Core
019 **	Coin DTMF - POTS 1FR line	29.3	16.3 *
020 **	Coin DTMF - EAS trunk	29.4	14.8 *
910	FGB coin DTMF - AT MF	28.5	14.3
952	Coin DTMF - direct to IC FGC trunk	38.8	19.5 *
953	Coin DTMF - via AT to IC FGC trunk	39.1	19.6 *
954	Coin DTMF - direct to IC FGD	38.6	21.4 *
955 **	Coin DTMF - via AT to IC FGD trunk	42.9	21.5 *
982	Coin DTMF - operator trunk	33.0	17.0
908	Coin DTMF - trunk (1+800)	34.5	17.3 *
018	Coin DTMF - busy	18.7	10.6
054 **	PBX DOD trunk - POTS 1FR line	17.7	10.1
055 **	PBX DOD trunk - LAMA trunk	27.1	13.6 *
914 **	PBX DTMF DOD - non-LAMA MF EAS	16.4	8.2
915	FGB DTMF PBX DOD - AT MF trunk	20.5	10.3
916	FGC DTMF PBX DOD - AT MF trunk	30.7	15.4 *
917 **	FGD DTMF PBX DOD - AT MF trunk	33.6	16.9 *
988	OUTWATS - direct to IC FGB trunk	30.6	15.4 *
918	FGC DTMF OUTWATS - AT MF trunk	31.5	15.8 *
989 **	OUTWATS - direct to IC FGD	34.1	17.1 *
052 **	OUTWATS - LAMA trunk	24.8	12.5 *
309	OUTWATS (enhanced) - ATC trunk	34.8	17.5 *
805	MDC DTMF - false start	6.9	3.7
888 **	MDC DTMF - MDC line	17.7	9.4
889 **	MDC DTMF - EAS trunk	18.4	10.1
881	FGB DP MDC - AT MF	21.4	10.8
882	FGC DTMF MDC - AT MF	32.9	16.5 *
883 **	FGD DTMF MDS - AT MF	36.1	18.2 *

-continued-

Table 6-15
CPU call times-line origination (continued)

Call type	Call description	ms perC/A NT40	ms per C/A DMS-Core
884 **	DTMF MDC intraLATA - MF toll trunk	27.1	13.9 *
886	E800 EAEO DTMF MDC - IC trunk	50.6	25.4 *
873	MDC DTMF - EBS without display	20.4	10.4
874	MDC DTMF - MDC MF trunk	28.7	14.5 *
857	MDC DTMF second DT - POTS 1FR	21.7	10.9
858	MDC DTMF - abandon after two digits	15.0	8.1
850	Attendant - MDC DTMF line (SCG)	24.3	12.2
891 **	EBS with display - EBS with display	28.3	11.9
892	EBS with display - EAS trunk	22.5	10.1
893	EBS with display - LAMA trunk	30.8	13.8 *
863	EBS without display - EBS without display	20.2	10.2
894 **	EBS with display - EBS without display	23.8	10.3
885	EBS with display FGD - AT MF	40.5	18.2 *
876	EBS without display - MDC MF trunk	28.4	14.3 *
875	EBS without display DTMF FX trunk	19.1	9.6
890	EBS with display - abandon after two digits	17.4	7.9
862	EBS without display - MDC DTMF line (SCG)	20.6	9.1
861	EBS without display - attendant	20.7	10.4
864	EBS without display second DT - POTS 1FR	21.3	10.7
	Data path - line	32.5 D	16.1 D
	Data path - non-LAMA (EAS)	33.7 D	16.7 D
	Data path - LAMA	50.3 D	24.9 D

End

Table 6-16xxx
Call types with CLASS features

POTS custom calling features (CCF)

3 - way calling (3WC)
Call waiting (CWT)
Speed calling (SC1)
Call forward (CFW)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1065	1FR line (all CCF assigned) - 1FR line	18.2	9.8
1066	1FR line (3WC activated) - 1FR line	145.4	73.5 *
1067	1FR line (SC1 activated) - 1FR line	17.5	9.4
1070	1FR line - 1FR line (CFU assigned)	20.3	10.2
1072	1FR line - 1FR line (all CCF assigned)	18.8	10.1
1073	1FR line - 1FR line (CFU activated)	24.1	12.8
1074	1FR line - 1FR line (CWT activated)	109.1	58.8 *
1105	1FR line - 1FR line (3WC, SC1, CWT assigned)	19.7	9.9

MDC custom calling features (CCF)

3 - way calling (3WC)
Call waiting (CWT)
Speed calling short list (SC1)
Speed calling long list (SC2)
Call forward busy (CFB)
Call forward universal (CFU)
Call forward don't answer CFD)
Call transfer (CXR)
Call hold (CH)
Ring again (RA)
Call pick-up (CPU)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1075	MDC line - MDC line	18.5	9.3
1085	MDC line (all CCF assigned) - MDC line	17.6	9.4
1086	MDC line (3WC activated) - MDC line	119.3	61.6 *
1087	MDC line (SC1 activated) - MDC line	22.7	11.4
1088	MDC line (SC2 activated) - MDC line	21.1	11.3

-continued-

Table 6-16xxx
Call types with CLASS features (continued)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1089	MDC line (CH activated) - MDC line	107.5	55.2 *
1107	MDC line (RA activated) - MDC line	83.3	43.0
1092	MDC line - MDC line (CFU assigned)	19.7	9.9
1095	MDC line - MDC line (CFB assigned)	19.5	9.8
1096	MDC line - MDC line (CFD assigned)	27.1	13.6
1099	MDC line - MDC line (all CCF assigned)	26.3	13.7
1100	MDC line - MDC line (CFU activated)	27.1	13.6
1101	MDC line - MDC line (CWT activated)	127.7	67.9 *
1102	MDC line - MDC line (CFB activated)	27.0	13.6
1103	MDC line - MDC line (CFD activated)	49.8	25.2
1104	MDC line - MDC line (CXR activated)	97.7	49.3 *
1106	MDC line - MDC line (3WC, SC1, SC2, CWT, CH, CXR assigned)	18.7	9.4
1108	MDC line - MDC line (CPU activated)	55.1	29.6

RES custom local area signaling services (CLASS)

Automatic call back (ACB)
Automatic recall (AR)
Calling number delivery (CND)
Calling name delivery
Calling number delivery blocking (CNDB
Selective call rejection (SCRJ)
Customer originated trace (COT)
Usage sensitive billing (USB)
Selective call forward (SCFWD)
Selective call acceptance (SCA)
Distinctive ring (DR)

Call type	Call description	NT40	DMS-Core
1205	RES - RES (ACB, AR, CND, COT assigned originating and terminating	25.9	13.4
1206	RES (ACB intraNODAL activated) - RES	115.1	60.2
1207	RES - RES (AR intraNODAL activated	38.7	19.8

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Table 6-16xxx
Call types with CLASS features (continued)

Call type	Call description	NT40	DMS-Core
1208	RES (ACB network activated - SS7 - RES	213.6	106.9 *
1209	RES (AR network activated) - SS7 - RES	66.7	33.5 *
1210	RES - RES (SCRJ activated)	43.5	22.7 *
1211	RES - RES (SCFWD activated)	67.0	33.4 *
1212	RES - RES (SCA activated)	53.8	27.3 *
1213	RES - RES (DR activated)	53.0	26.8 *
1214	RES - RES (COT activated)	23.4	12.5
1215	RES (CNDB activated) - RES	28.8	15.5
1216	RES (CNDB activated, USB on) - RES	35.7	18.5 *
1217	1FR line - RES (CNAMD activated)	65.7	33.2 *
1218	1 FR line - RES (CND activated)	47.0	24.2 *
RES simplified message desk interface (SMDI)			
SMDI call forward busy (CFB) SMDI call forward don't answer (CFD) SMDI call forward always (CFA)			
		ms per C/A	
Call type	**Call description**	**NT40**	**DMS-Core**
1220	RES - SMDI (direct)	51.6	31.9
1221	POTS 1FR - RES SMDI (CFR)	61.4	36.0
1222	POTS 1FR - RES SMDI (CFD)	83.4	47.1
1223	POTS 1FR - RES SMDI (CFA)	61.7	36.0
End			

Table 6-17
Incoming trunk origination

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
997	MF tandem INCAMA trunk - MF tandem trunk	9.0	5.3
996 **	MF trunk - POTS 1FR line	13.1	7.3
998 **	MF IT trunk - IT trunk	12.0	7.1
453	MF IC trunk - POTS 1FR line	24.6	12.1 *
999	MF trunk - busy	19.7	9.9 *
031 **	MF trunk - INWATS line	25.7	12.9 *
879	MF trunk - EBS without display	15.2	7.8
946	MF trunk - abandon (no start signal)	6.4	3.6
854	MF POTS trunk - MDC DTMF line	13.3	7.4
046	MF INCAMA trunk - POTS 1FR line	23.4	11.7 *
048 **	MF INCAMA trunk - trunk	18.4	10.2 *
990	IC trunk - POTS 1FR line (LCM)	24.6	12.1 *
456 **	IC carrier trunk - IT trunk	20.0	10.5 *
991	IC trunk - MF PBX DID (PX)	23.0	11.6 *
455	IT trunk - IC carrier trunk	12.0	7.0
919 **	FGC leased MF incoming trunk - IC trunk	30.7	15.4 *
920 **	FGD leased MF incoming trunk - IC trunk	33.2	16.7 *
921 **	Leases MF incoming trunk - tandem MF IT trunk	33.2	16.7 *
855	MDC MF trunk - MDC DTMF line	16.2	8.1
856	MDC DTMF FX trunk - MDC DTMF line (SCG)	21.8	11.0
868	MDC MF trunk - attendant	19.2	9.6
958	MF PX DOD trunk DIG (PX) - direct to IC trunk	33.0	18.2 *
959	MF PX DOD trunk DIG - via AT to IC trunk	34.0	17.1 *
961	MF PX DOD trunk DIG - MF EAS trunk	16.0	9.4
986	DTMF PBX DOD (FX) trunk - operator trunk	21.7	10.9
987	MF PBX DOD trunk - operator trunk	22.6	11.3

Table 6-18
E911 trunking

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1201	FX trunk - E911 tandem	26.4	13.3
1202	E911 trunk - E911 tandem PSAP QRY	21.6	10.9
1202	E911 trunk - PSAP line with ORIGHOLD	30.3	16.6 *

Table 6-19
SS7 trunking

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
577	DTMF POTS line - SS7 trunk	19.7	10.6
578 **	DTMF MDC line - SS7 trunk	23.0	12.1
579 **	DTMF POTS line - SS7 trunk	28.4	14.4 *
580	SS7 trunk - DTMF POTS line	15.9	8.2
581	SS7 trunk - DTMF MDC line	18.1	9.1
582	SS7 trunk - EBS with display (network name display)	28.5	14.3
583	EBS with display - SS7 trunk (network ring again)	96.1	48.3
584	SS7 trunk - EBS with display (network number display)	21.7	10.9
585	EBS with display - SS7 trunk (network name display)	32.0	16.1
598	SS7 trunk - EBS with display (network ring again)	17.7	8.9
599	EBS with display - SS7 trunk (network number display)	25.3	12.7
1230	FGD MF trunk - SS7 trunk	17.9	10.4
1231	FGD SS7 trunk - MF trunk	16.5	9.0
1232 **	FGD SS7 trunk - SS7 trunk	15.3	8.0
1233	FGD E800 SS7 trunk - MF trunk (database query)	35.8	17.9
1234	FGD E800 SS7 trunk - SS7 trunk	34.6	17.0
1231	FGB SS7 trunk - MF trunk	12.1	6.9

Table 6-20
800 service

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
922	E800 DTMF 1FR - IC (DB query)	48.4	24.3 *
924 **	E800 DTMF 1FR - IC (DB query)	45.6	22.5 *
927	E800 EAEO DTMF 1FR - reorder (DB query)	41.2	20.7
928	E800 EAEO DTMF 1FR - AT (DB query)	51.7	26.0 *
929	E800 AT - IT (DB query)	41.6	20.9 *
943	E800 AT - reorder (DB query)	26.1	13.1

Table 6-21xxx
Call time adjustments

Call description	ms per C/A NT40	ms per C/A DMS-Core
Remote line origination	.8	.4
Incoming dial pulse	-2.4	-1.4
Incoming AMA	9.1D	4.9D
Originating dial pulse line	-1.5D	-1.1D
Originating MADN	.6 plus number of secondary members x .5 ms D	.3 plus number of secondary members x .5 ms D
Terminating MADN	11.7 plus ringing secondary members x 2.5 ms D	5.9 plus ringing secondary members x 2.5 ms D
MDC SMDR	5.3D	2.8D
MDC attendant console termination	3.0D	1.5D
MDC attendant console origination	5.6D	2.8D
UTR	-2.0D	-1.0D
Alternate routing	1.1D	.6D
Virtual facility group	1.5D	.8D

-continued-

Table 6-21xxx
Call time adjustments (continued)

Call description	ms per C/A NT40	ms per C/A DMS-Core
Hunt group	2.4D	1.3D
Permanent signal	1.1D	.6D

End

Table 6-22
POTS feature activation

Call description	ms per C/A NT40	ms per C/A DMS-Core
Call waiting	62.4	33.7
Three-way calling	99.9	49.0
Call forward	5.3	2.7
Speed calling	-0.7	-0.4

Table 6-23
MDC feature activation

Call description	ms per C/A NT40	ms per C/A DMS-Core
Call waiting	66.0	35.6
Three-way calling	75.0	37.9
Ring again	63.5	33.7
Call transfer	44.7	21.3
Call pick-up	35.3	20.3
Call forward, no answer	30.0	15.9
Call forward, universal	7.3	4.3
Call forward, busy	7.2	4.3
Speed calling	4.3	2.0
Call hold	80.2	40.9

Table 6-24
CLASS feature activation

Call description	ms per C/A NT40	ms per C/A DMS-Core
ACB intra-NODAL	89.6	46.8
ACB - SS7 network	110.9	55.1
SS7 network - ACB	55.4	27.5
AR intra-NODAL	13.2	6.4
AR - SS7 network	13.1	6.2
SS7 network - AR	6.5	3.1
CND	3.2	1.5
CNAMD	21.9	10.5
CDNB	3.2	2.0
COT	23.4	12.5
Selective call rejection (SCRJ)	12.0	6.3
Selective call forward (SCFWD)	19.9	9.2
Distinctive ring, call forward	5.9	2.6
Selective call acceptance	6.7	3.1
Usage sensitive billing	6.9	3.0

Table 6-25
CLASS feature assignment

Call description	ms per C/A NT40	ms per C/A DMS-Core
Automatic recall (AR) terminating	3.2	1.6
Automatic callback (ACB) originating	2.3	1.1
Customer originated trace (COT) terminating	3.2	1.6

Table 6-26xxx
TOPS extended Bellcore AMA format phase 0/DA phase 1-stand-alone TOPS configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
316 **	0-; OH; non-coin; information only, no outpulsing	41.4	21.8
314	0-; OH; non-coin; inter exchange carrier	76.6	40.3
315 **	0-; OH; non-coin; person paid; end office	69.8	35.3
317	0-; OH; non-coin; station special; BNS = yes	75.4	39.7
513	0-; OH; non-coin; OVS; transfer IC; inter-LATA carrier	61.8	32.5
813 **	0-; OH; coin; person paid; end office; without rate step	91.8	48.3
819	0-; OH; person paid; end office; TICS	93.3	49.1
1142	0-; OH; non-coin; person paid; AMA; answer	93.3	49.1
824 **	0+; MCCS; SS7 database; successful	75.6	39.8
802	0+; MCCS; hook flash to operator	90.8	47.8
327	0+; MCCS; no query database	61.5	31.5
320	0+; MCCS; OH; no query database; with timeout	91.2	48.0
331	0+; OA; non-coin; station collect; end office	71.1	37.4
329	0+; OA; non-coin; station paid; end office	70.7	37.2
332	0+; OA; non-coin; person collect; end office	71.4	37.6
330 **	0+; OA; non-coin; person paid; end office	72.5	36.9
509	0+; non coin, inter-LATA carrier	34.4	18.1
515	0+; coin; OVS; inter-LATA carrier	33.4	17.6
814 **	0+; OH; coin; person paid; end office; without rate step	89.9	47.1
818	0+; OA; non-coin; person paid; end office; TICS	73.3	38.6
825	0+; OA; CCN; SS7 database; deny first number; complete second number	156.2	82.2
826	0+; OA; CCN; SS7 database; service deny, no payment	92.0	48.4
827	0+; OA; CCN; SS7 database; successful	104.3	54.9
828	0+; OA; BNS; SS7 database; verify collect	94.4	49.7

-continued-

Table 6-26xxx
TOPS extended Bellcore AMA format phase 0/DA phase 1-stand-alone TOPS configuration (continued)

		ms per C/A	
Call type	**Call description**	**NT40**	**DMS-Core**
830	0+; OA; BNS; SS7 database; verify third number	128.4	67.6
807	1+; ACTS; coin; initial deposit	126.2	66.4
326 **	1+; ACTS; coin	65.8	34.7
321 **	1+; CAMA; ONI; non-coin	46.7	24.6
322 **	1+; ONI; successful validation	33.4	17.6
328 **	1+; direct dialed; hotel; person paid	77.9	41.0
809	1+; OH; hotel; bill to room	75.2	39.6
815 **	1+; direct dialed; coin; station paid; end office; without rate step	92.0	48.4
518	Queue search for CAMA calls	46.2	24.3
520	Verify and connect	91.8	48.3
526 **	Verify with scrambler	59.6	29.8

End

Table 6-27xxx
Host OC TOPS configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
335 **	0-; OH; non-coin; information only, no outpulsing	31.2	14.2
333	0-; OH; non-coin; interconnect carrier	47.5	21.6
334 **	0-; OH; non-coin; person paid; end office	44.0	19.6
337	0-; OH; non-coin; station special	57.0	25.9
531	0-; OH; non-coin, OVS; transfer IC; inter-LATA carrier	34.1	15.5
613 **	0-; OH; coin; person paid; end office without step rate	48.2	21.5
619	0-; OH; coin; person paid; end office; TICS	44.9	20.4
1140	0-; OH; non-coin; person paid; AMA, answer	67.3	30.6
602	0+; MCCS; hook flash to operator	59.0	26.8
340	0+; MCCS; no query database	4.4	2.1
336	0+; MCCS; OH; no query database; with timeout	57.0	25.9
488	0+; OA; non-coin; station collect; end office	43.3	19.7
486	0+; OA; non-coin; station paid; end office	42.2	19.2
489	0+; OA; non-coin; person collect; end office	42.9	19.5
487 **	0+; OA; non-coin; person paid; end office	42.6	19.4
614 **	0+; OH; coin; person paid; end office; without rate step	43.5	19.8
618	0+; OA; non-coin; person paid; end office; TICS	40.0	18.2
625	0+; OA; CCN; SS7 database; deny first number; complete second number	87.3	39.7
626	0+; OA; CCN; SS7 database; service deny no payment	59.4	27.0
627	0+; OA; CCN; SS7 database; successful	53.5	24.3
628	0+; OA; BNS; SS7 database; verify collect	43.6	19.8
630	0+; OA; BNS; SS7 database; verify third number	77.7	35.3
607	1+; ACTS; coin; T/O initial deposit	68.0	30.9
341 **	1+; CAMA; ONI; non-coin	25.3	11.5
342 **	1+; ONI; successful validation	25.1	11.4

-continued-

Table 6-27xxx
Host OC TOPS configuration (continued)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
347 **	1+; direct dial; hotel; person paid	46.6	21.2
609	1+; OH; hotel; bill to room	40.3	18.3
615 **	1+; direct dial; coin; station paid; end office; without step rate	46.6	21.0
536	Queue search for CAMA calls	30.4	13.8
538	Verify and connect	76.3	34.7
544 **	Verify with scrambler	47.7	21.7

End

Table 6-28xxx
Remote OC TOPS configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
492 **	0-; OH; non-coin; information only, no outpulsing	47.8	23.9
490	0-; OH; non-coin; interconnect carrier	85.0	42.5
491 **	0-; OH; non-coin; person paid; end office	77.2	38.6
494	0-; OH; non-coin; station special BNS = yes	91.2	45.6
549	0-; OH; non-coin, OVS; transfer IC; inter-LATA carrier	68.4	34.2
713 **	0-; OH; coin; person paid; end office without step rate	98.1	50.5
719	0-; OH; coin; person paid; end office; TICS	103.9	52.0
1141	0-; OH; non-coin; person paid; AMA, answer	100.0	50.0
724 **	0+; MCCS; SS7 database; successful	79.6	39.8
702	0+; MCCS; hook flash to operator	117.8	58.9
497	0+; MCCS; no query database	65.4	33.9
493	0+; MCCS; OH; no query database; with timeout	107.4	53.7
507	0+; OA; non-coin; station collect; end office	81.8	40.9
505	0+; OA; non-coin; station paid; end office	80.4	40.2

-continued-

Table 6-28xxx
Remote OC TOPS configuration (continued)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
508	0+; OA; non-coin; person collect; end office	83.0	41.5
506 **	0+; OA; non-coin; person paid; end office	81.6	40.3
545	0+; non-coin; inter-LATA carrier	35.2	17.6
551	0+; coin; OVS; inter-LATA carrier	32.8	16.4
714 **	0+; non-coin; person paid; end office; without rate step	99.2	50.0
718	0+; OA; non-coin; person paid; end office; TICS	86.6	43.3
725	0+; OA; CCN; SS7 database; deny first number; complete second number	170.6	85.3
726	0+; OA; CCN; SS7 database; service deny no payment	97.8	48.9
727	0+; OA; CCN; SS7 database; successful	115.2	59.0
728	0+; OA; BNS; SS7 database; verify collect	103.0	51.5
730	0+; OA; BNS; SS7 database; verify third number	142.0	71.0
707	1+; ACTS; coin; T/O initial deposit	144.8	72.4
503 **	1+; ACTS; coin;	65.8	34.7
498 **	1+; CAMA; ONI; non-coin	52.2	26.1
499 **	1+; ONI; successful validation	35.8	17.9
504 **	1+; direct dial; hotel; person paid	88.2	44.1
709	1+; OH; hotel; bill to room	83.0	41.5
715 **	1+; direct dial; coin; station paid; end office; without step rate	104.0	52.0
554	Queue search for CAMA calls	52.0	26.0
556	Verify and connect	106.2	53.1
562 **	Verify with scrambler	64.4	32.2

End

Table 6-29
TOPS multi-purpose-stand-alone TOPS MP configuration

		ms per C/A	
Call type	**Call description**	**NT40**	**DMS-Core**
1130	0-; OH; non-coin; person paid; end office	67.1	35.3
1136	0-; OH; coin; person paid; end office	85.3	44.9
1133	0+; OA; non-coin; person paid; end office	71.3	37.5
1139	0+; OA; coin; person paid; end office	88.2	46.4

Table 6-30
TOPS multi-purpose-host OC TOPS MP configuration

		ms per C/A	
Call type	**Call description**	**NT40**	**DMS-Core**
1128	0-; OH; non-coin; person paid; end office	44.4	20.2
1134	0-; OH; coin; person paid; end office	44.7	20.3
1131	0+; OA; non-coin; person paid; end office	43.1	19.6
1137	0+; OA; coin; person paid; end office	41.8	19.8

Table 6-31
TOPS multi-purpose-remote OC TOPS MP configuration

		ms per C/A	
Call type	**Call description**	**NT40**	**DMS-Core**
1129	0-; OH; non-coin; person paid; end office	76.9	38.5
1135	0-; OH; coin; person paid; end office	94.9	47.5
1132	0+; OA; non-coin; person paid; end office	80.8	40.4
1138	0+; OA; coin; person paid; end office	98.2	49.1

Table 6-32
Stand-alone AABS configuration

		ms per C/A	
Call type	**Call description**	**NT40**	**DMS-Core**
1172 **	AABS; 0+; collect; non-coin; LIDB database; verify	98.0	51.6
1175 **	AABS; 0+; bill third party; non-coin; LIDB database; verify;	120.5	63.4
1178 **	AABS; 0+; calling card number; non-coin; LIDB verify	78.7	41.4
1254	Operator handoff via VSN billed collect	133.0	70.0
1257	Operator handoff via VSN billed third party	145.2	39.9

Table 6-33
Host OC AABS configuration

		ms per C/A	
Call type	**Call description**	**NT40**	**DMS-Core**
1170 **	AABS; 0+; collect; non-coin; LIDB database; verify	0.0	0.0
1173 **	AABS; 0+; bill third party; non-coin; LIDB database; verify;	0.0	0.0
1176 **	AABS; 0+; calling card number; non-coin; LIDB verify	0.0	0.0
1252	Operator handoff via VSN billed collect	71.5	32.5
1255	Operator handoff via VSN billed third party	69.1	31.4

Table 6-34
Remote OC AABS configuration

		ms per C/A	
Call type	**Call description**	**NT40**	**DMS-Core**
1171 **	AABS; 0+; collect; non-coin; LIDB database; verify	103.2	51.6
1174 **	AABS; 0+; bill third party; non-coin; LIDB database; verify;	126.8	63.4
1177 **	AABS; 0+; calling card number; non-coin; LIDB verify	82.8	41.4
1253	Operator handoff via VSN billed collect	141.8	70.9
1256	Operator handoff via VSN billed third party	152.0	76.0

Table 6-35
TOPS directory assistance-stand-alone TOPS MP configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1148	411; combined trunk and voice quote	62.3	32.8
1151	411; combined trunk and external ARU	69.5	36.6 **
1154	411; DA trunk; external ARU; no ANI	61.6	32.4
1163	Intercept; intercept trunk; external ARU	42.6	22.4
1166	Intercept; intercept trunk; number not in database; voice quote	50.5	26.6
1169	Intercept; intercept trunk; ONI; external ARU	69.4	36.5
1242	411; combined trunk; call completion; station paid	95.4	50.2
1245	411; call completion; station paid AABS calling card	142.0	74.7
1248	411; call completion; station paid AABS collect	162.1	85.3
1251	411; call completion; station paid AABS bill third party	182.2	95.9

Table 6-36
TOPS directory assistance-host OC TOPS MP configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1146	411; combined trunk and voice quote	37.4	17.0
1149	411; combined trunk and external ARU	32.3	14.7 **
1152	411; DA trunk; external ARU; no ANI	36.3	16.5
1161	Intercept; intercept trunk; external ARU	0.0	0.0
1164	Intercept; intercept trunk; number not in database; voice quote	27.9	12.7
1167	Intercept; intercept trunk; ONI; external ARU	30.6	13.9
1240	411; combined trunk; call completion; station paid	32.6	14.8
1243	411; call completion; station paid AABS calling card	36.5	16.6
1246	411; call completion; station paid AABS collect	40.7	18.5
1249	411; call completion; station paid AABS bill third party	43.8	19.9

Table 6-37
TOPS directory assistance-remote OC TOPS MP configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1147	411; combined trunk and voice quote	66.8	33.4
1150	411; combined trunk and external ARU	74.0	37.0 **
1153	411; DA trunk; external ARU; no ANI	65.6	32.8
1162	Intercept; intercept trunk; external ARU	44.8	22.4
1165	Intercept; intercept trunk; number not in database; voice quote	56.4	28.2
1168	Intercept; intercept trunk; ONI; external ARU	71.6	35.8
1241	411; combined trunk; call completion; station paid	102.4	51.2
1244	411; call completion; station paid AABS calling card	146.4	73.2
1247	411; call completion; station paid AABS collect	160.6	80.3
1250	411; call completion; station paid AABS bill third party	182.2	91.1

Table 6-38
Stand-alone EAOSS

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1115	0-; inter-LATA; dial pulse; non-coin; person paid	66.1	34.8
1124	0-; inter-LATA; DTMF; pre-subscription; coin; person paid	98.6	51.9
1112	0+; inter-LATA; DTMF; non-coin; person paid	68.4	36.0
1118	0+; inter-LATA; DTMF; pre-subscription; non-coin; person paid	76.6	40.3
1121	0+; inter-LATA; DTMF; 10XXX; non-coin; person paid	76.6	40.3
1127	1+; inter-LATA; dial pulse; 10XXX; CAMA; ANI failure	50.5	26.6

Table 6-39
Host OC EAOSS

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1113	0-; inter-LATA; dial pulse; non-coin; person paid	43.6	19.8
1122	0-; inter-LATA; DTMF; pre-subscription; coin; person paid	47.5	21.6
1110	0+; inter-LATA; DTMF; non-coin; person paid	42.2	19.2
1116	0+; inter-LATA; DTMF; pre-subscription; non-coin; person paid	37.8	17.2
1119	0+; inter-LATA; DTMF; 10XXX; non-coin; person paid	39.4	17.9
1125	1+; inter-LATA; dial pulse; 10XXX; CAMA; ANI failure	25.3	11.5

Table 6-40
Remote OC EAOSS

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1114	0-; inter-LATA; dial pulse; non-coin; person paid	74.6	37.3
1123	0-; inter-LATA; DTMF; pre-subscription; coin; person paid	110.6	55.3
1111	0+; inter-LATA; DTMF; non-coin; person paid	78.4	39.2
1117	0+; inter-LATA; DTMF; pre-subscription; non-coin; person paid	86.9	43.4
1120	0+; inter-LATA; DTMF; 10XXX; non-coin; person paid	89.0	44.5
1126	1+; inter-LATA; dial pulse; 10XXX; CAMA; ANI failure	59.4	29.7

Table 6-41
PVN call times

Call description	ms per C/A NT40	ms per C/A DMS-Core
PVN trunk (DTMF) - PVN trunk; trunks available in primary trunk group	36.2	18.7
PVN trunk (DTMF) - PVN trunk; primary trunk group busy and alternate trunk group used	42.2	21.8

-continued-

Table 6-41
PVN call times (continued)

Call description	NT40	DMS-Core
PVN trunk (DTMF) - PVN trunk; primary and alternate trunk groups busy; second alternate trunk group used	43.8	22.7
PVN trunk (DTMF) - POTS trunk	35.8	18.5
PVN trunk (DTMF) - POTS line	38.4	19.9
PVN trunk (DTMF) - IC; trunks available for primary carrier	41.0	21.3
PVN trunk (DTMF) - IC; primary and alternate carrier group busy; second alternate carrier group used	48.2	24.9
PVN trunk (FGD) - PVN trunk; trunks available in primary trunk group	35.7	18.5
PVN trunk (FGD) - POTS trunk; trunks available in primary trunk group	32.8	17.0
PVN line (DTMF) - IC; trunks available for primary carrier	39.7	20.6
PVN line (DTMF) - POTS line	37.2	19.3
PVN line (DTMF) - PVN trunk; trunks available in primary trunk group	35.2	18.2
PVN trunk (DTMF) - PVN trunk; trunks available in primary trunk group; announcement and AUTHCODE collection	68.8	35.7
PVN trunk (DTMF) - PVN trunk; trunks available in primary trunk group; special dial tone and AUTHCODE collection	68.8	35.7
PVN trunk (FGD) - PVN trunk; trunks available in primary trunk group; announcement and AUTHCODE collection	68.3	35.3
POTS line (DTMF) - POTS line; PVN remote access from POTS line	54.4	28.2

End

Table 6-42xxx
ISDN call times

Call description	ms per C/A NT40	ms per C/A DMS-Core
Basic rate interface (stimulus signaling) - basic rate interface (stimulus signaling)	40.9	19.2
Basic rate interface (stimulus signaling) - POTS 1FR	29.0	13.7
Basic rate interface (stimulus signaling) - EBS with display	35.8	16.9

-continued-

Table 6-42xxx
ISDN call times (continued)

Call description	NT40	DMS-Core
EBS with display - basic rate interface (stimulus signaling)	29.0	13.7
Basic rate interface (stimulus signaling) - Basic rate interface (functional signaling)	47.3	22.3
Basic rate interface (stimulus signaling) - primary rate interface	30.3	14.3
Basic rate interface (functional signaling) - basic rate interface (functional signaling)	53.8	25.3
Basic rate interface (functional signaling) - POTS 1FR	33.9	16.0
Basic rate interface (functional signaling) - EBS with display	40.3	19.0
EBS with display - basic rate interface (functional signaling)	35.2	16.6
Basic rate interface (functional signaling) - basic rate interface (stimulus signaling)	45.1	21.2
Basic rate interface (functional signaling) - primary rate interface	39.2	18.4
Primary rate interface - primary rate interface	16.7	7.8
Primary rate interface - POTS 1FR	17.2	8.1
Primary rate interface - EBS with display	22.7	10.7
EBS with display - primary rate interface	33.5	15.8
Primary rate interface - basic rate interface (stimulus signaling)	27.0	12.7
Primary rate interface - basic rate interface (functional signaling)	32.6	15.3
Basic rate interface (stimulus signaling) - SS7 trunk	39.1	18.4
Basic rate interface (functional signaling) - SS7 trunk	47.3	22.3
Primary rate interface - SS7 trunk	26.7	12.6
Basic rate interface (Meridian feature transparency) - basic rate interface (Meridian feature transparency)	32.7	15.5
Basic rate interface (Meridian feature transparency) - POTS 1FR	26.3	12.4
Basic rate interface (Meridian feature transparency) - EBS with display	28.6	13.5
EBS with display - basic rate interface (Meridian feature transparency)	28.6	13.4
Basic rate interface (Meridian feature transparency) - basic rate interface (functional signaling)	39.5	18.6
Basic rate interface (Meridian feature transparency) - primary rate interface	38.3	18.0

-continued-

Table 6-42xxx
ISDN call times (continued)

Call description	NT40	DMS-Core
Basic rate interface (functional signaling) - basic rate interface (Meridian feature transparency)	43.8	20.6
Primary rate interface - basic rate interface (Meridian feature transparency)	26.4	12.4
Basic rate interface (Meridian feature transparency) - SS7 trunk	43.5	20.5
SS7 trunk - primary rate interface	20.0	9.4
SS7 trunk - basic rate interface (functional signaling)	36.5	17.2
SS7 trunk - basic rate interface (Meridian feature transparency)	29.1	13.7

End

BCS 32 call times

BCS32 (NT40 and DMS-Core) call time values

Introduction

This section contains NT40 and DMS-Core call time values for real time planning purposes as well as a series of office models that are representative of general office configurations. New call time models are introduced in BCS32 to better represent the U.S. marketplace as it is today. The new models differ from the old in that they contain significant penetrations of signaling system number 7 (SS7), custom calling, custom local area signaling services (CLASS), and business features.

Call times in support of the Japanese market are also found in this section.

NT40 and DMS-Core call times are measured in a laboratory environment. The hardware and software in the laboratory is configured to emulate realistic switch parameters, and the call times have been measured in the following configuration:

NT40

- 40 Mhz clock — in sync
- DTSR — unbound
- AMA format — Bellcore format (BCFMT)
- LOGAMA — off
- AMA tape mounted — no
- data billed to — disk
- UTR — yes
- SMDR — off
- TOPS EBAF — phase 2

DMS-Core

- CC — DMS-Core Series 20
- 20 Mhz clock — in sync
- DTSR — unbound
- LOGAMA — off
- AMA tape mounted — no

- data billed to disk
- UTR yes
- data cache on
- data cache parity on
- TOPS EBAF phase 2

Please note that beginning with BCS32, UTRs are on and AMA is billed to disk. EBAF phase 2 is utilized on TOPS calls.

The call times in this section are always reported in milliseconds and are considered to be within plus or minus 5 percent accuracy unless otherwise noted.

The call times are categorized as follows:

- actual
- derived
- estimated

Actual call times

Actual call times are those measured in the current BCS. times with no symbol indicate actual call times.

Derived call times

Derived call times are used to determine the real time cost of specific features. These call times are utilized as adjustments to base call types for capacity planning purposes. times followed by the letter “D” indicate derived call times.

Estimated call times

Estimated call times are determined by using current base measured call times along with design estimates. These estimated call times are considered to be accurate within plus or minus 15 percent accuracy. times followed by the letter “E” indicate estimated call times.

A series of call type models representative of general office configurations are provided as well as a complete list of all call times measured at each BCS interval.

A “*” next to each call time indicates an AMA record is included in the time. A “**” next to the call type or time indicates that the call type is included in the REAL::TIME capacity planning tool.

Finally, a listing of estimated call times for various features and call types is provided. These features and call types have been included in the REAL::TIME tool for estimating future CPU capacity requirements.

The REAL::TIME capacity planning tool or times provided should be used to estimate the CPU real time impact for various offices.

BCS32 CPU call time models

This section contains a series of office models that are representative of general office configurations in the U.S. marketplace. These models are introduced for the first time with BCS32 and will serve as a baseline for future BCS comparisons. Unlike call time models utilized in the past, these models contain significant penetrations of custom calling, CLASS, and business services.

Call time models are defined as follows:

- Suburban — Residential end office
- Urban — Business end office
- Access tandem — Tandem office
- TOPS — Combination of operator services and access tandem

Each call time model is configured as discussed in the following paragraphs.

Base model

The base model contains the basic traffic mix of line-line, line-trunk, trunk-line and trunk-trunk calls.

Feature model

The feature model contains feature penetrations within the base model. Feature adjustments are applied as necessary to the base model. The actual feature mix utilized with each model was determined through studies conducted in various field offices.

Model summary

The model summary provides the maximum call rate possible for each processor series. The average work time in milliseconds for each processor is also provided.

Actual office BCS impact for a specific traffic mix can be estimated by using the REAL::TIME capacity planning tool.

The NT40 has a maximum call processing capacity of 83 percent. This percentage has been adjusted when necessary to allow for average work time (AWT). Table 7-1 illustrates the percentage adjustment needed at various levels of AWT for the NT40. For example, in the urban model, an AWT of 42.4 ms equates to a 3.0 percent adjustment to the maximum call processing of 83 percent.

Table 7-1
NT40 average work time (AWT) adjustments

AWT (average ms)	Call processing adjustments
< 15 ms	0 percent
15.0 ms to 25.9 ms	1 percent
26.0 ms to 40.0 ms	2 percent
> 40.0 ms	3 percent

The DMS-Core has a maximum call processing capacity of 86 percent. This percentage has been adjusted when necessary to allow for average work time (AWT). Table 7-2 illustrates the percentage adjustment needed at various levels of AWT for each series of processor. For example, in the Urban model, an AWT of 22.4 ms (Series 20) equates to a 1.5 percent adjustment to the maximum call processing of 86 percent.

Table 7-2
DMS-Core average work time (AWT) adjustments
20.0 % grade of service

AWT (average ms)	Call processing adjustments
Series 20 processor	
< 12.6 ms	0 percent
12.6 ms to 20.0 ms	1 percent
> 20.0 ms	1.5 percent
Series 30 processor	
< 8.7 ms	0 percent
8.7 ms to 13.3 ms	1 percent
> 13.3 ms	1.5 percent
Series 40 processor	
< 7.2 ms	0 percent
7.2 ms to 11.1 ms	1 percent
>11.1 ms	1.5 percent
Series 50 processor	
< 5.3 ms	0 percent
5.3 ms to 8.0 ms	1 percent
> 8.0 ms	1.5 percent

Actual office BCS impact can be estimated by using the capacity prediction tool REAL::TIME.

Table 7-3
Suburban model NT40 @ 40 Mhz

Base model			BCS32 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**
994	POTS 1FR - POTS 1FR	19.3%	16.7	3.223
995	POTS 1FR - EAS trunk (MF)	12.0%	13.4	1.608
402	POTS 1FR - toll trunk (MF/FGD)	2.4%	30.7	.737
577	POTS 1FR - EAS trunk (SS7)	12.0%	18.5	2.220
1226	POTS 1FR - toll trunk (SS7/FGD)	2.4%	42.4	1.018
996	MF trunk - POTS 1FR	12.8%	11.6	1.485
580	SS7 trunk - POTS 1FR	12.8%	16.7	2.138
014	Line ineffective	18.0%	4.4	.792
946	Trunk ineffective	3.0%	4.8	.144
993	Partial dial	5.3%	6.2	.329
Feature model		**Mix**		
SS7		50.0%		
AMA billing		100.0%		
POTS custom calling		20.0%		
RES CLASS		20.0%		
SMDI		3.0%		
Suburban model summary		**NT40 @ 36Mhz**		**NT40 @ 40Mhz**
Maximum CPH @ 82 %		144,653		157,231
Average work time		20.4 ms		18.8 ms

Table 7-4
Urban model NT40 @ 40 Mhz

Base model			BCS32 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**
888	MDC line - MDC line	17.1%	16.1	2.573
889	MDC line - EAS trunk (MF)	11.1%	16.6	1.843
883	MDC line - toll trunk (MF/FGD)	6.5%	32.0	2.080
578	MDC line - EAS trunk (SS7)	11.1%	21.5	2.387
1228	MDC line - toll trunk (SS7/FGD)	6.5%	41.4	2.691
854	MF trunk - MDC line	17.5%	11.7	2.048
581	SS7 trunk - MDC line	17.5%	17.0	2.975
805	Line ineffective	7.2%	5.0	.360
946	Trunk ineffective	3.0%	4.8	.144
858	Partial dial	2.5%	13.9	.348
Feature model		**Mix**		
SS7		50.0%		
AMA billing		100.0%		
POTS custom calling		100.0%		
RES CLASS		10.0%		
SMDI		10.0%		
MADN		20.0%		
EBS with display		20.0%		
Urban model summary		**NT40 @ 36Mhz**		**NT40 @ 40Mhz**
Maximum CPH @ 80 %		64,135		69,712
Average work time		44.9 ms		41.3 ms

Table 7-5
ACCESS tandem model NT40 @ 40 Mhz

Base model			**BCS32 RTM Weighted ms/CA**	
Call type	**Call description**	**Mix**	**Call**	**Time**
998	MF IT trunk - MF IT trunk	23.0%	10.4	2.392
1232	SS7 IT trunk - SS7 ATC trunk	60.0%	16.4	9.840
1230	MF IT trunk - SS7 ATC trunk	5.0%	17.8	.890
1231	SS7 IT trunk - MF ATC trunk	5.0%	17.0	.850
1233	E800 SS7 trunk - MF trunk	3.0%	37.9	1.137
1234	E800 SS7 trunk - SS7 trunk	4.0%	37.3	1.492
Feature model		**Mix**		
SS7		77.0%		
AMA billing		100.0%		
E800		7.0%		
ACCESS tandem model summary		**NT40 @ 36Mhz**		**NT40 @ 40Mhz**
Maximum CPH @ 82 %		163,595		177,821
Average work time		18.0 ms		16.6 ms

Table 7-6
TOPS SA/HOC/DA/AT model NT40 @ 40 Mhz

Base model			BCS32 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**
824	SA mechanized calling card service	11.0%	76.6	8.426
1178	SA AABS calling card number 0+	10.0%	81.7	8.170
326	SA automated coin toll service	10.0&	65.0	6.500
1151	SA 411 external ARU	9.0%	69.9	6.291
1163	SA intercept external ARU	3.0%	33.8	1.014
1149	HOC 411 external ARU	7.0%	32.6	2.282
1128	HOC non-coin 0-	10.5%	45.0	4.725
1137	HOC coin 0+	4.6%	44.2	2.033
1130	SA non-coin 0-	14.7%	69.0	10.143
1139	SA coin 0+	6.2%	89.9	5.571
1232	SS7 trunk - SS7 trunk	8.0%	16.4	1.312
998	MF trunk - MF trunk	6.0%	10.4	0.624
Feature model		**Mix**		
Directory assistance		19.0%		
Mechanized calling card service		11.0%		
Automated coin toll service		10.0%		
Automated alternate billing service		10.0%		
SS7		8.0%		
TOPS SA/HOC/DA/AT model summary		**NT40 @ 36Mhz**		**NT40 @ 40Mhz**
Maximum CPH @ 80 %		46,408		50,443
Average work time		62.1 ms		57.1 ms

Table 7-7
TOPS ROC/DA/AT model NT40 @ 40 Mhz

Base model			BCS32 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**
724	ROC mechanized calling card service	9.0%	76.6	6.894
1177	ROC AABS calling card number 0+	8.0%	81.7	6.536
503	ROC automated coin toll service	8.0%	65.0	5.200
1150	ROC 411 external ARU	12.0%	69.8	8.376
1162	ROC intercept external ARU	3.0%	33.8	1.014
1129	ROC non-coin 0-	10.4%	76.9	7.998
1138	ROC coin 0+	4.6%	96.7	4.448
1232	SS7 trunk - SS7 trunk	25.0%	16.4	4.100
1234	E800 SS7 - SS7 trunk	4.0%	37.3	1.492
998	MF trunk - MF trunk	16.0%	10.4	1.664
Feature model		**Mix**		
Directory assistance		15.0%		
Mechanized calling card service		9.0%		
Automated coin toll service		8.0%		
Automated alternate billing service		8.0%		
SS7		29.0%		
TOPS ROC/DA/AT model summary		**NT40 @ 36Mhz**		**NT40 @ 40Mhz**
Maximum CPH @ 80 %		55,522		60,350
Average work time		51.8 ms		47.7 ms

Table 7-8
Suburban model DMS-Core Series 20 processor

Base model			BCS32 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**
994	POTS 1FR - POTS 1FR	19.3%	9.2	1.777
995	POTS 1FR - EAS trunk (MF)	12.0%	7.5	.900
402	POTS 1FR - toll trunk (MF/FGD)	2.4%	16.8	.403
577	POTS 1FR - EAS trunk (SS7)	12.0%	9.6	1.152
1226	POTS 1FR - toll trunk (SS7/FGD)	2.4%	21.5	.516
996	MF trunk - POTS 1FR	12.8%	6.7	.858
580	SS7 trunk - POTS 1FR	12.8%	8.6	1.101
014	Line ineffective	18.0%	2.4	.432
946	Trunk ineffective	3.0%	3.4	.102
993	Partial dial	5.3%	3.5	.186
Feature model		**Mix**		
SS7		50.0%		
AMA billing		100.0%		
POTS custom calling		20.0%		
RES CLASS		20.0%		
SMDI		3.0%		

Table 7-9
Urban model DMS-Core Series 20 processor

Base model			BCS32 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**
888	MDC line - MDC line	17.1%	8.8	1.505
889	MDC line - EAS trunk (MF)	11.1%	9.3	1.032
883	MDC line - toll trunk (MF/FGD)	6.5%	17.3	1.125
578	MDC line - EAS trunk (SS7)	11.1%	11.0	1.221
1228	MDC line - toll trunk (SS7/FGD)	6.5%	22.1	1.437
854	MF trunk - MDC line	17.5%	6.8	1.190
581	SS7 trunk - MDC line	17.5%	8.7	1.523
805	Line ineffective	7.2%	2.7	.194
946	Trunk ineffective	3.0%	3.4	.102
858	Partial dial	2.5%	7.6	.190
Feature model		**Mix**		
SS7		50.0%		
AMA billing		100.0%		
MDC custom calling		100.0%		
MDC CLASS		10.0%		
SMDI		10.0%		
MADN		20.0%		
EBS with display		20.0%		

Table 7-10
Access tandem model DMS-Core Series 20 processor

Base model			BCS32 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**
998	MF IT trunk - MF IT trunk	23.0%	6.2	1.426
1232	SS7 IT trunk - SS7 ATC trunk	60.0%	8.3	4.980
1230	MF IT trunk - SS7 ATC trunk	5.0%	9.3	.465
1231	SS7 IT trunk - MF ATC trunk	5.0%	9.2	.460
1233	E800 SS7 trunk - MF trunk	3.0%	18.7	.561
1234	E800 SS7 trunk - SS7 trunk	4.0%	17.6	.704
Feature model		**Mix**		
SS7		77.0%		
AMA billing		100.0%		
E800		7.0%		

Table 7-11
TOPS SA/HOC/DA/AT model DMS-Core Series 20 processor

Base model			BCS32 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**
824	SA mechanized calling card service	11.0%	39.7	4.367
1178	SA AABS calling card number 0+	10.0%	41.9	4.190
326	SA automated coin toll service	10.0%	34.9	3.490
1151	SA 411 external ARU	9.0%	34.9	3.141
1163	SA intercept external ARU	3.0%	18.3	.549
1149	HOC 411 external ARU	7.0%	15.3	1.071
1128	HOC non-coin 0-	10.5%	21.1	2.216
1137	HOC coin 0+	4.6%	21.0	.966
1130	SA non-coin 0-	14.7%	35.8	5.263
1139	SA coin 0+	6.2%	46.3	2.871
1232	SS7 trunk - SS7 trunk	8.0%	8.3	.664
998	MF trunk - MF trunk	6.0%	6.8	.408
Feature model		**Mix**		
Directory assistance		19.0%		
MCCS		11.0%		
ACTS		10.0%		
ABBS		10.0%		
SS7		8.0%		

Table 7-12
TOPS ROC/DA/AT model DMS-Core Series 20 processor

Base model			BCS32 RTM Weighted ms/CA	
Call type	**Call description**	**Mix**	**Call**	**Time**
724	ROC mechanized calling card service	9.0%	39.7	3.573
1177	ROC ABBS calling card number 0+	8.0%	41.9	3.352
503	ROC automated coin toll service	8.0%	34.9	2.792
1150	ROC 411 external ARU	12.0%	36.9	4.428
1162	ROC intercept external ARU	3.0%	18.3	.549
1129	ROC non-coin 0-	10.4%	39.1	4.066
1138	ROC coin 0+	4.6%	50.3	2.314
1232	SS7 trunk - SS7 trunk	25.0%	8.3	2.075
1234	E800 SS7 - SS7 trunk	4.0%	17.6	.704
998	MF trunk - MF trunk	16.0%	6.2	.992
Feature model		**Mix**		
Directory assistance		15.0%		
MCCS		9.0%		
ACTS		8.0%		
ABBS		8.0%		
SS7		29.0%		
E800		4.0%		

Table 7-13
Call time model summary

Suburban model summary	**SR20**	**SR30**	**SR40**	**SR50**
Maximum calls/hour @ 86%	303,829	455,744	516,509	759,573
Average work time	10.2 ms	6.8 ms	6.0 ms	4.1 ms
Urban model summary	**SR20**	**SR30**	**SR40**	**SR50**
Maximum calls/hour @ 84.5%	135,750	203,625	230,775	339,375
Average work time	22.4 ms	14.9 ms	13.2 ms	9.0 ms
Access tandem model summary	**SR20**	**SR30**	**SR40**	**SR50**
Maximum calls/hour @ 86%	360,138	540,252	612,286	900,420
Average work time	8.6 ms	5.7 ms	5.1 ms	3.4 ms
TOPS SA/HOC/DA/AT model summary	**SR20**	**SR30**	**SR40**	**SR50**
Maximum calls/hour @ 84.5%	104,192	156,288	177,126	260,480
Average work time	29.2 ms	19.5 ms	17.2 ms	11.7 ms
TOPS ROC/DA/AT model summary	**SR20**	**SR30**	**SR40**	**SR50**
Maximum calls/hour @ 84.5%	122,439	183,659	208,146	306,098
Average work time	24.8 ms	16.6 ms	14.6 ms	9.9 ms

Table 7-14
CPU call times-line origination

Call type	Call description	ms per C/A DMS-Core	ms per C/A NT40
947	POTS DP 1FR - POTS DTMF 1FR line	17.6	9.0
005	POTS DP 1FR - LAMA trunk	23.3	11.8 *
979	POTS DP 2FR - POTS 1FR line	22.1	11.2
014 **	POTS DTMF 1FR - false start	4.4	2.4
994 **	POTS DTMF 1FR line - POTS 1FR line	16.7	9.2
015	POTS DTMF 1MR line - POTS 1FR line	24.0	12.5 *
962	POTS DTMF 1FR line - POTS 1MR line	17.9	8.9
950	POTS DTMF 1MR line - POTS 1MR line	25.1	13.0 *
859	POTS DTMF 1FR line - MDC DTMF line	17.9	9.2
1059	POTS DTMF 1FR line - EBS with display	26.0	12.7
1236	POTS DTMF 1FR line - MADN primary	32.2	16.5
995 **	POTS DTMF 1FR line - EAS trunk	13.4	7.5
016 **	POTS DTMF 1MR line - EAS trunk	22.5	11.8 *
360	FGC 1+10 digits - IC (PIC)	28.1	14.4 *
378 **	FGC 1+10 digits - AT (PIC)	27.9	14.3 *
401	FGD 1+7 digits - IC (OCS on, PIC)	30.5	16.7 *
402 **	FGD 1+10 digits - AT (OCS on, PIC)	30.7	16.8 *
974	POTS DTMF 1MR line - via AT TO IC FGD trunk	31.2	17.0 *
011 **	POTS DTMF 1FR line - LAMA trunk	21.5	11.7 *
949	POTS DTMF 1FR line - operator trunk	23.2	11.9
966 **	POTS DTMF 1FR line - announcement BLDN treatment	17.4	8.9
019 **	Coin DTMF - POTS 1FR line	27.2	15.1 *
020	Coin DTMF - EAS trunk	26.7	13.9 *
910	FGB coin DTMF - AT MF	29.4	15.1
952	Coin DTMF - direct to IC FGC trunk	36.9	18.9 *
308	POTS DTMF 1MR line - busy	14.3	7.6
951	POTS DTMF 1MR line - abandon after 5 digits	7.3	3.5

-continued-

Table 7-14
CPU call times-line origination (continued)

Call type	Call description	ms per C/A DMS-Core	ms per C/A NT40
993 **	POTS DTMF 1FR line - abandon after 6 digits	6.2	3.5
948	POTS DTMF 1FR line - busy DTMF 1FR	14.4	7.2
967	POTS DTMF 1FR line - MF operator trunk	21.3	10.9
963	POTS DTMF 1FR line - MF PBX DID trunk	15.8	8.1
953	Coin DTMF - via AT to IC FGC trunk	37.6	19.1 *
954	Coin DTMF - direct to IC FGD	36.9	18.9 *
955	Coin DTMF - via AT to IC FGD trunk	41.5	21.1 *
982	Coin DTMF - operator trunk	29.4	15.1
908	Coin DTMF - trunk (1+800)	33.0	16.9 *
018	Coin DTMF - busy	19.1	9.8
054	PBX DOD trunk - POTS 1FR line	17.2	8.8
055	PBX DOD trunk - LAMA trunk	23.2	11.9 *
914	PBX DTMF DOD - non-LAMA MF EAS	14.2	7.3
915	FGB DTMF PBX DOD - AT MF trunk	18.3	9.4
916	FGC DTMF PBX DOD - AT MF trunk	28.0	14.3 *
917	FGD DTMF PBX DOD - AT MF trunk	30.9	15.9 *
988	OUTWATS - direct to IC FGB trunk	28.0	14.3 *
918	FGC DTMF OUTWATS - AT MF trunk	28.9	14.8 *
989	OUTWATS - direct to IC FGD	31.6	16.2 *
052	OUTWATS - LAMA trunk	23.1	11.7 *
309	OUTWATS (enhanced) - ATC trunk	32.0	16.4 *
805	MDC DTMF - false start	5.0	2.7
888 **	MDC DTMF - MDC line	16.1	8.8
1109	MDC DTMF (with SMDR) - MDC line	25.9	13.6
889	MDC DTMF - EAS trunk	16.6	9.3
881	FGB DP MDC - AT MF	19.9	10.2
882	FGC DTMF MDC - AT MF	30.4	15.6 *

-continued-

Table 7-14
CPU call times-line origination (continued)

Call type	Call description	ms per C/A DMS-Core	ms per C/A NT40
883	FGD DTMF MDS - AT MF	36.1	18.2 *
884	DTMF MDC intraLATA - MF toll trunk	24.0	13.1 *
886	E800 EAEO DTMF MDC - IC trunk	48.7	25.0 *
873	MDC DTMF - EBS without display	19.0	9.9
1199 **	MDC DTMF - EBS with display	25.1	12.1
1224	MDC DTMF - EBS with display MADN 3 secondary members	50.9	25.9
1239 **	MDC DTMF - EBS with display MADN 4 secondary members	52.8	27.1
874	MDC DTMF - MDC MF trunk	25.2	13.6 *
857 **	MDC DTMF second DT - POTS 1FR	20.0	10.2
858	MDC DTMF - abandon after two digits	13.9	7.6
850	Attendant - MDC DTMF line (SCG)	25.2	12.9
891 **	EBS with display - EBS with display	29.3	13.4
892	EBS with display - EAS trunk	20.7	10.6
893	EBS with display - LAMA trunk	27.5	14.1 *
863	EBS without display - EBS without display	21.1	10.8
894	EBS with display - EBS without display	24.5	11.1
885	EBS with display FGD - AT MF	38.2	18.5 *
876	EBS without display - MDC MF trunk	29.1	15.2 *
875	EBS without display DTMF FX trunk	19.8	10.1
890	EBS with display - abandon after two digits	17.6	8.4
862	EBS without display - MDC DTMF line (SCG)	21.3	9.7
861 **	EBS without display - attendant	21.8	11.2
864	EBS without display second DT - POTS 1FR	21.9	11.4
1198 **	EBS with display - MDC line	21.4	10.0
864	EBS with display MADN 4 secondary - MDC line	36.5	17.6
	Data path - line	33.3 D	17.1E

-continued-

Table 7-14
CPU call times-line origination (continued)

Call type	Call description	ms per C/A DMS-Core	ms per C/A NT40
	Data path - non-LAMA (EAS)	34.6 D	17.7E
	Data path - LAMA	51.6 D	26.4E

End

Table 7-15xxx
Call types with custom calling features

POTS custom calling features (CCF)

3 - way calling (3WC)
Call waiting (CWT)
Speed calling (SC1)
Call forward (CFW)
Teen service

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1065	1FR line (all CCF assigned) - 1FR line	16.6	9.2
1066	1FR line (3WC activated) - 1FR line	147.0	79.1 *
1067	1FR line (SC1 activated) - 1FR line	16.0	8.8
1070	1FR line - 1FR line (CFU assigned)	18.5	9.5
1072	1FR line - 1FR line (all CCF assigned)	17.2	9.6
1073	1FR line - 1FR line (CFU activated)	22.5	12.3
1074	1FR line - 1FR line (CWT activated)	114.5	65.4 *
1105	1FR line - 1FR line (3WC, SC1, CWT assigned)	18.5	9.3
1225	1FR line - 1FR line (teen service activated)	16.7	9.3

MDC custom calling features (CCF)

3 - way calling (3WC)
Call waiting (CWT)
Speed calling short list (SC1)
Speed calling long list (SC2)
Call forward busy (CFB)
Call forward universal (CFU)
Call forward don’t answer CFD)
Call transfer (CXR)
Call hold (CH)
Ring again (RA)
Call pick-up (CPU)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1075	MDC line - MDC line	16.8	8.6
1085	MDC line (all CCF assigned) - MDC line	17.0	8.7
1086	MDC line (3WC activated) - MDC line	123.8	68.0 *
1087	MDC line (SC1 activated) - MDC line	19.4	10.8

-continued-

Table 7-15xxx
Call types with custom calling features(continued)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1088	MDC line (SC2 activated) - MDC line	19.6	10.8
1089	MDC line (CH activated) - MDC line	109.4	59.8 *
1107	MDC line (RA activated) - MDC line	93.5	50.5
1092	MDC line - MDC line (CFU assigned)	18.1	9.3
1095	MDC line - MDC line (CFB assigned)	18.1	9.3
1096	MDC line - MDC line (CFD assigned)	27.1	13.9
1099	MDC line - MDC line (all CCF assigned)	25.5	14.0
1100	MDC line - MDC line (CFU activated)	25.8	13.4
1101	MDC line - MDC line (CWT activated)	139.9	77.7 *
1102	MDC line - MDC line (CFB activated)	25.8	13.4
1103	MDC line - MDC line (CFD activated)	50.5	26.7
1104	MDC line - MDC line (CXR activated)	100.7	54.1 *
1106	MDC line - MDC line (3WC, SC1, SC2, CWT, CH, CXR assigned)	17.0	8.7
1108	MDC line - MDC line (CPU activated)	51.7	28.9
RES custom local area signaling services (CLASS)			
Automatic call back (ACB) Automatic recall (AR) Calling number delivery (CND) Calling name delivery Calling number delivery blocking (CNDB Selective call rejection (SCRJ) Customer originated trace (COT) Usage sensitive billing (USB) Selective call forward (SCFWD) Selective call acceptance (SCA) Distinctive ring (DR)			
Call type	**Call description**	**NT40**	**DMS-Core**
1205	RES - RES (ACB, AR, CND, COT assigned originating and terminating	25.4	13.0
1258	RES (ACB, AR, CND, COT assigned) - RES	19.6	11.2

-continued-

Table 7-15xxx
Call types with custom calling features(continued)

Call type	Call description	NT40	DMS-Core
1259	RES (ACB, AR, CND, COT assigned) - RES	23.4	12.6
1206	RES - RES (ACB intraNODAL activated)	120.3	65.0
1207	RES - RES (AR intraNODAL activated	37.9	20.0
1208	RES (ACB network activated - SS7 - RES	213.8	106.0 *
1209	RES (AR network activated) - SS7 - RES	63.5	32.3 *
1210	RES - RES (SCRJ activated)	42.1	21.5 *
1211	RES - RES (SCFWD activated)	57.1	29.6 *
1212	RES - RES (SCA activated)	49.2	25.3 *
1213	RES - RES (DR activated)	49.2	25.6 *
1214	RES - RES (COT activated)	24.9	13.6
1215	RES (CNDB activated) - RES	27.5	15.1
1216	RES (CNDB activated, USB on) - RES	32.9	17.9 *
1217	1FR line - RES (CNAMD activated)	65.7	32.2 *
1218	1 FR line - RES (CND activated)	46.0	23.6 *
RES simplified message desk interface (SMDI)			
SMDI call forward busy (CFB) SMDI call forward don't answer (CFD) SMDI call forward always (CFA)		**ms per C/A**	
Call type	**Call description**	**NT40**	**DMS-Core**
1220	RES - SMDI (direct)	52.5	29.2
1221	POTS 1FR - RES SMDI (CFR)	66.1	33.9
1222	POTS 1FR - RES SMDI (CFD)	87.2	44.7
1223	POTS 1FR - RES SMDI (CFA)	58.1	29.8
End			

Table 7-16
Incoming trunk origination

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
997 **	MF tandem INCAMA trunk - MF tandem trunk	7.3	4.4
996 **	MF trunk - POTS 1FR line	11.6	6.7
998 **	MF IT trunk - IT trunk	10.4	6.2
453	MF IC trunk - POTS 1FR line	22.0	11.3 *
999 **	MF trunk - busy	18.1	9.3 *
031 **	MF trunk - INWATS line	24.0	12.3 *
879	MF trunk - EBS without display	13.6	7.2
946	MF trunk - abandon (no start signal)	4.8	3.4
854	MF POTS trunk - MDC DTMF line	11.7	6.8
046	MF INCAMA trunk - POTS 1FR line	21.8	11.1 *
048	MF INCAMA trunk - trunk	16.1	9.2 *
990	IC trunk - POTS 1FR line (LCM)	22.9	11.3 *
456	IC carrier trunk - IT trunk	17.7	9.6 *
991	IC trunk - MF PBX DID (PX)	20.8	10.7 *
455	IT trunk - IC carrier trunk	10.4	5.8
919	FGC MF incoming trunk - IC trunk	36.9	13.8 *
920	FGD MF incoming trunk - IC trunk	29.3	15.0 *
921	MF incoming trunk - tandem MF IT trunk	29.8	15.3 *
855	MDC MF trunk - MDC DTMF line	14.8	7.6
856	MDC DTMF FX trunk - MDC DTMF line (SCG)	22.6	11.6
868	MDC MF trunk - attendant	17.8	9.1
958	MF PX DOD trunk DIG (PX) - direct to IC trunk	33.0	16.9 *
959	MF PX DOD trunk DIG - via AT to IC trunk	29.6	15.2 *
961	MF PX DOD trunk DIG - MF EAS trunk	13.2	7.9
986	DTMF PBX DOD (FX) trunk - operator trunk	22.4	11.5
987	MF PBX DOD trunk - operator trunk	19.1	9.8

Table 7-17
E911 trunking

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1201	FX trunk - E911 tandem	28.1	14.4
1202	E911 trunk - E911 tandem PSAP QRY	21.2	10.9
1203	E911 trunk - PSAP line with ORIGHOLD	33.7	17.3 *
1204	E911 trunk - PSAP line with SBT - LDTPSAP	179.8	92.7

Table 7-18
SS7 trunking

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
577 **	DTMF POTS line - SS7 trunk	18.5	9.6
578 **	DTMF MDC line - SS7 trunk	21.5	11.0
1219 **	DTMF MDC line (with SMDR) - SS7 trunk	29.3	15.4
579 **	DTMF POTS line - SS7 trunk	26.7	13.2 *
580 **	SS7 trunk - DTMF POTS line	16.7	8.6
581	SS7 trunk - DTMF MDC line	17.0	8.7
582	SS7 trunk - EBS with display (network name display)	29.6	15.2
583	EBS with display - SS7 trunk (network ring again)	100.0	51.3
584	SS7 trunk - EBS with display (network number display)	22.6	11.6
585	EBS with display - SS7 trunk (network name display)	33.3	17.1
598	SS7 trunk - EBS with display (network ring again)	18.5	9.5
599	EBS with display - SS7 trunk (network number display)	26.3	13.5
1230	FGD MF trunk - SS7 trunk	17.1	9.3
1231	FGD SS7 trunk - MF trunk	17.0	9.2
1232 **	FGD SS7 trunk - SS7 trunk	16.4	8.3
1233	FGD E800 SS7 trunk - MF trunk (database query)	37.9	18.7
1234	FGD E800 SS7 trunk - SS7 trunk	37.3	17.6
1235	FGB SS7 trunk - MF trunk	12.9	7.3

Table 7-19
800 service

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
922	E800 DTMF 1FR - IC (DB query)	46.6	23.9 *
924	E800 DTMF 1FR - IC (DB query)	41.9	22.0 *
927	E800 EAEO DTMF 1FR - reorder (DB query)	42.1	21.6
928	E800 EAEO DTMF 1FR - AT (DB query)	48.0	24.6 *
929 **	E800 AT - IT (DB query)	39.8	20.4 *
943	E800 AT - reorder (DB query)	26.6	13.7

Table 7-20xxx
Call time adjustments

Call description	ms per C/A NT40	ms per C/A DMS-Core
Automatic message accounting	9.1	4.3D **
Originating MADN (1 primary; 4 secondary members)	15.1	7.6D
Terminating MADN (1 primary; 4 secondary members)	27.7	15.1D
Station message detail recording	5.8	3.2D **
MDC attendant console termination	2.1	1.1D
MDC attendant console origination	5.7	2.9D
UTR	-2.0	-1.3D **
Alternate routing	1.1	.6
Virtual facility group	1.5	.8
Hunt group	2.0	1.0
Permanent signal	21.7	10.9D
EBS (P-phone) with display	9.0	3.3D**
ACD termination (line-line intra-office)	20.0	10.3 **
ACD termination (trunk-line)	15.0	7.7D**
ACD termination queue	8.0	4.1 **
ACD with MIS	23.4	12.0 **
UCD termination	12.3	6.3 **

-continued-

Table 7-20xxx
Call time adjustments (continued)

Call description	ms per C/A NT40	ms per C/A DMS-Core
UCD termination queue	6.2	3.2
MDC second dial tone access	1.8	.9D **

End

Table 7-21
POTS feature activation

Call description	ms per C/A NT40	ms per C/A DMS-Core
Call waiting	68.5	40.8D **
Three-way calling	107.2	59.0D **
Call forward	5.2	2.5D **
Speed calling	-0.5	-0.4D **

Table 7-22
MDC feature activation

Call description	ms per C/A NT40	ms per C/A DMS-Core
Call waiting	73.8	44.1D **
Three-way calling	78.8	59.0D **
Ring again	79.5	41.7D **
Call transfer	46.2	26.5D **
Call pick-up	35.6	20.2D **
Call forward, no answer	24.1	12.8D **
Call forward, universal	11.8	4.6D **
Call forward, busy	11.8	4.6D **
Speed calling	3.6	2.1D **
Call hold	84.4	46.8D

Table 7-23
CLASS feature activation

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1206	ACB intra-NODAL	100.9	54.8D **
1208	ACB - SS7 network	113.3	56.9D **
1208	SS7 network - ACB	56.6	28.4D **
1207	AR intra-NODAL	14.2	6.8D **
1209	AR - SS7 network	10.5	5.5D **
1209	SS7 network - AR	5.3	2.8D **
1218	CND	1.4	1.0D **
1217	CNAMD	21.1	9.6D **
	CDNB	5.4	3.5D **
	COT	26.8	14.9D **
	Selective call rejection (SCRJ)	9.1	4.2D **
	Selective call forward (SCFWD)	10.3	5.6D **
	Distinctive ring, call forward	1.4	1.3D **
	Selective call acceptance	1.6	1.3D **
	Usage sensitive billing	3.8	1.4D

Table 7-24
CLASS feature assignment

Call description	ms per C/A NT40	ms per C/A DMS-Core
CLASS feature assignment; originations	3.0	1.6D **
CLASS feature assignment; terminations	6.8	3.3D **

Table 7-25xxx
Stand-alone TOPS configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
316 **	0-; OH; non-coin; information only, no outpulsing	39.4	20.4
314	0-; OH; non-coin; inter exchange carrier	74.0	38.4
315	0-; OH; non-coin; person paid; end office	68.0	35.4
317	0-; OH; non-coin; station special; BNS = yes	75.4	39.0
513	0-; OH; non-coin; OVS; transfer IC; inter-LATA carrier	59.4	30.8
813	0-; OH; coin; person paid; end office; without rate step	92.8	48.1
819	0-; OH; person paid; end office; TICS	95.7	49.9
1142	0-; OH; non-coin; person paid; AMA; answer	104.2	54.0
824 **	0+; MCCS; SS7 database; successful	76.6	39.7
802	0+; MCCS; hook flash to operator	89.5	47.7
327	0+; MCCS; no query database	62.5	32.4
320	0+; MCCS; OH; no query database; with timeout	88.5	47.9
331	0+; OA; non-coin; station collect; end office	73.0	37.8
329	0+; OA; non-coin; station paid; end office	70.6	36.6
332	0+; OA; non-coin; person collect; end office	74.1	38.4
330 **	0+; OA; non-coin; person paid; end office	71.8	37.2
509	0+; non coin, inter-LATA carrier	33.4	17.3
515	0+; coin; OVS; inter-LATA carrier	31.1	16.8
814 **	0+; OH; coin; person paid; end office; without rate step	91.3	47.3
818 **	0+; OA; non-coin; person paid; end office; TICS	75.9	39.3
825	0+; OA; CCN; SS7 database; deny first number; complete second number	153.0	83.0
826	0+; OA; CCN; SS7 database; service deny, no payment	89.3	48.4
827	0+; OA; CCN; SS7 database; successful	102.7	53.6
828	0+; OA; BNS; SS7 database; verify collect	95.5	49.5
830	0+; OA; BNS; SS7 database; verify third number	129.5	67.1

-continued-

Table 7-25xxx
Stand-alone TOPS configuration (continued)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
807	1+; ACTS; coin; initial deposit	123.2	66.8
326 **	1+; ACTS; coin	65.0	34.9
321 **	1+; CAMA; ONI; non-coin	46.8	24.2
322 **	1+; ONI; successful validation	35.8	18.6
328 **	1+; direct dialed; hotel; person paid	79.4	41.1
809	1+; OH; hotel; bill to room	76.4	39.6
815 **	1+; direct dialed; coin; station paid; end office; without rate step	92.8	49.0
518	Queue search for CAMA calls	49.1	25.4
520	Verify and connect	99.4	51.5
526 **	Verify with scrambler	61.8	32.0

End

Table 7-26xxx
Host OC TOPS configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
335 **	0-; OH; non-coin; information only, no outpulsing	31.4	14.8
333	0-; OH; non-coin; interconnect carrier	41.4	21.1
334	0-; OH; non-coin; person paid; end office	44.2	20.7
337	0-; OH; non-coin; station special	57.7	27.2
531	0-; OH; non-coin, OVS; transfer IC; inter-LATA carrier	34.3	16.2
613	0-; OH; coin; person paid; end office without rate step	43.6	22.6
619	0-; OH; coin; person paid; end office; TICS	47.8	22.4
1140	0-; OH; non-coin; person paid; AMA, answer	72.4	34.2
602	0+; MCCS; hook flash to operator	56.5	26.2
340	0+; MCCS; no query database	4.7	2.2
336	0+; MCCS; OH; no query database; with timeout	55.2	25.3
488	0+; OA; non-coin; station collect; end office	43.7	20.6
486	0+; OA; non-coin; station paid; end office	42.4	20.0
489	0+; OA; non-coin; person collect; end office	43.7	20.6
487 **	0+; OA; non-coin; person paid; end office	43.5	20.5
614 **	0+; OH; coin; person paid; end office; without rate step	43.5	20.5
618 **	0+; OA; non-coin; person paid; end office; TICS	40.9	19.3
625	0+; OA; CCN; SS7 database; deny first number; complete second number	84.6	39.4
626	0+; OA; CCN; SS7 database; service deny no payment	56.9	26.4
627	0+; OA; CCN; SS7 database; successful	51.1	23.6
628	0+; OA; BNS; SS7 database; verify collect	44.3	20.9
630	0+; OA; BNS; SS7 database; verify third number	78.4	37.0
607	1+; ACTS; coin; T/O initial deposit	65.5	30.4
341 **	1+; CAMA; ONI; non-coin	25.7	12.1
342 **	1+; ONI; successful validation	25.7	12.1

-continued-

Table 7-26xxx
Host OC TOPS configuration (continued)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
347 **	1+; direct dial; hotel; person paid	47.5	22.4
609 **	1+; OH; hotel; bill to room	41.8	19.7
615	1+; direct dial; coin; station paid; end office; without step rate	46.6	22.0
536 **	Queue search for CAMA calls	27.6	13.0
538	Verify and connect	75.5	35.6
544 **	Verify with scrambler	44.9	21.2

End

Table 7-27xxx
Remote OC TOPS configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
492 **	0-; OH; non-coin; information only, no outpulsing	45.7	23.5
490	0-; OH; non-coin; interconnect carrier	85.0	42.5
491	0-; OH; non-coin; person paid; end office	77.2	38.6
494	0-; OH; non-coin; station special; BNS = yes	91.1	46.7
549	0-; OH; non-coin, OVS; transfer IC; inter-LATA carrier	67.9	34.8
713	0-; OH; coin; person paid; end office without rate step	101.0	51.8
719	0-; OH; coin; person paid; end office; TICS	103.3	53.0
1141	0-; OH; non-coin; person paid; AMA; answer	115.0	59.0
724 **	0+; MCCS; SS7 database; successful	76.6	39.7
702	0+; MCCS; hook flash to operator	115.3	59.1
497	0+; MCCS; no query database	67.3	34.5
493	0+; MCCS; OH; no query database; with timeout	105.2	53.8
507	0+; OA; non-coin; station collect; end office	81.2	41.7
505	0+; OA; non-coin; station paid; end office	79.7	40.9
508	0+; OA; non-coin; person collect; end office	81.0	41.5
506 **	0+; OA; non-coin; person paid; end office	80.0	41.0
545	0+; non-coin; inter-LATA carrier	32.9	16.9
551	0+; coin; OVS; inter-LATA carrier	30.5	15.5
714 **	0+; non-coin; person paid; end office; without rate step	99.5	51.0
718	0+; OA; non-coin; person paid; end office; TICS	84.8	43.5
725	0+; OA; CCN; SS7 database; deny first number; complete second number	167.2	86.2
726	0+; OA; CCN; SS7 database; service deny no payment	95.0	48.9
727	0+; OA; CCN; SS7 database; successful	112.2	57.5
728	0+; OA; BNS; SS7 database; verify collect	102.6	52.6
730	0+; OA; BNS; SS7 database; verify third number	141.8	72.7

-continued-

Table 7-27xxx
Remote OC TOPS configuration (continued)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
707	1+; ACTS; coin; T/O initial deposit	141.6	73.0
503 **	1+; ACTS; coin	65.0	34.9
498 **	1+; CAMA; ONI; non-coin	50.6	26.0
499 **	1+; ONI; successful validation	37.5	19.2
504 **	1+; direct dial; hotel; person paid	86.1	44.1
709 **	1+; OH; hotel; bill to room	83.3	42.7
715	1+; direct dial; coin; station paid; end office; without step rate	104.5	53.6
554 **	Queue search for CAMA calls	62.2	31.9
556	Verify and connect	110.6	56.7
562 **	Verify with scrambler	68.7	35.2

End

Table 7-28
Stand-alone TOPS MP configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1130	0-; OH; non-coin; person paid; end office	69.0	35.8
1136	0-; OH; coin; person paid; end office	87.0	45.1
1133	0+; OA; non-coin; person paid; end office	72.2	37.4
1139	0+; OA; coin; person paid; end office	90.0	46.3

Table 7-29
Host OC TOPS MP configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1128	0-; OH; non-coin; person paid; end office	45.0	21.1
1134	0-; OH; coin; person paid; end office	45.2	21.3
1131	0+; OA; non-coin; person paid; end office	44.3	20.9
1137	0+; OA; coin; person paid; end office	44.2	21.0

Table 7-30
Remote OC TOPS MP configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1129	0-; OH; non-coin; person paid; end office	76.9	39.1
1135	0-; OH; coin; person paid; end office	93.8	48.1
1132	0+; OA; non-coin; person paid; end office	77.8	39.9
1138	0+; OA; coin; person paid; end office	96.7	50.3

Table 7-31
Stand-alone AABS configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1172 **	AABS; 0+; collect; non-coin; LIDB database; verify	101.7	52.1
1175 **	AABS; 0+; bill third party; non-coin; LIDB database; verify;	121.6	63.6
1178 **	AABS; 0+; calling card number; non-coin; LIDB verify	81.7	41.9
1254	Operator handoff via VSN billed collect	136.8	70.9
1257	Operator handoff via VSN billed third party	150.9	77.2

Table 7-32
Host OC AABS configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1170	AABS; 0+; collect; non-coin; LIDB database; verify	0.0	0.0
1173	AABS; 0+; bill third party; non-coin; LIDB database; verify;	0.0	0.0
1176	AABS; 0+; calling card number; non-coin; LIDB verify	0.0	0.0
1252	Operator handoff via VSN billed collect	72.2	34.0
1255	Operator handoff via VSN billed third party	69.6	32.4

Table 7-33
Remote OC AABS configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1171 **	AABS; 0+; collect; non-coin; LIDB database; verify	101.7	52.1
1174 **	AABS; 0+; bill third party; non-coin; LIDB database; verify;	121.6	63.6
1177 **	AABS; 0+; calling card number; non-coin; LIDB verify	81.7	41.9
1253	Operator handoff via VSN billed collect	140.3	71.0
1256	Operator handoff via VSN billed third party	148.0	75.8

Table 7-34
Stand-alone TOPS MP configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1148	411; combined trunk and voice quote	61.8	32.0
1151	411; combined trunk and external ARU	69.9	34.9 **
1154	411; DA trunk; external ARU; no ANI	63.9	33.1
1163	Intercept; intercept trunk; external ARU	33.8	18.3
1166	Intercept; intercept trunk; number not in database; voice quote	44.5	23.0 **
1169	Intercept; intercept trunk; ONI; external ARU	64.5	33.4
1242	411; combined trunk; call completion; station paid	91.6	50.2 **
1245	411; call completion; station paid AABS calling card	146.1	74.8
1248	411; call completion; station paid AABS collect	165.3	83.9
1251	411; call completion; station paid AABS bill third party	186.3	95.9

Table 7-35
Host OC TOPS MP configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1146	411; combined trunk and voice quote	37.7	17.8
1149	411; combined trunk and external ARU	32.6	15.3 **
1152	411; DA trunk; external ARU; no ANI	36.3	17.1
1161	Intercept; intercept trunk; external ARU	0.0	0.0
1164	Intercept; intercept trunk; number not in database; voice quote	28.2	13.3 **
1167	Intercept; intercept trunk; ONI; external ARU	30.3	14.3
1240	411; combined trunk; call completion; station paid	32.5	15.2 **
1243	411; call completion; station paid AABS calling card	36.1	17.1
1246	411; call completion; station paid AABS collect	39.8	18.9
1249	411; call completion; station paid AABS bill third party	42.1	20.1

Table 7-36
Remote OC TOPS MP configuration

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1147	411; combined trunk and voice quote	67.3	34.5
1150	411; combined trunk and external ARU	69.8	36.9 **
1153	411; DA trunk; external ARU; no ANI	65.9	33.8
1162	Intercept; intercept trunk; external ARU	33.8	18.3
1165	Intercept; intercept trunk; number not in database; voice quote	50.0	25.6 **
1168	Intercept; intercept trunk; ONI; external ARU	65.3	33.5
1241	411; combined trunk; call completion; station paid	98.8	50.3 **
1244	411; call completion; station paid AABS calling card	142.9	74.0
1247	411; call completion; station paid AABS collect	158.2	80.9
1250	411; call completion; station paid AABS bill third party	177.8	92.0

Table 7-37
Stand-alone EAOSS

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1115	0-; inter-LATA; dial pulse; non-coin; person paid	66.3	34.4
1124	0-; inter-LATA; DTMF; pre-subscription; coin; person paid	96.5	50.0
1112	0+; inter-LATA; DTMF; non-coin; person paid	70.0	36.3
1118	0+; inter-LATA; DTMF; pre-subscription; non-coin; person paid	77.1	41.2
1121	0+; inter-LATA; DTMF; 10XXX; non-coin; person paid	77.6	40.2
1127	1+; inter-LATA; dial pulse; 10XXX; CAMA; ANI failure	49.9	25.9

Table 7-38
Host OC EAOSS

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1113	0-; inter-LATA; dial pulse; non-coin; person paid	43.0	20.3
1122	0-; inter-LATA; DTMF; pre-subscription; coin; person paid	51.5	24.3
1110	0+; inter-LATA; DTMF; non-coin; person paid	43.5	20.5
1116	0+; inter-LATA; DTMF; pre-subscription; non-coin; person paid	41.4	19.3
1119	0+; inter-LATA; DTMF; 10XXX; non-coin; person paid	42.6	20.1
1125	1+; inter-LATA; dial pulse; 10XXX; CAMA; ANI failure	25.7	12.1

Table 7-39
Remote OC EAOSS

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1114	0-; inter-LATA; dial pulse; non-coin; person paid	74.4	38.1
1123	0-; inter-LATA; DTMF; pre-subscription; coin; person paid	112.0	57.4
1111	0+; inter-LATA; DTMF; non-coin; person paid	75.7	38.8

-continued-

Table 7-39
Remote OC EAOSS (continued)

Call type	Call description	ms per C/A NT40	ms per C/A DMS-Core
1117	0+; inter-LATA; DTMF; pre-subscription; non-coin; person paid	85.9	39.5
1120	0+; inter-LATA; DTMF; 10XXX; non-coin; person paid	86.0	44.1
1126	1+; inter-LATA; dial pulse; 10XXX; CAMA; ANI failure	56.0	28.7

End

Table 7-40
Japan call times

Call type	Call description	ms per C/A SR20	ms per C/A SR30
1870	SRMF trunk (IET) - EBS ACD	22.9	15.3D
1871	SRMF trunk (IET) - DTMF ACD (6X33)	23.3	15.5D
1872	EBS ACD - DTMF ACD (6X33)	29.0	19.3D
1873	DTMF ACD (6X33) - DTMF ACD (6X33)	25.8	17.2D
1874	DTMF ACD (6X33) - EBS ACD	28.9	19.3D
1875	SRMF trunk (IET) EBS ACD/queued	31.1	27.0D
1876	SRMF trunk (IET) - DTMF ACD/queued (6X33)	30.1	20.1D
1877	EBS ACD - DTMF ACD/queued (6X33)	36.9	24.6D
1878	DTMF ACD (6X33) - DTMF ACD/queued (6X33)	32.2	21.5D
1879	DTMF ACD (6x33) - EBS ACD/queued	33.7	22.5D
1880	SRMF trunk (IET) - SRMF trunk (IET)	5.0	3.3D
1881	SRMF trunk (IET) - tone	4.7	3.1D
1882	PRI trunk (IBNT2) - DTMF trunk (IBNT0)	11.9	7.9D
1883	PRI trunk (IBNT2) - DP trunk (IBNT0)	9.6	6.4D
1884	DTMF trunk (IBNT1) - PRI trunk (IBNT2)	17.6	11.7D
1885	DP trunk (IBNT1) - PRI trunk (IBNT2)	14.9	9.9D
1886	DP trunk (IBNT1) - IBN7 ISUP trunk	12.3	8.2D
1887	PRI trunk (IBNT2) - IBN7 ISUP trunk	11.7	7.8D
1888	IBN7 ISUP trunk - DTMF trunk (IBNT0)	10.4	6.9D
1889	DTMF trunk (IBNT1) - IBN7 ISUP trunk	15.2	10.0D
1890	DP trunk (IBNT1) - DTMF trunk (IBNT0)	13.1	8.7D
1891	DTMF trunk (IBNT1) - DP trunk (IBNT0)	13.8	9.2D
1892	DP trunk (IBNT1) - DP trunk (IBNT0)	11.7	7.8D
1893	DTMF trunk (IBNT1) - DTMF trunk (IBNT0)	16.8	11.2D
1894	IBN7 ISUP trunk - DP trunk (IBNT0)	8.3	5.5D
1895	IBN7 ISUP trunk - PRI trunk (IBNT2)	13.2	8.8D
1896	PRI trunk (IBNT2) - PRI trunk (IBNT2)	12.8	8.5D

Table 7-41xxx
ISDN call times

Call description	ms per C/A NT40	ms per C/A DMS-Core
Basic rate interface (stimulus signaling) - basic rate interface (stimulus signaling)	40.9	19.2
Basic rate interface (stimulus signaling) - POTS 1FR	29.0	13.7
Basic rate interface (stimulus signaling) - EBS with display	35.8	16.9
EBS with display - basic rate interface (stimulus signaling)	29.0	13.7
Basic rate interface (stimulus signaling) - Basic rate interface (functional signaling)	47.3	22.3
Basic rate interface (stimulus signaling) - primary rate interface	30.3	14.3
Basic rate interface (functional signaling) - basic rate interface (functional signaling)	53.8	25.3
Basic rate interface (functional signaling) - POTS 1FR	33.9	16.0
Basic rate interface (functional signaling) - EBS with display	40.3	19.0
EBS with display - basic rate interface (functional signaling)	35.2	16.6
Basic rate interface (functional signaling) - basic rate interface (stimulus signaling)	45.1	21.2
Basic rate interface (functional signaling) - primary rate interface	39.2	18.4
Primary rate interface - primary rate interface	16.7	7.8
Primary rate interface - POTS 1FR	17.2	8.1
Primary rate interface - EBS with display	22.7	10.7
EBS with display - primary rate interface	33.5	15.8
Primary rate interface - basic rate interface (stimulus signaling)	27.0	12.7
Primary rate interface - basic rate interface (functional signaling)	32.6	15.3
Basic rate interface (stimulus signaling) - SS7 trunk	39.1	18.4
Basic rate interface (functional signaling) - SS7 trunk	47.3	22.3
Primary rate interface - SS7 trunk	26.7	12.6
Basic rate interface (Meridian feature transparency) - basic rate interface (Meridian feature transparency)	32.7	15.5
Basic rate interface (Meridian feature transparency) - POTS 1FR	26.3	12.4

BCS 33 call times

BCS33 (NT40 and SuperNode) call time values

This section contains NT40 and SuperNode call time values for real time planning purposes as well as a series of office models that are representative of general office configurations found in the North American marketplace. Call timings in support of the international marketplace are also provided.

NT40 and SuperNode call time values are measured by Bell Northern Research (BNR) in a lab environment. The hardware and software in the lab is configured to emulate realistic switch parameters. A detailed description of each U.S. call type in this document can be found in Switching Engineering Bulletin (SEB) *Call Type Description Reference*, SEB 89-06-001. NT40 and SuperNode call times are measured in the following configurations:

NT40:

- NT40/40MHZ — In synchronization
- Dial tone speed recorder — Unbound
- LOGAMA — Off
- AMA tape mount — No
- Data billed to disk — Yes
- Bellcore AMA — Yes
- Universal tone receivers — Yes
- Station message detail recording — Off
- TOPS enhanced Bellcore AMA format — Phase 2

Supernode:

- Series 20/40 — In synchronization
- Dial tone speed recorder — Unbound
- LOGAMA — Off
- AMA tape mount — No
- Data billed to disk — Yes
- Bellcore AMA — Yes

- Universal tone receivers Yes
- Station message detail recording Off
- TOPS enhanced Bellcore AMA format Phase 2
- Data Cache On
- Cache Parity On

The call times in this document are always reported in milliseconds and are considered to be within +/- 5% accuracy unless otherwise noted. The call times are categorized as actual, derived, and estimated.

Actual call time values are those measured in the current BCS. Timings with no symbol indicate actual call times.

Derived call time values are used to determine the real time cost of specific features. These call times are used as adjustments to base call types for capacity planning purposes. Times followed by the letter 'D' indicate derived call times.

Estimated call time values are determined by using current base measured call time along with design estimates. These estimated call times are considered to be within +/- 15% accuracy. Times followed by the letter 'E' indicate estimated call times.

BCS33 CPU call time models

This section contains a series of office models that are representative of general office configurations in North America. These models were introduced for the first time in BCS32 and will serve as a baseline for future BCS comparisons. Unlike call time models utilized in the past, these models contain significant penetrations of Custom Calling, CLASS/CMS, and Business Services found in the markets today. North American call time models are defined as follows:

U.S. call time models:

- Suburban - Residential end office
- Urban - Business end office
- Access tandem - Tandem Traffic
- TOPS - Combination of operator services and access tandem

Canada call time models

- DMS100/POTS - Residential end office (POTS)
- DMS200 - Tandem/toll Office
- DMS200/TOPS - Tandem/toll/TOPS/AOSS office
- DMS100/POTS/CMS - Residential end office (CMS)

- DMS100/POTS/MDC- Business end office (MDC/POTS)

Each call time model is configured as described in the following paragraphs.

The base model contains the basic traffic mix of line-to-line, line-to-trunk, trunk-to-line, and trunk-to-trunk call types. To provide base traffic mixes that are representative of today's market, a thorough analysis of actual field office mixes was done.

The feature model contains feature penetrations within the base model. Time adjustments related to feature assignment and activation are applied as necessary to the base model. The actual feature mix utilized with each model was determined through studies conducted on various field offices.

The model summary provides the maximum call rate possible for each processor type through SuperNode 40. The average work time in milliseconds for each processor is also provided. Actual office BCS impact for a specific traffic mix can be estimated by using the REAL::TIME capacity planning tool.

The NT40 has a maximum of 83.0 percent of CPU real time available for call processing. This percentage is adjusted when necessary to allow for average work time (AWT) differences. Table 8-1 illustrates the percentage adjustment needed at various levels of AWT for an NT40. As an example, in the urban model an AWT of 42.6ms (NT40/40 MHz) equates to a 3.0 percent adjustment to the maximum call processing of 83.0 percent.

The DMS-Core has a maximum of 86.0 percent of real time available for call processing. This percentage is adjusted when necessary to allow for average work time (AWT) differences. Tables 8-2 through 8-3 illustrate the percent adjustment needed at various levels of AWT for each series of processor. As an example, in the urban model an AWT of 22.9ms (Series 20) equates to a 1.5 percent adjustment to the maximum call processing of 86.0 percent.

Additional information concerning AWT and how it relates to processors above Supernode 40 can be found in *BRISC Engineering Philosophy*, SEB 91-11-003.

Table 8-4xxx
U.S. CPU call times-suburban base model

Call type	Call description	Mix (%)	NT40 weighted ms/call attempt Call	NT40 weighted ms/call attempt Time	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time
994	POTS 1FR-POTS 1FR	19.3	16.9	3.262	9.4	1.814
995	POTS 1FR-EAS trunk (MF)	12.0	13.7	1.644	7.7	0.924
402	POTS 1FR-toll trunk (MF/FGD)	2.4	31.3	0.751	17.0	0.408
577	POTS 1FR-EAS trunk (SS7)	12.0	19.3	2.316	9.8	1.176
1226	POTS 1FR-toll trunk (SS7/FGD)	2.4	36.5	0.876	18.2	0.437
996	MF trunk-POTS 1FR	12.8	11.8	1.510	6.7	0.858
580	SS7 trunk-POTS 1FR	12.8	17.6	2.253	9.0	1.152
014	Line ineffective	18.0	4.4	0.792	2.4	0.432
946	trunk ineffective	3.0	5.0	0.150	2.6	0.078
			Base AWT=13.88			7.459

Table 8-5xxx
U.S. CPU call times-suburban feature model

Call description	Mix (%)	NT40 weighted ms/call attempt Call	NT40 weighted ms/call attempt Time	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time
POTS custom calling/terminating	1.7	76.0	1.297	41.0	0.700
Call Waiting/terminating	1.0	110.8	1.066	54.9	0.528
3-Way Calling/originating	1.3	6.1	0.082	3.2	0.043
Call Forward/terminating	1.0	-0.7	-0.007	-0.3	-0.003
RES CLASS/originating	4.8	6.8	0.327	3.8	0.183
RES CLASS/terminating	4.5	6.6	0.296	2.7	0.121
ACB Nodal delayed/originating	0.5	99.2	0.459	53.0	0.245
ACB Network delayed/originating	0.7	169.2	0.736	81.9	0.356
Customer Originated Trace/terminating	1.1	25.9	0.279	13.3	0.143
AR Nodal Immediate/terminating	0.7	12.4	0.081	9.4	0.062
AR Network Immediate/terminating	0.9	16.1	0.099	8.7	0.054
Calling Number Delivery Block/originating	1.4	7.0	0 .101	4.0	0.058

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Table 8-5xxx
U.S. CPU call times-suburban feature model (continued)

Call description	Mix (%)	NT40 weighted ms/call attempt Call	NT40 weighted ms/call attempt Time	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time
Selective Call Forward/terminating	1.1	11.3	0.122	6.2	0.067
SMDI/terminating	0.3	26.8	0.072	14.8	0.040
		Base AWT= 5.457			2.811
		Model AWT=19.345			10.270
End					

Table 8-6xxx
U.S. suburban model call rate summary

NT40/40	SN20	SN30	SN40
152,598	301,461	452,192	512,484

Note: NT40/40 call processing=82% SN20-40 call processing=86%

Table 8-7xxx
U.S. CPU call times-urban base model

Call type	Call description	Mix (%)	NT40 weighted ms/call attempt Call	NT40 weighted ms/call attempt Time	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time
888	MDC line-MDC line	17.1	16.5	2.822	8.9	1.522
889	MDC line-EAS trunk (MF)	11.1	17.0	1.887	9.4	1.043
883	MDC line-toll trunk (MF/FGD)	6.5	32.6	2.119	17.6	1.144
578	MDC line-EAS trunk (SS7)	11.1	22.3	2.475	12.4	1.376
1228	MDC line-toll trunk (SS7/FGD)	6.5	38.5	2.503	19.6	1.274
854	MF trunk-MDC line	17.5	12.0	2.100	7.2	1.260
581	SS7 trunk-MDC line	17.5	17.9	3.133	10.4	1.820
805	Line ineffective	7.2	5.0	0.360	2.7	0.194
946	Trunk ineffective	3.0	5.0	0.150	2.6	0.078
858	Partial dial	2.5	14.3	0.358	7.5	0.188
			Base AWT=17,905			9,900

Table 8-8xxx
U.S. CPU call times-urban feature model

Call description	Mix (%)	NT40 weighted ms/call attempt Call	NT40 weighted ms/call attempt Time	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time
MDC Custom Calling/originating	26.2	0.0	0.000	0.0	0.000
MDC Custom Calling/terminating	26.1	9.7	2.527	4.8	1.250
Call Waiting/terminating	1.0	82.0	0.854	42.7	0.445
3-Way Calling/originating	5.2	84.9	4.440	45.7	2.390
Speed Calling/originating	1.0	3.6	0.038	2.0	0.021
Call Forward No Answer/terminating	15.6	24.7	3.861	14.8	2.313
Ring Again/originating	1.0	81.5	0.852	41.5	0.434
Call Pick-Up/terminating	5.2	37.9	1.975	19.9	1.037
Call Hold/originating	1.0	88.2	0.923	49.2	0.515
Call Transfer/terminating	5.2	50.7	2.641	27.0	1.407
MDC CLASS/originating	2.6	6.8	0.178	3.8	0.099
MDC CLASS/terminating	2.6	6.6	0.172	2.7	0.070
ACB nodal/originating	0.3	99.2	0.339	53.0	0.181
ACB network/originating	0.7	169.2	1.188	81.9	0.575

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Table 8-8xxx
U.S. CPU call times-urban feature model (continued)

Call description	Mix (%)	NT40 weighted ms/call attempt Call	NT40 weighted ms/call attempt Time	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time
Customer Originated Trace/terminating	0.2	25.9	0.044	13.3	0.023
AR nodal/terminating	0.6	12.4	0.072	9.4	0.055
AR network/terminating	1.2	16.1	0.192	8.7	0.104
Calling Number Delivery Block/originating	1.0	7.0	0.073	4.0	0.042
Selective Call Forward /terminating	0.5	11.3	0.059	6.2	0.032
		Feature AWT=24,693			13,036
		Model AWT=42,598			22,936

End

Table 8-9xxx
U.S. urban model call rate summary

NT40/40	SN20	SN30	SN40
67,609	132,630	198,945	225,471

Note: NT40/40 call processing=80% SN20-40 call processing=84.5%

Table 8-10xxx
U.S. CPU call times-access tandem model

Call type	Call description	Mix (%)	NT40 weighted ms/call attempt Call	NT40 weighted ms/call attempt Time	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time
998	MF IT trunk-MF IT trunk	23.0	10.6	2.438	6.3	1.449
1232	SS7 IT trunk-SS7 ATC trunk	60.0	22.2	13.320	9.7	5.820
1230	MF IT trunk-SS7 ATC trunk	5.0	17.7	0.885	9.4	0.470
1231	SS7 IT trunk-MF ATC trunk	5.0	17.9	0.895	9.7	0.485
1233	E800 SS7 trunk-MF trunk	3.0	38.8	1.164	19.2	0.576
1234	E800 SS7 trunk-SS7 trunk	4.0	43.5	1.740	19.3	0.772
			Model AWT=20.442			9.572

Table 8-11xxx
U.S. access tandem model call rate summary

NT40/40	SN20	SN30	SN40
144,409	323,443	485,165	549,853

Note: NT40/40 call processing=82% SN20-40 call processing=86%

Table 8-12xxx
U.S. CPU call times-TOPS SA/HOC/DA/AT model

Call type	Call description	Mix (%)	NT40 weighted ms/call attempt Call	NT40 weighted ms/call attempt Time	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time
824	SA MCCS	11.0	78.6	8.646	41.5	4.565
1178	SA AABS CCN 0+	10.0	84.0	8.400	42.6	4.260
326	SA ACTS	10.0	67.6	6.760	35.9	3.590
1151	SA 411 external ARU	9.0	71.7	6.453	37.0	3.330
1163	SA intercept external ARU	3.0	34.6	1.038	18.7	0.561
1149	HOC 411 external ARU	7.0	33.8	2.366	15.6	1.092
1128	HOC non-coin 0-	10.5	47.6	4.998	21.7	2.279
1137	HOC CN 0+	4.6	47.2	2.171	21.4	0.984
1130	SA non-coin 0-	14.7	72.3	10.62	37.4	5.498
1139	SA CN 0+	6.2	94.2	5.840	48.5	3.007
1232	SS7 trunk-SS7 trunk	8.0	22.2	1.776	9.7	0.776
998	MF trunk-MF trunk	6.0	10.6	0.636	6.3	0.378
			Model AWT=59.713			30.320

Table 8-13xxx
U.S. TOPS SA/HOC/DA/AT model call rate summary

NT40/40	SN20	SN30	SN40
48,231	100,330	150,495	170,561

Note: NT40/40 call processing=80% SN20-40 call processing=84.5%

Table 8-14xxx
U.S. CPU call times-TOPS ROC/DA/AT model

Call type	Call description	Mix (%)	NT40 weighted ms/call attempt Call	NT40 weighted ms/call attempt Time	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time
724	ROC MCCS	9.0	78.6	7.074	41.5	3.735
1177	ROC AABS CCN 0+	8.0	84.0	6.720	42.6	3.408
503	ROC ACTS	8.0	67.6	5.408	35.9	2.872
1150	ROC 411 external ARU	12.0	73.0	8.760	37.9	4.548
1162	ROC intercept external ARU	3.0	34.6	1.038	18.7	0.561
1129	ROC non-coin 0-	10.4	80.2	8.341	40.3	4.191
1138	ROC CN 0+	4.6	102.5	4.715	52.0	2.392
1232	SS7 trunk-SS7 trunk	25.0	22.2	5.550	9.7	2.425
1234	E800 SS7-SS7 trunk	4.0	43.5	1.740	19.3	0.772
998	MF trunk-MF trunk	16.0	10.6	1.696	6.3	1.008
			Model AWT=56,907			28,336

Table 8-15xxx
U.S. TOPS ROC/DA/AT model call rate summary

NT40/40	SN20	SN30	SN40
50,609	107,355	161,033	182,504

Note: NT40/40 call processing=80% SN20-40 call processing=84.5%

Table 8-16xxx
Canadian CPU call times-DMS-100 POTS base model

Call type	Call description	Mix (%)	NT40 weighted ms/call attempt Call	NT40 weighted ms/call attempt Time	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time
657	POTS/DP-EAS trunk (SS7)	8.00	12.7	1.01	7.5	0.60
1851	POTS/DT-EAS trunk (SS7)	30.19	15.3	4.63	9.2	2.77
001	POTS/DP-ineffective	1.64	2.2	0.04	1.3	0.02
008	POTS/DT-ineffective	6.63	2.2	0.15	1.3	0.09
1855	POTS/DP-toll trunk (SS7)	0.78	16.8	0.13	9.8	0.08
1856	POTS/DT-toll trunk (SS7)	5.11	16.9	0.86	9.9	0.50
002	POTS/DP-POTS line	0.81	6.9	0.06	4.1	0.03
009	POTS/DT-POTS line	3.61	7.2	0.26	4.2	0.15
038	EAS trunk (MF)-POTS line	3.63	6.9	0.25	4.2	0.15
654	EAS trunk (SS7)-POTS line	32.62	9.0	2.95	5.4	1.75
029	EAS trunk (MF)-ineffective	0.10	4.7	0.00	3.0	0.00
604	EAS trunk (SS7)-ineffective	0.42	8.1	0.04	5.0	0.02
658	EAS trunk (MF)-EAS trunk (SS7)	0.65	6.6	0.04	4.0	0.03
660	EAS trunk (SS7)-EAS trunk (SS7)	5.81	9.3	0.54	5.7	0.33
			Base AWT = 10.95			6.54

Table 8-17xxx
Canadian CPU call times-DMS-100 POTS feature model

Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
3-Way Calling/assigned	0.60	1.2	0.01	0.7	0.00
Call Waiting/assigned	19.33	1.2	0.23	0.6	0.12
Call Forward/assigned	4.54	1.5	0.07	0.9	0.04
Speed Calling/assigned	0.60	1.0	0.01	0.6	0.00
3-Way Calling/ACT	0.01	57.5	0.01	33.3	0.00
Call Waiting/ACT	0.74	33.3	0.25	19.0	0.14
Call Forward/ACT	1.39	1.7	0.02	1.3	0.02
Speed Calling/ACT	0.05	0.3	0.00	0.2	0.00
		Feature AWT=.58			.33
		Model AWT = 11.53			6.87

Table 8-18xxx
Canadian DMS-100 POTS model call rate summary

NT40/40	SN20	SN30	SN40
134,259	268,517	402,776	450,655

Note: SN20 call processing=86% SN40 call processing=86%

Table 8-19xxx
Canadian CPU call times-DMS-200 toll (DDD/non-TOPS/non-AOSS) model

Call type	Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
1850	incoming AMA trunk (MF)-SS7 trunk	31.30	18.6	5.82	11.2	3.51
660	SS7 trunk (IT)-SS7 trunk (IT)	63.50	9.3	5.89	5.7	3.63
793	800+ trunk-DB QRY-trunk	3.20	20.3	0.65	11.9	0.38
029	EAS trunk (MF)-ineffective	2.00	4.7	0.09	3.0	0.06
			Model AWT=12.45			7.59

Table 8-20xxx
Canadian DMS-200 toll (DDD/non-TOPS/non-AOSS) model call rate summary

NT40/40	SN20	SN30	SN40
124,337	248,675	373,013	403,162

Note: SN20 call processing=86% SN40 call processing=85%

Table 8-21xxx
Canadian CPU call times-DMS-200 toll/TOPS (DDD/TOPS/AOSS) model

Call type	Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
1850	incoming AMA trunk (MF)-SS7 trunk	23.00	18.6	4.27	11.2	2.58
660	SS7 trunk (IT)-SS7 trunk (IT)	34.00	9.3	3.16	5.7	1.94
793	800+ trunk-database query-trunk	6.00	20.3	1.22	11.9	0.72
092	Stand-alone OH non-coin	3.00	40.5	1.22	29.6	0.89
093	Stand-alone OH coin	0.90	48.4	0.44	34.1	0.31
098	Stand-alone OA non-coin	3.60	46.5	1.67	29.6	1.07
099	Stand-alone OA coin	0.90	49.4	0.44	34.3	0.31
115	Stand-alone non-coin ONI (CAMA)	3.60	26.7	0.96	9.3	0.69
1853	AOSS	12.00	34.1	4.09	20.1	2.41
1854	AOSS VR	4.00	20.0	0.80	11.8	0.47
784	ACCS SCP query	2.50	19.0	0.48	11.2	0.28
787	BNS collect call	1.25	16.5	0.21	10.6	0.13
791	BNS bill to 3rd party	1.25	51.0	0.64	29.7	0.37
029	EAS trunk (MF)-ineffective	4.00	4.7	0.19	3.0	0.12
			Model AWT =	19.78		12.29

Table 8-22xxx
Canadian DMS-200 toll/TOPS (DDD/TOPS/AOSS) model call rate summary

NT40/40	SN20	SN30	SN40
77,351	154,702	232,053	247,518

Note: SN20 call processing=85% SN40 call processing=84.5%

Table 8-23xxx
Canadian CPU call times-DMS-100 POTS/CMS model

Call type	Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
657	POTS/DP-EAS trunk (SS7)	6.00	12.7	0.76	7.5	0.45
1851	POTS/DT-EAS trunk (SS7)	22.64	15.3	3.47	9.2	2.08
1852	RES/DT-EAS trunk (SS7)	9.55	17.5	1.67	10.3	0.99
001	POTS/DP-ineffective	1.23	2.2	0.03	1.3	0.02
008	POTS/DT-ineffective	4.79	2.2	0.11	1.3	0.06
674	RES/DT-ineffective	2.07	2.7	0.06	1.6	0.03
1855	POTS/DP-toll trunk (SS7)	0.59	16.8	0.10	9.8	0.06
1856	POTS/DT-toll trunk (SS7)	3.83	16.9	0.65	9.9	0.38
1857	RES/DT-toll trunk (SS7)	1.47	18.7	0.27	11.0	0.16
002	POTS/DP-POTS line	0.61	6.9	0.04	4.1	0.03
009	POTS/DT-POTS line	2.71	7.1	0.19	4.2	0.11
1182	RES/DT-RES/DT	1.21	9.8	0.12	5.7	0.07
038	EAS trunk (MF)-POTS line	2.72	6.9	0.19	4.2	0.11
654	EAS trunk (SS7)-POTS line	24.51	9.0	2.21	5.4	1.32
704	EAS trunk (MF)-RES line	0.97	8.2	0.08	4.9	0.05
672	EAS trunk (SS7)-RES line	8.17	9.8	0.80	5.7	0.47
029	EAS trunk (MF)-ineffective	0.05	4.7	0.00	3.0	0.00
604	EAS trunk (SS7)-ineffective	0.42	8.4	0.04	5.0	0.02
658	EAS trunk (MF)-EAS trunk (SS7)	0.65	6.6	0.04	4.0	0.03
660	EAS trunk (SS7)-EAS trunk (SS7)	5.81	9.3	0.54	5.7	0.33
			Base AWT=11.37			6.76

Table 8-24xxx
Canadian CPU call times-DMS-100 POTS/CMS feature model

Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
3-Way Calling/assigned	0.60	1.2	0.01	0.7	0.00
Call Waiting/assigned	19.33	1.2	0.23	0.6	0.12
Call Forwarding/assigned	4.54	1.5	0.07	0.9	0.04
Speed Calling/assigned	0.60	1.0	0.01	0.6	0.00

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Table 8-24xxx
Canadian CPU call times-DMS-100 POTS/CMS feature model (continued)

Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
3-Way Calling/ACT	0.01	57.5	0.01	33.3	0.00
Call Waiting/ACT	0.74	33.3	0.25	19.0	0.14
Call Forwarding/ACT	1.39	1.7	0.02	1.3	0.02
Speed Calling/ACT	0.05	0.3	0.00	0.2	0.00
Calling Number Delivery/assigned	9.60	2.2	0.21	1.2	0.12
Customer Originated Trace/assigned	2.00	1.9	0.04	1.0	0.02
Auto Call Back/assigned	4.32	0.4	0.02	0.1	0.01
Auto Recall/assigned	3.60	2.0	0.07	1.1	0.04
Customer Originated Trace/ACT	0.12	3.9	0.00	2.4	0.00
Auto Call Back Nodal Originating/ACT	0.02	8.8	0.00	5.4	0.00
Auto Call Back Nodal terminating/ACT	0.02	11.0	0.00	6.5	0.00
Auto Call Back Network Originating/ACT	0.79	13.6	0.11	8.0	0.06
Auto Call Back Network terminating/ACT	0.65	13.0	0.09	7.8	0.05
AUto Recall Network Originating/ACT	0.04	13.5	0.01	8.3	0.00
Auto Recall Network terminating/ACT	0.03	13.2	0.00	7.9	0.00
		Feature AWT=1.13			0.64
		Model AWT=12.5			7.40

End

Table 8-25xxx
Canadian DMS-100 POTS/CMS feature model call rate summary

NT40/40	SN20	SN30	SN40
123,840	247,680	371,520	413,514

Note: SN20 call processing=86% SN40 call processing=85%

Table 8-26xxx
Canadian CPU call times-DMS-100 POTS/centrex base model

Call type	Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
657	POTS/DP-EAS trunk (SS7)	4.27	12.7	0.54	7.5	0.32
1851	POTS/DT-EAS trunk (SS7)	9.38	15.3	1.44	9.2	0.86
001	POTS/DP-ineffective	1.01	2.2	0.02	1.3	0.01
008	POTS/DT-ineffective	1.99	2.2	0.04	1.3	0.03
1855	POTS/DP-toll trunk (SS7)	0.67	16.8	0.11	9.8	0.07
1856	POTS/DT-toll trunk (SS7)	1.06	16.9	0.18	9.9	0.10
002	POTS/DP-POTS line	1.23	6.9	0.09	4.1	0.05
009	POTS/DT-POTS line	2.08	7.1	0.15	4.2	0.09
038	EAS trunk (MF)-POTS line	6.85	6.9	0.47	4.2	0.29
654	EAS trunk (SS7)-POTS line	22.89	9.0	2.07	5.4	1.23
029	EAS trunk (MF)-ineffective	0.26	4.7	0.01	3.0	0.01
604	EAS trunk (SS7)-ineffective	0.25	8.4	0.02	5.0	0.01
040	EAS trunk (MF)-EAS trunk	1.09	6.0	0.06	3.7	0.04
660	EAS trunk (SS7)-EAS trunk (SS7)	0.41	9.3	0.04	5.7	0.02
454	IBN/DT-EAS trunk (SS7)	8.35	19.3	1.61	11.3	0.95
661	P-Phone-EAS trunk (SS7)	2.04	17.6	0.36	10.7	0.22
938	IBN/DT-tie trunk (DTMF)	2.15	13.8	0.30	8.5	0.18
876	P-Phone-tie trunk (DTMF)	0.48	14.3	0.07	9.5	0.05
935	IBN/DT-ineffective	2.66	2.7	0.07	1.6	0.04
077	P-Phone-ineffective	0.62	3.6	0.02	2.2	0.01
072	IBN/DT-IBN line	5.14	10.4	0.53	5.9	0.31
863	P-Phone-IBN line	1.13	12.3	0.14	7.6	0.09
185	IBN/DT-toll trunk (SS7)	1.60	20.4	0.33	12.1	0.19
1859	P-Phone-toll trunk (SS7)	0.39	21.7	0.08	13.1	0.05
656	SS7 trunk (IT)-IBN line	16.52	10.2	1.68	6.0	0.98
662	SS7 trunk (IT)-P-Phone line	2.93	11.2	0.33	6.7	0.20
084	Tie trunk (MF)-IBN line	1.18	10.0	0.12	6.4	0.08
930	Tie trunk (MF)-P-Phone line	0.24	13.1	0.03	8.6	0.02
086	Tie trunk (MF)-tie trunk (DTMF)	1.13	11.1	0.13	7.3	0.08
			Base AWT=11.04			6.57

Table 8-27xxx
Canadian CPU call times-DMS-100 POTS/centrex feature model

Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
POTS					
3-Way Calling/assigned	0.13	1.2	0.01	0.7	0.00
Call Waiting/assigned	1.38	1.2	0.23	0.6	0.12
Call Forward/assigned	1.48	1.5	0.07	0.9	0.04
Speed Calling/assigned	0.06	1.0	0.01	0.6	0.00
Call Waiting/ACT	0.02	33.3	0.25	19.0	0.14
Call Forward/ACT	0.15	1.7	0.02	1.3	0.02
CENTREX					
Call Forward/assigned	29.93	0.7	0.22	0.3	0.10
Call Forward Busy/assigned	11.31	0.4	0.04	0.5	0.05
Call Forward No Answer/assigned	16.19	4.6	0.74	3.0	0.48
3-Way Calling/assigned	59.15	0.1	0.08	0.0	0.00
Call Waiting/assigned	3.21	0.2	0.01	0.0	0.00
Speed Calling/assigned	2.48	0.3	0.01	0.0	0.00
Call Transfer/assigned	59.15	0.1	0.08	0.0	0.00
Ring Again/ACT	0.06	35.2	0.02	21.0	0.01
Call Forward/ACT	3.23	5.3	0.17	3.7	0.12
Call Forward Busy/ACT	2.48	5.4	0.13	3.7	0.09
Call Forward No Answer/ACT	2.88	14.2	0.41	8.6	0.25
3-Way Calling/ACT	1.95	45.8	0.89	27.5	0.54
Call Pick-Up/ACT	1.36	12.5	0.17	7.1	0.10
Call Waiting/ACT	0.42	42.8	0.18	24.5	0.10
Speed Calling/ACT	0.41	1.2	0.01	1.0	0.00
Message Waiting/ACT	0.18	27.0	0.05	16.8	0.03
Call Transfer/ACT	1.42	27.0	0.38	16.6	0.24
Auto Route Selection/ACT	5.75	0.5	0.03	0.3	0.02
Second Dial Tone/ACT	3.76	0.6	0.02	0.4	0.02
Dial Tone Detect/ACT	3.76	6.0	0.23	3.8	0.14
SMDR/ACT	7.17	3.8	0.27	2.4	0.17

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Table 8-27xxx
Canadian CPU call times-DMS-100 POTS/centrex feature model (continued)

Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
		Feature AWT=4.20			2.48
		Model AWT=15.24			9.05
		End			

Table 8-28xxx
Canadian DMS-100 POTS/centrex model call rate summary

NT40/40	SN20	SN30	SN40
100,394	200,787	301,181	338,122

Note: SN20 call processing=85% SN40 call processing=85%

Table 8-29xxx
NT40 average work time (AWT) adjustments

AWT (average ms)	Call processing adjustments
< 15 ms	0.0 percent
15.0 ms to 25.9 ms	1.0 percent
26.0 ms to 40.0 ms	2.0 percent
> 40.0 ms	3.0 percent

Table 8-30xxx
SN20 average work time (AWT) adjustments

AWT (average ms)	Call processing adjustments
< 12.6 ms	0.0 percent
12.6 ms-20.0 ms	1.0 percent
> 20.0 ms	1.5 percent

Table 8-31xxx
SN30 average work time (AWT) adjustments

AWT (average ms)	Call processing adjustments
< 8.7 ms	0.0 percent
8.7 ms-13.3 ms	1.0 percent
> 13.3 ms	1.5 percent

Table 8-32xxx
SN40 average work time (AWT) adjustments

AWT (average ms)	Call processing adjustments
< 7.2 ms	0.0 percent
7.2 ms-11.1 ms	1.0 percent
> 11.1ms	1.5 percent

Table 8-33xxx
U.S. CPU call times-line origination

Call type	Call description	ms/call attempt NT40	SN20
947	POTS DP 1FR-POTS DTMF 1FR line	18.8	9.4
005	POTS DP 1FR-LAMA trunk	24.0	*12.0
979	POTS DP 2FR-POTS 1FR line	22.6	11.3
**014	POTS DTMF 1FR line-false start	4.4	2.4
**994	POTS DTMF 1FR line-POTS 1FR line	16.9	9.4
015	POTS DTMF 1MR line-POTS 1FR line	25.6	*12.8
962	POTS DTMF 1FR line-POTS 1MR line	18.0	9.0
950	POTS DTMF 1MR line-POTS 1MR line	26.2	*13.1
859	POTS DTMF 1FR line-MDC DTMF line	12.4	11.2
1059	POTS DTMF 1FR line-EBS with display	26.4	12.7
1236	POTS DTMF 1FR line-MADN primary	37.6	18.8
**995	POTS DTMF 1FR line-EAS trunk	13.7	7.7
**016	POTS DTMF 1MR line-EAS trunk	23.0	*11.9
360	FGC 1+10 digits-IC (PIC)	29.0	*14.5
**378	FGC 1+10 digits-AT (PIC)	28.8	*14.4
401	FGD 1+7 digits-IC (OCS ON,PIC)	31.0	*16.9
**402	FGD 1+10 digits-AT (OCS ON,PIC)	31.3	*17.0
974	POTS DTMF 1MR line-AT to IC FGD trunk	31.7	*17.5
011	POTS DTMF 1FR line-LAMA trunk	23.6	*11.8
949	POTS DTMF 1FR line-operator trunk	22.6	11.3
308	POTS DTMF 1MR line-busy	15.6	8.2
951	POTS DTMF 1FR line-abandon/5 digits	7.0	3.5
993	POTS DTMF 1FR line-abandon/6 digits	6.3	3.4
**948	POTS DTMF 1FR line-busy DTMF 1FR	15.7	7.9
967	POTS DTMF 1FR line-MF operator trunk	22.3	11.2

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Table 8-33xxx
U.S. CPU call times-line origination (continued)

Call type	Call description	ms/call attempt NT40	SN20
963	POTS DTMF 1FR line-MF PBX DID trunk	16.3	8.1
**966	POTS DTMF 1FR line-BLDN announcement	17.8	8.9
**019	Coin DTMF-POTS 1FR line	31.8	*15.9
020	Coin DTMF-EAS trunk	28.0	*14.0
910	FGB coin DTMF-AT MF	28.8	14.4
952	Coin DTMF-direct to IC FGC trunk	38.4	*19.2
953	Coin DTMF-via AT to IC FGC trunk	38.6	*19.3
954	Coin DTMF-direct to IC FGD	43.8	*21.9
955	Coin DTMF-via AT TO IC FGD trunk	42.6	*21.3
982	Coin DTMF-operator trunk	32.3	16.1
908	Coin DTMF-trunk (1+800)	34.8	*17.4
018	Coin DTMF-busy	20.6	10.3
054	PBX DOD trunk-POTS 1FR line	17.6	8.8
055	PBX DOD trunk-LAMA trunk	24.0	*12.0
914	PBX DTMF DOD-NON-LAMA MF EAS	14.8	7.4
915	FGB DTMF PBX DOD-AT MF trunk	19.2	9.6
916	FGC DTMF PBX DOD-AT MF trunk	29.0	*14.5
917	FGD DTMF PBX DOD-AT MF trunk	32.0	*16.0
988	OUTWATS-direct to IC FGB trunk	29.1	*14.5
918	FGC DTMF OUTWATS-AT MF trunk	30.0	*15.0
989	OUTWATS-direct to IC FGD	32.5	*16.3
052	OUTWATS-LAMA trunk	23.6	*11.8
309	OUTWATS(Enhanced)-ATC trunk	33.4	*16.7
899	MDC OUTWATS(Enhanced-ATC trunk	34.2	19.0
805	MDC DTMF-false start	5.0	2.7
**888	MDC DTMF-MDC line	16.5	8.9
1109	MDC DTMF (with SMDR)-MDC line	25.2	13.9
889	MDC DTMF-EAS trunk	17.0	9.4
881	FGB DP MDC-AT MF	20.6	10.3
882	FGC DTMF MDC-AT MF	31.9	*15.9
883	FGD DTMF MDC-AT MF	32.6	*17.6

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Table 8-33xxx
U.S. CPU call times-line origination (continued)

Call type	Call description	ms/call attempt NT40	SN20
884	DTMF MDC intraLATA-MF toll trunk	24.0	*13.3
886	E800 EAEO DTMF MDC-IC trunk	48.7	*25.0
873	MDC DTMF-EBS without display	19.6	10.1
**1199	MDC DTMF-EBS with display	25.5	12.2
1224	MDC DTMF-EBS with display MADN 3 secondary members	56.0	27.5
**1239	MDC DTMF-EBS with display MADN 4 secondary members	59.7	29.2
874	MDC DTMF-MDC MF trunk	25.6	*13.7
**857	MDC DTMF 2ND DT-POTS 1FR	20.8	10.4
858	MDC DTMF-abandon after 2 digits	14.3	7.5
850	Attendant-MDC DTMF line (SCG)	26.4	13.2
891	EBS with display-EBS with display	31.0	13.2
892	EBS with display-EAS trunk	21.6	10.8
893	EBS with display-LAMA trunk	29.2	*14.6
863	EBS without display-EBS without display	22.0	11.0
894	EBS with display-EBS without display	25.2	11.3
885	EBS with display FGD-AT MF	39.1	*19.0
876	EBS without display- MDC MF trunk	29.4	*15.4
875	EBS without display-DTMF FX trunk	20.7	10.3
890	EBS with display-abandon after 2 digits	17.8	8.5
862	EBS without display-MDC DTMF line (SCG)	21.5	11.9
**861	EBS without display-attendant	22.6	11.3
864	EBS without display 2ND DT-POTS 1FR	22.1	11.5
**1198	EBS with display-MDC line	22.0	11.9
**1238	EBS with display MADN (4 SEC)-MDC line	33.8	16.0
	Datapath-line	34.6E	17.3E
	Datapath-nonLAMA (EAS)	35.8E	17.9E
	Datapath-LAMA	53.4E	26.7E

End

Table 8-34xxx
U.S. call times-call types with custom calling/CLASS/SMDI features

POTS Custom Calling Features (CCF)

3-Way Calling (3WC)
Call Waiting (CWT)
Speed Calling (SC1)
Call Forward (CFW)
Teen Service

Call type	Call description	ms/C/A NT40	SN20
1065	1FR (all CCF assigned)-1FR line	16.9	9.3
1066	1FR line (3WC activated)-1FR line	153.9	*77.7
1067	1FR line (SC1 activated)-1FR line	16.2	9.0
1070	1FR line-1FR line (CFU assigned)	19.2	9.6
1072	1FR line-1FR line (all CCF assigned)	17.5	9.6
1073	1FR line-1FR line (CFU activated)	23.6	12.8
1074	1FR line-1FR line (CWT activated)	120.3	*64.4
1105	1FR line-1FR line (3WC,SC1,CWT assigned)	18.8	9.4
1225	1FR line-1FR line (Teen Service activated)	17.2	9.6

MDC Custom Calling Features (CCF):

3-Way Calling (3WC)
Call Waiting (CWT)
Speed Calling Short List (SC1)
Speed Calling Long List (SC2)
Call forward Busy (CFB)
Call Forward Universal (CFU)
Call Forward Don’t Answer (CFD)
Call Transfer (CXR)
Call Hold (CH)
Ring Again (RA)
Call Pick-Up (CPU)

Call type	Call description	ms/C/A NT40	SN20
1075	MDC line-MDC line	16.3	8.7
1085	MDC line (all CCF assigned)-MDC line	16.4	8.8
1086	MDC line (3WC activated)-MDC line	129.0	*68.8

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Table 8-34xxx
U.S. call times-call types with custom calling/CLASS/SMDI features (continued)

1087	MDC line (SC1 activated)-MDC line	19.9	10.9
1088	MDC line (SC2 activated)-MDC line	20.0	10.8
1089	MDC line (CH activated)-MDC line	113.9	*62.2
1107	MDC line (RA activated)-MDC line	98.0	50.4
1092	MDC line-MDC line (CFU assigned)	18.6	9.3
1095	MDC line-MDC line (CFB assigned)	18.8	9.4
1096	MDC line-MDC line (CFD assigned)	27.0	13.5
1099	MDC line-MDC line (all CCF assigned)	26.2	13.7
1100	MDC line-MDC line (CFU activated)	26.5	15.2
1101	MDC line-MDC line (CWT activated)	145.7	*75.6
1102	MDC line-MDC line (CFB activated)	26.5	15.3
1103	MDC line-MDC line (CFD activated)	52.3	28.3
1104	MDC line-MDC line (CXR activated)	104.6	*55.0
1106	MDC line-MDC line (3WC,SC1,CWT,SC2,CH,CXR, ASGN)	17.6	8.8
1108	MDC line-MDC line (CPU activated)	54.1	28.8
RES Custom Local Area Signalling Services (CLASS)			
Automatic Call Back (ACB)			
Automatic RecalL (AR)			
Calling Number DeliverY (CND)			
Calling Name Delivery (CNAMD)			
Calling Number Delivery Blocking (CNDB)			
Selective Call Rejection (SCRJ)			
Customer Originated Trace (COT)			
Usage Sensitive Billing (USB)			
Selective Call Forward (SCFWD)			
Selective Call Acceptance (SCA)			
Distinctive Ring (DR)			
Call type	**Call description**	**ms/C/A NT40**	**SN20**
1205	RES-RES (ACB,AR,CND,COT assigned originating/terminating)	24.8	12.4
1258	RES (ACB,AR,COT,CND assigned)-RES	23.7	13.2
1259	RES-RES (ACB,AR,COT,CND assigned)	23.5	12.1
1206	RES (ACB Intra-Nodal activated)-RES	124.0	66.2

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Table 8-34xxx
U.S. call times-call types with custom calling/CLASS/SMDI features (continued)

1207	RES-RES (AR Intra-Nodal activated)	37.2	21.5
1208	RES (ACB Network ACT)-SS7-RES	218.8	*106.5
1209	RES-SS7-RES (AR network ACT)	65.6	*33.2
1210	RES-RES (SCRJ activated)	43.5	*22.1
1211	RES-RES (SCFWD activated)	60.8	*30.7
1212	RES-RES (SCA activated)	50.7	*25.8
1213	RES-RES (DR activated)	51.7	*25.9
1214	RES-RES (COT activated)	25.9	13.3
1215	RES (CNDB activated-RES)	31.8	17.2
1216	RES (CNDB activated/USB ON)-RES	37.4	*19.8
1217	1FR line-RES (CNAMD activated)	68.1	*33.2
1218	1FR line-RES (CND activated)	47.3	*24.1
RES Simplified Message Desk Interface (SMDI)			
SMDI Call Forward Busy (CFB)			
SMDI Call Forward Don’t Answer (CFD)			
SMDI Call Forward Always (CFA)			
Call type	**Call description**	**ms/C/A NT40**	**SN20**
1220	RES-SMDI (direct)	51.6	27.2
1221	1FR line-RES (SMDI-CFB)	62.8	31.4
1222	1FR line-RES (SMDI CFD)	84.4	42.2
1223	1FR line-RES (SMDI-CFA)	62.8	31.4
End			

Table 8-35xxx
U.S. call times-incoming trunk origination

Call type	Call description	ms/call attempt NT40	SN20
**997	MF tandem incoming AMA trunk-MF tandem trunk	7.5	4.5
**996	MF trunk-POTS 1FR line	11.8	6.7
**998	MF IT trunk-IT trunk	10.6	6.3
453	MF IC trunk-POTS 1FR line	23.0	*11.5
**999	MF trunk-busy	18.8	*9.4
031	MF trunk-INWATS line	24.9	*12.4
879	MF trunk-EBS without display	14.2	7.3
946	MF trunk-abandon (no start signal)	5.0	2.6
854	MF POTS trunk-MDC DTMF line	12.0	7.2
046	MF incoming AMA trunk-POTS 1FR line	22.2	*11.1
048	MF incoming AMA trunk-trunk	16.5	*9.2
990	IC trunk-POTS 1FR line (LCM)	23.1	*11.4
456	IC carrier trunk-IT trunk	17.4	*9.5
991	IC trunk-MF PBX DID (PX)	21.2	*10.6
455	IT trunk-IC carrier trunk	11.8	6.4
919	FGC LEAS MF incoming trunk-IC trunk	27.8	*13.9
920	FGD LEAS MF incoming trunk-IC trunk	30.4	*15.2
921	LEAS MF incoming trunk-tandem MF IT	31.0	*15.5
855	MDC MF trunk-MDC DTMF line	16.2	8.1
856	MDC DTMF FX trunk-MDC DTMF line (SCG)	21.4	10.7
868	MDC MF trunk-attendant	18.0	9.0
958	MF PX DOD trunk-DIG(PX)-direct to IC	34.2	*17.1
959	MF PX DOD trunk-DIG-VIA AT to IC	30.6	*15.3
961	MF PX DOD trunk-DIG-MF EAS trunk	13.4	8.0
986	DTMF PBX DOD (FX) trunk-operator trunk	21.0	10.5
987	MF PBX DOD trunk-operator trunk	20.2	10.1
E911 trunking			
Call type	**Call description**	**ms/C/A NT40**	**SN20**
1201	FX trunk-E911 tandem	29.1	14.5
1202	E911 trunk-E911 tandem PSAP query	22.0	11.0

-continued-

Table 8-35xxx
U.S. call times-incoming trunk origination (continued)

Call type	Call description	ms/call attempt NT40	SN20
1203	E911 trunk-PSAP line without hold	35.6	*17.8
1204	E911 trunk-PSAP line with SBT-LDTPSAP	184.0	90.2
SS7 trunking			
Call type	**Call description**	**ms/C/A NT40**	**SN20**
** 577	DTMF POTS line-SS7 trunk EAS	19.3	9.8
1226	DTMF POTS line-SS7 trunk toll	36.5	*18.2
578	DTMF MDC line -SS7 trunk EAS	22.3	11.1
1228	DTMF MDC line-SS7 trunk toll	38.5	*19.6
**1219	DTMF MDC line (with SMDR)-SS7 trunk	28.1	14.4
579	DTMF POTS line-SS7 trunk EAS	27.6	*13.5
**580	SS7 trunk-DTMF POTS line	17.6	9.0
581	SS7 trunk-DTMF MDC line	17.9	10.4
582	SS7 trunk-EBS with display (network name display)	30.8	15.4
583	EBS with display-SS7 trunk (network ring again)	103.6	51.8
584	SS7 trunk-EBS with display (network number display)	23.4	11.7
585	EBS with display-SS7 trunk (network name display)	34.5	17.3
598	SS7 trunk-EBS with display (network ring AGAIN)	19.2	9.6
599	EBS with display-SS7 trunk (network number display)	27.3	13.6
1230	FGD MF trunk-SS7 trunk	17.7	9.4
1231	FGD SS7 trunk-MF trunk	17.9	9.7
**1232	FGD SS7 trunk-SS7 trunk	22.2	9.7
1233	FGD E800 SS7 trunk-MF trunk (DB query)	38.8	19.2
1234	FGD E800 SS7 trunk-SS7 trunk (DB query)	38.6	19.3
1235	FGB SS7 trunk-MF trunk	13.5	7.7
800 service			
Call type	**Call description**	**ms/C/A NT40**	**SN20**
922	E800 DTMF 1FR-IC (DB query)	46.0	*23.0
924	E800 AT-IC (DB query)	42.2	*22.3
927	E800 EAEO DTMF 1FR-reorder (DB query)	43.6	21.8

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Table 8-35xxx
U.S. call times-incoming trunk origination (continued)

Call type	Call description	ms/call attempt NT40	SN20
928	E800 EAEO DTMF 1FR-AT (DB query)	49.8	*24.9
*929	E800 AT-IT (DB query)	40.8	*20.4
943	E800 AT-reorder (DB query)	27.6	13.8

End

Table 8-36xxx
U.S. CPU call timing adjustments

Call description	ms/call attempt NT40	SN20
AMA	9.3	**4.2D
Originating MADN (1 Primary/4 Secondary Members)	11.8	**4.1D
Terminating MADN (1 Primary/4 Secondary Members)	34.2	**17.0D
SMDR	5.8	**3.3D
MDC Attendant Console Termination	2.1	**1.1D
MDC Attendant Console Origination	6.0	3.0D
UTR	-2.0	**-1.3D
Alternate Routing	1.1	.6D
Virtual Facility Group	1.5	.8D
Hunt Group	2.0	1.0D
Permanent Signal	21.7	10.9D
EBS (P-Phone) with display	9.0	**3.3D
ACD Termination (line-line Intra-office)	32.0	**16.0D
ACD Termination (trunk-line)	32.0	**16.0D
ACD Termination Queue	16.0	**8.0D
ACD with MIS	4.2	** 2.1D
UCD Termination	12.3	**6.3D
UCD Termination Queue	6.2	**3.2D
MDC 2nd Dial Tone Access	1.8	.**9D
Pots feature activation		
Call Waiting (Ref. #1074)	76.0	**41.0D
Three-Way Calling (Ref. #1066)	110.8	**54.9D
Call Forward (Ref. #1073)	6.1	**3.2D
Speed Calling (Ref. #1067)	-.7	**-.3D
MDC feature activation		
Call Waiting (Ref. #1101)	82.0	**42.7D
Three-Way Calling (Ref. #1086)	84.9	**45.7D
Ring Again (Ref. #1107)	81.5	**41.5D
Call Transfer (Ref. #1104)	50.7	**27.0D
Call Pick-Up (Ref. #1108)	37.9	**19.9D
Call Forward No Answer (Ref. #1103)	24.7	**14.8D

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Table 8-36xxx
U.S. CPU call timing adjustments (continued)

Call description	ms/call attempt NT40	SN20
Call Forward Universal (Ref. #1100)	10.0	**6.3D
Call Forward Busy (Ref. #1102)	10.0	**6.4D
Speed Calling (Ref. #1087/#1088)	3.6	**2.1D
Call Hold (Ref. #1089)	88.2	49.2D
CLASS feature activation		
ACB Intra-nodal (Ref. #1206)(Delay)	99.2	**53.0D
ACB-SS7 Network (Ref. #1208)(Delay)	114.6	**54.6D
SS7 Network-ACB (Ref. #1208)(Delay)	57.3	**27.3D
Ar Intra-nodal (Ref. #1207)(Immediate)	12.4	**9.4D
Ar-SS7 Network (Ref. #1209)(Immediate)	12.5	**5.8D
SS7 Network-AR (Ref. #1209)(Immediate)	6.3	**2.9D
CND (Ref. #1218)	3.5	**.9D
CNAMD (Ref. #1217)	24.3	**10.0D
CNDB	7.0	**4.0D
COT	25.9	**13.3D
Selective Call Rejection (SCRJ)	12.1	**7.0D
Selective Call Forward (SCFWD)	14.0	**6.2D
Distinctive Ring	4.9	**1.4D
Selective Call Acceptance	3.9	**1.3D
Usage Sensitive Billing	5.6	2.6D
Note: The scanning time associated with CLASS ACB/AR is detailed in SEA 90-04-001 Issue #1 April 9, 1990.		
CLASS FEATURE ASSIGNMENT		
CLASS with Outgoing Memory (ACB)	7.6	**3.8 D
CLASS with Incoming Memory (AR,COT,SCRJ,SCFWD,DRCW)	5.4	**2.7 D
Note: CLASS feature assignment cost are not cumulative.		
End		

Table 8-37xxx
U.S. CPU call times-TOPS stand-alone configuration

Call type	Call description	ms/call attempt NT40	SN20
**316	0-;OH;non-coin;information only;no outpulsing	45.0	22.5
314	0-;OH;non-coin;interexchange carrier	82.4	41.2
315	0-;OH;non-coin;person paid;end_office	71.0	37.1
317	0-;OH;non-coin;station special;BNS=Y	83.2	41.6
513	0-;OH;non-coin;OVS;transfer IC;interLATA carrier	64.4	32.2
813	0-;OH;CN;person paid;end_office without rate step	102.2	51.1
819	0-;OH;CN;person paid;end_office;TICS	103.5	54.8
1142	0-;OH;non-coin;person paid;AMA;answer	112.6	56.3
**824	0+;MCCS;SS7 database;successful	78.6	41.5
802	0+;MCCS;hook flash to operator	98.7	49.4
327	0+;MCCS;no query database	66.4	33.2
320	0+;MCCS;OH;no query database;with timeout	99.2	49.6
331	0+;OA;non-coin;station collect;end office	82.6	41.3
329	0+;OA;non-coin;station paid;end office	77.2	38.6
332	0+;OA;non-coin;person collect;end office	82.0	41.0
**330	0+;OA;non-coin;person paid; end office	77.0	38.5
509	0+;non-coin;interLATA carrier	34.2	17.1
515	0+;coin;overseas services;interLATA carrier	34.8	17.4
**814	0+;OH;coin;person paid;end office; without rate step	97.6	48.8
**818	0+;OA;non-coin;person paid;end office;TICS	80.2	40.1
825	0+;OA;calling card number;SS7 database;deny 1st #;complete 2nd #	171.8	85.9
826	0+;OA;calling card number;SS7 database;service deny no payment	100.2	50.1
827	0+;OA;calling card number;SS7 database;successful	111.8	55.9
828	0+;OA;BNS;SS7 database;verify collect	106.0	53.0
830	0+;OA;BNS;SS7 database;verify 3rd number	147.0	73.5
807	1+;ACTS;coin;T/O initial deposit	138.3	69.1
**326	1+;ACTS;coin	67.6	35.9
**321	1+;CAMA;ONI;non-coin	50.0	25.0
**322	1+;ONI;successful validation	38.4	19.2
**328	1+;DD;hotel;person paid	86.2	43.1

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Table 8-37xxx
U.S. CPU call times-TOPS stand-alone configuration (continued)

Call type	Call description	ms/call attempt NT40	SN20
**809	1+;OH;hotel;bill to room	82.2	41.1
**815	1+;DD;coin;station paid;end office without rate step	96.9	51.2
518	Queue search for CAMA calls	52.2	26.1
520	verify and connect	109.8	54.9
**526	verify with scrambler	66.4	33.2

End

Table 8-38xxx
U.S. CPU call times-host OC TOPS configuration

Call type	Call description	ms/call attempt NT40	SN20
**335	0-;OH;non-coin;information only;no outpulsing	33.9	15.4
333	0-;OH;non-coin;interexchange carrier	51.0	23.2
334	0-;OH;non-coin;person paid;end office	46.2	21.4
337	0-;OH;non-coin;station special;BNS=Y	61.4	27.9
531	0-;OH;non-coin;overseas services;transfer IC;interLATA carrier	35.9	16.3
613	0-;OH;coin;person paid;end office;without rate step	51.3	23.3
619	0-;OH;coin;person paid;end office;TICS	54.7	25.1
1140	0-;OH;non-coin;person paid;AMA;answer	78.3	35.6
602	0+;MCCS;hook flash to operator	59.7	27.1
340	0+;MCCS;no query database	5.1	2.3
336	0+;MCCS;OH;no query database;with timeout	57.6	26.2
488	0+;OA;non-coin;station collect;end office	50.2	22.8
486	0+;OA;non-coin;station paid;end office	46.0	20.9
489	0+;OA;non-coin;person collect;end office	50.4	22.9
**487	0+;OA;non-coin;person paid;end office	46.2	21.0
**614	0+;OH;coin;person paid;end office; without rate step	46.6	21.2
**618	0+;OA;non-coin;person paid;end office;TICS	43.6	19.8
625	0+;OA;calling card number;SS7 database;deny 1st #;complete 2nd #	89.7	40.8

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Table 8-38xxx
U.S. CPU call times-host OC TOPS configuration (continued)

Call type	Call description	ms/call attempt NT40	SN20
626	0+;OA;calling card number;SS7 database;service deny no payment	60.1	27.3
627	0+;OA;calling card number;SS7 database;successful	56.2	24.5
628	0+;OA;BNS;SS7 database;verify collect	50.4	22.9
630	0+;OA;BNS;SS7 database;verify 3rd number	86.5	39.3
607	1+;ACTS;coin;T/O initial deposit	69.2	31.5
**341	1+;CAMA;ONI;non-coin	27.3	12.4
**342	1+;ONI;successful validation	27.3	12.4
**347	1+;DD;hotel;person paid	50.6	23.0
**609	1+;OH;hotel;bill to room	44.2	20.1
615	1+;DD;coin;station paid;end office;without rate step	50.5	22.8
**536	Queue search for CAMA calls	29.0	13.2
538	Verify and connect	79.2	36.0
**544	Verify with scrambler	47.1	21.4

End

Table 8-39xxx
U.S. CPU call times-remote OC TOPS configuration

Call type	Call description	ms/call attempt NT40	SN20
**492	0-;OH;non-coin;information only;no outpulsing	49.8	24.9
490	0-;OH;non-coin;interexchange carrier	88.8	44.4
491	0-;OH;non-coin;person paid;end office	79.9	40.1
494	0-;OH;non-coin;station special;BNS=Y	98.4	49.2
549	0-;OH;non-coin;overseas services;transfer IC;interLATA carrier	71.4	35.7
713	0-;OH;coin;person paid;end office without rate step	116.6	53.0
719	0-;OH;coin;person paid;end office;TICS	112.9	59.2
1141	0-;OH;non-coin;person paid;AMA;answer	122.8	61.4
**724	0+;MCCS;SS7 database;successful	78.6	41.5
702	0+;MCCS;hook flash to operator	122.3	61.2
497	0+;MCCS;NO_X database	71.2	35.6
493	0+;MCCS;OH;NO_X database;with timeout	111.4	55.7

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Table 8-39xxx
U.S. CPU call times-remote OC TOPS configuration (continued)

Call type	Call description	ms/call attempt NT40	SN20
507	0+;OA;non-coin;station collect;end office	90.2	45.1
505	0+;OA;non-coin;station paid;end office	84.4	42.2
508	0+;OA;non-coin;person collect;end office	90.2	45.1
**506	0+;OA;non-coin;person paid;end office	85.4	42.7
545	0+;non-coin;interLATA carrier	33.8	16.9
551	0+;coin;overseas services;interLATA carrier	32.1	16.0
**714	0+;OH;coin;person paid;end office; without rate step	104.4	52.2
**718	0+;OA;non-coin;person paid;end office;TICS	87.6	43.8
725	0+;OA;calling card number;SS7 database;deny 1st #;complete 2nd #	178.4	89.2
726	0+;OA;calling card number;SS7 database;service deny;no payment	101.2	50.6
727	0+;OA;calling card number;SS7 database;successful	118.2	60.3
728	0+;OA;BNS;SS7 database;verify collect	114.6	57.3
730	0+;OA;BNS;SS7 database;verify 3rd number	153.4	76.7
707	1+;ACTS;coin;T/O initial deposit	151.1	75.6
**503	1+;ACTS;coin	67.6	35.9
**498	1+;CAMA;ONI;non-coin	55.0	27.5
**499	1+;ONI;successful validation	40.2	20.1
**504	1+;DD;hotel;person paid	92.2	46.1
**709	1+;OH;hotel;bill to room	88.0	44.0
715	1+;DD;coin;station paid;end office without rate step	107.2	54.2
**554	Queue search for CAMA calls	57.4	28.7
556	verify and connect	115.8	57.9
**562	verify with scrambler	74.4	37.2

End

Table 8-40xxx
U.S. CPU call times-TOPS multi-purpose configurations

Call type	Call description	ms/call attempt NT40	SN20
Stand alone TOPS-MP configuration			
1130	0-;OH;non-coin;person paid;end office	72.3	37.4
1136	0-;OH;coin;person paid;end office	94.8	47.4

Table 8-40xxx
U.S. CPU call times-TOPS multi-purpose configurations (continued)

Call type	Call description	ms/call attempt NT40	SN20
1133	0+;OA;non-coin;person paid;end office	78.6	39.3
1139	0+;OA;coin;person paid;end office	94.2	48.5
Host OC TOPS-MP configuration			
1128	0-;OH;non-coin;person paid;end office	47.6	21.7
1134	0-;OH;coin;person paid;end office	47.8	21.7
1131	0+;OA;non-coin;person paid;end office	46.6	21.2
1137	0+;OA;coin;person paid;end office	47.2	21.4
Remote OC TOPS-MP configuration			
1129	0-;OH;non-coin;person paid;end office	80.2	40.3
1135	0-;OH;coin;person paid;end office	98.8	49.4
1132	0+;OA;non-coin;person paid;end office	84.4	42.2
1138	0+;OA;coin;person paid;end office	102.5	52.0

Table 8-41xxx
U.S. CPU call times-TOPS AABS configuration

Call type	Call description	ms/call attempt NT40	SN20
Stand alone TOPS-MP configuration			
**1172	AABS;0+;collect;non-coin;LIDB database;verify	104.2	52.6
**1175	AABS;0+;bill 3rd party;non-coin;LIDB database;verify	121.4	64.5
**1178	AABS;0+;calling card number;non-coin;LIDB database	84.0	42.6
1254	Operator handoff via VSN billed collect	144.0	72.6
1257	Operator handoff via VSN billed 3rd party	158.3	79.8
Host OC TOPS-MP configuration			
1170	AABS;0+;collect;non-coin;LIDB database;verify	0.0	0.0
1173	AABS;0+;bill 3rd party;non-coin;LIDB database;verify	0.0	0.0
1176	AABS;0+;calling card number;non-coin;LIDB database	0.0	0.0
1252	operator handoff via VSN billed collect	76.2	34.6
1255	operator handoff via VSN billed 3rd party	71.6	32.9
Remote OC TOPS-MP configuration			
**1171	AABS;0+;COLLECT;non-coin;LIDB database;verify	104.4	52.6
**1174	AABS;0+;bill 3rd party;non-coin;LIDB database;verify	121.4	64.5

-continued-

Table 8-41xxx
U.S. CPU call times-TOPS AABS configuration (continued)

Call type	Call description	ms/call attempt NT40	SN20
**1177	AABS;0+;calling card number;non-coin;LIDB database	84.0	42.6
1253	Operator handoff via VSN billed collect	146.5	72.4
1256	Operator handoff via VSN billed 3rd party	157.2	78.3

End

Table 8-42xxx
U.S. CPU call times-TOPS directory assistance configuration

Call type	Call description	ms/call attempt NT40	SN20
Stand alone TOPS-MP configuration			
1148	411 combined trunk voice quote	66.6	33.3
1151	411 combined trunk external ARU	71.7	**37.0
1154	411 directory assistance trunk external ARU no ANI	68.2	34.1
1163	Intercept;intercept_trunk external ARU	34.6	18.7
1166	Intercept;intercept_trunk # not in database voice quote	48.0	**24.0
1169	Intercept;intercept trunk ONI external ARU	69.4	34.7
1242	411 combined trunk call completion station paid	101.1	**51.8
1245	411 call completion AABS calling card	150.7	76.4
1248	411 call completion AABS collect	169.6	85.4
1251	411 call completion AABS bill 3rd party	192.9	97.6
Host OC TOPS-MP configuration			
1146	411 combined trunk voice quote	40.0	18.2
1149	411 combined trunk external ARU	33.8	**15.6
1152	411 directory assistance trunk external ARU no ANI	38.7	17.6
1161	Intercept;intercept trunk external ARU	0.0	0.0
1164	Intercept;intercept trunk # not in database voice quote	29.9	**13.6
1167	Intercept;intercept trunk ONI external ARU	32.1	14.6
1240	411 combined trunk call completion station paid	34.4	**15.6
1243	411 call completion AABS calling card	37.4	17.5
1246	411 call completion AABS collect	41.0	19.3
1249	411 call completion AABS bill 3rd party	43.5	20.4

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Table 8-42xxx
U.S. CPU call times-TOPS directory assistance configuration (continued)

Call type	Call description	ms/call attempt NT40	SN20
Remote OC TOPS-MP configuration			
1147	411 combined trunk voice quote	69.0	34.5
1150	411 combined trunk external ARU	73.0	**37.9
1153	411 directory assistance trunk external ARU no ANI	68.8	34.4
1162	Intercept;intercept trunk external ARU	34.6	18.7
1165	Intercept;intercept trunk # not in database voice quote	51.8	**25.9
1168	Intercept;intercept trunk ONI external ARU	69.2	34.6
1241	411 combined trunk call completion station paid	104.4	**52.2
1244	411 call completion AABS calling card	148.3	75.5
1247	411 call completion AABS collect	163.6	82.7
1250	411 call completion AABS bill 3rd party	183.3	94.0

End

Table 8-43xxx
U.S. CPU call times-equal access operator services system configuration

Call type	Call description	ms/call attempt NT40	SN20
Stand alone			
1115	IntraLATA;DP;0-;non-coin;person paid	73.0	36.5
1124	InterLATA;DTMF;pre-subscription;0-;coin;person paid	117.2	58.6
1112	IntraLATA;DTMF;O+;non-coin;person paid	75.4	37.7
1118	InterLATA;DTMF;pre-subscription;O+;non-coin;person paid	80.1	42.4
1121	InterLATA;DTMF;10XXX;0+;non-coin;person paid	85.2	42.6
1127	InterLATA;DP;10XXX;1+;CAMA;ANI failure	55.2	27.6
Host			
1113	IntraLATA;DP;0-;non-coin;person paid	46.9	21.3
1122	InterLATA;DTMF;pre-subscription;0-;coin;person paid	58.1	26.4
1110	IntraLATA;DTMF;O+;non-coin;person paid	46.4	21.1
1116	InterLATA;DTMF;pre-subscription;O+;non-coin;person paid	45.1	19.9
1119	InterLATA;DTMF;10XXX;0+;non-coin;person paid	43.6	19.8
1125	InterLATA;DP;10XXX;1+;CAMA;ANI_FAIL	27.3	12.4

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Table 8-43xxx
U.S. CPU call times-equal access operator services system configuration (continued)

Call type	Call description	ms/call attempt NT40	SN20
Remote			
1114	IntraLATA;DP;0-;non-coin;person paid	79.4	39.7
1123	InterLATA;DTMF;pre-subscription;0-;coin;person paid	124.0	62.0
1111	IntraLATA;DTMF;O+;non-coin;person paid	83.8	41.9
1117	InterLATA;DTMF;pre-subscription;O+;non-coin;person paid	88.5	46.0
1120	InterLATA;DTMF;10XXX;0+;non-coin;person paid	92.2	46.1
1126	InterLATA;DP;10XXX;1+;CAMA;ANI failure	59.0	29.5

End

Table 8-44xxx
Canadian CPU call times-line origination

Call type	Call description	ms/call attempt SN20	SN40
001	POTS DP line-ineffective	2.2	1.3
002	POTS DP line-POTS line	6.9	4.1
003	POTS DP line-EAS trunk	6.5	3.9
006	POTS DP line-LAMA trunk	13.0	*7.8
007	POTS DP line- OUTCAMA trunk	13.0	*8.0
675	POTS DP line-RES line	8.3	5.1
**008	POTS DTMF line-ineffective	2.2	1.3
**009	POTS DTMF line- POTS line	7.1	4.2
676	POTS DTMF line-RES line	10.2	6.1
**010	POTS DTMF line-EAS trunk	6.5	3.9
**012	POTS DTMF line-LAMA trunk	12.6	*7.7
013	POTS DTMF line-OUTCAMA trunk	13.2	*8.0
699	RES DP line-POTS line	16.0	*9.9
716	RES DP line-RES line	10.0	6.1
673	RES DP line-ineffective	2.6	1.5
677	RES DP line-MF trunk	8.7	5.3
670	RES DTMF line-POTS line	9.1	5.4
1182	RES DTMF line-RES DTMF line	9.8	5.7

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Table 8-44xxx
Canadian CPU call times-line origination (continued)

Call type	Call description	ms/call attempt SN20	SN40
674	RES DTMF line-ineffective	2.7	1.6
669	RES DTMF line-MF trunk	8.6	5.3
798	RES DTMF line-LAMA trunk	14.1	*11.0
799	RES DTMF line-CAMA trunk	18.3	*11.5
**060	MDC DP line-MDC line	9.8	5.2
934	MDC DP line-ineffective	2.7	1.7
**061	MDC DP line with SMDR-MDC line	13.7	*8.4
062	MDC DP line-MDC line (no answer)	9.4	5.5
063	MDC DP line-MDC line (busy)	2.7	1.6
064	MDC DP line-EAS trunk	10.7	6.5
646	MDC DP line-LAMA trunk	18.4	*9.7
066	MDC DP line-OUTCAMA trunk	16.5	*10.1
067	MDC DP line-tie DP trunk	17.8	11.4
305	MDC DP line-tie MF trunk	11.4	9.7
068	MDC DP line-tie DTMF trunk	20.0	13.7
069	MDC DP line-attendant	11.8	8.1
**072	MDC DTMF line-MDC line	10.4	5.9
935	MDC DTMF line-ineffective	2.7	1.6
351	MDC DTMF line-attendant	11.8	8.1
073	MDC DTMF line-EAS trunk	10.8	6.6
421	MDC DTMF line-MF LAMA trunk	16.8	*9.8
350	MDC DTMF line-OUTCAMA trunk	16.4	*7.7
937	MDC DTMF line-DP tie trunk	11.3	7.5
938	MDC DTMF line-DTMF tie trunk	13.8	8.5
298	MDC DTMF line-off hook queuing	28.0	16.8
299	MDC DTMF line-call back queuing	34.7	21.9
077	EBS line-ineffective	3.6	2.2
079	EBS line-EAS trunk	12.2	7.5
936	EBS line-OUTCAMA trunk	17.7	*11.2
861	EBS without display-attendant	12.2	8.6
863	EBS without display-EBS without display	12.3	7.6

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Table 8-44xxx
Canadian CPU call times-line origination (continued)

Call type	Call description	ms/call attempt SN20	SN40
876	EBS without display-MF IBNT2 trunk	14.3	9.5
053	PBX DOD-ineffective	6.8	4.7
588	PBX DP DOD-PBX DP DID	7.5	4.5

End

Table 8-45xxx
Canadian CPU call times-trunk origination

Call type	Call description	ms/call attempt SN20	SN40
671	DP trunk-RES line	6.5	4.1
024	DP trunk-ineffective	3.6	2.4
029	MF trunk-ineffective	4.7	3.0
034	MF trunk-MDC line	8.2	5.0
647	MF trunk-MDC line (busy)	6.7	4.0
704	MF trunk-RES line	8.2	4.9
035	MF trunk-EBS line	9.2	5.6
036	MF trunk-attendant-MDC line	22.0	15.2
037	DP EAS trunk-POTS line	5.3	3.3
**038	MF EAS trunk-POTS line	6.9	4.2
932	DP EAS trunk-MDC line	6.5	4.1
365	DP EAS trunk-MDC line (busy)	4.8	3.1
933	DP EAS trunk-EBS	7.5	4.9
039	DP trunk-trunk	4.3	2.7
**040	MF trunk-trunk	6.0	3.7
041	DP IT trunk-trunk	4.8	3.0
042	MF IT trunk-trunk	5.8	3.6
045	DP incoming AMA trunk-trunk	12.3	*7.7
049	MF incoming AMA trunk-trunk	12.4	*7.6
080	DP tie trunk-MDC line	10.0	6.5
931	DP tie trunk-EBS line	11.0	4.1
081	DP tie trunk-DP tie trunk	9.4	6.3

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Table 8-45xxx
Canadian CPU call times-trunk origination (continued)

Call type	Call description	ms/call attempt SN20	SN40
082	DP tie trunk-DTMF tie trunk	9.6	7.2
084	MF tie trunk-MDC line	10.0	6.4
930	MF tie trunk-EBS line	13.1	8.6
085	MF tie trunk-DP tie trunk	2.7	1.7
086	MF tie trunk-DTMF tie trunk	11.1	7.3
088	DTMF tie trunk-MDC line	12.3	7.8
090	DTMF tie trunk-DTMF tie trunk	14.3	9.5
**793	800+ trunk-trunk w/query	20.3	*11.9
SS7 trunking			
1855	DP POTS line-SS7 LAMA trunk	16.8	*9.9
657	DP POTS line-SS7 IT trunk	12.7	7.5
795	DP POTS line-SS7 TO trunk	15.1	11.9
678	DP RES line-SS7 TO trunk	17.4	10.3
748	DP RES line-SS7 IT LAMA trunk	19.0	*13.8
655	DP MDC line-SS7 IT LAMA trunk	20.3	*12.3
**1851	DT POTS line-SS7 EAS trunk	15.3	9.2
1856	DT POTS line-SS7 LAMA trunk	16.9	*9.9
747	DT POTS line-SS7 IT trunk	12.9	7.8
796	DT POTS line-SS7 TO trunk	15.5	11.9
1852	DT RES line-SS7 EAS trunk	17.5	10.3
698	DT RES line-SS7 TO trunk	17.4	10.2
749	DT RES line-SS7 IT trunk	14.6	11.5
1857	DT RES line-SS7 LAMA trunk	18.7	*11.0
1858	DT MDC line-SS7 LAMA trunk	20.4	*12.1
454	DTMF MDC line-SS7 EAS trunk	19.3	11.3
421	DTMF MDC line-SS7 TOLL trunk	16.5	9.7
1859	EBS line-SS7 LAMA trunk	21.7	*13.1
649	EBS line-SS7 TO trunk	21.0	12.6
661	EBS line-SS7 IT trunk	17.6	10.7
**654	SS7 IT trunk-POTS line	9.0	5.4
797	SS7 TI trunk-POTS line	9.1	5.5

-continued-

Table 8-45xxx
Canadian CPU call times-trunk origination (continued)

Call type	Call description	ms/call attempt SN20	SN40
672	SS7 TI trunk-RES line	9.8	5.7
604	SS7 trunk-MDC line (no answer)	8.4	5.0
656	SS7 IT trunk-DP MDC line	10.2	6.0
662	SS7 IT trunk-EBS line	11.2	6.7
1850	MF incoming AMA trunk-SS7 trunk	18.6	*11.2
658	MF PTS trunk-SS7 IT trunk	6.6	4.0
659	SS7 IT trunk-MF PTS trunk	7.6	4.9
**660	SS7 IT trunk-SS7 IT trunk	9.3	5.7
1849	SS7 TC trunk-SS7 IT trunk	9.7	5.9

End

Table 8-46xxx
Canadian CPU call timing adjustments

Call description	ms/call attempt SN20	SN40
ACD Termination (line-line;Intra-office)	32.0	**16.0D
ACD Termination (trunk-line)	32.0	**16.0D
ACD Termination Queue	16.0	**8.0D
ACD with MIS	4.2	**2.1D
UCD Termination	12.3	**6.3D
UCD Termination Queue	6.2	**3.2D
ARS	0.5	0.3D
2ND Dial Tone	0.6	0.4D
Dial Tone Detect	6.0	3.8D
SMDR	3.8	2.4D
POTS custom calling adjustments		
Assignments		
3-Way Calling	1.2	0.7
Call Waiting	1.2	0.6
Call Forward	1.5	0.9
Speed Calling	1.0	0.6

-continued-

Table 8-46xxx
Canadian CPU call timing adjustments (continued)

Call description	ms/call attempt SN20	SN40
Activations		
3-Way Calling	57.5	33.3
Call Waiting	33.3	19.0
Call Forward	1.7	1.3
Speed Calling	0.3	0.2
MDC custom calling adjustments		
Assignments		
Call Forward	0.7	0.3
Call Forward Busy	0.4	0.4
Call Forward No Answer	4.6	3.0
3-Way Calling	0.1	0.0
Call Waiting	0.2	0.0
Speed Calling	0.3	0.0
Call Transfer	0.1	0.0
Activations		
Ring Again	35.2	21.0
Call Forward	5.3	3.7
Call Forward Busy	5.4	3.7
Call Forward No Answer	14.2	8.6
3-Way Calling	45.8	27.5
Call Pick-Up	12.5	7.1
Call Waiting	42.8	24.5
Speed Calling	1.2	0.9
Message Waiting	27.0	6.8
Call Transfer	27.0	6.6
Call Management Services (CMS) custom calling adjustments		
Assignments		
Calling Number Delivery	2.2	1.2
Customer Originated Trace	1.9	.0
Automatic Call Back	0.4	0.1
Automatic Recall	2.0	1.1

-continued-

Table 8-46xxx
Canadian CPU call timing adjustments (continued)

Call description	ms/call attempt SN20	SN40
Activations		
Customer Originated Trace termination	3.9	2.4
ACB nodal origination	8.8	5.4
ACB nodal termination	11.0	6.5
ACB network origination	3.6	8.0
ACB network termination	13.1	7.8
AR nodal origination	14.9	8.8
AR nodal termination	8.7	5.2
AR network origination	13.5	8.3
AR network termination	13.2	7.9

End

Table 8-47xxx
Canadian CPU call times-TOPS/AOSS

Call type	Call description	ms/call attempt SN20	SN40
TOPS stand-alone			
092	Operator handled non-coin	40.5	29.6
093	Operator handled coin	48.4	34.1
098	Operator assisted non-coin	46.5	29.6
099	Operator assisted coin	49.4	34.3
113	0- information only	23.4	14.4
115	Non-coin ONI CAMA	26.7	19.3
117	Busy line verify	025.9	17.1
TOPS remote			
138	0- information only	22.5	14.8
140	Busy line verify	26.1	16.9
AOSS			

-continued-

Table 8-47xxx
Canadian CPU call times-TOPS/AOSS (continued)

Call type	Call description	ms/call attempt SN20	SN40
1853	AOSS trunk-AOSS position-ARU	34.1	20.1
1854	AOSS trunk-ARU	20.0	11.8

End

Table 8-48xxx
CPU call times (Japan/Turkey/Belize/China)

Call type	Call description	ms/call attempt	
Japan		**SN20**	**SN30**
1870	MF trunk (IET)-EBS ACD	23.9	15.9E
1871	MF trunk (IET)-DTMF ACD (6X33)	24.3	16.2E
1872	EBS ACD-DTMF ACD (6X33)	30.2	20.1E
1873	DTMF ACD (6X33)-DTMF ACD (6X33	26.9	17.9E
1874	DTMF ACD (6X33)-EBS ACD	30.1	20.1E
1875	MF trunk (IET)-EBS ACD	32.4	21.6E
1876	MF trunk (IET)-DTMF ACD (6X33)	31.4	20.9E
1877	EBS ACD-DTMF ACD (6X33)	38.5	25.7E
1878	DTMF ACD (6X33)-DTMF ACD (6X33)	33.7	22.5E
1879	DTMF ACD (6X33)-EBS ACD	35.1	23.4E
1880	MF trunk (IET)-MF trunk (IET)	5.2	3.5E
1881	MF trunk (IET)-TONE	4.9	3.3E
1882	PRI trunk (IBNT2)-DTMF trunk (IBNT0)	12.3	8.2E
1883	PRI trunk (IBNT2)-DP trunk (IBNT0)	10.2	6.8E
1884	DTMF trunk (IBNT1)-PRI trunk (IBNT2)	18.3	12.2E
1885	DP trunk (IBNT1)-PRI trunk (IBNT2)	15.5	10.3E
1886	DP trunk (IBNT1)-IBN7 ISUP trunK	12.9	8.6E
1887	PRI trunk (IBNT2)-IBN7 ISUP trunk	12.2	8.1E
1888	IBN7 ISUP trunk-DTMF trunk (IBNT0)	10.8	7.2E
1889	DTMF trunk (IBNT1)-IBN7 ISUP trunk	15.7	10.5E
1890	DP trunk (IBNT1)-DTMF trunk (IBNT0)	13.7	9.1E
1891	DTMF trunk (IBNT1)-DP trunk (IBNT0)	14.4	9.6E
1892	DP trunk (IBNT1)-DP trunk (IBNT0)	12.2	8.1E

-continued-

Table 8-48xxx
CPU call times (Japan/Turkey/Belize/China) (continued)

Call type	Call description	ms/call attempt	
1893	DTMF trunk (IBNT1)-DTMF trunk (IBNT0)	17.6	11.7E
1894	IBN7 ISUP trunk-DP trunk (IBNT0)	8.6	5.7E
1895	IBN7 ISUP trunk-PRI trunk (IBNT2)	13.8	9.2E
1896	PRI trunk (IBNT2)-PRI trunk (IBNT2)	13.4	8.9E
Turkey/Belize		**SN20**	**NT40/40**
742	DP line-announcement	7.3E	14.7
731	DT line-line	6.9E	13.8
732	DT line-busy tone	5.7E	11.5
743	DT line-announcement	7.4E	14.7
733	DT line-false start	2.0E	4.1
734	DT line-partial dial abandon	2.1E	4.1
735	DT line-trunk	6.5E	13.0
736	DT line-BLDN announcement	7.4E	14.8
738	Trunk-busy tone	4.6E	9.1
1019	Trunk-abandon	5.2E	10.3
China		**SN20**	**NT40/40**
831	DP line-DP line	6.9E	13.7
832	DP line-busy tone	5.8E	11.5
833	DP line-false start	2.0E	4.1
834	DP line-partial dial abandon/3 digits	2.0E	4.1
835	DT line-DT line	6.9E	13.7
836	DT line-busy tone	5.8E	11.5
837	DT line-false start	2.0E	4.1
838	DT line-partial dial abandon/3 digits	2.1E	4.1
896	DT line-C1none trunk	6.7E	13.4
1008	DT line-C1ITLL trunk	7.4E	14.8
898	C1none trunk-DT line	6.5E	13.0
895	C1none trunk-busy tone	5.2E	10.5
1039	C1none trunk-abandon	5.9E	11.8
1018	C1ITLL trunk-DT line	7.0E	14.0
1048	C1CAMA trunk-abandon	5.9E	11.8
897	C1none trunk-C1none trunk	7.0E	13.9

-continued-

Table 8-48xxx
CPU call times (Japan/Turkey/Belize/China) (continued)

Call type	Call description	ms/call attempt	
1049	C1CAMA trunk-C1ITLL trunk	6.9E	13.8
1058	C1ITLL trunk-C1none trunk	6.2E	12.5

End

Table 8-49xxx
International feature activation costs

Call description	ms/call attempt SN20	NT40/40
ABB Dialing	1.4E	2.8
Call Diversion	3.3E	6.6
Call Diversion On Busy Line	3.3E	6.6
Warm Line	1.1E	2.1
Hot Line	0.1E	0.3
3-way Calling Enquiring	16.5E	32.9
3-way Calling Conference	26.3E	52.6
6-way Calling Enquiring	16.9E	33.8
6-way Calling Conference	27.8E	55.5
6-way Calling Subsequent Conference	19.5E	39.0
Call Waiting	6.2E	12.3
Call Waiting/Reject Waiting Call	18.9E	37.8
Call Waiting/Reject Original Call	30.8E	61.7
Call Waiting/Switch Between Parties	18.2E	36.4
Call Recording	1.6E	3.1

Table 8-50xxx
International feature assignment costs

Call description	ms/call attempt SN20	NT40/40
Abnormal Dialing	0.4E	0.8
Warm Line	0.6E	1.3
Hot Line	0.4E	0.8
Call Diversion Standby	0.3E	0.6
Call Diversion Busy	0.4E	0.8
Call Waiting	0.3E	0.6
3-way Calling	0.4E	0.8
6-way Calling	0.4E	0.8

Table 8-51xxx
ISDN call times

Call type	Call description	ms/call attempt SN20	SN40
1811	BRI (SS)-POTS 1FR	16.0	14.8
1812	BRI (SS)-EBS with display	20.8	13.1
1813	EBS with display-BRI (SS)	20.0	12.4
1814	BRI (SS)-BRI (FS)	27.2	17.8
1815	BRI (SS)-PRI	22.7	18.5
1816	BRI (FS)-BRI (FS)	31.0	20.9
1817	BRI (FS)-POTS 1FR	19.3	17.8
1818	BRI (FS)-EBS with display	23.9	15.7
1819	EBS with display-BRI (FS)	23.6	15.3
1820	BRI (FS)-BRI (SS)	26.1	17.1
1821	BRI (FS)-PRI	27.8	23.1
1826	PRI-PRI	11.7	8.4
1827	PRI-POTS 1FR	10.1	6.8
1828	PRI-EBS with display	14.8	9.9
1829	EBS with display-PRI	20.1	16.7
1830	PRI-BRI (SS)	17.0	11.5
1831	PRI-BRI (FS)	20.0	14.2

-continued-

Table 8-51xxx
ISDN call times (continued)

Call type	Call description	ms/call attempt SN20	SN40
1832	BRI (SS)-SS7 trunk	24.0	18.7
1833	BRI (FS)-SS7 trunk	30.6	24.2
1834	PRI-SS7 trunk	15.5	12.4
1835	BRI (MFT)-BRI (MFT)	22.4	14.0
1836	BRI (MFT)-POTS 1FR	14.6	14.0
1837	BRI (MFT)-EBS with display	19.9	12.5
1838	EBS with display-BRI (MFT)	19.8	12.2
1839	BRI (MFT)-BRI (FS)	25.7	16.8
1840	BRI (MFT)-PRI	27.5	18.6
1841	BRI (FS)-BRI (MFT)	25.7	16.9
1842	PRI-BRI (MFT)	17.0	11.6
1843	BRI (MFT)-SS7 trunk	23.2	18.2
1844	SS7 trunk-PRI	18.0	14.3
1845	SS7 trunk-BRI (FS)	27.9	18.5
1846	SS7 trunk-BRI (MFT)	19.3	12.4
1847	BRI (SS)-BRI (MFT)	22.9	14.4

Note: BRI=Basic Rate Service
PRI=Primary Rate Interface
SS=Stimulus Signaling
FS=Functional Signaling
MFT=Meridian Feature Transparency

End

BCS 34 call times

BCS34 SuperNode call time values

This section contains SuperNode call time values for real time planning purposes as well as a series of office models that are representative of general office configurations found in the North American marketplace. Also found within this document are call times in support of the international marketplace.

Call times and models for NT40 are no longer available for the North American market. NT40 call capacities can be estimated at one-half of SuperNode 20.

SuperNode call times are measured by Bell Northern Research (BNR) in a lab environment. The hardware and software in the lab is configured to emulate realistic switch parameters. A detailed description of each U.S. call type in this document can be found in *Call Type Description Reference*, SEB 89-06-001. SuperNode call times are measured in the following configuration:

- SuperNode series 20/40 -In synchronization
- Dial tone speed recorder -Unbound
- LOGAMA -Off
- AMA tape mount -No
- Data billed to disk -Yes
- Bellcore AMA -Yes
- Universal tone receivers -Yes
- Station message detail recording -Off
- TOPS enhanced Bellcore AMA format -Phase 2
- Data Cache -On
- Cache parity -On

The call times in this document are reported in milliseconds and are considered to be within +/- 5% accuracy unless otherwise noted. The call times are categorized as actual, derived, and estimated.

Actual call times are those measured in the current BCS. times with no symbol indicate actual call times.

Derived call times are used to determine the real time cost of specific features. These call times are used as adjustments to base call types for capacity planning purposes. times followed by the letter 'D' indicate derived call times.

Estimated call times are determined by using current base measured call times along with design estimates. These estimated call times are considered to be within +/- 15% accuracy. times followed by the letter 'E' indicate estimated call times.

An asterisk (*) next to a call time indicates an AMA record is included in the time. TOPS call times within this document are measured with AMA and are thus not indicated. A double asterisk (**) next to the call type/time indicates that the call type is utilized in Version 6.4 of the REAL::TIME capacity planning tool.

The REAL::TIME capacity planning tool and call times listed in this section should be used to estimate the computing module real time impact for actual offices.

BCS34 computing module call time models

This section contains a series of office models that are representative of general office configurations in North America. These models were introduced for the first time in BCS32 and serve as a baseline for future BCS comparisons. Unlike call time models utilized in the past, these models contain significant penetrations of Custom Calling, CLASS/CMS, and Business Services found in the markets today.

North American call time models are defined as follows:

U.S.

- Suburban - Residential end office
- Urban - Business end office
- Access tandem - Tandem traffic
- TOPS access tandem - Combination of operator services and

Canada

- DMS100/POTS - Residential end office (POTS)
- DMS200 - Tandem/toll office
- DMS200/TOPS - Tandem/toll/TOPS/AOSS office
- DMS100/POTS/CMS - Residential end office (CMS)

- DMS100/POTS/MDC -Business end office (MDC/POTS)

Each call time model is configured as follows:

The base model contains the basic traffic mix of line-to-line, line-to-trunk, trunk-to-line, and trunk-to-trunk call types. To provide base traffic mixes that are representative of today's market, a thorough analysis of actual field office mixes was accomplished.

The feature model reflects feature penetrations to the base model. Feature adjustment costs are applied to the base model as necessary. The actual feature mix utilized with each model was determined through studies conducted on various field offices.

The model summary provides the maximum call rate possible for each processor type through SuperNode 40. The average work time in milliseconds for each processor is also provided.

Actual office BCS impact for a specific traffic mix can be estimated by using the REAL::TIME capacity planning tool.

The SuperNode has a maximum of 86 percent of real time available for call processing. This percentage is adjusted when necessary to allow for average work time (AWT). Tables 9-26 through 9-28 illustrate the percent adjustment needed at various levels of AWT for each series of processor. As an example, in the urban model an AWT of 23.4ms (SN20) equates to a 1.5 percent adjustment to the maximum call processing of 86 percent.

Table 9-1xxx
U.S. CM call times-suburban base model

Call type	Call description	Mix %	SN20 weighted ms/call attempt Call	Time
994	POTS 1FR-POTS 1FR	19.3	9.3	1.795
995	POTS 1FR-EAS trunk (MF)	12.0	7.8	0.936
402	POTS 1FR-toll trunk (MF)	2.4	17.0	0.408
577	POTS 1FR-EAS trunk (SS7)	12.0	10.4	1.248
1226	POTS 1FR-toll trunk (SS7/FGD)	2.4	18.5	0.444
996	MF trunk-POTS 1FR	12.8	6.9	0.883
580	SS7 trunk-POTS 1FR	12.8	9.1	1.165
014	Line ineffective	18.0	2.4	0.432
946	Trunk ineffective	3.0	2.7	0.081
993	Partial dial	5.3	3.6	0.191
			Base	AWT=7.583

Table 9-2xxx
U.S. CM call times-suburban feature model

Call description	Mix %	BCS34 SN20 weighted ms/call attempt Call	Time
POTS Custom Calling/originating	4.8	0.0	0.000
POTS Custom Calling/terminating	4.5	0.3	0.013
Call Waiting/terminating	1.7	50.5	0.862
3-way Calling/originating	1.0	67.4	0.648
Call Forward/terminating	1.3	3.1	0.042
Speed Calling/originating	1.0	-0.4	-0.004
RES CLASS/originating	4.8	1.9	0.091
RES CLASS/terminating	4.5	3.9	0.175
ACB Nodal Delayed/originating	0.5	57.0	0.264
ACB Network Delayed/originating	0.7	86.6	0.565
Customer Originated Trace/terminating	1.1	14.6	0.157
AR Nodal Immediate/terminating	0.7	6.9	0.045
AR Network Immediate/terminating	0.9	10.3	0.095
Calling Number Delivery Block/originating	1.4	4.7	0.068
Selective Call Forward/terminating	1.1	8.8	0.095
SMDI/terminating	0.3	16.1	0.043
		Feature	AWT=3.161
		Model	AWT=10.744

Table 9-3xxx
U.S. suburban model busy hour call rate summary

SN20	SN30	SN40
288,000	432,000	490,000
Note: SN20-40 call processing=86%		

Table 9-4xxx
U.S. CM call times-urban base model

Call type	Call description	Mix %	BCS34 SN20 weighted ms/call attempt Call	Time
888	MDC line-MDC line	17.1	9.0	1.539
889	MDC line-EAS trunk (MF)	11.1	9.7	1.077
883	MDC line-toll trunk (MF/FGD)	6.5	17.8	1.157
578	MDC line-EAS trunk (SS7)	11.1	12.9	1.432
1228	MDC line-toll trunk (SS7/FGD)	6.5	19.9	1.294
854	MF trunk-MDC Line	17.5	6.7	1.173
581	SS7 trunk-MDC Line	17.5	9.2	1.610
805	Line ineffective	7.2	2.7	0.194
946	Trunk ineffective	3.0	2.7	0.081
858	Partial dial	2.5	7.6	0.190
			Base AWT=9.746	

Table 9-5xxx
U.S. CM call times-urban feature model

Call description	Mix %	BCS34 SN20 weighted ms/call attempt Call	Time
MDC Custom Calling/originating	26.2	0.0	0.000
MDC Custom Calling/terminating	26.1	5.2	1.355
Call Waiting/terminating	1.0	45.4	0.473
3-way Calling/originating	5.2	49.0	2.563
Speed Calling/originating	1.0	2.0	0.021
Call Forward No Answer/terminating	15.6	14.3	2.235
Ring Again/originating	1.0	44.6	0.467
Call Pick-up/terminating	5.2	19.4	1.011
Call Hold/originating	1.0	63.9	0.668
Call Transfer/terminating	5.2	27.9	1.454
MDC CLASS/originating	2.6	1.9	0.050
MDC CLASS/terminating	2.6	3.9	0.102
ACB Nodal/originating	0.3	57.0	0.195
ACB Network/originating	0.7	86.6	0.608

-continued-

Table 9-5xxx
U.S. CM call times-urban feature model (continued)

Call description	Mix %	BCS34 SN20 weighted ms/call attempt Call	Time
Customer Originated Trace/terminating	0.2	14.6	0.025
AR Nodal/terminating	0.6	6.9	0.040
AR Network/terminating	1.2	10.3	0.123
Calling Number Delivery Block/originating	1.0	4.7	0.049
Selective Call Forward/terminating	0.5	8.8	0.046
SMDI/terminating	5.2	16.1	0.839
MADN/originating	5.2	5.8	0.303
MADN/terminating	5.2	16.3	0.849
EBS With display/originating	5.2	0.0	0.000
EBS With display/terminating	5.2	3.4	0.177
		Feature AWT=13.651	
		Model AWT=23.397	

End

Table 9-6xxx
U.S. urban model busy hour call rate summary

SN20	SN30	SN40
130,000	195,000	221,000

Note: SN20-40 call processing=84.5%

Table 9-7xxx
U.S. CM call times-access tandem model

Call type	Call description	Mix %	BCS34 SN20 weighted ms/call attempt Call	Time
998	MF IT trunk-MF IT trunk	23.0	7.7	1.771
1232	SS7 IT trunk-SS7 ATC trunk	60.0	11.4	6.840
1230	MF IT trunk-SS7 ATC trunk	5.0	11.0	0.550
1231	SS7 IT trunk-MF ATC trunk	5.0	9.9	0.495
1233	E800 SS7 trunk-MF trunk	3.0	19.7	0.591
1234	E800 SS7 trunk-SS7 trunk	4.0	21.4	0.856
			Model AWT=11.103	

Table 9-8xxx
U.S. access tandem model busy hour call rate summary

SN20	SN30	SN40
279,000	418,000	474,000

Note: SN20-40 call processing=86.0%

Table 9-9xxx
U.S. CM call times-TOPS SA/HOC/DA/AT model

Call type	Call description	Mix %	BCS34 SN20 weighted ms/call attempt Call	Time
824	SA MCCS	11.0	42.3	4.653
1178	SA AABS CCN 0+	10.0	43.8	4.380
326	SA ACTS	10.0	35.8	3.580
1151	SA 411 external ARU	9.0	36.8	3.312
1163	SA intercept external ARU	3.0	18.8	0.564
1149	HOC 411 external ARU	7.0	15.6	1.092
1128	HOC NCN 0-	10.5	21.6	2.268
1137	HOC CN 0+	4.6	22.8	1.049
1130	SA NCN 0-	14.7	37.4	5.498

-continued-

Table 9-9xxx
U.S. CM call times-TOPS SA/HOC/DA/AT model (continued)

Call type	Call description	Mix %	BCS34 SN20 weighted ms/call attempt Call	Time
1139	SA CN 0+	6.2	50.4	3.125
1232	SS7 trunk-SS7 trunk	8.0	11.4	0.912
998	MF trunk-MF trunk	6.0	7.7	0.462
			Model AWT=30,894	

End

Table 9-10xxx
U.S. TOPS SA/HOC/DA/AT model busy hour call rate summary

SN20	SN30	SN40
98,000	148,000	167,000

Note: SN20-40 call processing=84.5%

Table 9-11xxx
U.S. CM call times-TOPS ROC/DA/AT model

Call type	Call description		Mix %	BCS34 SN20 weighted ms/call attempt Call	Time
724	ROC MCCS		9.0	42.3	3.807
1177	ROC AABS CCN 0+		8.0	43.8	3.504
503	ROC ACTS		8.0	35.8	2.864
1150	ROC 411 external ARU		12.0	37.3	4.476
1162	ROC intercept externaL ARU		3.0	18.8	0.564
1129	ROC NCN 0-		10.4	40.5	4.212
1138	ROC CN 0+		4.6	53.3	2.452
1232	SS7 trunk-SS7 trunk		25.0	11.4	2.850
1234	E800 SS7-SS7 trunk		4.0	10.3	2.575
998	MF trunk-MF trunk		16.0	7.7	1.232
				Model AWT	= 26.809
Selective Call Ac-ceptance		**3.9D	**3.9D	**3.9D	**3.9 D

Table 9-12xxx
U.S. TOPS ROC/DA/AT model busy hour call rate summary

SN20	SN30	SN40
113,000	170,000	193,000

Note: SN20-SN40 call processing=84.5%

Table 9-13xxx
Canadian CM call times-DMS-100 POTS base model

Call type	Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
657	POTS/DP-EAS trunk (SS7)	8.00	17.4	1.39	11.1	0.89
1851	POTS/DT-EAS trunk (SS7)	30.19	19.9	6.00	11.4	3.45
001	POTS/DP-ineffective	1.64	2.1	0.03	1.3	0.02
008	POTS/DT-ineffective	6.63	2.1	0.14	1.3	0.08
1855	POTS/DP-toll trunk (SS7)	0.78	17.2	0.13	10.4	0.08
1856	POTS/DT-toll trunk (SS7)	5.11	17.3	0.89	10.5	0.53
002	POTS/DP-POTS line	0.81	7.0	0.06	4.1	0.03
009	POTS/DT-POTS line	3.61	7.1	0.26	4.2	0.15
038	EAS trunk (MF)-POTS line	3.63	6.9	0.25	4.1	0.15
654	EAS trunk (SS7)-POTS line	32.62	9.2	3.00	5.4	1.76
029	EAS trunk (MF)-ineffective	0.10	4.7	0.00	2.9	0.00
604	EAS trunk (SS7)-ineffective	0.42	8.4	0.04	5.0	0.02
658	EAS trunk (MF)-EAS trunk (SS7)	0.65	7.0	0.05	4.3	0.03
660	EAS trunk (SS7)-EAS trunk (SS7)	5.81	9.8	0.57	6.1	0.35
			Base AWT=12.78			7.56

Table 9-14xxx
Canadian CM call times-DMS-100 POTS feature model

Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
3-way Calling/assigned	0.60	1.2	0.01	0.6	0.00
Call Waiting/assigned	19.33	1.2	0.23	0.6	0.12
Call Forward/assigned	4.54	1.4	0.06	0.8	0.04
Speed Calling/assigned	0.60	1.0	0.01	0.5	0.00
3-way Calling/activated	0.01	61.7	0.01	37.4	0.00
Call Waiting/activated	0.74	35.4	0.26	20.7	0.15
Call Forward/activated	1.39	1.9	0.03	1.4	0.02
Speed Calling/activated	0.05	0.2	0.00	0.3	0.00
		Feature AWT=0.60			0.35
		Model AWT=13.38			7.91

Table 9-15xxx
Canadian DMS-100 POTS model busy hour call rate summary

SN20	SN30	SN40
229,000	343,000	387,000

Note: SN20-SN40 call processing=85.0%

Table 9-16xxx
Canadian CM call times-DMS-200 toll(DDD/non-TOPS/non-AOSS model

Call type	Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
1850	INCAMA trunk (MF)-SS7 trunk	13.00	15.1	1.96	8.7	1.13
660	SS7 trunk (IT)-SS7 trunk (IT)	57.26	9.8	5.60	6.1	3.48
1849	SS7 trunk (TC)-SS7 trunk (IT)	24.54	9.8	2.41	6.1	1.50
793	800+ trunk-database query-trunk	3.20	21.0	0.67	12.4	0.40
029	EAS trunk (MF)-ineffective	2.00	4.7	0.09	2.9	0.06
			Model AWT=10.74			6.56

Table 9-17xxx
Canadian DMS-200 toll model busy hour call rate summary

SN20	SN30	SN40
288,000	432,000	472,000

Note: SN20-SN40 call processing=86.0%

Table 9-18xxx
Canadian CM call times-DMS-200 toll/TOPS (DDD/TOPS/AOSS) model0

Call type	Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
1850	INCAMA trunk (MF)-SS7 trunk	9.30	15.1	1.40	8.7	0.81
660	SS7 trunk (IT)-SS7 trunk (IT)	33.39	9.8	3.27	6.1	2.03
1849	SS7 trunk (TC)-SS7 trunk (IT)	14.31	9.8	1.41	6.1	0.87
793	800+ trunk-data base query-trunk	6.00	21.0	1.26	12.4	0.74
092	Stand-alone operator handled non-coin	3.00	41.5	1.24	24.4	0.73
093	Stand-alone operator handled coin	0.90	49.7	0.45	31.0	0.28
098	Stand-alone operator assisted non-coin	3.60	41.6	1.50	24.5	0.88
099	Stand-alone operator assisted coin	0.90	50.1	0.45	31.3	0.28
115	Stand-alone non-coin ONI (CAMA)	3.60	26.7	0.96	16.1	0.58
1853	AOSS	12.00	36.8	4.42	21.7	2.60
185	AOSS verify	4.00	18.8	0.75	11.1	0.44
784	ACCS service control point query	2.50	16.0	0.40	9.4	0.24
787	BNS collect call	1.25	21.8	0.27	12.9	0.16
791	BNS bill to 3rd party	1.25	46.9	0.59	27.6	0.34
029	EAS trunk (MF)-ineffective	4.00	4.7	0.19	2.9	0.12
			Model AWT=18.55			11.11

Table 9-19xxx
Canadian DMS-200 toll model busy hour call rate summary

SN20	SN30	SN40
165,000	247,000	275,000

Note: SN20-SN40 call processing=85.0%

Table 9-20xxx
Canadian CM call times-DMS-100 POTS/CMS base model

Call type	Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
657	POTS/DP-EAS trunk (SS7)	6.00	17.4	1.04	11.1	0.67
1851	POTS/DT-EAS trunk (SS7)	22.64	19.9	4.49	11.4	2.59
1852	RES/DT-EAS trunk (SS7)	9.55	22.8	2.18	13.2	1.26
001	POTS/DP-ineffective	1.23	2.1	0.03	1.3	0.02
008	POTS/DT-ineffective	4.79	2.1	0.10	1.3	0.06
674	RES/DT-ineffective	2.07	2.6	0.05	1.5	0.03
1855	POTS/DP-toll trunk (SS7)	0.59	17.2	0.10	10.4	0.06
1856	POTS/DT-toll trunk (SS7)	3.83	17.3	0.66	10.5	0.40
1857	RES/DT-toll trunk (SS7)	1.47	19.3	0.28	11.6	0.17
002	POTS/DP-POTS line	0.61	7.0	0.04	4.1	0.03
009	POTS/DT-POTS line	2.71	7.1	0.19	4.2	0.11
1182	RES/DT-RES/DT	1.21	9.9	0.12	4.9	0.06
038	EAS trunk (MF)-POTS line	2.72	6.9	0.19	4.1	0.11
654	EAS trunk (SS7)-POTS line	24.51	9.2	2.24	5.4	1.32
704	EAS trunk (MF)-RES Line	0.97	8.1	0.08	4.8	0.05
672	EAS trunk (SS7)-RES Line	8.17	9.9	0.81	5.8	0.47
029	EAS trunk (MF)-ineffective	0.05	4.7	0.00	2.9	0.00
604	EAS trunk (SS7)-ineffective	0.42	8.4	0.04	5.0	0.02
658	EAS trunk (MF)-EAS trunk (SS7)	0.65	7.0	0.05	4.3	0.03
660	EAS trunk (SS7)-EAS trunk (SS7)	5.81	9.8	0.57	6.1	0.35
			Base AWT =	13.26		7.81

Table 9-21xxx
Canadian CM call times-DMS-100 POTS/CMS feature model

Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
3-way Calling/assigned	0.60	1.2	0.01	0.6	0.00
Call Waiting/assigned	19.33	1.2	0.23	0.6	0.12
Call Forward/assigned	4.54	1.4	0.06	0.8	0.04
Speed Calling/assigned	0.60	1.0	0.01	0.5	0.00
3-way Calling/activated	0.01	61.7	0.01	37.4	0.00
Call Waiting/activated	0.74	35.4	0.26	20.7	0.15
Call Forward/activated	1.39	1.9	0.03	1.4	0.02
Speed Calling/activated	0.05	0.2	0.00	0.3	0.00
Calling Number Delivery/assigned	9.60	2.2	0.21	2.0	0.19
Customer Originated Call Trace/assigned	2.00	2.1	0.04	1.9	0.04
Auto Call Back/assigned	4.32	0.5	0.02	1.1	0.05
Auto Recall/assigned	3.60	1.9	0.07	1.9	0.07
Customer Originated Trace/activated	0.12	5.1	0.01	3.9	0.00
Auto Call Back Nodal originating/activated	0.02	9.3	0.00	6.7	0.00
Auto Call Back Nodal terminating/activated	0.02	11.8	0.00	8.1	0.00
Auto Call Back Network originating/activated	0.79	14.6	0.12	9.8	0.08
Auto Call Back Network terminating/activated	0.65	14.2	0.09	9.5	0.06
Auto Recall Network originating/activated	0.04	14.6	0.01	10.0	0.00
Auto Recall Network terminating/activated	0.03	14.2	0.00	9.5	0.00
		Feature AWT=1.17			0.84
		Model AWT=14.4			8.65

Table 9-22xxx
Canadian DMS-100 POTS/CMS model busy hour call rate summary

SN20	SN30	SN40
213,000	319,000	354,000

Note: SN20-SN40 call processing=85.0%

Table 9-23xxx
Canadian CM call times-DMS-100 POTS/centrex base model

Call type	Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
1851	POTS/DT-EAS trunk (SS7)	9.38	19.9	1.86	11.4	1.07
001	POTS/DP-ineffective	1.01	2.1	0.02	1.3	0.01
008	POTS/DT-ineffective	1.99	2.1	0.04	1.3	0.03
1855	POTS/DP-toll trunk (SS7)	0.67	17.2	0.12	10.4	0.07
1856	POTS/DT-toll trunk (SS7)	1.06	17.3	0.18	10.5	0.11
002	POTS/DP-POTS line	1.23	7.0	0.09	4.1	0.05
009	POTS/DT-POTS line	2.08	7.1	0.15	4.2	0.09
038	EAS trunk (MF)-POTS line	6.85	6.9	0.47	4.1	0.28
654	EAS trunk (SS7)-POTS line	22.89	9.2	2.09	5.4	1.23
029	EAS trunk (MF)-ineffective	0.26	4.7	0.01	2.9	0.01
604	EAS trunk (SS7)-ineffective	0.25	8.4	0.02	5.0	0.01
040	EAS trunk (MF)-EAS trunk	1.09	5.9	0.06	3.7	0.04
660	EAS trunk (SS7)-EAS trunk (SS7)	0.41	9.8	0.04	6.1	0.02
454	IBN/DT-EAS trunk (SS7)	8.35	23.8	1.99	14.3	1.19
661	P-Phone-EAS trunk (SS7)	2.04	22.4	0.46	13.6	0.28
938	IBN/DT-tie trunk (DTMF)	2.15	13.0	0.28	7.4	0.16
876	P-Phone-tie trunk (DTMF)	0.48	14.9	0.07	9.2	0.04
935	IBN/DT-ineffective	2.66	2.7	0.07	1.5	0.04
077	P-Phone-ineffective	0.62	3.6	0.02	2.2	0.01
072	IBN/DT-IBN line	5.14	10.2	0.53	6.0	0.31
863	P-Phone-IBN line	1.13	12.7	0.14	7.6	0.09
1858	IBN/DT-toll trunk (SS7)	1.60	21.2	0.34	12.7	0.20
1859	P-Phone-toll trunk (SS7)	0.39	22.3	0.09	13.6	0.05
656	SS7 trunk (IT)-IBN line	16.52	10.2	1.69	6.0	0.99
662	SS7 trunk (IT)-P-Phone line	2.93	11.4	0.33	6.8	0.20
084	TIE trunk (MF)-IBN line	1.18	10.0	0.12	6.4	0.08
930	TIE trunk (MF)-P-Phone line	0.24	13.2	0.03	8.5	0.02
086	TIE trunk (MF)-tie trunk (DTMF)	1.13	10.1	0.11	6.9	0.08
			Base AWT =	12.18		7.25

Table 9-24xxx
Canadian CM call times-DMS-100 POTS/centrex feature model

Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
POTS					
3-way Calling/assigned	0.13	1.2	0.00	0.6	0.00
Call Waiting/assigned	1.38	1.2	0.02	0.6	0.01
Call Forward/assigned	1.48	1.4	0.02	0.8	0.01
Speed Calling/assigned	0.06	1.0	0.00	0.5	0.00
Call Waiting/activated	0.02	35.4	0.01	20.7	0.00
Call Forward/activated	0.15	1.9	0.00	1.4	0.00
Centrex					
Call Forward/assigned	29.93	0.6	0.18	0.4	0.13
Call Forward Busy/assigned	11.31	0.7	0.08	0.5	0.05
Call Forward No Answer/assigned	16.19	5.1	0.83	3.0	0.49
3-way Calling/assigned	59.15	0.0	0.00	0.0	0.00
Call Waiting/assigned	3.21	0.1	0.00	0.0	0.00
Speed Calling/assigned	2.48	0.2	0.00	0.0	0.00
Call Transfer/assigned	59.15	0.0	0.00	0.0	0.00
Ring Again/activated	0.06	37.9	0.02	23.0	0.01
Call Forward/activated	3.23	5.7	0.19	4.0	0.13
Call Forward Busy/activated	2.48	6.0	0.15	4.2	0.10
Call Forward No Answer/activated	2.88	15.5	0.45	9.7	0.28
3-way Calling/activated	1.95	60.5	1.18	34.4	0.67
Call Pick-up/activated	1.36	14.5	0.20	8.4	0.11
Call Waiting/activated	0.42	46.4	0.19	27.1	0.11
Speed Calling/activated	0.41	1.3	0.01	1.0	0.00
Message Waiting/activated	0.18	30.4	0.06	16.2	0.03
Call Transfer/activated	1.42	29.7	0.42	18.4	0.26
Auto Route Selection/activated	5.75	0.5	0.03	0.5	0.03
Second Dial Tone/activated	3.76	0.6	0.02	0.6	0.02
Dial Tone Detect/activated	3.76	6.0	0.23	6.0	0.23
SMDR/activated	7.17	3.9	0.28	2.5	0.18
		Feature AWT =	4.56		2.88
		Model AWT =	16.74		10.13

Table 9-25xxx
Canadian DMS-100 POTS/centrex model busy hour call rate summary

SN20	SN30	SN40
183,000	274,000	302,000
Note: SN20-SN40 call processing=85.0%		

Table 9-26xxx
SuperNode 20 average work time (AWT) adjustments (20.0% GOS)

AWT (average ms)	Call processing adjustments
< 12.6 ms	0.0 percent
12.6 ms to 20.0 ms	1.0 percent
> 20.0 ms	1.5 percent

Table 9-27xxx
SuperNode 30 average work time (AWT) adjustments (20.0% GOS)

AWT (average ms)	Call processing adjustments
< 8.7 ms	0.0 percent
8.7 ms to 13.3 ms	1.0 percent
> 13.3 ms	1.5 percent

Table 9-28xxx
SuperNode 40 average work time (AWT) adjustments (20.0% GOS)

AWT (average ms)	Call processing adjustments
< 7.2 ms	0.0 percent
7.2 ms to 11.1 ms	1.0 percent
> 11.1 ms	1.5 percent

Table 9-29xxx
Canadian CM call times-line origination model

Call type	Call description	ms/call attempt SN20
947	POTS DP 1FR-POTS DTMF 1FR line	9.4
005	POTS DP 1FR-LAMA trunk	*12.3
**014	POTS DTMF 1FR line-false start	2.4
**994	POTS DTMF 1FR line-POTS 1FR line	9.3
015	POTS DTMF 1MR line-POTS 1FR line	*12.9
859	POTS DTMF 1FR line-MDC DTMF line	9.5
1059	POTS DTMF 1FR line-EBS with display	13.6
1236	POTS DTMF 1FR line-MADN primary	17.0
**995	POTS DTMF 1FR line-EAS trunk	7.8
**016	POTS DTMF 1MR line-EAS trunk	*12.2
3031	POTS DTMF 1FR line with LPIC-ATC trunk	*16.6
**378	FGC 1+10 digits-AT (PIC)	*14.9
401	1+7 digits-IC (OCS ON,PIC)	*17.3
**402	1+10 digits-AT (OCS ON,PIC)	*17.4
974	POTS DTMF 1MR line-AT to IC FGD trunk	*17.5
949	POTS DTMF 1FR line-operator trunk	11.2
308	POTS DTMF 1MR line-busy	8.1
993	POTS DTMF 1FR line-abandon/6 digits	3.6
**948	POTS DTMF 1FR line-busy DTMF 1FR	7.8
967	POTS DTMF 1FR line-MF operator trunk	11.4
963	POTS DTMF 1FR line-MF PBX DID trunk	8.3
**966	POTS DTMF 1FR line-BLDN announcement	9.2
**019	Coin DTMF-POTS 1FR line	*16.5
020	Coin DTMF-EAS trunk	*14.5
910	FGB coin DTMF-AT MF	14.7
954	Coin DTMF-direct to IC FGD	*22.0
982	Coin DTMF-operator trunk	15.8
908	Coin DTMF-trunk (1+800)	*17.0
018	Coin DTMF-busy	11.0
054	PBX DOD trunk-POTS 1FR line	9.0
055	PBX DOD trunk-LAMA trunk	*11.1

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Table 9-29xxx
Canadian CM call times-line origination model (continued)

Call type	Call description	ms/call attempt SN20
9154	FGB DTMF PBX DOD-AT MF trunk	9.9
917	FGD DTMF PBX DOD-AT MF trunk	*16.4
988	OUTWATS-direct to IC FGB trunk	*14.6
918	FGC DTMF OUTWATS-AT MF trunk	*15.1
989	OUTWATS-direct to IC FGD	*16.5
309	OUTWATS (enhanced)-ATC trunk	*17.0
899	MDC OUTWATS (enhanced)-ATC trunk	24.3
805	MDC DTMF-false start	2.7
**888	MDC DTMF-MDC line	9.0
1109	MDC DTMF (w/SMDR)-MDC line	14.1
889	MDC DTMF-EAS trunk	9.7
882	FGC DTMF MDC-AT MF	*16.0
883	FGD DTMF MDC-AT MF	*17.8
884	DTMF MDC intraLATA-MF toll trunk	*13.4
886	E800 EAEO DTMF MDC-IC trunk	*25.8
873	MDC DTMF-EBS without display	10.1
**1199	MDC DTMF-EBS with display	12.4
1224	MDC DTMF-EBS with display MADN (3 secondary members)	26.9
**1239	MDC DTMF-EBS with display MADN (4 secondary members)	28.7
874	MDC DTMF-MDC MF trunk	*14.0
**857	MDC DTMF 2ND DT-POTS 1FR	10.4
858	MDC DTMF-abandon after 2 digits	7.6
850	AttendanT-MDC DTMF line (SCG)	13.0
891	EBS with display-EBS with display	13.8
892	EBS with display-EAS trunk	11.1
893	EBS with display-LAMA trunk	*14.6
863	EBS without display-EBS without display	11.2
894	EBS with display-EBS without display	11.4
885	EBS with display FGD-AT MF	*19.4

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Table 9-29xxx
Canadian CM call times-line origination model (continued)

Call type	Call description	ms/call attempt SN20
875	EBS without display-DTMF FX trunk	10.4
862	EBS without display-MDC DTMF line (SCG)	10.0
**861	EBS without display-attendant	11.4
**1198	EBS with display-MDC line	10.2
**1238	EBS with display MADN	
	(4 secondary members)-MDC line	16.0
	Datapath-Line	17.8E
	Datapath-Non-LAMA(EAS)	18.4E
	Datapath-LAMA	27.5E

End

Table 9-30xxx
U.S. CM call times-call types with custom calling/CLASS/SMDI features model

POTS Custom Calling Features (CCF)

3-way Calling (3WC)
Call Waiting (CWT)
Speed Calling (SC1)
Call Forward (CFW)
Teen Service

Call type	Call description	ms/call attempt SN20
1065	1FR (all CCF assigned)-1FR line	9.3
1066	1FR line (3WC activated)-1FR line	*90.4
1067	1FR line (SC1 activated)-1FR line	8.9
1070	1FR line-1FR line (CFU assigned)	9.6
1072	1FR line-1FR line (all CCF assigned)	9.6
1073	1FR line-1FR line (CFU activated)	12.7
1074	1FR line-1FR line (CWT activated)	*74.1
1105	1FR line-1FR line (3WC,SC1,CWT assigned)	9.4

-continued-

Table 9-30xxx
U.S. CM call times-call types with custom calling/CLASS/SMDI features model (continued)

1225	1FR line-1FR line (Teen Service activated)	9.5
MDS custom ca;;ing features (CCF)		
3-way Calling (3WC)		
Call Waiting (CWT)		
Speed Calling Short List (SC1)		
Speed Calling Long List (SC2)		
Call Forward Busy (CFB)		
Call Forward Universal (CFU)		
Call Forward Don't Answer (CFD)		
Call Transfer (CXR)		
Call Hold (CH)		
Ring Again (RA)		
Call Pick-up (CPU)		
Call type	**Call description**	**ms/call attempt SN20**
1085	MDC line (all CCF assigned)-MDC line	8.9
1086	MDC line (3WC activated)-MDC line	*72.5
1087	MDC line (SC1 activated)-MDC line	10.9
1088	MDC line (SC2 activated)-MDC line	11.0
1089	MDC line (CH activated)-MDC line	*77.2
1107	MDC line (RA activated)-MDC line	53.6
1092	MDC line-MDC line (CFU assigned)	9.5
1095	MDC line-MDC line (CFB assigned)	9.5
1096	MDC line-MDC line (CFD assigned)	13.9
1099	MDC line-MDC line (ALL CCF assigned)	14.2
1100	MDC line-MDC line (CFU activated)	14.0
1101	MDC line-MDC line (CWT activated)	*79.5
1102	MDC line-MDC line (CFB activated)	14.1
1103	MDC line-MDC line (CFD activated)	28.2
1104	MDC line-MDC line (CXR activated)	56.7*
1106	MDC line-MDC line (3WC,SC1,CWT,SC2,CH,CXR, ASGN)	8.9
1108	MDC line-MDC line (CPU activated)	31.0
RES custom local area signaling services (CLASS)		

-continued-

Table 9-30xxx
U.S. CM call times-call types with custom calling/CLASS/SMDI features model (continued)

Automatic Call Back (ACB)
Automatic Recall (AR)
Calling Number Delivery (CND)
Calling Number Delivery Blocking (CNDB)
Selective Call Rejection (SCRJ)
Customer Originated Trace (COT)
Usage Sensitive Billing (USB)
Selective Call Forward (SCFWD)
Selective Call Acceptance (SCA)
Distinctive Ring (DR)

Call type	Call description	ms/call attempt SN20
3033	RES-RES	10.8
3034	RES coin-RES	13.9
1205	RES-RES (ACB,AR,CND,COT assigned originating/terminating)	13.4
1258	RES (ACB,AR,COT,CND assigned)-RES	11.2
1259	RES-RES (ACB,AR,COT,CND assigned)	13.2
1206	RES (ACB intra-nodal activated)-RES	68.2
1207	RES-RES (AR intra-nodal activated)	20.1
1208	RES (ACB network ACT)-SS7-RES	109.4
1209	RES-SS7-RES (AR network ACT)	33.0
1210	RES-RES (SCRJ activated)	*22.8
1211	RES-RES (SCFWD activated)	*31.5
1212	RES-RES (SCA activated)	*26.6
1213	RES-RES (DR activated)	*26.6
1214	RES-RES (COT activated)	14.6
1215	RES (CNDB activated-RES)	15.9
1217	1FR line-RES (CNAMD activated)	*34.4
1218	1FR line-RES (CND activated)	*24.8
3032	1FR line-RES (SCWID activated)	62.3
3030	SS7 EAS trunk-RES (BCLID activated)	10.4
RES simplified message desk interface (SMDI)		

-continued-

Table 9-30xxx
U.S. CM call times-call types with custom calling/CLASS/SMDI features model

SMDI Call Forward Busy (CFB)
SMDI Call Forward Don't Answer (CFD)
SMDI Call Forward Always (CFA)

Call type	Call description	ms/call attempt SN20
1220	RES-SMDI (direct)	29.5
1221	1FR line-RES (SMDI-CFB)	35.0
1222	1FR line-RES (SMDI CFD)	46.5
1223	1FR line-RES (SMDI-CFA)	33.6

End

Table 9-31xxx
U.S. CM call times-incoming trunk origination model

Call type	Call description	ms/call attempt SN20
**997	MF tandem INCAMA trunk-MF tandem trunk	4.6
**996	MF trunk-POTS 1FR line	6.9
**998	MF IT trunk-IT trunk	6.4
453	MF IC trunk-POTS 1FR line	*11.5
**999	MF trunk-busy	*9.6
031	MF trunk-INWATS line	*12.9
879	MF trunk-EBS without display	7.3
946	MF trunk-abandon (no start signal)	2.7
854	MF POTS trunk-MDC DTMF line	6.7
046	MF INCAMA trunk-POTS 1FR line	*11.0
048	MF INCAMA trunk-trunk	*9.2
456	IC carrier trunk-IT trunk	*9.7
991	IC trunk-MF PBX DID (PX)	*10.6
455	IT trunk-IC carrier trunk	6.3
919	FGC LEAS MF incoming trunk-IC trunk	*15.5
920	FGD LEAS MF incoming trunk-IC trunk	*16.7

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Table 9-31xxx
U.S. CM call times-incoming trunk origination model (continued)

Call type	Call description	ms/call attempt SN20
921	LEAS MF incoming trunk-tandem MF IT	*16.8
855	MDC MF trunk-MDC DTMF line	7.6
856	MDC DTMF FX trunk-MDC DTMF line (SCG)	10.4
868	MDC MF trunk-attendant	9.2
958	MF PX DOD trunk-DIG(PX)-direct to IC	*17.3
959	MF PX DOD trunk-DIG-VIA AT TO IC	*15.3
961	MF PX DOD trunk-DIG-MF EAS trunk	8.3
986	DTMF PBX DOD (FX) trunk-operator trunk	10.4
987	MF PBX DOD trunk-operator trunk	10.0
E911 trunking		
1201	FX trunk-E911 tandem	31.1
1202	E911 trunk-E911 tandem PSAP QRY	29.8
1203	E911 trunk-PSAP line without RIGHOLD	*17.8
1204	E911 trunk-PSAP line with SBT-LDTPSAP	90.2
SS7 trunking		
**577	DTMF POTS line-SS7 trunk EAS	10.4
1226	DTMF POTS line-SS7 trunk toll	*18.5
578	DTMF MDC line-SS7 trunk EAS	11.6
1228	DTMF MDC line-SS7 trunk toll	*19.9
**1219	DTMF MDC line (with SMDR)-SS7 trunk	14.9
579	DTMF POTS line-SS7 trunk EAS	*13.9
**580	SS7 trunk-DTMF POTS line	9.1
581	SS7 trunk-DTMF MDC line	9.2
1230	FGD MF trunk-SS7 trunk	9.7
1231	FGD SS7 trunk-MF trunk	9.9
**1232	FGD SS7 trunk-SS7 trunk	11.4
1233	FGD E800 SS7 trunk-MF trunk (database query)	19.7
1234	FGD E800 SS7 trunk-SS7 trunk (database query)	21.4
1235	FGB SS7 trunk-MF trunk	7.7
800 trunking		
922	E800 DTMF 1FR-IC (database query)	*24.8

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Table 9-31xxx
U.S. CM call times-incoming trunk origination model (continued)

Call type	Call description	ms/call attempt SN20
924	E800 AT-IC (database query)	*22.4
928	E800 EAEO DTMF 1FR-AT (database query)	*25.5
**929	E800 AT-IT (database query)	*20.5

End

Table 9-32xxx
U.S. CM call time adjustments

Call description	ms/call attempt SN20
AMA	**4.4D
Originating MADN (1 primary/4 secondary Members)	**5.8D
Terminating MADN (1 primary/4 secondary Members)	**16.3D
SMDR	**3.3D
MDC attendant console termination	**1.1D
MDC attendant console origination	3.0D
UTR	**-1.3D
Alternate routing	.6D
Virtual facility group	.8D
Hunt group	1.0D
Permanent signal	10.9D
EBS (P-Phone) with display	**3.4D
ACD termination (line-line intraoffice)	**16.8D
ACD termination (trunk-line)	**12.3D
ACD termination queue	**8.2D
ACD with MIS	**.4D
UCD termination	**6.3D
UCD termination queue	**3.2D
MDC 2nd dial tone access	**1.1D
POTS feature activation	

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Table 9-32xxx
U.S. CM call time adjustments (continued)

Call description	ms/call attempt SN20
Call Waiting (Ref. #1074)	**50.5D
Three-Way Calling (Ref. #1066)	**67.4D
Call Forward (Ref. #1073)	**3.1D
Speed Calling (Ref. #1067)	**-.4D
MDC feature activation	
Call Waiting (Ref. #1101)	**45.4D
Three Way Calling (Ref. #1086)	**49.0D
Ring Again (Ref. #1107)	**44.6D
Call Transfer (Ref. #1104)	**27.9D
Call Pick-up (Ref. #1108)	**19.4D
Call Forward No Answer (Ref. #1103)	**14.3D
Call Forward Universal (Ref. #1100)	**5.0D
Call Forward Busy (Ref. #1102)	**5.1D
Speed Calling (Ref. #1087/#1088)	**2.1D
Call Hold (Ref. #1089)	63.9D
CLASS feature activation	
ACB Intra-nodal (Ref. #1206)(Delay)	**57.0D
ACB-SS7 Network (Ref. #1208)(Delay)	**57.7D
SS7 Network-ACB (Ref. #1208)(Delay)	**28.9D
AR Intra-nodal (Ref. #1207)(Immediate)	**6.9D
AR-SS7 Network (Ref. #1209)(Immediate)	**6.9D
SS7 Network-AR (Ref. #1209)(Immediate)	**3.4D
CND (Ref. #1218)	**2.2D
CNAMD (Ref. #1217)	**11.8D
CNDB	**4.7D
COT	**14.6D
Selective Call Rejection (SCRJ)	**6.6D
Selective Call Forward (SCFWD)	**8.8D
Distinctive Ring	**3.9D
Selective Call Acceptance	**3.9D
Usage Sensitive Billing	2.9D

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Table 9-32xxx
U.S. CM call time adjustments

Call description	ms/call attempt SN20
Note: The scanning time associated with CLASS ACB/AR is detailed in SEA 90-04-001 CLASS-ACB/AR Scanning, Issue #1 April 9, 1990.	
CLASS feature assignment	
CLASS With Outgoing Memory (ACB)	
CLASS With Incoming Memory (AR, COT, SCRJ, SCFWD, DRCW)	
Note: CLASS feature assignment costs are not cumulative.	

End

Table 9-33xxx
U.S. CM call times-TOPS stand-alone configuration model

Call type	Call description	ms/call attempt SN20
**316	0-;operator handled;non-coin;information only;no outpulsing	21.8
314	0-;operator handled;non-coin;interexchange carrier	39.6
315	0-;operator handled;non-coin;person paid;end office	37.0
513	0-;operator handled;non-coin;overseas;transfer interexchange carrier;interLATA carrier	32.0
813	0-;operator handled;coin;person paid; end office without rate step	50.1
819	0-;operator handled;coin;person paid;end office;TICS	52.9
1142	0-;operator handled;non-coin;person paid;AMA;answer	51.9
**824	0+;MCCS;SS7 database;successful	42.3
327	0+;MCCS;no query database	33.5
331	0+;OA;non-coin;station collect;end office	41.4
329	0+;OA;non-coin;station paid;end office	39.0
332	0+;OA;non-coin;person collect;end office	40.9
**330	0+;OA;non-coin;person paid;end office	39.0
509	0+;non-coin;interLATA carrier	16.7
**814	0+;operator handled;coin;person paid;end office;without rate step	48.9
**818	0+;OA;non-coin;person paid;end office;TICS	42.3

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Table 9-33xxx
U.S. CM call times-TOPS stand-alone configuration model (continued)

Call type	Call description	ms/call attempt SN20
827	0+;OA;calling card number;SS7 database;successful	55.8
828	0+;OA;BNS;SS7 database;verify collect	54.0
830	0+;OA;BNS;SS7database;verify 3rd number	77.9
**326	1+;ACTS;on	35.8
**321	1+;CAMA;ONI;non-coin	25.2
**322	1+;ONI;successful validation	19.6
**328	1+;DD;hotel;person paid	42.7
**809	1+;operator handled;hotel;bill to room	41.5
**815	1+;DD;coin;station paid;end office;without rate step	51.3
518	Queue search for CAMA calls	26.1
520	Verify and connect	53.8
**526	Verify with scrambler	33.1

End

Table 9-34xxx
U.S. CM call times-host OC TOPS configuration model

Call type	Call description	ms/call attempt SN20
**335	0-;operator handled;information only;no outpulsing	15.2
333	0-;operator handled;non-coin;interexchange carrier	22.8
334	0-;operator handled;non-coin;person paid;end office	21.1
531	0-;operator handled;non-coin;overseas;transfer; interexchange carrier;interLATA carrier	16.4
613	0-;operator handled;CN;person paid;end office without rate step	23.0
619	0-;operator handled;CN;person paid;end office;TICS	22.8
1140	0-;operator handled;non-coin;person paid;AMA;answer	32.4
340	0+;MCCS;no query database	2.9
488	0+;operator assisted;non-coin;station collect;end office	23.4
486	0+;operator assisted;non-coin;station paid;end office	20.9

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Table 9-34xxx
U.S. CM call times-host OC TOPS configuration model (continued)

Call type	Call description	ms/call attempt SN20
489	0+;operator assisted;non-coin;person collect;end office	22.5
**487	0+;operator assisted;non-coin;person paid;end office	20.8
**614	0+;operator handled;coin;person paid;end office; without rate step	22.2
** 618	0+;operator assisted;non-coin;person paid;end office;TICS	20.6
627	0+;operator assisted;coin;SS7 database;successful	24.6
628	0+;operator assisted;BNS;SS7 database;verify collect	23.6
630	0+;operator assisted;BNS;SS7 database;verify 3rd number	40.0
** 341	1+;CAMA;ONI;non-coin	12.4
** 342	1+;ONI;successful validation	12.3
**347	1+;DD;hoteL;person paid	22.6
**609	1+;operator handled;hotel;bill to room	19.8
615	1+;DD;coin;station paid;end office;without rate step	23.6
**536	Queue search for CAMA calls	13.4
538	Verify and connect	34.7
**544	Verify with scrambler	21.4

End

Table 9-35xxx
U.S. CM call times-remote OC TOPS configuration model

Call type	Call description	ms/call attempt SN20
**492	0-;operator handled;non-coin;information only;no outpulsing	23.9
490	0-;operator handled;non-coin;interexchange carrier	43.3
491	0-;operator handled;non-coin;person paid;end office	40.3
549	0-;operator handled;non-coin;overseas;transfer interexchange carrier;interLATA carrier	35.3
713	0-;operator handled;coin;person paid;end office;without rate step	52.3
719	0-;operator handled;coin;person paid;end office;TICS	56.7
1141	0-;operator handled;non-coin;person paid;AMA;answer	54.5

-continued-

Table 9-35xxx
U.S. CM call times-remote OC TOPS configuration model (continued)

Call type	Call description	ms/call attempt SN20
**724	0+;MCCS;SS7 database;successful	42.3
497	0+;MCCS;no query database	36.0
507	0+;operator assisted;non-coin;station collect;end office	48.9
505	0+;operator assisted;non-coin;station paid;end office	42.6
508	0+;operator assisted;non-coin;person collect;end office	44.6
**506	0+;operator assisted;non-coin;person paid;end office	43.2
545	0+;non-coin;interLATA carrier	16.8
**714	0+;operator handled;coin;person paid;end office;without rate step	52.0
**718	0+;operator assisted;non-coin;person paid;end office;TICS	45.2
727	0+;operator assisted;coin;SS7 database;successful	60.1
728	0+;operator assisted;BNS;SS7 database;verify collect	56.8
730	0+;operator assisted;BNS;SS7 database;verify 3rd number	82.9
**503	1+;ACTS;coin	35.8
**498	1+;CAMA;ONI;non-coin	27.2
**499	1+;ONI;successful validation	20.4
**504	1+;DD;hotel;person paid	47.0
**709	1+;operator handled;hotel;bill to room	44.3
715	1+;DD;coin;station paid;end office without rate step	55.0
**554	Queue search for CAMA calls	28.8
556	Verify and connect	59.5
**562	Verify with scrambler	36.2

End

Table 9-36xxx
U.S. CM call times-TOPS multi-purpose model

Call type	Call description	ms/call attempt SN20
Stand-alone TOPS-MP configuration		
1130	0-;operator handled;non-coin;person paid;end office	37.4
1136	0-;operator handled;coin;person paid;end office	48.0
1133	0+;operator assisted;non-coin;person paid;end office	39.8
1139	0+;operator assisted;coin;person paid;end office	50.4
Host OC TOPS-MP configuration		
1128	0-;operator handled;non-coin;person paid;end office	21.6
1134	0-;operator handled;coin;person paid;end office	21.7
1131	0+;operator assisted;non-coin;person paid;end office	21.3
1137	0+;operator assisted;coin;person paid;end office	22.8
Remote OC TOPS-MP configuration		
1129	0-;operator handled;non-coin;person paid;end office	40.5
1135	0-;operator handled;coin;person paid;end office	51.6
1132	0+;operator assisted;non-coin;person paid;end office	43.2
1138	0+;operator assisted;coin;person paid;end office	53.3

Table 9-37xxx
U.S. CM call times-TOPS automated alternate billing service model

Call type	Call description	ms/call attempt SN20
Stand-alone configuration		
**1172	AABS;0+;collect;non-coin;line information database;verify	53.6
**1175	AABS;0+;bill 3rd party;non-coin;line information database;verify	65.3
**1178	AABS;0+;coin;non-coin;line information database	43.8
1254	Operator handoff via VSN billed collect	74.3
1257	Operator handoff via VSN billed 3rd party	81.5
Host OC configuration		
1170	AABS;0+;collect;non-coin;line information database;verify	0.0
1173	AABS;0+;bill 3rd party;non-coin;line information database;verify	0.0

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Table 9-37xxx
U.S. CM call times-TOPS automated alternate billing service model (continued)

Call type	Call description	ms/call attempt SN20
1176	AABS;0+;coin;non-coin;line information database	0.0
1252	Operator handoff via billed collect	34.3
1255	Operator handoff via billed 3rd party	32.8
Remote OC configuration		
**1171	AABS;0+;collect;non-coin;line information database;verify	53.6
**1174	AABS;0+;bill 3rd party;non-coin;line information database;verify	65.3
**1177	AABS;0+;coin;non-coin;line information database	43.8
1253	Operator_handoff via billed collect	73.9
1256	Operator_handoff via billed 3rd party	78.8

End

Table 9-38xxx
U.S. CM call times-TOPS directory assistance model

Call type	Call description	ms/call attempt SN20
Stand-alone TOPS MP configuration		
1148	411 combined trunk;voicequote	33.4
1151	411 combined trunk;external ARU	**36.8
1154	411 directory assistance trunk;external ARU;no ANI	34.3
1163	Intercept;intercept trunk;external ARU	18.8
1166	Intercept;intercept trunk # not in directory assistance database;voice quote	**27.4
1169	Intercept;intercept trunk;ONI;external ARU	34.1
1242	411 combined trunk;call completion;station paid	**52.4
1245	411 call completion;AABS calling card	77.7
1248	411 call completion;AABS collect	86.3
1251	411 call completion;AABS bill 3rd party	99.2
Host 0C TOPS MP configuration		
1146	411 combined trunk;voice quote	18.2
1149	411 combined trunk;external ARU	**15.6

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Table 9-38xxx
U.S. CM call times-TOPS directory assistance model (continued)

Call type	Call description	ms/call attempt SN20
1152	411 directory assistance trunk;external ARU;no ANI	17.5
1161	Intercept;intercept trunk external ARU	0.0
1164	Intercept;intercept trunk # not in database;voice quote	**15.6
1167	Intercept;intercept trunk;ONI;external ARU	14.4
1240	411 combined trunk; call completion;station paid	**15.5
1243	411 call completion;AABS calling card	17.3
1246	411 call completion;AABS collect	19.1
1249	411 call completion;AABS bill 3rd party	20.4
Remote 0C TOPS MP configuration		
1147	411 combined trunk;voice quote	34.5
1150	411 combined trunk;external ARU	**37.3
1153	411 directory assistance trunk;external ARU;no ANI	34.7
1162	Intercept;intercept trunk;external ARU	18.8
1165	Intercept;intercept trunk;# not in database;voice quote	**27.8
1168	Intercept;intercept trunk;ONI;external ARU	36.3
1241	411 combined trunk;call completion;station paid	**52.9
1244	411 call completion;AABS calling card	76.7
1247	411 call completion;AABS collect	83.6
1250	411 call completion;AABS bill 3rd party	94.8

End

Table 9-39xxx
U.S. CM call times-equal access operator services system model

Call type	Call description	ms/call attempt SN20
Stand-alone		
1115	IntraLATA;dial pulse;0-;non-coin;person paid	37.6
1124	InterLATA;DTMF;presubscription;0-;coin;person paid	53.1
1112	IntraLATA;DTMF;O+;non-coin;person paid	38.4

-continued-

Table 9-39xxx
U.S. CM call times-equal access operator services system model (continued)

Call type	Call description	ms/call attempt SN20
1118	InterLATA;DTMF;presubscription;O+;non-coin;person paid	43.2
1121	InterLATA;DTMF;10XXX;0+;non-coin;person paid	42.2
1127	InterLATA;dial pulse;10XXX;1+;CAMA;ANI failure	27.0
Host		
1113	IntraLATA;dial pulse;0-;non-coin;person paid	20.9
1122	InterLATA;DTMF;presubscription;0-;coin;person paid	24.4
1110	intraLATA;DTMF;O+;non-coin;person paid	20.6
1116	InterLATA;DTMF;presubscription;O+;non-coin;person paid	20.7
1119	InterLATA;DTMF;10XXX;0+;non-coin;person paid	20.7
1125	InterLATA;dial pulse;10XXX;1+;CAMA;ANI failure	12.4
Remote		
1114	IntraLATA;dial pulse;0-;non-coin;person paid	39.6
1123	InterLATA;DTMF;presubscription;0-;coin;person paid	59.4
1111	IntraLATA;DTMF;O+;non-coin;person paid	41.8
1117	InterLATA;DTMF;presubscription;O+;non-coin;person paid	46.8
1120	InterLATA;DTMF;10XXX;0+;non-coin;person paid	45.4
1126	InterLATA;dial pulse;10XXX;1+;CAMA;ANI failure	29.1

End

Table 9-40xxx
Canadian CM call times-line origination model

Call type	Call description	ms/call attempt SN20	SN40
Line origination			
001	POTS dial pulse line-ineffective	2.1	1.3
002	POTS dial pulse line-POTS line	7.0	4.1
003	POTS dial pulse line-EAS trunk	6.5	3.9
006	POTS dial pulse line-LAMA trunk	13.0	*7.8
007	POTS dial pulse line- OUTCAMA trunk	9.1	5.7*
675	POTS dial pulse line-RES line	8.2	4.8
** 008	POTS DTMF line-ineffective	2.1	1.3
**009	POTS DTMF line-POTS line	7.1	4.2
676	POTS DTMF line-RES line	8.5	4.9
**010	POTS DTMF line-EAS trunk	6.6	3.9
**012	POTS DTMF line-LAMA trunk	12.8	*8.0
013	POTS DTMF line-OUTCAMA trunk	9.2	*5.7
699	RES dial pulse line-POTS line	12.3	*8.5
716	RES dial pulse line-RES line	8.3	6.0
673	RES dial pulse line-ineffective	2.2	1.5
677	RES dial pulse line-MF trunk	8.8	5.4
670	RES DTMF line-POTS line	9.2	5.4
1182	RES DTMF line-RES DTMF line	9.9	4.9
674	RES DTMF line-ineffective	2.6	1.5
669	RES DTMF line-MF trunk	8.9	5.3
798	RES DTMF line-LAMA trunk	14.4	*8.6
799	RES DTMF line-CAMA trunk	14.4	*8.9
**060	MDC dial pulse line-MDC line	10.1	6.0
934	MDC dial pulse line-ineffective	2.6	1.5
**061	MDC dial pulse line with SMDR-MDC line	14.0	*8.5
062	MDC dial pulse line-MDC line (no answer)	9.6	5.6
063	MDC dial pulse line-MDC line (busy)	2.7	1.5
064	MDC dial pulse line-EAS trunk	11.1	6.5
646	MDC dial pulse line-LAMA trunk	16.3	*12.1
066	MDC dial pulse line-OUTCAMA trunk	13.1	*7.7

-continued-

Table 9-40xxx
Canadian CM call times-line origination model (continued)

Call type	Call description	ms/call attempt SN20	SN40
067	MDC dial pulse line-tie dial pulse trunk	15.3	9.5
305	MDC dial pulse line-tie MF trunk	11.8	7.1
068	MDC dial pulse line-tie DTMF trunk	17.3	10.7
069	MDC dial pulse line-attendant	12.0	8.1
** 072	MDC DTMF line-MDC line	10.2	6.0
935	MDC DTMF line-ineffective	2.7	1.5
351	MDC DTMF line-attendant	12.0	8.1
073	MDC DTMF line-EAS trunk	11.1	6.6
421	MDC DTMF line-MF LAMA trunk	16.3	*9.9
350	MDC DTMF line-OUTCAMA trunk	12.8	*7.7
937	MDC DTMF line-DP tie trunk	11.7	7.1
938	MDC DTMF line-DTMF tie trunk	13.0	7.4
298	MDC DTMF line-off-hook queuing	27.8	17.7
299	MDC DTMF line-call back queuing	37.4	22.7
077	EBS line-ineffective	3.6	2.2
079	EBS line-EAS trunk	12.3	7.6
936	EBS line-OCAMA trunk	13.8	*8.6
861	EBS without display-attendant	12.5	8.5
863	EBS without display-EBS without display	12.7	7.6
876	EBS without display-MF IBNT2 trunk	14.9	9.2
053	PBX DOD-ineffective	6.7	4.4
588	PBX dial pulse DOD-PBX dial pulse DID	7.3	4.3

End

Table 9-41xxx
Canadian CM call times-trunk origination model

Call type	Call description	ms/call attempt SN20	SN40
Trunk origination			
671	Dial pulse trunk-RES line	6.4	4.0
024	Dial pulse trunk-ineffective	3.8	2.4

-continued-

Table 9-41xxx
Canadian CM call times-trunk origination model (continued)

Call type	Call description	ms/call attempt SN20	SN40
**029	MF trunk-ineffective	4.7	2.9
034	MF trunk-MDC line	8.1	4.8
647	MF trunk-MDC line (busy)	6.5	4.0
704	MF trunk-RES line	8.1	4.8
035	MF trunk-EBS line	9.0	5.5
036	MF trunk-attendant-MDC line	21.3	15.0
037	Dial pulse EAS trunk-POTS line	5.2	3.2
**038	MF EAS trunk-POTS line	6.9	4.1
932	Dial pulse EAS trunk-MDC line	6.4	3.8
365	Dial pulse EAS trunk-MDC line (busy)	4.9	3.1
933	Dial pulse EAS trunk-EBS	7.5	4.6
039	Dial pulse trunk-trunk	4.3	2.7
**040	MF trunk-trunk	5.9	3.7
041	Dial pulse IT trunk-trunk	4.7	3.0
042	MF IT trunk-trunk	5.8	3.5
045	Dial pulse INCAMA trunk-trunk	12.2	*7.6
049	MF INCAMA trunk-trunk	12.2	*7.4
080	Dial pulse tie trunk-MDC line	9.9	6.6
931	Dial pulse tie trunk-EBS line	11.1	7.2
081	Dial pulse tie trunk-DP tie trunk	9.3	6.3
082	Dial pulse tie trunk-DTMF tie trunk	11.0	6.3
084	MF tie trunk-MDC line	10.0	6.4
930	MF tie trunk-EBS line	13.2	8.5
085	MF tie trunk-DP tie trunk	2.6	1.8
086	MF tie trunk-DTMF tie trunk	10.1	6.9
088	DTMF tie trunk-MDC line	12.1	7.9
090	DTMF tie trunk-DTMF tie trunk	14.3	9.5
**793	800+ trunk-trunk with query	21.0	*12.4
SS7 trunking			
1855	Dial pulse POTS line-SS7 LAMA trunk	17.2	*10.4
657	Dial pulse POTS line-SS7 IT trunk	17.4	11.1

-continued-

Table 9-41xxx
Canadian CM call times-trunk origination model (continued)

Call type	Call description	ms/call attempt SN20	SN40
795	Dial pulse POTS line-SS7 TO trunk	20.0	11.9
678	Dial pulse RES line-SS7 TO trunk	19.6	13.2
748	Dial pulse RES line-SS7 IT LAMA trunk	17.2	*11.7
655	Dial pulse MDC line-SS7 IT LAMA trunk	21.0	*12.6
**1851	DT POTS line-SS7 EAS trunk	19.9	11.4
1856	DT POTS line-SS7 LAMA trunk	17.3	*10.5
747	DT POTS line-SS7 IT trunk	18.2	10.5
796	DT POTS line-SS7 TO trunk	19.8	11.9
1852	DT RES line-SS7 EAS trunk	22.8	13.2
698	DT RES line-SS7 TO trunk	22.0	13.1
749	DT RES line-SS7 IT trunk	17.4	11.6
1857	DT RES line-SS7 LAMA trunk	19.3	*11.6
1858	DT MDC line-SS7 LAMA trunk	21.2	*12.7
454	DTMF MDC line-SS7 EAS trunk	23.8	14.3
421	DTMF MDC line-SS7 toll trunk	16.3	9.9
1859	EBS line-SS7 LAMA trunk	22.3	*13.6
649	EBS line-SS7 TO trunk	25.4	15.7
661	EBS line-SS7 IT trunk	22.4	13.6
** 654	SS7 IT trunk-POTS line	9.2	5.4
797	SS7 TI trunk-POTS line	9.1	5.4
672	SS7 TI trunk-RES line	9.9	5.8
604	SS7 trunk-MDC line (no answer)	8.4	5.0
656	SS7 IT trunk-DP MDC line	10.2	6.0
662	SS7 IT trunk-EBS line	11.4	6.8
1850	MF INCAMA trunk-SS7 trunk	13.4	*8.7
658	MF PTS trunk-SS7 IT trunk	7.0	4.3
659	SS7 IT trunk-MF PTS trunk	7.6	4.7
**660	SS7 IT trunk-SS7 IT trunk	9.8	6.1
1849	SS7 TC trunk-SS7 IT trunk	9.8	6.1

End

Table 9-42xxx
Canadian CM call times-call time adjustments

Call description	ms/call attempt SN20	SN40
ACD termination (line-line intraoffice)	16.8	**10.8D
ACD termination (trunk-line)	12.3	**8.0D
ACD termination queue	8.2	**3.9D
ACD with MIS	.4	**.3D
UCD termination	12.3	**6.3D
UCD termination queue	6.2	**3.2D
Automatic Route Selection	0.5	0.5D
2nd dial tone	0.6	0.6D
Dial tone detect	6.0	6.0D
Station Message Detail Recording	3.9	2.5D
POTS custom calling adjustments		
Assignments		
3-Way Calling	1.2	0.6
Call Waiting	1.2	0.6
Call Forward	1.4	0.8
Speed Calling	1.0	0.5
Activations		
3-Way Calling	61.7	37.4
Call Waiting	35.4	20.7
Call Forward	1.9	1.4
Speed Calling	0.2	0.3
MDC custom calling adjustments		
Assignments		
Call Forward	0.6	0.4
Call Forward Busy	0.7	0.5
Call Forward No answer	5.1	3.0
Call Waiting	0.1	0.0
Speed Calling	0.2	0.0
Activations		
Ring Again	37.9	23.0
Call Forward	5.7	4.0

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Table 9-42xxx
Canadian CM call times-call time adjustments (continued)

Call description	ms/call attempt SN20	SN40
Call Forward Busy	6.0	4.2
Call Forward No answer	15.5	9.7
3-Way Calling	60.5	34.4
Call Pick-Up	14.5	8.4
Call Waiting	46.4	27.1
Speed Calling	1.3	1.0
Message Waiting	30.4	16.2
Call Transfer	29.7	18.4
CMS custom calling adjustments		
Assignments		
Calling Number Delivery	2.2	2.0
Customer Originating Trace	2.1	1.9
Automatic Call Back	0.5	1.1
Automatic Recall	1.9	1.9
Activations		
Customer Originated Trace terminating	5.1	3.9
Automatic Call Back nodal originating	9.3	6.7
Automatic Call Back nodal terminating	11.8	8.1
Automatic Call Back network originating	14.6	9.8
Automatic Call Back network terminating	14.2	9.5
Automatic Recall nodal originating	13.1	8.6
Automatic Recall nodal terminating	8.8	6.6
Automatic Recall network originating	14.6	10.0
Automatic Recall network terminating	14.2	9.5

End

Table 9-43xxx
Canadian CM call times-TOPS/AOSS model

Call type	Call description	ms/call attempt SN20	SN40
092	Operator handled noncoin	41.5	30.3
093	Operator handled coin	49.7	31.0
098	Operator assisted non-Coin	41.6	26.5
099	Operator assisted coin	50.1	31.3
113	0-information only	22.7	14.3
115	Non-coin ONI CAMA	26.7	16.1
117	Busy line verify	25.9	17.1
TOPS remote OC			
138	0-information only	22.2	14.1
140	Busy line verify	26.1	16.9
AOSS			
1853	AOSS trunk-AOSS position-automatic recording unit	36.8	21.7
1854	AOSS trunk-automatic recording unit	18.8	11.1

Table 9-44xxx
Canadian CM call times-TOPS/AOSS model

Call type	Call description	ms/call attempt SN20	SN40
1870	MF trunk (IET)-EBS ACD	24.6E	16.4E
1871	MF trunk (IET)-DTMF ACD (6X33)	25.0E	16.7E
1872	EBS ACD-DTMF ACD (6X33)	31.1E	20.7E
1873	DTMF ACD (6X33)-DTMF ACD (6X33	27.7E	18.4E
1874	DTMF ACD (6X33)-EBS ACD	31.0E	20.7E
1875	MF trunk (IET)-EBS ACD	33.4E	22.2E
1876	MF trunk (IET)-DTMF ACD (6X33)	32.3E	21.5E
1877	EBS ACD-DTMF ACD (6X33)	39.7E	26.5E
1878	DTMF ACD (6X33)-DTMF ACD (6X33)	34.7E	23.2E
1879	DTMF ACD (6X33)-EBS ACD	36.2E	24.1E
1880	MF trunk (IET)-MF trunk (IET)	5.4E	3.6E
1881	MF trunk (IET)-TONE	5.0E	3.4E

-continued-

Table 9-44xxx
Canadian CM call times-TOPS/AOSS model (continued)

Call type	Call description	ms/call attempt SN20	SN40
1882	PRI trunk (IBNT2)-DTMF trunk (IBNT0)	12.7E	8.4E
1883	PRI trunk (IBNT2)-DP trunk (IBNT0)	10.5E	7.0E
1884	DTMF trunk (IBNT1)-PRI trunk (IBNT2)	18.8E	12.6E
1885	Dial pulse trunk (IBNT1)-PRI trunk (IBNT2)	16.0E	10.6E
1886	Dial pulse trunk (IBNT1)-IBN7 ISUP trunk	13.3E	8.9E
1887	PRI trunk (IBNT2)-IBN7 ISUP trunk	12.6E	8.3E
1888	IBN7 ISUP trunk-DTMF trunk (IBNT0)	11.1E	7.4E
1889	DTMF trunk (IBNT1)-IBN7 ISUP trunk	16.2E	10.8E
1890	Dial pulse trunk (IBNT1)-DTMF trunk (IBNT0)	14.1E	9.4E
1891	DTMF trunk (IBNT1)-DP trunk (IBNT0)	14.8E	9.9E
1892	Dial pulse trunk (IBNT1)-DP trunk (IBNT0)	12.6E	8.3E
1893	DTMF trunk (IBNT1)-DTMF trunk (IBNT0)	18.1E	12.1E
1894	IBN7 ISUP trunk-DP trunk (IBNT0)	8.9E	5.9E
1895	IBN7 ISUP trunk-PRI trunk (IBNT2)	14.2E	9.5E
1896	PRI trunk (IBNT2)-PRI trunk (IBNT2)	13.8E	9.2E
Turkey/Belize			
742	Dial pulse line-announcement	7.3E	14.7
731	DT line-line	7.0E	14.0
732	DT line-busy tone	5.5E	11.0
743	DT line-announcement	7.3E	14.7
733	DT line-false start	2.0E	4.1
734	DT line-partial dial abandon	2.0E	4.1
735	DT line-trunk	8.0E	15.9
736	DT line-BLDN announcement	7.4E	14.8
738	Trunk-busy tone	4.4E	8.7
1019	Trunk-abandon	5.3E	10.5
China			
831	Dial pulse line-DP line	7.0E	14.0
832	Dial pulse line-busy tone	5.5E	11.0
833	Dial pulse line-false start	2.0E	4.1
834	Dial pulse line-partial dial abandon/3 digits	2.0E	4.1

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Table 9-44xxx
Canadian CM call times-TOPS/AOSS model (continued)

Call type	Call description	ms/call attempt SN20	SN40
835	DT line-DT line	7.0E	14.0
836	DT line-busy TONE	5.6E	11.1
837	DT line-false start	2.0E	4.1
838	DT line-partial dial abandon/3 digits	2.0E	4.1
896	DT line-C1NONE trunk	8.1E	16.2
1008	DT line-C1ITLL trunk	8.1E	16.2
898	C1NONE trunk-DT line	7.9E	15.7
895	C1NONE trunk-busy TONE	4.7E	9.3
1039	C1NONE trunk-abandon	5.9E	11.7
1018	C1ITLL trunk-DT line	7.7E	15.3
1048	C1CAMA trunk-abandon	6.0E	12.0
1049	C1CAMA trunk-C1ITLL trunk	8.4E	16.7
1058	C1ITLL trunk-C1NONE trunk	6.2E	12.5

End

Table 9-45xxx
International CM call times

Call description	ms/call attempt SN20	SN40
International feature activation costs		
Abnormal Dialing	1.4E	2.8
Call Diversion	3.6E	7.2
Call Diversion On Busy line	3.4E	6.7
Warm line	1.1E	2.1
Hot line	0.2E	0.3
3-Way Calling Enquiring	16.0E	31.9
3-Way Calling Conference	27.5E	54.9
6-Way Calling Enquiring	16.5E	32.1
6-Way Calling Conference	27.8E	55.5
6-Way Calling Subsequent Conference	19.5E	39.0
Call Waiting	6.2E	12.3
Call Waiting/Reject Waiting Call	18.9E	37.8
Call Waiting/Reject Original Call	31.3E	62.7
Call Waiting/Switch Between Parties	18.5E	37.0
Call Recording	1.6E	3.1
International feature assignment costs		
Abnormal Dialing	0.4E	0.8
Warm line	0.6E	1.3
Hot line	0.4E	0.8
Call Diversion Standby	0.3E	0.8
Call Diversion Busy	0.4E	0.8
Call Waiting	0.3E	0.8
3-Way Calling	0.4E	0.9
6-Way Calling	0.4E	0.7

Table 9-46xxx
Canadian CM call times-TOPS/AOSS model

Call type	Call description	ms/call attempt SN20	SN40
Integrated services digital network (ISDN)			
1811	BRI (SS)-POTS 1FR	16.3	10.4
1812	BRI (SS)-EBS with display	21.5	13.5
1813	EBS with display-BRI (SS)	20.4	12.7
1814	BRI (SS)-BRI (FS)	27.8	18.2
1815	BRI (SS)-PRI	22.8	15.2
1816	BRI (FS)-BRI (FS)	31.4	21.0
1817	BRI (FS)-POTS 1FR	19.5	12.9
1818	BRI (FS)-EBS with display	24.2	15.9
1819	EBS with display-BRI (FS)	23.9	15.4
1820	BRI (FS)-BRI (SS)	26.5	17.5
1821	BRI (FS)-PRI	29.9	20.9
1826	PRI-PRI	12.5	9.0
1827	PRI-POTS 1FR	10.6	7.0
1828	PRI-EBS with display	15.4	10.4
1829	EBS with display-PRI	20.4	13.5
1830	PRI-BRI (SS)	18.0	12.1
1831	PRI-BRI (FS)	22.7	15.8
1832	BRI (SS)-SS7 trunk	24.5	15.6
1833	BRI (FS)-SS7 trunk	31.7	21.5
1834	PRI-SS7 trunk	20.5	13.4
1835	BRI (MFT)-BRI (MFT)	22.5	14.2
1836	BRI (MFT)-POTS 1FR	14.9	9.3
1837	BRI (MFT)-EBS with display	20.1	12.6
1838	EBS with display-BRI (MFT)	19.9	12.3
1839	BRI (MFT)-BRI (FS)	25.9	17.1
1840	BRI (MFT)-PRI	27.5	18.6
1841	BRI (FS)-BRI (MFT)	26.1	17.1
1842	PRI-BRI (MFT)	17.7	12.0
1843	BRI (MFT)-SS7 trunk	23.6	15.2
1844	SS7 trunk-PRI	22.7	14.8

-continued-

Table 9-46xxx
Canadian CM call times-TOPS/AOSS model (continued)

Call type	Call description	ms/call attempt SN20	SN40
1845	SS7 trunk-BRI (FS)	27.9	18.5
1846	SS7 trunk-BRI (MFT)	19.7	12.5
1847	BRI (SS)-BRI (MFT)	23.1	14.4

End

BCS 35 call times

BCS35 SuperNode call time values

This section contains SuperNode call timings for real-time planning purposes as well as a series of office models that are representative of general office configurations found in the North American marketplace. Also found within this document are call timings in support of the international marketplace.

It should be noted that call timings and models for NT40 are no longer available for the North American market. NT40 call capacities can be estimated at one-half of SuperNode 20. SuperNode call timings are measured by BNR in a laboratory environment. SuperNode call timings are measured in the following configuration:

- SuperNode series 20/40 -in synchronization
- Dial tone speed recorder -unbound
- LOGAMA -offAMA
- AMA tape mount -no
- Data billed to disk -yes
- Bellcore AMA -yes
- Universal tone receivers -yes
- Station message detail recording -off
- TOPS Enhanced Bellcore AMA format -phase 2
- Data Cache -on
- Cache parity -on

The call timings in this section are reported in milliseconds and are considered to be within +/- 5% accuracy unless otherwise noted. The call timings are categorized as follows:

- actual
- derived
- estimated

Actual call timings are those measured in the current BCS. Timings with no symbol indicate actual call timings.

Derived call timings are used to determine the real time cost of specific features. These call timings are utilized as adjustments to base call types for capacity planning purposes. Timings followed by the letter ‘D’ indicate derived call timings.

Estimated call timings are determined by using current base measured call timings along with design estimates. These estimated call timings are considered to be within +/- 15% accuracy. Timings followed by the letter ‘E’ indicate Estimated call timings.

This section contains:

- a series of call type models which are representative of general office configurations found in North America
- a complete list of all U.S call timings measured by BNR at each BCS interval
- a complete list of all Canadian call timings measured by BNR at each BCS interval
- call timings in support of markets found in Australia, Japan, Turkey, Belize, and China. These call timings were measured with processors as indicated in the listings.
- a listing of ISDN call timings measured at each BCS interval
- a list of acronyms and abbreviations commonly used in the description of call types

  Note: A * next to a call timing indicates an AMA record is included in the timing. TOPS call timings within this document are measured with AMA and are thus not indicated.

  Note: A ** next to the call type/timing indicates that the call type is utilized in Version 6.5 of the REAL::TIME Capacity Planning Tool. The REAL::TIME capacity planning tool and call timings listed in this document should be used to estimate the CM real time impact for actual offices.

BCS35 computing module call time models

This section contains a series of office models that are representative of general office configurations in North America. These models were introduced for the first time in BCS32 and serve as a baseline for future BCS comparisons. Unlike call time models utilized in the past, these models contain significant penetrations of Custom Calling, CLASS/CMS, and Business Services found in the markets today.

North American call time models are defined as follows:

U.S.

- Suburban - Residential end office
- Urban - Business end office
- Access tandem - Tandem traffic
- TOPS access tandem - Combination of operator services and

Canada

- DMS100/POTS - Residential end office (POTS)
- DMS200 - Tandem/toll office
- DMS200/TOPS - Tandem/toll/TOPS/AOSS office
- DMS100/POTS/CMS - Residential end office (CMS)
- DMS100/POTS/MDC -Business end office (MDC/POTS)

Each call time model is configured as follows:

The base model contains the basic traffic mix of line-to-line, line-to-trunk, trunk-to-line, and trunk-to-trunk call types. To provide base traffic mixes that are representative of today's market, a thorough analysis of actual field office mixes was accomplished.

The feature model reflects feature penetrations to the base model. Feature adjustment costs are applied to the base model as necessary. The actual feature mix utilized with each model was determined through studies conducted on various field offices.

The model summary provides the maximum call rate possible for each processor type through SuperNode 40. The average work time in milliseconds for each processor is also provided.

Actual office BCS impact for a specific traffic mix can be estimated by using the REAL::TIME capacity planning tool.

The SuperNode has a maximum of 86 percent of real time available for call processing. This percentage is adjusted when necessary to allow for average work time (AWT). Tables illustrate the percent adjustment needed at various levels of AWT for each series of processor. As an example, in the urban model an AWT of 25.042 ms (SN20) equates to a 1.5 percent adjustment to the maximum call processing of 86 percent.

Table 10-1xxx
U.S. CM call times-suburban base model

Call type	Call description	Mix %	SN20 weighted ms/call attempt Call	Time
994	POTS 1FR - POTS 1FR	19.3	10.1	1.949
995	POTS 1FR - EAS Trunk (MF)	12.0	8.0	0.960
402	POTS 1FR - Toll Trunk (MF)	2.4	17.5	0.420
577	POTS 1FR - EAS Trunk (SS7)	12.0	11.1	1.332
1226	POTS 1FR - Toll Trunk (SS7/FGD)	2.4	19.6	0.470
996	MF Trunk - POTS 1FR	12.8	7.1	0.909
580	SS7 Trunk - POTS 1FR	12.8	10.3	1.318
014	Line Ineffective	18.0	2.5	0.450
946	Trunk Ineffective	3.0	2.8	0.084
993	Partial Dial	5.3	3.7	0.196
			Base AWT = 8.089	

Table 10-2xxx
U.S. CM call times-suburban feature model

Call description	Mix %	SN20 weighted ms/call attempt Call	Time
POTS Custom Calling / Originating	4.8	0.0	0.000
POTS Custom Calling / Terminating	4.5	0.3	0.013
Call Waiting / Terminating	1.7	50.3	0.858
3-Way Calling / Originating	1.0	69.5	0.669
Call Forward / Terminating	1.3	4.0	0.054
Speed Calling / Originating	1.0	-0.3	-0.003
Res Class / Originating	4.8	2.1	0.101
Res Class / Terminating	4.5	4.2	0.189
ACB Nodal Delayed / Originating	0.5	59.0	0.273
ACB Network Delayed / Originating	0.7	89.9	0.587
Customer Originated Trace / Terminating	1.1	15.9	0.171
AR Nodal Immediate / Terminating	0.7	7.3	0.048
AR Network Immediate / Terminating	0.9	5.8	0.052

-continued-

Table 10-2xxx
U.S. CM call times-suburban feature model (continued)

Call description	Mix %	SN20 weighted ms/call attempt Call	Time
Calling Number Delivery Block / Originating	1.4	5.7	0.082
Selective Call Forward / Terminating	1.1	8.1	0.087
SMDI / Terminating	0.3	15.4	0.041
		Feature AWT = 3.225	

End

Table 10-3xxx
U.S. suburban model busy hour call rate summary

SN20	SN30	SN40
274,000	410,000	465,000

Note: SN20-40 call processing = 86%

Table 10-4xxx
U.S. CM call times-urban base model

Call description	Mix %	SN20 weighted ms/call attempt Call	Time
888 MDC Line - MDC Line	17.1	9.7	1.659
889 MDC Line - EAS Trunk (MF)	11.1	10.0	1.110
883 MDC Line - Toll Trunk (MF/FGD)	6.5	18.2	1.183
578 MDC Line - EAS Trunk (SS7)	11.1	13.7	1.521
1228 MDC Line - Toll Trunk (SS7/FGD)	6.5	21.4	1.391
854 MF Trunk - MDC Line	17.5	7.0	1.225
581 SS7 Trunk - MDC Line	17.5	10.3	1.803
805 Line Ineffective	7.2	2.9	0.209
946 Trunk Ineffective	3.0	2.8	0.084
858 Partial Dial	2.5	7.9	0.198
		Base AWT = 10.381	

Table 10-5xxx
U.S. CM call times-urban feature model

Call description	Mix %	SN20 weighted ms/call attempt Call	Time
MDC Custom Calling / Originating	26.2	0.0	0.000
MDC Custom Calling / Terminating	26.1	6.5	1.693
Call Waiting / Terminating	1.0	46.1	0.480
3-Way Calling / Originating	5.2	53.4	2.793
Speed Calling / Originating	1.0	2.1	0.022
Call Forward No Answer / Terminating	15.6	15.9	2.485
Ring Again / Originating	1.0	46.9	0.491
Call Pick-up / Terminating	5.2	21.3	1.110
Call Hold / Originating	1.0	66.0	0.690
Call Transfer / Terminating	5.2	28.6	1.490
MDC CLASS / Originating	2.6	2.1	0.055
MDC CLASS / Terminating	2.6	4.2	0.109
ACB Nodal / Originating	0.3	59.0	0.202
ACB Network / Originating	0.7	89.9	0.631
Customer Originated Trace / Terminating	0.2	15.9	0.027
AR Nodal / Terminating	0.6	7.3	0.042
AR Network / Terminating	1.2	5.8	0.070
Calling Number Delivery Block / Originating	1.0	5.7	0.060
Selective Call Forward /Terminating	0.5	8.1	0.042
SMDI / Terminating	5.2	15.4	0.802
MADN / Originating	5.2	6.2	0.324
MADN / Terminating	5.2	16.1	0.839
EBS With Display / Originating	5.2	0.0	0.000
EBS With Display / Terminating	5.2	3.9	0.203
	Feature AWT = 14.661 Model AWT = 25.042		

Table 10-6xxx
U.S. urban model busy hour call rate summary

SN20	SN30	SN40
121,000	182,000	206,000

Note: SN20-40 call processing = 84.5%

Table 10-7xxx
U.S. CM call times-access tandem model

Call type	Call description	Mix %	SN20 weighted ms/call attempt Call	Time
998	MF IT Trunk - MF IT Trunk	23.0	7.7	1.771
1232	SS7 IT Trunk - SS7 ATC Trunk	60.0	12.5	7.500
1230	MF IT Trunk - SS7 ATC Trunk	5.0	11.7	0.585
1231	SS7 IT Trunk - MF ATC Trunk	5.0	10.3	0.515
1233	E800 SS7 Trunk - MF Trunk	3.0	21.0	0.630
1234	E800 SS7 Trunk - SS7 Trunk	4.0	23.1	0.924
			Model AWT = 11.925	

Table 10-8xxx
U.S. access tandem model busy hour call rate summary

SN20	SN30	SN40
260,000	389,000	441,000

Note: SN20-40 call processing = 86.0%

Table 10-9xxx
U.S. CM call times-TOPS SA/HOC/DA/AT model

Call type	Call description	Mix %	SN20 weighted ms/call attempt Call	Time
824	SA MCCS	11.0	42.8	4.708
1178	SA AABS CCN 0+	10.0	44.1	4.410
326	SA ACTS	10.0	36.6	3.660
1151	SA 411 External ARU	9.0	37.2	3.348

-continued-

Table 10-9xxx
U.S. CM call times-TOPS SA/HOC/DA/AT model (continued)

Call type	Call description	Mix %	SN20 weighted ms/call attempt Call	Time
1163	SA Intercept External ARU	3.0	18.8	0.564
1149	HOC 411 External ARU	7.0	15.9	1.113
1128	HOC NCN 0-	10.5	21.8	2.289
1137	HOC CN 0+	4.6	23.1	1.063
1130	SA NCN 0-	14.7	38.3	5.630
1139	SA CN 0+	6.2	51.5	3.193
1232	SS7 Trunk - SS7 Trunk	8.0	12.5	1.000
998	MF Trunk - MF Trunk	6.0	7.7	0.462
		ModeL AWT = 31.440		

End

Table 10-10xxx
U.S. TOPS SA/HOC/DA/AT model busy hour call rate summary

SN20	SN30	SN40
97,000	145,000	164,000

Note: SN20-40 call processing = 84.5%

Table 10-11xxx
U.S. CM call times-TOPS ROC/DA/AT model

Call type	Call description	Mix %	SN20 weighted ms/call attempt Call	Time
724	ROC MCCS	9.0	42.8	3.852
1177	ROC AABS CCN 0+	8.0	44.1	3.528
503	ROC ACTS	8.0	36.6	2.928
1150	ROC 411 External ARU	12.0	37.4	4.488
1162	ROC Intercept External ARU	3.0	18.8	0.564
1129	ROC NCN 0-	10.4	40.7	4.233
1138	ROC CN 0+	4.6	53.8	2.475
1232	SS7 Trunk - SS7 Trunk	25.0	12.5	3.125
1234	E800 SS7 - SS7 Trunk	4.0	23.1	0.924
998	MF Trunk - MF Trunk	16.0	7.7	1.232
		Model AWT = 27.349		

Table 10-12xxx
U.S. TOPS ROC/DA/AT model busy hour call rate summary

SN20	SN30	SN40
111,000	167,000	189,000

Note: SN20-SN40 call processing = 84.5%

Table 10-13xxx
Canadian CM call times-DMS-100 POTS base model

Call type	Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
657	POTS/DP - EAS Trunk (SS7)	8.00	14.6	1.17	8.7	0.70
1851	POTS/DT - EAS Trunk (SS7)	30.19	12.7	3.83	7.6	2.30
001	POTS/DP - Ineffective	1.64	2.2	0.04	1.3	0.02
008	POTS/DT - Ineffective	6.63	2.3	0.15	1.4	0.09
1855	POTS/DP - Toll Trunk (SS7)	0.78	18.8	0.15	11.1	0.09
1856	POTS/DT - Toll Trunk (SS7)	5.11	18.9	0.96	11.3	0.58
002	POTS/DP - POTS Line	0.81	7.3	0.06	4.5	0.04
009	POTS/DT - POTS Line	3.61	7.5	0.27	4.6	0.16
038	EAS Trunk (MF) - POTS Line	3.63	6.7	0.24	4.0	0.15
654	EAS Trunk (SS7) - POTS Line	32.62	9.9	3.24	6.0	1.94
029	EAS Trunk (MF) - Ineffective	0.10	4.7	0.00	2.8	0.00
604	EAS Trunk (SS7) - Ineffective	0.42	8.2	0.03	4.9	0.02
658	EAS Trunk (MF) - EAS Trunk (SS7)	0.65	7.4	0.05	4.5	0.03
660	EAS Trunk (SS7) - EAS Trunk (SS7)	5.81	10.7	0.62	6.5	0.38
			Base AWT = 10.81			6.49

Table 10-14xxx
Canadian CM call times-DMS-100 POTS feature model

Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
3-Way Calling / ASSIGN	0.60	1.4	0.01	0.8	0.00
Call Waiting / ASSIGN	19.33	1.4	0.28	0.8	0.16
Call Forward / ASSIGN	4.54	1.8	0.08	1.1	0.05
Speed Calling / ASSIGN	0.60	1.1	0.01	0.6	0.00
3-Way Calling / ACT	0.01	63.7	0.01	37.2	0.00
Call Waiting / ACT	0.74	36.2	0.27	21.2	0.16
Call Forward / ACT	1.39	2.0	0.03	1.5	0.02
Speed Calling / ACT	0.05	0.2	0.00	0.3	0.00
		Feature AWT =.70			.40
		ModeL AWT = 11.50			6.90

Table 10-15xxx
Canadian DMS-100 POTS model busy hour call rate summary

SN20	SN30	SN40
227,000	405,000	450,000

Note: SN20-SN40 call processing = 86.0%

Table 10-16xxx
Canadian CM call times-DMS-200 Toll(DDD/non-TOPS/non-AOSS model)

Call type	Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
1850	INCAMA Trunk (MF) - SS7 Trunk	13.00	15.1	1.96	9.2	1.20
660	SS7 Trunk (IT) - SS7 Trunk (IT)	57.26	10.7	6.11	6.5	3.72
1849	SS7 Trunk (TC) - SS7 Trunk (IT)	24.54	10.6	2.60	6.5	1.60
793	800+ Trunk - DB QRY - Trunk	3.20	22.9	0.73	13.5	0.43
029	EAS Trunk (MF) - Ineffective	2.00	4.7	0.09	2.8	0.06
			Model AWT = 11.50			7.01

Table 10-17xxx
Canadian DMS-200 toll model busy hour call rate summary

SN20	SN30	SN40
269,000	404,000	442,000

Note: SN20-SN40 call processing = 86.0%

Table 10-18xxx
Canadian CM call times-DMS-200 toll/TOPS (DDD/TOPS/AOSS) model

Call type	Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
1850	INCAMA Trunk (MF) - SS7 Trunk	9.30	15.1	1.40	9.2	0.86
660	SS7 Trunk (IT) - SS7 Trunk (IT)	33.39	10.7	3.56	6.5	2.17
1849	SS7 Trunk (TC) - SS7 Trunk (IT)	14.31	10.6	1.52	6.5	0.93
793	800+ Trunk - DB QRY - Trunk	6.00	22.9	1.37	13.5	0.81
092	Standalone OH NCN	3.00	42.6	1.28	27.2	0.82
093	Standalone OH CN	0.90	49.3	0.44	32.4	0.29
098	Standalone OA NCN	3.60	43.1	1.55	26.8	0.97
099	Standalone OA CN	0.90	50.3	0.45	32.6	0.29
115	Standalone NCN ONI (CAMA)	3.60	26.6	0.96	17.2	0.62
1853	AOSS	12.00	37.2	4.46	21.9	2.63
1854	AOSS VR	4.00	18.8	0.75	11.1	0.44
784	ACCS SCP QRY	2.50	17.4	0.44	10.3	0.26
787	BNS Collect CALL	1.25	23.7	0.30	14.0	0.17
791	BNS Bill to 3rd Party	1.25	51.1	0.64	30.1	0.38
029	EAS Trunk (MF) - Ineffective	4.00	4.7	0.19	2.8	0.11
			Model AWT = 19.31			11.74

Table 10-19xxx
Canadian DMS-200 toll model busy hour call rate summary

SN20	SN30	SN40
158,000	237,000	261,000

Note: SN20-SN40 call processing = 85.0%

Table 10-20xxx
Canadian CM call times-DMS-100 POTS/CMS base model

Call type	Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
657	POTS/DP - EAS Trunk (SS7)	6.00	14.6	0.87	8.7	0.52
1851	POTS/DT - EAS Trunk (SS7)	22.64	12.7	2.87	7.6	1.72
1852	RES/DT - EAS Trunk (SS7)	9.55	15.8	1.51	11.1	1.06
001	POTS/DP - Ineffective	1.23	2.2	0.03	1.3	0.02
008	POTS/DT - Ineffective	4.79	2.3	0.11	1.4	0.07
674	RES/DT - Ineffective	2.07	2.8	0.06	1.7	0.03
1855	POTS/DP - Toll Trunk (SS7)	0.59	18.8	0.11	11.1	0.07
1856	POTS/DT - Toll Trunk (SS7)	3.83	18.9	0.72	11.3	0.43
1857	RES/DT - Toll Trunk (SS7)	1.47	21.0	0.31	12.7	0.19
002	POTS/DP - POTS Line	0.61	7.3	0.04	4.5	0.03
009	POTS/DT - POTS Line	2.71	7.5	0.20	4.6	0.12
1182	RES/DT - RES/DT	1.21	10.7	0.13	5.4	0.07
038	EAS Trunk (MF) - POTS Line	2.72	6.7	0.18	4.0	0.11
654	EAS Trunk (SS7) - POTS Line	24.51	9.9	2.44	6.0	1.46
704	EAS Trunk (MF) - RES Line	0.97	8.2	0.08	4.9	0.05
672	EAS Trunk (SS7) - RES Line	8.17	10.9	0.89	6.5	0.53
029	EAS Trunk (MF) - Ineffective	0.05	4.7	0.00	2.8	0.00
604	EAS Trunk (SS7) - Ineffective	0.42	8.2	0.03	4.9	0.02
658	EAS Trunk (MF) - EAS Trunk (SS7)	0.65	7.4	0.05	4.5	0.03
660	EAS Trunk (SS7) - EAS Trunk (SS7)	5.81	10.7	0.62	6.5	0.38
			Base AWT=11.26			6.89

Table 10-21xxx
Canadian CM call times-DMS-100 POTS feature model

Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
3-Way Calling / ASSIGN	0.60	1.4	0.01	0.8	0.00
Call Waiting / ASSIGN	19.33	1.4	0.28	0.8	0.16
Call Forward / ASSIGN	4.54	1.8	0.08	1.1	0.05
Speed Calling / ASSIGN	0.60	1.1	0.01	0.6	0.00

-continued-

Table 10-21xxx
Canadian CM call times-DMS-100 POTS feature model (continued)

Call description	Mix (%)	SN20 weighted ms/call attempt Call	SN20 weighted ms/call attempt Time	SN40 weighted ms/call attempt Call	SN40 weighted ms/call attempt Time
3-Way Calling / ACT	0.01	63.7	0.01	37.2	0.00
Call Waiting / ACT	0.74	36.2	0.27	21.2	0.16
Call Forward / ACT	1.39	2.0	0.03	1.5	0.02
Speed Calling / ACT	0.05	0.2	0.00	0.3	0.00
Calling Number Delivery / Assign	9.60	2.1	0.20	1.9	0.18
Customer Originated Trace / Assign	2.00	2.1	0.04	1.9	0.04
Auto Call Back / Assign	4.32	0.3	0.01	0.2	0.01
Auto RECall / Assign	3.60	2.4	0.08	1.6	0.06
Customer originated Trace / ACT	0.12	5.6	0.01	4.6	0.01
Auto Call Back Nodal Originating / ACT	0.02	9.7	0.00	7.6	0.00
Auto Call Back Nodal Terminating / ACT	0.02	13.0	0.00	9.4	0.00
Auto Call Back NTWK Originating / ACT	0.79	14.2	0.11	9.2	0.07
Auto Call Back NTWK Terminating / ACT	0.65	14.1	0.09	9.2	0.06
Auto Recall NTWK Originating / ACT	0.04	14.3	0.01	10.8	0.00
Auto Recall NTWK Terminating / ACT	0.03	14.4	0.00	10.3	0.00
		Feature AWT= 1.24 Model AWT = 12.50			0.83 7.72

End

Table 10-22xxx
Canadian DMS-100 POTS/CMS model busy hour call rate summary

SN20	SN30	SN40
248,000	372,000	396,000

Note: SN20-SN40 Call processing = 85.0%

Table 10-23xxx
Canadian CM call times-DMS-100 POTS/centrex base model

Call type	Call description	Mix (%)	SN20 weighted ms/Call attempt Call	SN20 weighted ms/Call attempt Time	SN40 weighted ms/Call attempt Call	SN40 weighted ms/Call attempt Time
657	POTS/DP - EAS Trunk (SS7)	4.27	14.6	0.62	8.7	0.37
1851	POTS/DT - EAS Trunk (SS7)	9.38	12.7	1.19	7.6	0.71
001	POTS/DP - Ineffective	1.01	2.2	0.02	1.3	0.01
008	POTS/DT - Ineffective	1.99	2.3	0.04	1.4	0.03
1855	POTS/DP - Toll Trunk (SS7)	0.67	18.8	0.13	11.1	0.07
1856	POTS/DT - Toll Trunk (SS7)	1.06	18.9	0.20	11.3	0.12
002	POTS/DP - POTS Line	1.23	7.3	0.09	4.5	0.05
009	POTS/DT - POTS Line	2.08	7.5	0.16	4.6	0.09
038	EAS Trunk (MF) - POTS Line	6.85	6.7	0.46	4.0	0.27
654	EAS Trunk (SS7) - POTS Line	22.89	9.9	2.28	6.0	1.36
029	EAS Trunk (MF) - Ineffective	0.26	4.7	0.01	2.8	0.01
604	EAS Trunk (SS7) - Ineffective	0.25	8.2	0.02	4.9	0.01
040	EAS Trunk (MF) - EAS Trunk	1.09	5.9	0.06	3.6	0.04
660	EAS Trunk (SS7) - EAS Trunk (SS7)	0.41	10.7	0.04	6.5	0.03
454	IBN/DT - EAS Trunk (SS7)	8.35	20.0	1.67	12.3	1.03
661	P-Phone - EAS Trunk (SS7)	2.04	19.9	0.41	12.3	0.25
938	IBN/DT - TIE Trunk (DTMF)	2.15	12.7	0.27	8.2	0.18
876	P-Phone - TIE Trunk (DTMF)	0.48	15.1	0.07	9.8	0.05
935	IBN/DT - Ineffective	2.66	2.9	0.08	1.7	0.04
077	P-Phone - Ineffective	0.62	3.8	0.02	2.3	0.01
072	IBN/DT - IBN Line	5.14	10.8	0.56	6.0	0.31
863	P-Phone - IBN Line	1.13	13.4	0.15	8.3	0.09
1858	IBN/DT - Toll Trunk (SS7)	1.60	22.6	0.36	13.8	0.22
1859	P-Phone - Toll Trunk (SS7)	0.39	23.1	0.09	14.9	0.06
656	SS7 Trunk (IT) - IBN Line	16.52	10.8	1.78	6.4	1.06
662	SS7 Trunk (IT) - P-Phone Line	2.93	12.0	0.35	7.3	0.21
084	TIE Trunk (MF) - IBN Line	1.18	10.1	0.12	6.6	0.08
930	TIE Trunk (MF) - P-Phone Line	0.24	13.4	0.03	8.9	0.02
086	TIE Trunk (MF) - TIE Trunk (DTMF)	1.13	11.3	0.13	6.9	0.08
			Base AWT = 11.42			6.89

Table 10-24xxx
Canadian CM call times-DMS-100 POTS/centrex feature model

Call description	Mix (%)	SN20 weighted ms/Call attempt Call	Time	SN40 weighted ms/Call attempt Call	Time
POTS					
3-Way Calling / Assign	0.13	1.4	0.00	0.8	0.00
Call Waiting / Assign	1.38	1.4	0.02	0.8	0.01
Call Forward / Assign	1.48	1.8	0.03	1.1	0.02
Speed Calling / Assign	0.06	1.1	0.00	0.6	0.00
Call Waiting / ACT	0.02	36.2	0.01	21.2	0.00
Call Forward / ACT	0.15	2.0	0.00	1.5	0.00
Centrex					
Ring Again / Assign	4.94	0.1	0.00	0.1	0.00
Call Forward / Assign	29.93	0.8	0.23	0.6	0.16
Call Forward Busy / Assign	11.31	0.9	0.10	0.7	0.08
Call Forward No Answer / Assign	16.19	5.6	0.90	3.9	0.64
3-Way Calling / Assign	59.15	0.0	0.00	0.0	0.00
Call Pick-up / Assign	22.66	0.0	0.01	0.0	0.00
Call Waiting / Assign	3.21	0.0	0.00	0.0	0.00
Speed Calling / Assign	2.48	0.3	0.01	0.2	0.00
Call Transfer / Assign	59.15	0.0	0.00	0.0	0.00
Ring Again / ACT	0.06	38.6	0.02	24.4	0.02
Call Forward / ACT	3.23	6.6	0.21	4.7	0.15
Call Forward Busy / ACT	2.48	6.7	0.17	4.9	0.12
Call Forward No Answer / ACT	2.88	16.6	0.48	10.5	0.30
3-Way Calling / ACT	1.95	50.9	0.99	33.7	0.66
Call Pick-up / ACT	1.36	14.6	0.20	8.4	0.11
Call Waiting / ACT	0.42	47.7	0.20	28.0	0.12
Speed Calling / ACT	0.41	1.6	0.01	0.9	0.00
Message Waiting / ACT	0.18	30.1	0.06	20.7	0.04
Call Transfer / ACT	1.42	30.4	0.43	20.5	0.29
Auto Route Selection / ACT	5.75	0.5	0.03	0.5	0.03
Second Dial Tone / ACT	3.76	0.6	0.02	0.6	0.02
Dial Tone Detect / ACT	3.76	6.0	0.23	6.0	0.23
SMDR / ACT	7.17	3.9	0.28	2.5	0.18
		Feature AWT = 4.63 Model AWT= 16.05			3.19 10.08

Table 10-25xxx
Canadian DMS-100 POTS/centrex model busy hour call rate summary

SN20	SN30	SN40
193,000	289,000	307,000
Note: SN20-SN40 Call processing = 85.0%		

Table 10-26xxx
SuperNode 20 average work time (AWT) adjustments (20.0% GOS)

AWT (average ms)	Call processing adjustments
< 12.6 ms	0.0 %
12.6 ms to 20.0 ms	1.0 %
> 20.0 ms	1.5 %

Table 10-27xxx
SuperNode 30 average work time (AWT) adjustments (20.0% GOS)

AWT (average ms)	Call processing adjustments
< 8.7 ms	0.0 %
8.7 ms to 13.3 ms	1.0 %
> 13.3 ms	1.5 %

Table 10-28xxx
SuperNode 40 average work time (AWT) adjustments (20.0% GOS)5

AWT (average ms)	Call processing adjustments
< 7.2 ms	0.0 %
7.2 ms to 11.1 ms	1.0 %
> 11.1 ms	1.5 %

Table 10-29xxx
Canadian CM call times-Line origination model (SN20)

Call type	Call description	ms/Call attempt SN20
947	POTS DP 1FR - POTS DTMF 1FR Line	10.2
005	POTS DP 1FR - LAMA Trunk	*12.4
**014	POTS DTMF 1FR Line - False Start	2.5
**994	POTS DTMF 1FR Line - POTS 1FR Line	10.1
015	POTS DTMF 1MR Line - POTS 1FR Line	*14.7
859	POTS DTMF 1FR Line - MDC DTMF Line	11.4
1059	POTS DTMF 1FR Line - EBS With Display	16.0
1236	POTS DTMF 1FR Line - MADN Primary	19.1
**995	POTS DTMF 1FR Line - EAS Trunk	8.0
**016	POTS DTMF 1MR Line - EAS Trunk	*13.7
3031	POTS DTMF 1FR Line With LPIC - ATC Trunk	*17.0
**378	FGC 1+10 DIGITS - AT (PIC)	*16.4
401	1+7 DIGITS - IC (OCS ON,PIC)	*18.8
**402	1+10 DIGITS - AT (OCS ON,PIC)	*18.8
974	POTS DTMF 1MR Line - AT TO IC FGD Trunk	*17.9
949	POTS DTMF 1FR Line - Operator Trunk	11.5
308	POTS DTMF 1MR Line - Busy	9.9
993	POTS DTMF 1FR Line - Abandon/6 Digits	5.0
**948	POTS DTMF 1FR Line - Busy DTMF 1FR	8.4
967	POTS DTMF 1FR Line - MF Operator Trunk	11.5
963	POTS DTMF 1FR Line - MF PBX DID Trunk	8.5
**966	POTS DTMF 1FR Line - BLDN Announcement	9.2
**019	Coin DTMF - POTS 1FR Line	*18.1
020	Coin DTMF - EAS Trunk	*17.0
910	FGB Coin DTMF - AT MF	18.9
954	Coin DTMF - DIRECT TO IC FGD	*22.0
982	Coin DTMF - Operator Trunk	16.7
908	Coin DTMF - Trunk (1+800)	*18.0
018	Coin DTMF - Busy	12.7
054	PBX DOD Trunk - POTS 1FR Line	9.4
055	PBX DOD Trunk - LAMA Trunk	*11.5

-continued-

Table 10-29xxx
Canadian CM call times-Line origination model (SN20) (continued)

Call type	Call description	ms/Call attempt SN20
915	FGB DTMF PBX DOD - AT MF Trunk	11.4
917	FGD DTMF PBX DOD - AT MF Trunk	*17.1
988	OUTWATS - Direct to IC FGB Trunk	*14.9
918	FGC DTMF OUTWATS - AT MF Trunk	*16.5
989	OUTWATS - Direct to IC FGD	*16.8
309	OUTWATS (Enhanced) - ATC Trunk	*17.2
899	MDC OUTWATS (Enhanced) - ATC Trunk	24.9
805	MDC DTMF - False Start	2.9
**888	MDC DTMF - MDC Line	9.7
1109	MDC DTMF (With SMDR) - MDC Line	14.5
889	MDC DTMF - EAS Trunk	10.0
882	FGC DTMF MDC - AT MF	*16.6
883	FGD DTMF MDC - AT MF	*18.2
884	DTMF MDC IntraLATA - MF Toll Trunk	*14.0
886	E800 EAEO DTMF MDC - IC Trunk	*27.0
873	MDC DTMF - EBS Without Display	11.0
**1199	MDC DTMF - EBS With Display	13.6
1224	MDC DTMF - EBS With Display MADN 3 SEC MEM	29.1
**1239	MDC DTMF - EBS With Display MADN 4 SEC MEM	31.2
874	MDC DTMF - MDC MF Trunk	*14.5
**857	MDC DTMF 2nd DT - POTS 1FR	11.1
858	MDC DTMF - Abandon after 2 Digits	7.9
850	Attendant - MDC DTMF Line (SCG)	13.6
891	EBS With Display - EBS With Display	14.8
892	EBS With Display - EAS Trunk	11.5
893	EBS With Display - LAMA Trunk	*15.1
863	EBS Without Display - EBS Without Display	11.9
894	EBS With Display - EBS Without Display	12.2
885	EBS With Display FGD - AT MF	*20.1
875	EBS Without Display - DTMF FX Trunk	10.7
862	EBS Without Display - MDC DTMF Line (SCG)	10.8

-continued-

Table 10-29xxx
Canadian CM call times-Line origination model (SN20) (continued)

Call type	Call description	ms/Call attempt SN20
**861	EBS Without Display - Attendant	11.7
**1198	EBS With Display - MDC Line	11.1
**1238	EBS With Display MADN (4 SEC) - MDC Line	17.3
	DATA PATH - Line	18.9E
	DATA PATH - Non-LAMA(EAS)	19.5E
	DATA PATH - LAMA	29.2E

End

Table 10-30xxx
U.S. CM call times-call types with custom calling/CLASS/SMDI features model 1

POTS Custom Calling Features (CCF)		
3-Way Calling (3WC)		
Call Waiting (CWT)		
Speed Calling (SC1)		
Call Forward (CFW)		
Teen Service		
Call type	**Call description**	**ms/Call attempt SN20**
1065	1FR (ALL CCF Assigned) - 1FR Line	10.0
1066	1FR Line (3WC Activated) - 1FR Line	*93.9
1067	1FR Line (SC1 Activated) - 1FR Line	9.7
1070	1FR Line - 1FR Line (CFU Assigned)	10.2
1072	1FR Line - 1FR Line (ALL CCF Assigned)	10.4
1073	1FR Line - 1FR Line (CFU Activated)	14.4
1074	1FR Line - 1FR Line (CWT Activated)	*75.5
1105	1FR Line - 1FR Line (3WC,SC1,CWT Assigned)	10.0
1225	1FR Line - 1FR Line (Teen SERVICE Activated)	10.4
MDC custom calling features (CCF):		
3-Way Calling (3WC)		
Call Waiting (CWT)		

-continued-

Table 10-30xxx
U.S. CM call times-call types with custom calling/CLASS/SMDI features model 1 (continued)

Speed Calling Short List (SC1)		
Speed Calling Long List (SC2)		
Call Forward Busy (CFB)		
Call Forward Universal (CFU)		
Call Forward Don't Answer (CFD)		
Call Transfer (CXR)		
Call Hold (CH)		
Ring Again (RA)		
Call Pick-up (CPU)		
Call type	**Call description**	**ms/Call attempt SN20**
1085	MDC Line (ALL CCF Assigned) - MDC Line	10.8
1086	MDC Line (3WC Activated) - MDC Line	*79.4
1087	MDC Line (SC1 Activated) - MDC Line	12.9
1088	MDC Line (SC2 Activated) - MDC Line	12.9
1089	MDC Line (CH Activated) - MDC Line	*81.2
1107	MDC Line (RA Activated) - MDC Line	56.6
1092	MDC Line - MDC Line (CFU Assigned)	11.6
1095	MDC Line - MDC Line (CFB Assigned)	11.5
1096	MDC Line - MDC Line (CFD Assigned)	16.2
1099	MDC Line - MDC Line (ALL CCF Assigned)	16.4
1100	MDC Line - MDC Line (CFU Activated)	17.2
1101	MDC Line - MDC Line (CWT Activated)	*83.3
1102	MDC Line - MDC Line (CFB Activated)	17.3
1103	MDC Line - MDC Line (CFD Activated)	32.1
1104	MDC Line - MDC Line (CXR Activated)	*60.2
1106	MDC Line - MDC Line (3WC,SC1,CWT,SC2,CH,CXR, ASGN)	10.2
1108	MDC Line - MDC Line (CPU Activated)	32.3
RES custom local area signalling services (CLASS)		
Automatic Call Back (ACB)		
Automatic Recall (AR)		
CallING Number Delivery (CND)		
CallING Name Delivery (CNAMD)		

-continued-

Table 10-30xxx
U.S. CM call times-call types with custom calling/CLASS/SMDI features model 1 (continued)

Calling Number Delivery Blocking (CNDB)		
Selective Call Rejection (SCRJ)		
Customer Originated Trace (COT)		
Usage Sensitive Billing (USB)		
Selective Call Forward (SCFWD)		
Selective Call Acceptance (SCA)		
Distinctive Ring (DR)		
Call type	**Call description**	**ms/Call attempt SN20**
3033	RES - RES	11.8
3034	RES Coin - RES	15.1
1205	RES - RES (ACB,AR,CND,COT Assigned Originating/Terminating)	14.6
1258	RES (ACB,AR,COT,CND Assigned) - RES	12.2
1259	RES - RES (ACB,AR,COT,CND Assigned)	14.3
1206	RES (ACB Intra-Nodal Activated) - RES	71.2
1207	RES - RES (AR Intra-Nodal Activated)	21.6
1208	RES (ACB Network ACT) - SS7 - RES	*116.5
1209	RES - SS7 - RES (AR Network ACT)	*35.7
1210	RES - RES (SCRJ Activated)	*24.3
1211	RES - RES (SCFWD Activated)	*35.1
1212	RES - RES (SCA Activated)	*29.2
1213	RES - RES (DR Activated)	*29.1
1214	RES - RES (COT Activated)	15.9
1215	RES (CNDB Activated - RES)	17.9
1216	RES (CNDB Activated/USB ON) - RES	*20.7
1217	1FR Line - RES (CNAMD Activated)	*37.2
1218	1FR Line - RES (CND Activated)	*27.0
3032	1FR Line - RES (SCWID Activated)	64.8
3030	SS7 EAS Trunk - RES (BCLID Activated)	11.4
RES simplified message desk interface (SMDI)		
SMDI Call Forward Busy (CFB)		
SMDI Call Forward DON'T Answer (CFD)		
SMDI Call Forward ALWAYS (CFA)		

-continued-

Table 10-30xxx
U.S. CM call times-call types with custom calling/CLASS/SMDI features model 1 (continued)

1220	RES - SMDI (Direct)	30.0
1221	1FR Line - RES (SMDI-CFB)	37.0
1222	1FR Line - RES (SMDI CFD)	49.4
1223	1FR Line - RES (SMDI-CFA)	36.8

End

Table 10-31xxx
U.S. CM call times-incoming trunk origination model

Call type	Call description	ms/Call attempt SN20
**997	MF Tandem INCAMA Trunk - MF Tandem Trunk	5.9
**996	MF Trunk - POTS 1FR Line	7.1
**998	MF IT Trunk - IT Trunk	7.7
453	MF IC Trunk - POTS 1FR Line	*13.2
**999	MF Trunk - Busy	*9.8
031	MF Trunk - INWATS Line	*14.4
879	MF Trunk - EBS Without Display	9.0
946	MF Trunk - Abandon (NO Start SIGNAL)	2.8
854	MF POTS Trunk - MDC DTMF Line	8.3
046	MF INCAMA Trunk - POTS 1FR Line	*11.7
048	MF INCAMA Trunk - Trunk	*10.5
456	IC Carrier Trunk - IT Trunk	*11.3
991	IC Trunk - MF PBX DID (PX)	*10.8
455	IT Trunk - IC Carrier Trunk	7.7
919	FGC LEAS MF INC Trunk - IC Trunk	*15.5
920	FGD LEAS MF INC Trunk - IC Trunk	*16.9
921	LEAS MF INC Trunk - Tandem MF IT	*17.1
855	MDC MF Trunk - MDC DTMF Line	8.1
856	MDC DTMF FX Trunk - MDC DTMF Line (SCG)	10.7
868	MDC MF Trunk - Attendant	9.4
958	MF PX DOD Trunk-DIG(PX) - Direct to IC	*17.5
959	MF PX DOD Trunk-DIG - VIA AT to IC	*15.6
961	MF PX DOD Trunk-DIG - MF EAS Trunk	8.3

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Table 10-31xxx
U.S. CM call times-incoming trunk origination model (continued)

Call type	Call description	ms/Call attempt SN20
986	DTMF PBX DOD (FX) Trunk - Operator Trunk	10.7
987	MF PBX DOD Trunk - Operator Trunk	10.3
E911 Trunking		
1201	FX Trunk - E911 Tandem	31.4
1202	E911 Trunk - E911 Tandem PSAP QRY	30.7
1203	E911 Trunk - PSAP Line With Originating Hold	*55.4
1204	E911 Trunk - PSAP Line With SBT - LDTPSAP	121.5
SS7 Trunking		
**577	DTMF POTS Line - SS7 Trunk EAS	12.4
1226	DTMF POTS Line - SS7 Trunk Toll	*19.6
578	DTMF MDC Line - SS7 Trunk EAS	13.7
1228	DTMF MDC Line - SS7 Trunk Toll	*21.4
**1219	DTMF MDC Line (With SMDR) - SS7 Trunk	16.9
579	DTMF POTS Line - SS7 Trunk EAS	*16.1
**580	SS7 Trunk - DTMF POTS Line	10.3
581	SS7 Trunk - DTMF MDC Line	10.3
1230	FGD MF Trunk - SS7 Trunk	11.7
1231	FGD SS7 Trunk - MF Trunk	10.3
**1232	FGD SS7 Trunk - SS7 Trunk	12.5
1233	FGD E800 SS7 Trunk - MF Trunk (DB Query)	21.0
1234	FGD E800 SS7 Trunk - SS7 Trunk (DB Query)	23.1
1235	FGB SS7 Trunk - MF Trunk	8.1
800 service		
922	E800 DTMF 1FR - IC (DB Query)	*25.7
924	E800 AT - IC (DB Query)	*25.1
928	E800 EAEO DTMF 1FR - AT (DB Query)	*26.4
**929	E800 AT - IT (DB Query)	*22.9
End		

Table 10-32xxx
U.S. CM call time adjustments

Call description	ms/Call attempt SN20
AMA	**4.4D
Originating MADN (1 Primary/4 Secondary Members)	**6.2D
Terminating MADN (1 Primary/4 Secondary Members)	**16.1D
SMDR	**3.2D
MDC Attendant Console Termination	**0.7D
MDC Attendant Console Origination	3.0D
UTR	**-1.3D
Alternate Routing	.6D
Virtual Facility Group	.8D
Hunt Group	1.0D
Permanent Signal	10.9D
EBS (P-Phone) With Display	**3.9D
ACD Terminating (Line-Line Intra-office)	**16.8D
ACD Terminating (Trunk-Line)	**12.3D
ACD Terminating Queue	**8.2D
ACD with MIS	**.4D
UCD Terminating	**6.3D
UCD Terminating Queue	**3.2D
MDC 2nd Dial Tone Access	**1.0D
POTS feature activation	
Call Waiting (Ref. #1074)	**50.3D
Three-Way Calling (Ref. #1066)	**69.5D
Call Forward (Ref. #1073)	**4.0D
Speed Calling (Ref. #1067)	**-.3D
MDC feature activation	
Call Waiting (Ref. #1101)	**46.1D
Three Way Calling (Ref. #1086)	**53.4D
Ring Again (Ref. #1107)	**46.9D
Call Transfer (Ref. #1104)	**28.6D
Call Pick-up (Ref. #1108)	**21.3D
Call Forward No Answer (Ref. #1103)	**15.9D

-continued-

Table 10-32xxx
U.S. CM call time adjustments (continued)

Call description	ms/Call attempt SN20
Call Forward Universal (Ref. #1100)	**7.5D
Call Forward Busy (Ref. #1102)	**7.6D
Speed Calling (Ref. #1087/#1088)	**2.1D
Call Hold (Ref. #1089)	66.0D
CLASS feature activation	
ACB Intra-Nodal (Ref. #1206)(Delay)	**59.0D
ACB - SS7 Network (Ref. #1208)(Delay)	**59.6D
SS7 Network - ACB (Ref. #1208)(Delay)	**29.8D
AR Intra-Nodal (Ref. #1207) (Immediate)	**7.3D
AR - SS7 Network (Ref. #1209) (Immediate)	**5.8D
SS7 Network - AR (Ref. #1209) (Immediate)	**2.9D
CND (Ref. #1218)	**1.3D
CNAMD (Ref. #1217)	**11.5D
CNDB	**5.7D
COT	**15.9D
Selective Call Rejection (SCRJ)	**7.0D
Selective Call Forward (SCFWD)	**8.1D
Distinctive Ring	**2.1D
Selective Call Acceptance	**2.2D
Usage Sensitive Billing	2.8D
CLASS featue assignment	
CLASS W/ Outgoing Memory (ACB)	**1.1 D
CLASS W/ Incoming Memory (AR,COT,SCRJ,SCFWD,DRCW)	**4.2 D
Note: CLASS feature assignment costs are not cumulative.	
End	

Table 10-33xxx
U.S. CM call times-TOPS stand-alone configuration model

Call type	Call description	ms/Call attempt SN20
Stand-alone TOPS configuration		
**316	0-;OH;NCN;INFO_ONLY_NO_OUTPULSING	24.1
314	0-;OH;NCN;INTER_X_CARRIER	42.8
315	0-;OH;NCN;PER_PD;END_OFFICE	38.1
513	0-;OH;NCN;OVS;XFR_IC;INTERLATA CARRIER	33.4
813	0-;OH;CN;PER_PD;END_OFFICE WITHOUT RATE STEP	51.4
819	0-;OH;CN;PER_PD;END_OFFICE;TICS	53.2
1142	0-;OH;NCN;PER_PD;GEN_AMA;ANS	61.5
**824	0+;MCCS;SS7_DB;SUCCESSFUL	42.8
327	0+;MCCS;NO_X_DB	33.9
331	0+;OA;NCN;STA_COL;END_OFFICE	45.6
329	0+;OA;NCN;STA_PD;END_OFFICE	40.0
332	0+;OA;NCN;PER_COL;END_OFFICE	42.6
**330	0+;OA;NCN;PER_PD;END_OFFICE	39.9
509	0+;NCN;INTERLATA_CARRIER	17.3
**814	0+;OH;CN;PER_PD;END OFFICE; WITHOUT RATE STEP	49.7
**818	0+;OA;NCN;PER_PD;END_OFFICE;TICS	43.1
827	0+;OA;CCN;SS7_DB;SUCCESSFUL	57.0
828	0+;OA;BNS;SS7_DB;VERIFY_COLLECT	54.3
830	0+;OA;BNS;SS7_DB;VERIFY_3RD_Number	79.8
**326	1+;ACTS;CN	36.6
**321	1+;CAMA;ONI;NCN	25.5
**322	1+;ONI;SUCCESSFUL_VALIDATION	20.0
**328	1+;DD;HTL;PER_PD	43.7
**809	1+;OH;HTL;BILL_TO_ROOM	41.9
**815	1+;DD;CN;STA_PD;END_OFFICE WITHOUT RATE_STEP	52.0
518	QUEUE SEARCH FOR CAMA CALLS	29.8
520	Verify and connect	56.6
**526	Verify with scrambler	35.0

Table 10-34xxx
U.S. CM call times-host OC toPS configuration model

Call type	Call description	ms/Call attempt SN20
HOST OC TOPS configuration		
**335	0-;OH;NCN;INFO_ONLY_NO_OUTPULSING	15.4
333	0-;OH;NCN;INTER_X_CARRIER	23.1
334	0-;OH;NCN;PER_PD;END_OFFICE	21.6
531	0-;OH;NCN;OVS;XFR_IC;INTERLATA CARRIER	17.1
613	0-;OH;CN;PER_PD;END_OFFICE WITHOUT RATE STEP	23.4
619	0-;OH;CN;PER_PD;END_OFFICE;TICS	23.7
1140	0-;OH;NCN;PER_PD;GEN_AMA;ANS	36.2
340	0+;MCCS;NO_X_DB	2.6
488	0+;OA;NCN;STA_COL;END_OFFICE	23.2
486	0+;OA;NCN;STA_PD;END_OFFICE	21.3
489	0+;OA;NCN;PER_COL;END_OFFICE	23.0
**487	0+;OA;NCN;PER_PD;END_OFFICE	21.4
**614	0+;OH;CN;PER_PD;END OFFICE; WITHOUT RATE STEP	22.7
**618	0+;OA;NCN;PER_PD;END_OFFICE;TICS	19.8
627	0+;OA;CCN;SS7_DB;SUCCESSFUL	25.3
628	0+;OA;BNS;SS7_DB;VERIFY_COLLECT	22.9
630	0+;OA;BNS;SS7_DB;VERIFY_3RD_NUMBER	39.4
**341	1+;CAMA;ONI;NCN	12.7
**342	1+;ONI;SUCCESSFUL_VALIDATION	12.7
**347	1+;DD;HTL;PER_PD	23.4
**609	1+;OH;HTL;BILL_to_ROOM	20.3
615	1+;DD;CN;STA_PD;END_OFFICE WITHOUT RATE_STEP	24.6
**536	Queue Search for CAMA Calls	14.6
538	Verify and connect	32.3
**544	Verify with scrambler	21.9

Table 10-35xxx
U.S. CM call times-remote OC TOPS configuration model

Call type	Call description	ms/Call attempt SN20
**492	0-;OH;NCN;INFO_ONLY_NO_OUTPULSING	25.4
490	0-;OH;NCN;INTER_X_CARRIER	45.5
491	0-;OH;NCN;PER_PD;END_OFFICE	41.0
549	0-;OH;NCN;OVS;XFR_IC;INTERLATA CARRIER	38.1
713	0-;OH;CN;PER_PD;END_OFFICE WITHOUT RATE STEP	53.8
719	0-;OH;CN;PER_PD;END_OFFICE;TICS	56.2
1141	0-;OH;NCN;PER_PD;GEN_AMA;ANS	69.0
**724	0+;MCCS;SS7_DB;SUCCESSFUL	42.3
497	0+;MCCS;NO_X_DB	36.1
507	0+;OA;NCN;STA_COL;END_OFFICE	46.4
505	0+;OA;NCN;STA_PD;END_OFFICE	43.4
508	0+;OA;NCN;PER_COL;END_OFFICE	45.9
**506	0+;OA;NCN;PER_PD;END_OFFICE	43.4
545	0+;NCN;INTERLATA_CARRIER	18.1
**714	0+;OH;CN;PER_PD;END OFFICE; WITHOUT RATE STEP	53.6
**718	0+;OA;NCN;PER_PD;END_OFFICE;TICS	47.2
727	0+;OA;CCN;SS7_DB;SUCCESSFUL	61.8
728	0+;OA;BNS;SS7_DB;VERIFY_COLLECT	58.6
730	0+;OA;BNS;SS7_DB;VERIFY_3RD_NUMBER	84.1
**503	1+;ACTS;CN	36.6
**498	1+;CAMA;ONI;NCN	28.6
**499	1+;ONI;SUCCESSFUL_VALIDATION	21.3
**504	1+;DD;HTL;PER_PD	47.9
**709	1+;OH;HTL;BILL_to_ROOM	44.3
715	1+;DD;CN;STA_PD;END_OFFICE WITHOUT RATE_STEP	55.2
**554	QUEUE SEARCH FOR CAMA CallS	30.7
556	Verify and connect	62.5
**562	Verify with scrambler	37.6

Table 10-36xxx
U.S. CM call times-TOPS multi-purpose model

Call type	Call description	ms/Call attempt SN20
Stand-alone TOPS-MP configuration		
1130	0-;OH;NCN;PER_PD;END_OFFICE	38.3
1136	0-;OH;CN;PER_PD;END_OFFICE	49.0
1133	0+;OA;NCN;PER_PD;END_OFFICE	40.0
1139	0+;OA;CN;PER_PD;END_OFFICE	51.5
Host OC TOPS-MP configuration		
1128	0-;OH;NCN;PER_PD;END_OFFICE	21.8
1134	0-;OH;CN;PER_PD;END_OFFICE	23.7
1131	0+;OA;NCN;PER_PD;END_OFFICE	21.6
1137	0+;OA;CN;PER_PD;END_OFFICE	23.1
Remote OC TOPS-MP configuration		
1129	0-;OH;NCN;PER_PD;END_OFFICE	40.7
1135	0-;OH;CN;PER_PD;END_OFFICE	52.4
1132	0+;OA;NCN;PER_PD;END_OFFICE	43.4
1138	0+;OA;CN;PER_PD;END_OFFICE	53.8

Table 10-37xxx
U.S. CM call times-TOPS automated alternate billing service model

Call type	Call description	ms/Call attempt SN20
Stand-alone configuration		
**1172	AABS;0+;Collect;NCN;LIDB_DB;VERIFY	53.6
**1175	AABS;0+;BILL_3RD_PARTY;NCN;LIDB_DB;VERIFY	65.7
**1178	AABS;0+;CCN;NCN;LIDB_DB	44.1
1254	OPERATOR_HANDOFF VIA VSN BILLED_COLLECT	74.3
1257	OPERATOR_HANDOFF VIA VSN BILLED_3RD PARTY	82.0
Host OC configuration		
1170	AABS;0+;COLLECT;NCN;LIDB_DB;VERIFY	0

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Table 10-37xxx
U.S. CM call times-TOPS automated alternate billing service model (continued)

Call type	Call description	ms/Call attempt SN20
1173	AABS;0+;BILL_3RD_PARTY;NCN;LIDB_DB;VERIFY	0
1176	AABS;0+;CCN;NCN;LIDB_DB	0
1252	OPERATOR_HANDOFF VIA VSN BILLED_COLLECT	34.2
1255	OPERATOR_HANDOFF VIA VSN BILLED_3RD PARTY	33.2
Remote OC configuration		
**1174	AABS;0+;BILL_3RD_PARTY;NCN;LIDB_DB;VERIFY	65.7
**1177	AABS;0+;CCN;NCN;LIDB_DB	44.1
1253	OPERATOR_HANDOFF VIA VSN BILLED_COLLECT	74.0
1256	OPERATOR_HANDOFF VIA VSN BILLED_3RD PARTY	79.6
**1171	AABS;0+;COLLECT;NCN;LIDB_DB;VERIFY	53.6

End

Table 10-38xxx
U.S. CM call times-TOPS directory assistance model

Call type	Call description	ms/Call attempt SN20
Stand-alone TOPS - MP configuration		
1148	411 COMBINED_TRUNK VOICE_QUOTE ***Note:*** With ADAS, this call time is 55.6 ms/call attempt.	33.9
1151	411 COMBINED_TRUNK EXT_ARU	**37.2
1154	411 DA_TRUNK EXT_ARU NO_ANI	34.7
1163	INTERCEPT INTERCEPT_TRUNK EXT_ARU	18.8
1166	INTERCEPT INTERCEPT_TRUNK #_NOT_IN_DB VOICE_QUOTE	**26.6
1169	INTERCEPT INTERCEPT_TRUNK ONI EXT_ARU	35.5
1242	411 COMBINED_TRUNK CALL_COMPLETION STA_PD	**52.4
1245	411 CALL_COMPLETION AABS_CALLING CARD	77.9
1248	411 CALL_COMPLETION AABS_COLLECT	88.9
1251	411 Call_COMPLETION AABS_BILL 3RD PARTY	99.9
Host 0C TOPS - MP configuration		
1146	411 COMBINED_TRUNK VOICE_QUOTE	18.0

-continued-

Table 10-38xxx
U.S. CM call times-TOPS directory assistance model (continued)

Call type	Call description	ms/Call attempt SN20
1149	411 COMBINED_TRUNK EXT_ARU	**15.9
1152	411 DA_TRUNK EXT_ARU NO_ANI	17.9
1161	INTERCEPT INTERCEPT_TRUNK EXT_ARU	0
1164	INTERCEPT INTERCEPT_TRUNK #_NOT_IN_DB VOICE_QUOTE	**13.9
1167	INTERCEPT INTERCEPT_TRUNK ONI EXT_ARU	14.9
1240	411 COMBINED_TRUNK CALL_COMPLETION STA_PD	**15.9
1243	411 CALL_COMPLETION AABS_CALLING CARD	17.2
1246	411 CALL_COMPLETION AABS_COLLECT	19.3
1249	411 Call_COMPLETION AABS_BILL 3RD PARTY	20.6
Remote 0C TOPS - MP configuration		
1147	411 COMBINED_TRUNK VOICE_QUOTE	34.7
1150	411 COMBINED_TRUNK EXT_ARU	**37.4
1153	411 DA_TRUNK EXT_ARU NO_ANI	34.7
1162	INTERCEPT INTERCEPT_TRUNK EXT_ARU	18.8
1165	INTERCEPT INTERCEPT_TRUNK #_NOT_IN_DB VOICE_QUOTE	**29.1
1168	INTERCEPT INTERCEPT_TRUNK ONI EXT_ARU	36.4
1241	411 COMBINED_TRUNK CALL_COMPLETION STA_PD	**52.6
1244	411 CALL_COMPLETION AABS_CALLING CARD	76.9
1247	411 CALL_COMPLETION AABS_COLLECT	84.7
1250	411 Call_COMPLETION AABS_BILL 3RD PARTY	95.0

End

Table 10-39xxx
U.S. CM call times-equal access operator services system model

Call type	Call description	ms/Call attempt SN20
Stand-alone		
1115	INTRALATA;DP;0-;NCN;PER_PD	37.1
1124	INTERLATA;DTMF;PRE_SUB;0-;CN;PER_PD	57.4
1112	INTRALATA;DTMF;O+;NCN;PER_PD	39.9

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Table 10-39xxx
U.S. CM call times-equal access operator services system model (continued)

Call type	Call description	ms/Call attempt SN20
1118	INTERLATA;DTMF;PRE_SUB;O+;NCN;PER_PD	43.7
1121	INTERLATA;DTMF;10XXX;0+;NCN;PER_PD	42.5
1127	INTERLATA;DP;10XXX;1+;CAMA;ANI_FAIL	28.5
Host		
1113	INTRALATA;DP;0-;NCN;PER_PD	21.4
1122	INTERLATA;DTMF;PRE_SUB;0-;CN;PER_PD	26.4
1110	INTRALATA;DTMF;O+;NCN;PER_PD	20.9
1116	INTERLATA;DTMF;PRE_SUB;O+;NCN;PER_PD	20.0
1119	INTERLATA;DTMF;10XXX;0+;NCN;PER_PD	20.0
1125	INTERLATA;DP;10XXX;1+;CAMA;ANI_FAIL	12.7
Remote		
1114	INTRALATA;DP;0-;NCN;PER_PD	42.1
1123	INTERLATA;DTMF;PRE_SUB;0-;CN;PER_PD	62.4
1111	INTRALATA;DTMF;O+;NCN;PER_PD	42.2
1117	INTERLATA;DTMF;PRE_SUB;O+;NCN;PER_PD	46.8
1120	INTERLATA;DTMF;10XXX;0+;NCN;PER_PD	47.8
1126	INTERLATA;DP;10XXX;1+;CAMA;ANI_FAIL	32.4

End

Table 10-40xxx
Canadian CM call times-line origination model

Call type	Call description	ms/Call attempt SN20	SN40
001	POTS DP Line - Ineffective	2.2	1.3
002	POTS DP Line - POTS Line	7.3	4.5
003	POTS DP Line - EAS Trunk	6.5	3.9
006	POTS DP Line - LAMA Trunk	13.2	*7.8
007	POTS DP Line- OUTCAMA Trunk	9.1	*5.7
675	POTS DP Line - RES Line	7.3	5.3
**008	POTS DTMF Line - Ineffective	2.3	1.4
**009	POTS DTMF Line- POTS Line	7.5	4.6

-continued-

Table 10-40xxx
Canadian CM call times-line origination model (continued)

Call type	Call description	ms/Call attempt SN20	SN40
676	POTS DTMF Line - RES Line	9.0	5.4
**010	POTS DTMF Line - EAS Trunk	6.5	3.9
**012	POTS DTMF Line - LAMA Trunk	12.9	*7.9
013	POTS DTMF Line - OUTCAMA Trunk	9.3	*5.8
699	RES DP Line - POTS Line	13.3	*8.3
716	RES DP Line - RES Line	10.4	6.4
673	RES DP Line - Ineffective	2.8	1.6
677	RES DP Line - MF Trunk	8.9	5.6
670	RES DTMF Line - POTS Line	7.5	6.1
1182	RES DTMF Line - RES DTMF Line	10.7	5.4
674	RES DTMF Line - Ineffective	2.8	1.7
669	RES DTMF Line - MF Trunk	9.0	5.6
798	RES DTMF Line - LAMA Trunk	13.1	*8.9
799	RES DTMF Line - CAMA Trunk	14.7	*9.3
**060	MDC DP Line - MDC Line	10.6	6.6
934	MDC DP Line - Ineffective	2.8	1.7
**061	MDC DP Line W/SMDR - MDC Line	14.5	*9.0
062	MDC DP Line - MDC Line (NO Answer)	9.9	6.2
063	MDC DP Line - MDC Line (Busy)	2.9	1.6
064	MDC DP Line - EAS Trunk	11.0	6.8
646	MDC DP Line - LAMA Trunk	16.3	*10.1
066	MDC DP Line - OUTCAMA Trunk	16.3	*9.6E
067	MDC DP Line - Tie DP Trunk	15.6	10.1
305	MDC DP Line - Tie MF Trunk	12.3	7.7
068	MDC DP Line - Tie DTMF Trunk	17.8	11.4
069	MDC DP Line - Attendant	12.2	8.5
**072	MDC DTMF Line - MDC Line	10.8	6.0
935	MDC DTMF Line - Ineffective	2.9	1.7
351	MDC DTMF Line - Attendant	12.2	8.6
073	MDC DTMF Line - EAS Trunk	11.0	6.9
421	MDC DTMF Line - MF LAMA Trunk	16.4	*10.1
350	MDC DTMF Line - OUTCAMA Trunk	12.8	*8.1

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Table 10-40xxx
Canadian CM call times-line origination model

Call type	Call description	ms/Call attempt SN20	SN40
937	MDC DTMF Line - DP Tie Trunk	12.1	7.7
938	MDC DTMF Line - DTMF Tie Trunk	12.8	8.2
298	MDC DTMF Line - Off Hook Queuing	28.3	18.3
299	MDC DTMF Line - Call Back Queuing	38.1	24.6
077	EBS Line - Ineffective	3.8	2.3
079	EBS Line - EAS Trunk	13.1	8.2
936	EBS Line - OCAMA Trunk	14.0	*8.9
861	EBS Without Display - Attendant	12.7	8.9
863	EBS Without Display - EBS Without Display	13.4	8.3
876	EBS Without Display - MF IBNT2 Trunk	15.1	9.8
053	PBX DOD - Ineffective	6.6	4.4
588	PBX DP DOD - PBX DP DID	8.0	4.8

End

Table 10-41xxx
Canadian CM call times-trunk origination model

Call type	Call description	ms/Call attempt SN20	SN40
Trunk origination			
671	DP Trunk - RES Line	6.8	4.1
024	DP Trunk - Ineffective	3.8	2.3
**029	MF Trunk - Ineffective	4.7	2.8
034	MF Trunk - MDC Line	8.2	4.9
647	MF Trunk - MDC Line (Busy)	6.6	4.0
704	MF Trunk - RES Line	8.2	4.9
035	MF Trunk - EBS Line	9.2	5.6
036	MF Trunk - Attendant - MDC Line	22.4	15.8
037	DP EAS Trunk - POTS Line	5.2	3.2
**038	MF EAS Trunk - POTS Line	6.7	4.0
932	DP EAS Trunk - MDC Line	6.7	4.0
365	DP EAS Trunk - MDC Line (Busy)	5.1	3.2

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Table 10-41xxx
Canadian CM call times-trunk origination model (continued)

Call type	Call description	ms/Call attempt SN20	SN40
933	DP EAS Trunk - EBS	7.7	4.8
039	DP Trunk - Trunk	4.5	2.6E
**040	MF Trunk - Trunk	5.9	3.6
041	DP IT Trunk - Trunk	4.7	2.9
042	MF IT Trunk - Trunk	5.6	3.3
045	DP INCAMA Trunk - Trunk	11.3	*7.5
049	MF INCAMA Trunk - Trunk	12.0	*7.3
080	DP Tie Trunk - MDC Line	10.3	6.8
931	DP Tie Trunk - EBS Line	11.4	7.5
081	DP Tie Trunk - DP Tie Trunk	9.6	6.7
082	DP Tie Trunk - DTMF Tie Trunk	9.6	6.6
084	MF Tie Trunk - MDC Line	10.1	6.6
930	MF Tie Trunk - EBS Line	13.4	8.9
085	MF Tie Trunk - DP Tie Trunk	3.1	2.0
086	MF Tie Trunk - DTMF Tie Trunk	11.3	6.9
088	DTMF Tie Trunk - MDC Line	12.4	8.1
090	DTMF Tie Trunk - DTMF Tie Trunk	14.5	8.5E
**793	800+ Trunk - Trunk W/Query	22.9	*13.5E
SS7 Trunking			
1855	DP POTS Line - SS7 LAMA Trunk	18.8	*11.1
657	DP POTS Line - SS7 IT Trunk	14.6	8.7
795	DP POTS Line - SS7 to Trunk	21.8	13.3
678	DP RES Line - SS7 to Trunk	24.1	14.4
748	DP RES Line - SS7 IT LAMA Trunk	20.8	*12.6
655	DP MDC Line - SS7 IT LAMA Trunk	22.8	*13.7
**1851	DT POTS Line - SS7 EAS Trunk	12.7	7.6
1856	DT POTS Line - SS7 LAMA Trunk	18.9	*11.3
747	DT POTS Line - SS7 IT Trunk	16.3	9.6
796	DT POTS Line - SS7 to Trunk	21.8	13.5
1852	DT RES Line - SS7 EAS Trunk	15.8	11.1
698	DT RES Line - SS7 to Trunk	24.1	14.3
749	DT RES Line - SS7 IT Trunk	18.1	10.7

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Table 10-41xxx
Canadian CM call times-trunk origination model (continued)

Call type	Call description	ms/Call attempt SN20	SN40
1857	DT RES Line - SS7 LAMA Trunk	21.0	*12.7
1858	DT MDC Line - SS7 LAMA Trunk	22.6	*13.8
454	DTMF MDC Line - SS7 EAS Trunk	20.0	12.3
422	DTMF MDC Line - SS7 Toll Trunk	24.0	*14.1E
1859	EBS Line - SS7 LAMA Trunk	23.1	*14.9
649	EBS Line - SS7 to Trunk	27.5	17.0
661	EBS Line - SS7 IT Trunk	19.9	12.3
**654	SS7 IT Trunk - POTS Line	9.9	6.0
797	SS7 TI Trunk - POTS Line	9.9	6.0
672	SS7 TI Trunk - RES Line	10.9	6.5
604	SS7 Trunk - MDC Line (No Answer)	8.2	4.9
656	SS7 IT Trunk - DP MDC Line	10.8	6.4
662	SS7 IT Trunk - EBS Line	12.0	7.3
1850	MF INCAMA Trunk - SS7 Trunk	15.1	*9.2
658	MF PTS Trunk - SS7 IT Trunk	7.4	4.5
659	SS7 IT Trunk - MF PTS Trunk	8.0	5.1
**660	SS7 IT Trunk - SS7 IT Trunk	10.7	6.5
1849	SS7 TC Trunk - SS7 IT Trunk	10.6	6.5

End

Table 10-42xxx
Canadian CM call times-call time adjustments

Call description	ms/Call attempt SN20	SN40
ACD Terminating (Line-Line Intra-office)	19.4D	**12.1D
ACD Terminating (Trunk-Line)	13.4D	**7.3D
ACD Terminating Queue	6.8D	**5.0D
ACD with MIS	0.3D	**0.3D
ARS	0.5	0.5D
2nd Dial Tone	0.6	0.6D
Dial Tone Detect	6.0	6.0D

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Table 10-42xxx
Canadian CM call times-call time adjustments (continued)

Call description	ms/Call attempt SN20	SN40
SMDR	3.9	2.5D
POTS custom calling adjustments		
Assignments		
3-Way Calling	1.4D	0.8D
Call Waiting	1.4D	0.8D
Call Forward	1.8D	1.1D
Speed Calling	1.1D	0.6D
ACTIVATIONS		
3-Way Calling	63.7D	37.2D
Call Waiting	36.2D	21.2D
Call Forward	2.0D	1.5D
Speed Calling	0.2D	0.3D
MDC custom calling adjustments		
Assignments		
Ring Again	0.1D	0.1D
Call Forward	0.8D	0.6D
Call Forward Busy	0.9D	0.7D
Call Forward No Answer	5.6D	3.9D
3-Way Calling	0.0D	0.0D
Call Pick-up	0.0D	0.0D
Call Waiting	0.0D	0.0D
Speed Calling	0.3D	0.2D
Message Waiting	0.0D	0.0D
Call Transfer	0.0D	0.0D
Activations		
Ring Again	8.6D	24.4D
Call Forward	6.6D	4.7D
Call Forward Busy	6.7D	4.9D
Call Forward No Answer	16.6D	10.5D
3-Way Calling	50.9D	33.7D
Call Pick-up	14.6D	8.4D
Call Waiting	47.7D	28.0D

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Table 10-42xxx
Canadian CM call times-call time adjustments (continued)

Call description	ms/Call attempt SN20	SN40
Speed Calling	1.6D	0.9D
Message Waiting	30.1D	20.7D
Call Transfer	30.4D	20.5D
CMS custom calling adjustments		
Assignments		
CND	2.1D	1.9D
COT	2.1D	1.9D
ACB	0.3D	0.2D
AR	2.4D	1.6D
Activations		
COT Terminating	5.6D	4.6D
ACB Nodal Originating	9.7D	7.6D
ACB Nodal Terminating	3.0D	9.4D
ACB NTWK Originating	14.2D	9.2D
ACB NTWK Terminating	14.1D	9.2D
AR Nodal Originating	9.6D	6.5D
AR Nodal Terminating	9.3D	7.0D
AR NTWK Originating	14.3D	10.8D
AR NTWK Terminating	14.4D	10.3D

End

Table 10-43xxx
U.S. CM call times-TOPS/AOSS model

Call type	Call description	ms/Call attempt SN20	ms/Call attempt SN40
TOPS standalone			
092	Operator HANDLED NCN	42.6	27.2
098	Operator Assisted NCN	43.1	26.8
099	Operator Assisted CN	50.3	32.6
113	0- Information Only	22.7	15.2
115	NCN ONI CAMA	26.6	17.2

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Table 10-43xxx
U.S. CM call times-TOPS/AOSS model (continued)

Call type	Call description	ms/Call attempt SN20	ms/Call attempt SN40
117	Busy Line Verify	28.1E	18.6E
TOPS Remote OC			
138	0- Information Only	22.8	15.9
140	Busy Line Verify	28.3E	18.3E
AOSS			
1853	AOSS Trunk - AOSS Position - ARU	37.2	21.9E
1854	AOSS Trunk - ARU	18.8	11.1E
DMS-300			
3500	ANSI#7 - CCITT#7 (Answered)	15.6	*9.2E
3501	ANSI#7 - CCITT#7 (Un-answered)	13.6	*8.0E
3502	ANSI#7 - CCITT#7 (Near-end Congest.)	15.5	*9.1E
3503	ANSI#7 - CCITT#7 (Far-end Congest.)	15.1	*8.9E
3504	ANSI#7 - N5 DIG. (Answered)	13.2	*7.8E
3505	ANSI#7 - N5 DIG. (Un-answered)	12.1	*7.1E
3506	ANSI#7 - N5 DIG. (Near-end Congest.)	9.7	*5.7E
3507	ANSI#7 - N5 DIG. (Far-end Congest.)	11.9	*7.0E
3508	ANSI#7 - NO6 (Answered)	13.1	*7.7E
3509	ANSI#7 - NO6 (Un-answered)	12.5	*7.4E
3510	ANSI#7 - NO6 (Near-end Congest.)	9.8	*5.8E
3511	ANSI#7 - NO6 (Far-end Congest.)	15.8	*9.3E
3512	CCITT#7 - ANSI#7 (Answered)	15.3	*9.0E
3513	CCITT#7 - ANSI#7 (Un-answered)	13.0	*7.6E
3514	CCITT#7 - ANSI#7 (Near-end Congest.)	14.7	*8.6E
3515	CCITT#7 - ANSI#7 (Far-end Congest.)	14.6	*8.6E
3516	CCITT#7 - CCITT#7 (Answered)	14.9	*8.8E
3517	CCITT#7 - CCITT#7 (Un-Answered)	13.4	*7.9E
3518	CCITT#7 - CCITT#7 (Near-end Congest.)	10.1	*5.9E
3519	CCITT#7 - CCITT#7 (Far-end Congest.)	14.8	**8.7E
3520	N5 DIG. - ANSI#7 (Answered)	14.8	8.7E
3521	N5 DIG. - ANSI#7 (Un-answered)	12.5	*7.4E
3522	N5 DIG. - ANSI#7 (Near-end Congest.)	12.2	*7.2E

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Table 10-43xxx
U.S. CM call times-TOPS/AOSS model (continued)

Call type	Call description	ms/Call attempt SN20	ms/Call attempt SN40
3523	N5 DIG. - ANSI#7 (Far-end Congest.)	17.4	*10.2E
3524	N5 DIG. - R1 DIG. (Answered)	12.0	*7.1E
3525	N5 DIG. - R1 DIG. (Un-answered)	11.2	*6.6E
3527	N5 DIG. - R1 DIG. (Far-end Congest.)	10.6	*6.2E
3528	NO6 - ANSI#7 (Answered)	12.6	*7.4E
3529	NO6 - ANSI#7 (Un-answered)	10.3	*6.1E
3530	NO6 - ANSI#7 (Near-end Congest.)	12.5	*7.4E
3531	NO6 - ANSI#7 (Far-end Congest.)	8.3	*4.9E
3532	NO6 - R1 DIG. (Answered)	10.5	*6.2E
3533	NO6 - R1 DIG. (Un-answered)	9.5	*5.6E
3535	NO6 - R1 DIG. (Far-end Congest.)	9.6	*5.6E
3536	R1 DIG. - N5 DIG. (Answered)	12.2	*7.2E
3537	R1 DIG. - N5 DIG. (Un-answered)	10.0	*5.9E
3539	R1 DIG. - N5 DIG. (Far-end Congest.)	13.9	*8.2E
3540	R1 DIG. - NO6 (Answered)	11.7	*6.8E
3541	R1 DIG. - NO6 (Un-answered)	11.0	*6.5E
3542	R1 DIG. - NO6 (Near-end Congest.)	11.0	*6.5E
3543	R1 DIG. - NO6 (Far-end Congest.)	11.3	*6.6E

End

Table 10-44xxx
CM call times-Japan, Turkey, Belize, China, and Australia

Call type	Call description	ms/Call attempt SN20	ms/Call attempt SN40
JAPAN			
*	ISUP Trunk - ISUP Trunk	14.3	9.5E
*	ISUP Ineffect	4.8	3.2E
*	ISUP Trunk - ACD (No Queue)	35.9	23.9E
*	ISUP Trunk - ACD (Queue)	51.8	34.5E
*	ISUP Trunk - ACD Ineffect	22.9	15.3E

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Table 10-44xxx
CM call times-Japan, Turkey, Belize, China, and Australia (continued)

Call type	Call description	ms/Call attempt SN20	ms/Call attempt SN40
*	SRMF Trunk - SRMF Trunk	5.4	3.6E
*	SRMF Trunk - Ineffect	4.0	2.7E
*	SRMF Trunk - ACD (No Queue)	29.4	19.6E
*	SRMF Trunk - ACD (Queue)	47.0	31.3E
*	SRMF Trunk - ACD Ineffect	18.2	12.1E
Note: * Call type numbers will be established in BCS-36			
1882	PRI Trunk (IBNT2) - DTMF Trunk (IBNT0)	15.0	10.0E
1883	PRI Trunk (IBNT2) - DP Trunk (IBNT0)	14.9	9.9E
1884	DTMF Trunk (IBNT1) - PRI Trunk (IBNT2)	18.3	12.2E
1885	DP Trunk (IBNT1) - PRI Trunk (IBNT2)	17.5	11.7E
1886	DP Trunk (IBNT1) - IBN7 ISUP Trunk	18.1	12.1E
1887	PRI Trunk (IBNT2) - IBN7 ISUP Trunk	19.1	12.7E
1888	IBN7 ISUP Trunk - DTMF Trunk (IBNT0)	14.3	9.5E
1889	DTMF Trunk (IBNT1) - IBN7 ISUP Trunk	18.7	12.5E
1890	DP Trunk (IBNT1) - DTMF Trunk (IBNT0)	15.8	10.5E
1891	DTMF Trunk (IBNT1) - DP Trunk (IBNT0)	16.7	11.1E
1892	DP Trunk (IBNT1) - DP Trunk (IBNT0)	39.9	26.6E
1893	DTMF Trunk (IBNT1) - DTMF Trunk (IBNT0)	41.7	27.8E
1894	IBN7 ISUP Trunk - DP Trunk (IBNT0)	14.2	9.5E
1895	IBN7 ISUP Trunk - PRI Trunk (IBNT2)	18.3	12.2E
1896	PRI Trunk (IBNT2) - PRI Trunk (IBNT2)	17.8	11.9E
Turkey/Belize			
742	DP Line - Announcement	7.3E	14.7
731	DT Line - Line	7.1E	14.2
732	DT Line - Busy Tone	5.6E	11.2
743	DT Line - Announcement	7.3E	14.6
733	DT Line - False Start	2.2E	4.3
734	DT Line - Partial Dial Abandon	2.2E	4.3
735	DT Line - Trunk	7.8E	15.6
736	DT Line - BLDN Announcement	7.4E	14.7
737	Trunk - Line	6.8E	13.7

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Table 10-44xxx
CM call times-Japan, Turkey, Belize, China, and Australia (continued)

Call type	Call description	ms/Call attempt SN20	ms/Call attempt SN40
738	Trunk - Busy Tone	4.4E	8.8
1019	Trunk - Abandon	5.3E	10.6
China			
831	DP Line - DP Line	7.1E	14.2
832	DP Line - Busy Tone	5.6E	11.2
833	DP Line - False Start	2.2E	4.3
834	DP Line - Partial Dial Abandon/3 Digits	2.2E	4.3
835	DT Line - DT Line	7.1E	14.2
836	DT Line - Busy Tone	5.6E	11.2
837	DT Line - False Start	2.2E	4.3
838	DT Line - Partial Dial Abandon/3 Digits	2.2E	4.3
896	DT Line - C1NONE Trunk	8.2E	16.4
1008	DT Line - C1ITLL Trunk	8.2E	16.4
898	C1NONE Trunk - DT Line	7.7E	15.4
895	C1NONE Trunk - Busy Tone	4.8E	9.6
1039	C1NONE Trunk - Abandon	6.1E	12.2
1018	C1ITLL Trunk - DT Line	7.5E	15.0
1048	C1CAMA Trunk - Abandon	6.1E	12.2
897	C1NONE Trunk - C1NONE Trunk	8.3E	16.6
1049	C1CAMA Trunk - C1ITLL Trunk	8.2E	16.4
1058	C1ITLL Trunk - C1NONE Trunk	6.2E	12.5E
Australia			
3400	ATUP - N5	17.1	10.1E
3401	ATUP - NO6	30.3	17.8E
3402	ATUP - CCITT ISUP	19.8	11.6E
3404	N5 - ATUP	18.5	10.9E
3414	N5 - AISUP	18.8	11.1E
3405	NO6 - ATUP	17.3	10.2E
3415	NO6 - AISUP	16.9	9.9E
3406	CCITT ISUP - ATUP	19.9	11.7E
3416	CCITT ISUP - AISUP	20.8	12.2E

-continued-

Table 10-44xxx
CM call times-Japan, Turkey, Belize, China, and Australia

Call type	Call description	ms/Call attempt SN20	ms/Call attempt SN40
3408	AISUP - N5	18.7	11.0E
3409	AISUP - NO6	18.6	10.9E
3410	AISUP - CCITT ISUP	20.5	12.1E

End

Table 10-45xxx
International feature activation/feature assignment costs

Call description	ms/Call attempt SN20	ms/Call attempt SN40
International feature activation costs		
Abbreviated Dialing	1.0E	2.1D
Call Diversion Subscriber	2.7E	5.8D
Call Diversion Busy	2.7E	5.8D
Warm Line	0.5E	0.9D
Hot Line	0.0E	0.0D
3-Way Calling Enquiring	16.0E	31.9D
3-Way Calling Conference	30.7E	61.5
6-Way Calling Enquiring	16.0E	31.9D
6-Way Calling Conference	29.0E	57.9
6-Way Calling Subsequent Conference	20.3E	40.5
Call Waiting	16.0E	32.0D
Call Waiting / Reject Waiting Call	19.4E	38.9
Call Waiting / Reject Original Call	31.7E	63.5
Call Waiting / Switch Between Parties	18.8E	37.6
Call Recording	1.8E	3.6D
International feature Assignment costs		
Abbreviated Dialing	0.4E	0.7D
Warm Line	0.6E	1.2D
Hot Line	0.4E	0.8D
Call Diversion Subscriber	0.4E	0.8D

-continued-

Table 10-45xxx
International feature activation/feature assignment costs (continued)

Call description	ms/Call attempt SN20	ms/Call attempt SN40
Call Diversion Busy	0.4E	0.8D
Call Waiting	0.3E	0.5D
3-Way Calling	0.3E	0.6D
6-Way Calling	0.4E	0.9D

End

Table 10-46xxx
ISDN call timings

Call type	Call description	ms/Call attempt SN20	ms/Call attempt SN40
Integrated services digital network (ISDN)			
1811	BRI (SS) - POTS 1FR	17.4	11.1
1812	BRI (SS) - EBS With Display	22.5	14.4
1813	EBS With Display - BRI (SS)	21.9	14.0
1814	BRI (SS) - BRI (FS)	29.5	19.3
1815	BRI (SS) - PRI	23.7	15.8
1816	BRI (FS) - BRI (FS)	33.6	22.9
1817	BRI (FS) - POTS 1FR	20.8	14.0
1818	BRI (FS) - EBS With Display	25.5	16.8
1819	EBS With Display - BRI (FS)	25.7	17.0
1820	BRI (FS) - BRI (SS)	28.2	18.8
1821	BRI (FS) - PRI	31.3	22.1
1826	PRI - PRI	12.9	9.2
1827	PRI - POTS 1FR	11.0	7.3
1828	PRI - EBS With Display	16.5	11.1
1829	EBS With Display - PRI	21.3	14.3
1830	PRI - BRI (SS)	19.3	13.1
1831	PRI - BRI (FS)	24.5	16.9
1832	BRI (SS) - SS7 Trunk	26.0	17.1
1833	BRI (FS) - SS7 Trunk	33.2	23.1

-continued-

Table 10-46xxx
ISDN call timings (continued)

Call type	Call description	ms/Call attempt SN20	ms/Call attempt SN40
1834	PRI - SS7 Trunk	21.6	14.2
1835	BRI (MFT) - BRI (MFT)	23.8	15.2
1836	BRI (MFT) - POTS 1FR	16.1	10.2
1837	BRI (MFT) - EBS With Display	21.1	13.6
1838	EBS With Display - BRI (MFT)	21.1	13.5
1839	BRI (MFT) - BRI (FS)	28.1	18.4
1840	BRI (MFT) - PRI	29.1E	19.7E
1841	BRI (FS) - BRI (MFT)	27.2	18.2
1842	PRI - BRI (MFT)	18.9	12.8
1843	BRI (MFT) - SS7 Trunk	25.4	16.5
1844	SS7 Trunk - PRI	23.7	15.6
1845	SS7 Trunk - BRI (FS)	26.8	15.8E
1846	SS7 Trunk - BRI (MFT)	20.7	13.4
1847	BRI (SS) - BRI (MFT)	24.4	15.6
BRI - Basic Rate Interface			
PRI - Primary Rate Interface			
SS - Stimulus Signalling			
FS - Functional Signalling			
MFT - Meridian Feature Transparency			
End			

Network capacity

Network architecture

A simplified block diagram of the basic DMS system (Figure 11-1) shows the relationship of the switching network to the DMS. The duplicated halves of the network are referred to as planes, designated plane-0 and plane-1. Each plane contains up to 32 network modules (NM). In this section, only the operation of plane-0 is described in detail; plane-1 operates identically and in parallel. Each of the 32 NMs in plane-0 has a corresponding mate in plane-1. The two corresponding NMs are referred to as a network pair.

Network modules

The network modules (NMs) are the major components of the network. An NM establishes and maintains two-way (4-wire) speech and signaling paths between itself and the peripheral modules (PM) for the duration of the call.

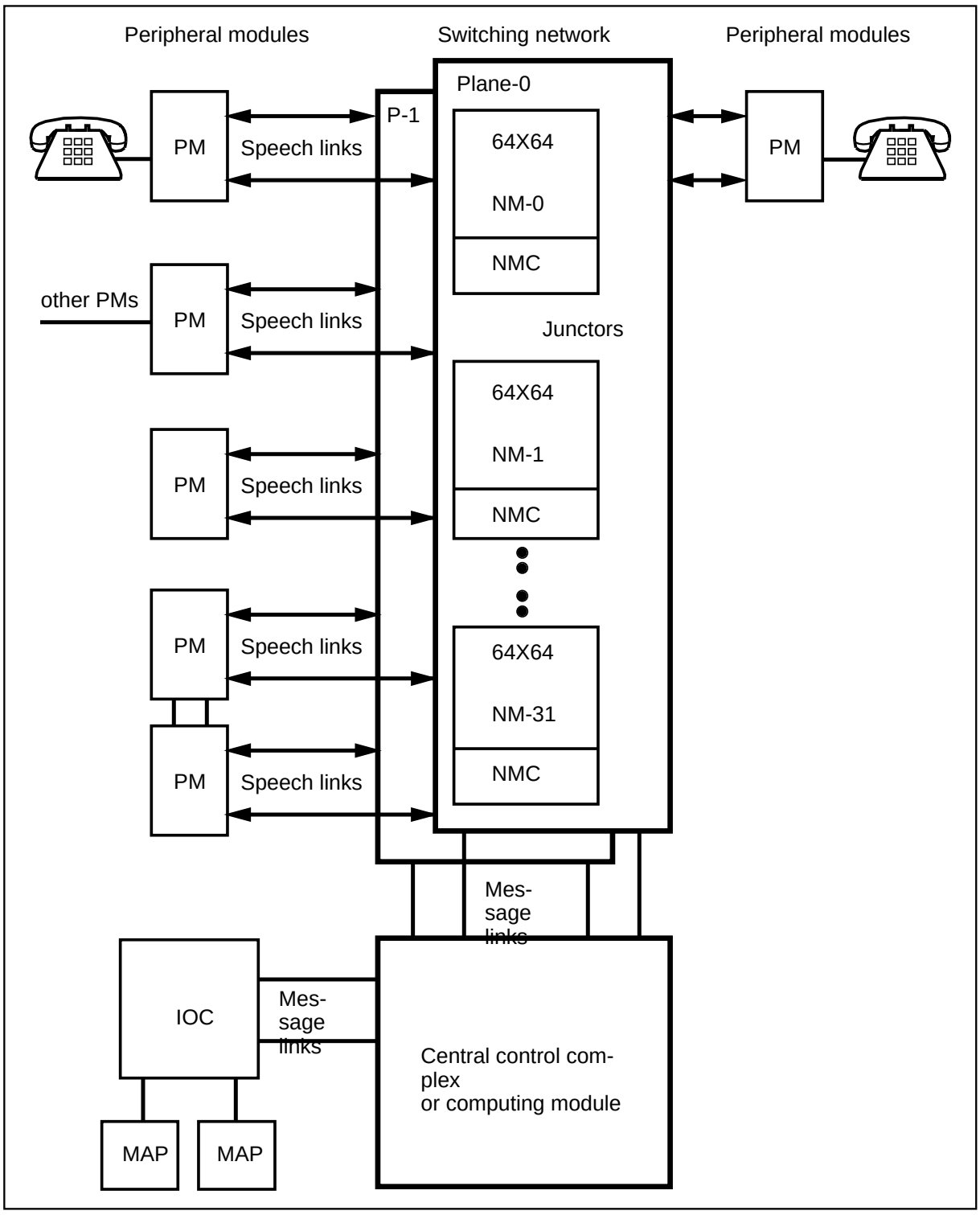
Each NM has the same configuration of 64 incoming ports and 64 outgoing ports to and from the PMs. There is more than one type of NM which accomplishes the same switching function, but they have different frame and card configurations. The frame and card configurations are described in the respective network descriptions.

Duplication of operation

The two planes of the network provide reliability for all call connections by duplicating the operation of the switching. Every active connection in one plane is backed-up by a corresponding inactive connection in the other plane. If any channel of the connection fails, the back-up channel is automatically made active, and takes over the call. A caller detects no loss of service when a back-up takes over.

The duplicated operation is supported by per-channel fault detection and parity checking, and the network maintenance subsystem. The duplication of the operation of an active component by an inactive component on standby is also referred to as redundancy. Each NM has 64 by 64 ports to handle the switching of calls.

Figure 11-1
Block diagram of simplified DMS-100 configuration



Network module controllers

Each NM contains a network message controller (NMC) that handles communications with the CC or DMS-Core and the PM. When control messages for the switching connections are handled, the NMC translates the messages into network connections. The NMC contains a pair of microprocessors that control the switching in the network and the test cards; and control communications with the PM and the CC or the computing module.

Network terminology

The terms that are used to describe the function of an NM are defined as follows. They are listed in logical sequence (not alphabetically).

Sides

Each NM has two sides, a receive (side-A) and a transmit (side-B). Side-A receives inputs from the PMs and switches outputs to Side-B of another or the same NM. Side-B receives inputs from Side-A of another or the same NM and transmits switched outputs to the PM.

Faces

Each side has two faces: the peripheral and the junctor. The peripheral face of side-A is connected to incoming channels from the PM and the peripheral face of side-B is connected to outgoing channels to the PM. The junctor face of side-A transmits outgoing channels from side-A to the side-B junctor face of another or the same NM.

Junctors

Junctors are the connections that carry data from side-A to side-B of the same or another NM. Junctors exist in two forms: serial and parallel. If the office has more than five network pairs, all junctors are serial.

Serial

Serial junctors carry 32 channels per junctor in serial data format between the junctor faces of sides-A and -B through the speech interfaces. Junctor patterns are adjustable to meet network traffic requirements. Serial junctors are used by the NT0X48, NT5X13, NT7X40, and NT8X11. The NT7X27 has no serial junctors because half of one network is hard-wired to half of the other.

Parallel

Parallel junctors are used by the NMs of the NT5X13 and consist of internal parallel buses from the outgoing time switches of side-A to the incoming time switches of side-B within the same NM. The parallel junctors carry from 32 to 512 channels in increments of 32 in parallel data format, and connect directly between time switches. Parallel junctors are used only if the total number of network pairs (planes-0 and -1) in an office is less than five.

The NT7X27 has only parallel junctors.

In the NT8X11 the parallel junctors occur in groups of 16 ports. Special cabling is required for the backplane.

Time switches

Each side of an NM (except for the NT8X11 which has one) has pairs of digital crosspoint time switches (TS); one incoming (IC) and one outgoing (OG). These form two stages of time switching for each NM. Each TS has a number of incoming and outgoing ports. The switching capability of an NM is expressed by the quantity of ports and channels.

Crosspoints

Crosspoints are the connections between the incoming and outgoing paths of a time switch.

Ports

Ports are the entry and exit points on the peripheral faces and junctor faces. Each port on the peripheral face carries 32 channels (30 voice, 1 signaling, and 1 used for system testing). The voice channels carry speech signals that are encoded into multiplexed pulse code modulated (PCM) encoded serial data samples. Each port on the junctor face carries 30 voice channels and two unused channels.

The sum of all the ports on all the TS is 64 ports incoming and 64 ports outgoing, per side, per NM. The ports are identified by an absolute port number in the range of 0-63.

Channels

There are 30 speech channels and 1 signaling channel per port, therefore, 64 ports gives 1920 speech channels and 64 signaling channels per side. One channel per port is used for testing the peripheral ports, but they can also be used for connections within the NM and on the junctors. The total channel capacity per side is: 1920 + 64 + 64 = 2048.

Interswitch links

The first- and second-stage crosspoints (IC and OG) are connected by interswitch link buses within each side of an NM. The crosspoints provide flexible (programmable) channel connectivity between each of the first stage and each of the second stage of time switching. Access to the interswitch link buses is controlled by timing so that the link between two TS exists only during the appropriate instant of the time switching. There are 2048 possible combinations of interswitch link buses. The buses are selected by messages from the CMC or the computing module, which maintain the busy or free status of the interswitch link buses.

Memories

Within each TS there is a data memory (DM) and a connection memory (CM). The DM is used to store PCM speech samples during the time switching, and the CM is used to store the addresses of the outgoing speech samples that are to be moved into specific timeslots by the switching process. Both the DM and the CM store one word of data for each channel entering the TS.

Since each TS accepts 16 ports at 32 channels per port, the memories have a capacity of 512 words each per TS (16x32=512). The words are identified as 0 through 511. For one side, the memory capacity of a single stage is 2048 words (4x512=2048). Therefore, there are 2048 words per face per side for both the DM and the CM.

Speech interface

Data passing to and from the PM, the junctors, and other networks is transmitted in the DS-30 format so that the PCM data and the clock and frame pulse may be sent over a single wire-pair. The speech interfaces contain encoding and decoding logic for clock and frame pulse data alignment buffers, and for balanced AC data driving and receiving circuits.

Network mounting frames

The frame configuration for the NT7X40 is the same as for the NT5X13. The difference between the NT5X13 and the package switches is the type and slot location of the cards. The NT7X27 is a single backplane version of the NT5X13 network with no junctor cards.

NT0X48 and NT5X13 frames mounted together

In an office having both NT0X48 and NT5X13 mounting frames, the frame discrimination number is used in a continuous sequence, regardless of NET frame type. In Figure 11-4 the second frame is identified as NETC 01, and the associated NM shelves are NET0 01 (plane-0) and NET1 01.

Network operation

The network types operate differently, but all types have the same function within the DMS system. The differences in the handling of signals are described in frame, channel, and bit times.

The differences in the uses of the link buses are described in:

- Interswitch link buses (NT0X48)
- Interswitch link buses (NT5X13)
- Interswitch link buses (NT8X11)

Frame, channel, and bit times

For the NT0X48, the signals arriving at the incoming ports of the crosspoint card consist of serial data streams.

For all other types of networks, the signals arriving at the incoming ports of the crosspoint cards consist of parallel data streams.

For all types of Networks, analog speech signals are encoded in 8-bit PCM and sampled at a rate of 8 kHz, or every 125 microseconds (us). The 125us are referred to as the frame-time.

During the frame-time, 32 different analog signals are sampled, which divides the 125us frame-time into 32 periods of 3.9us each. The 3.9us are called channel-times. The sample is coded by the PCM circuitry into an 8-bit number representing the binary value of the speech or signaling at that instant. This 8-bit value is part of a 10-bit word that also contains a parity bit and a channel supervision bit (CSB). The CSB is used to form a channel supervision message (CSM) between connected PM. These 10 bits subdivide each channel-time into 10 periods of 390 nanoseconds (ns) each, referred to as bit-times.

Incoming and outgoing formatters (NT0X48)

For the NT0X48 only, the incoming formatter is a dual-rank shift register with serial data entering the input rank while parallel data is leaving the output rank. The serial data is converted to parallel data. A mass transfer of the data accumulated in the input rank during one channel-time occurs at the end of that channel-time.

At the end of that channel-time, all data are transferred to the incoming formatter, second rank, while the data for the next channel enters the first rank. The parallel data words pass from the second rank incoming formatter to the DM where they are simultaneously written into word locations. From the DM the data continues through the time-switching process.

The cards that do the data conversion are as follows for the respective network type:

NT0X48

Serial to parallel conversion is done in the NT3X27 incoming crosspoint card. Parallel to serial conversion is done in the NT3X27 outgoing crosspoint card.

NT5X13

Serial to parallel conversion is done in the NT3X73 card. Parallel to serial conversion is done in the NT3X86 card.

NT8X11

Both serial to parallel and parallel to serial conversions are done in the NT8X12 port interface card.

Interswitch link buses (NT0X48)

In the serial-to-parallel (SP) conversion of the formatters, the 10-bit samples are written into permanently-assigned locations in the DM of the ICXPTs. During the time-switching that follows the formatting, the contents of any ICXPT DM is transferred over an interswitch link bus to any other OGXPT DM.

Each interswitch link bus provides ten parallel paths, one path for each of the ten bits of the parallel data. Since there are only ten physical connections between each of the eight pairs of ICXPT and OGXPT, and there are a total of 2048 samples to move, timing is used to obtain the number of unique paths required. With 64 interswitch link buses, there are 2048 unique paths that allow data to be transferred to a specific location in the DM of a particular OGXPT.

Selection of the links is controlled by the CC or the computing module software for the network. The 2048 interswitch links are identified by:

- the absolute link port number (0-63), representing one of the 64 interswitch link buses
- the link channel number (0-31), representing the channel-time that existed when the link was designated for the path.

Interswitch link buses (NT5X13)

Following the SP conversion process, the 10-bit samples are written into permanently-assigned locations in the DM of the first-stage TS. After the first-stage time switching operation, the contents of any first-stage DM location is transferred to any second-stage DM over an interswitch link bus.

Each interswitch link bus provides ten parallel paths, one path for each of the ten bits of the parallel data. Since there are only ten physical connections between each of the four pairs of first- and second-stage TS and there are a total of 2048 samples to move, timing is used to obtain the number of unique paths required.

The multiplexer (MUX) consists of ten paths, one for each DM bit. Each channel-time (3.9us) was used to build up a set of sixteen 10-bit data words

which were written into locations 0 through 15 in the DM. Each 195ns time slot within a channel-time represents the word from a particular channel and port (for example, time slot 0 during channel-time 0 represents the sample from port-0, channel-0). This same timing is used to enable the multiplexer to make a connection to the ten bits of a specific channel, port, and DM of the first-stage TS.

The interswitch link bus enables the 10-bit connection between the first- and second-stage TS DMs at word location 0. This interswitch link only exists during a 195ns time slot because, during the next time slot, the multiplexer moves on to access another channel-0 on the next port and switch. The selection by the multiplexer is controlled by the contents of the first-stage CM.

However, three other first- and second-stage TS memories are involved so that the 10-bit link buses are paralleled, making all four first-stage TS DMs equally accessible to all multiplexers and second-stage TS memories. For example, during time slot 0 of channel-time 0, while the interswitch link bus between ICXPT-0 and OGXPT-0 exists, three other interswitch link buses between the other pairs of switches also exist. The timing of the four multiplexers is offset so that interswitch link buses are always unique. The set of four multiplexers is referred to as the commutator.

Following the set of four interswitch link buses occurring during time slot 0 are fifteen other sets of four interswitch link buses during time slot 1 through 15 of channel-time 0. Time slots 16, 17, 18, and 19 are the unused dead times. Channel timing is arranged to cover the 4-slot gap. When channel-time 0 ends there will have existed 16 sets of 4 interswitch link buses for a total of 64.

This pattern of 64 interswitch link buses is referred to as one link channel and since it existed during channel-time 0, is referred to as link channel 0. Likewise, the patterns of 64 interswitch link buses occurring during channel-times 1 through 31 are designated link channels 1 through 31. The 64 link buses existing during each channel-time are identified individually by a link port number in the range of 0-63.

With 64 interswitch link buses, repeated during 32 channel-times, there are 2048 unique paths required to move the data over the links to a specific location in the DM of a particular second-stage TS. Selection of the links is controlled by the CC or the computing module through the first-stage CM. The 2048 interswitch links are identified by:

- the absolute link port number (0-63), representing one of the 64 interswitch link buses

- the link channel number (0-31), representing the channel-time during which the designated link bus existed.

Interswitch link buses (NT8X11)

The NT8X11 does not have interswitch link buses. Each of the two crosspoint cards gets 2048 channels in the DM so that 1024 outgoing channels can be switched.

Time switching

The activities of time switching for the NT0X48, NT5X13, and NT8X11 networks occur as follows (Figure 11-2).

- The calling party has dialed the digits of the directory number and the CC or the computing module has translated the digits of the called party into port and channel numbers on the peripheral face of:
  - an outgoing TS for all network types except NT8X11
  - the B-side TS (output bus) for NT8X11 (which has only one TS).
- The identification of the calling party was determined by the CC or the computing module when the calling party went off-hook (for example, port-0, channel-2); in terms of a port and channel number on the peripheral face of:
  - an incoming TS for all network types except NT8X11
  - the A-side TS (input bus) for NT8X11
- The CC or the computing module selects a path through a free interswitch link (NT5X13, NT7X27, NT7X40) or a free junctor between sides-A and -B (NT8X11); between:
  - the incoming and outgoing TSs for all network types except NT8X11
  - the input and output buses of the NT8X11

After the call path is established, each speech sample arriving at the incoming peripheral face on side-A of an NM progresses to its exit at the outgoing junctor face, or through an interswitch link enroute to side-B.

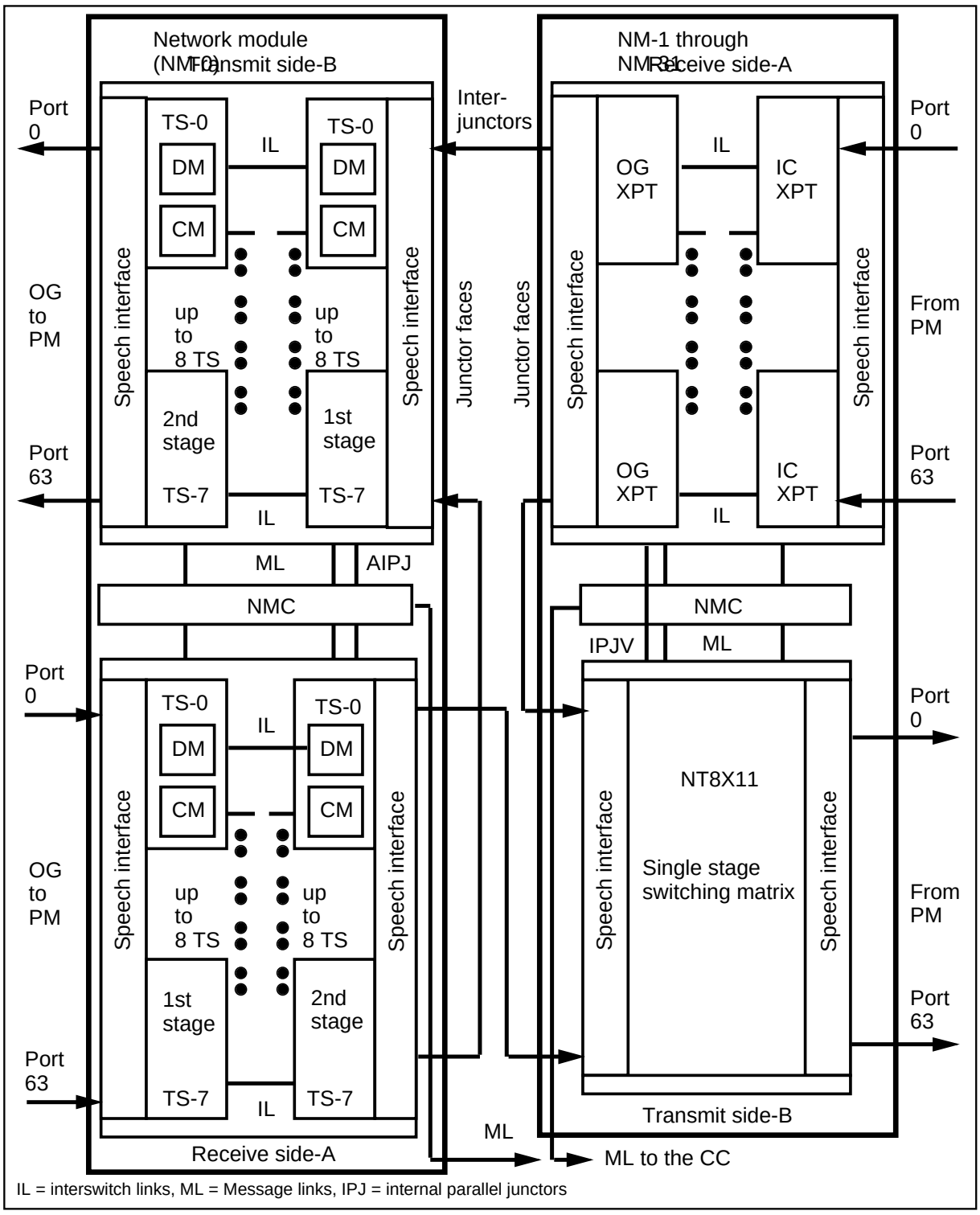
After decoding the speech sample in an interface card, data enters the DM of:

- the incoming TS for all Network types except NT8X11
- the A-side (input bus) TS for NT8X11.

The relationship between ports, channels, and word locations applies to:

- incoming XPT ports for NT0X48
- first-stage TS ports for NT5X13, NT7X27, and NT7X40.

Figure 11-2
Block diagram of NM functional units



The junctor port word locations are calculated by the NMC to adjust internal timing. The DM and CM word locations are actual numbers calculated by the NMC when the CC or the computing module assigns the network connection.

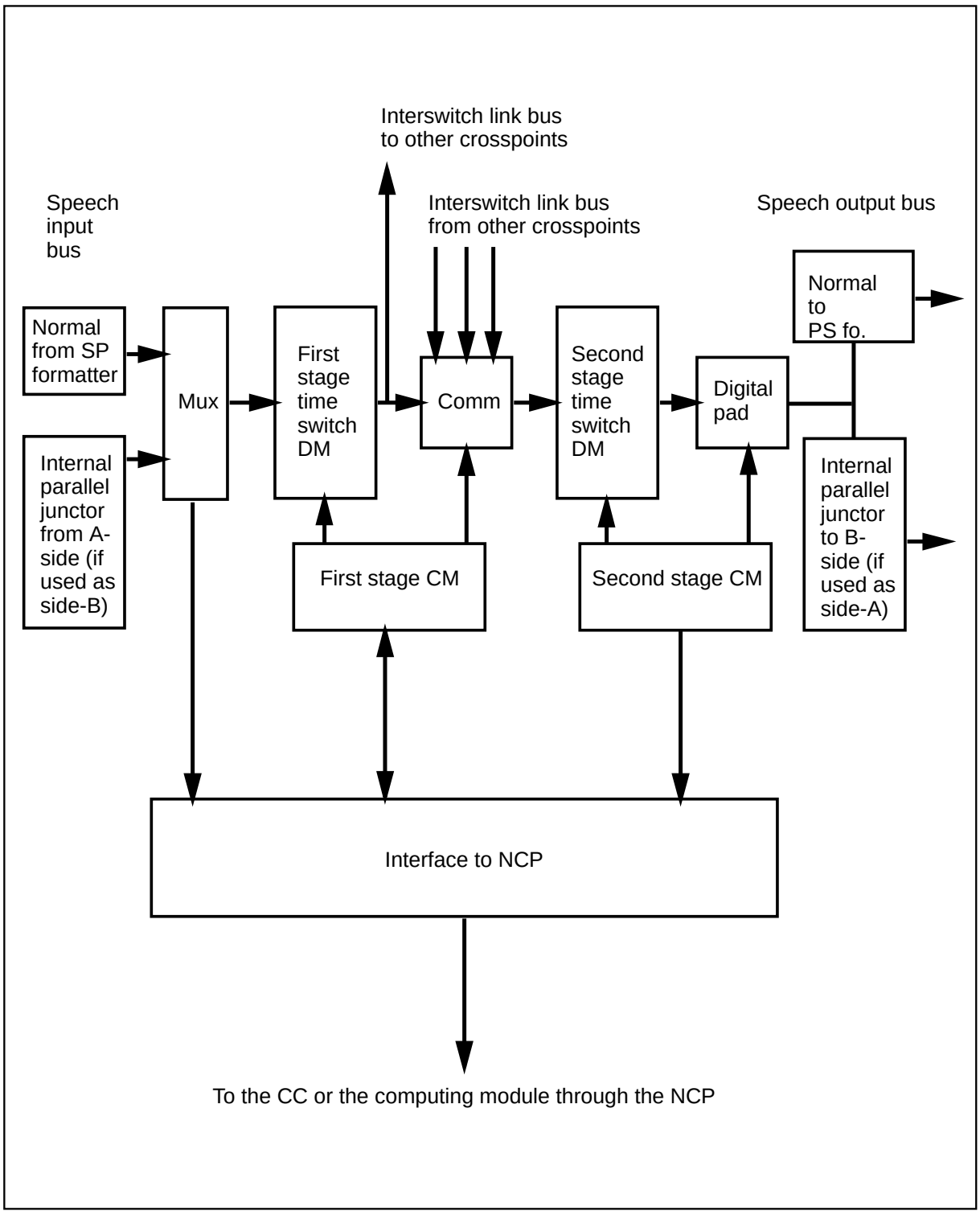
Parallel junctors (NT5X13, NT7X27, NT7X40)

The direct connections of the outgoing TS of side-A to the incoming TS of side-B provide sixteen parallel-data 32-channel junctor port connections between the DM of the first- and second-stage TSs in opposite sides of the same Network Crosspoint shelf. The advantage of the parallel junctor is that data between sides of the same NM need not be changed back to serial format through the PS formatter, but can be switched directly in parallel format between word locations in the respective DM. The requirements for serial interface cards and junctor cables are reduced, and in offices having a single NM pair, it is not necessary to have PS formatters or serial interface cards on the junctor face.

In Figure 11-3, parallel junctors are implemented by a multiplexer (MUX) on the crosspoint card, which is connected between the SP formatter and the input to the DM of the first-stage TS. The MUX normally passes speech samples (parallel data) from the SP formatter to the first-stage TS DM. If that junctor is a parallel junctor, a connection is made to permit data to enter the appropriate word location in the side-B DM.

All crosspoint cards are equipped with the MUX, which is only activated when the card is used in side-B. When used as a side-A crosspoint card, data from the second-stage TS DM is available to the MUX in side-B, but is only transferred to the side-B DM when the path through the MUX exists during the time-slot representing the assigned parallel junctor port and channel.

Figure 11-3
Block diagram of crosspoint card using parallel junctors



NT8X11

There are two kinds of junctors for the NT8X11 Network, called parallel intra-junctors and serial inter-junctors.

Intra-junctor

In an NM there are four intra-junctors, each of which is a 10-bit parallel bus running at 5.12 Mhz. Their function is to interconnect two crosspoint cards within the same NM. However, to reduce the quantity of junctor port cards, the parallel intra-junctors can also be used to connect up to three other network shelves provided the overall loop length is within 10 feet.

Using parallel junctors to interconnect NMs of the same network is possible only if the difference of the length between the links from the CMC or the message switch (MS) to the NMs is less than 200 feet. The differential phase between the network's shelf clock or frame pulse is within 90 nanoseconds. This is based on the assumption that the incoming PCM data from different NMs are latched in a register at the falling edge of the C195 clock in the crosspoint card before being written to the DM.

Data alignment of the frame pulse between network shelves may berequired for parallel junctoring. For the NT core only, a phase alignment circuit is in the clock card and can be manually adjusted during office commissioning.

Inter-junctor

When the network size grows beyond one network, inter-junctors are required to connect two networks. The parallel output port buses from the TS are input into the serial port cards within the NM. The serial port cards converts the parallel data into serial data. Since an inter-junctor port has the same DS-30 format as a PM port, the interface provided in the port card allows the serial inter-junctor.

On the other side of the TS, the port cards convert the serial PCM data before transferring it to the parallel input of the crosspoint card.

For an NT8X11, both P-side and junctor side use the same port card.

Comparison of port quantities

The main difference between the NT7X27 and the other types of networks is in the quantity of ports on each shelf.

- The NT5X13 and NT7X40 have eight interface cards at eight ports per card for a total of 64 ports per shelf (8x8).
- The NT7X27 has seven interface cards at eight ports per card for a total of 56 ports per shelf (7x8).

- The NT8X11 has four interface cards at sixteen ports per card for a total of 64 ports per shelf (4x16).

NT0X48 description

This part describes the configuration of the frame, the types of cards, and the function of the NT0X48. The NT0X48 has a single-bay network (NET) frame, as shown in Figure 11-4 .

The functions are performed by cards (printed circuit boards) that are plugged into the four NET shelves. All shelves are equipped with power converters which are fed from the -48V office battery through the power distribution center (PDC) and the frame supervisory panel (FSP) as described in *General Specification Frame Supervisory Panel,* GS0X28.

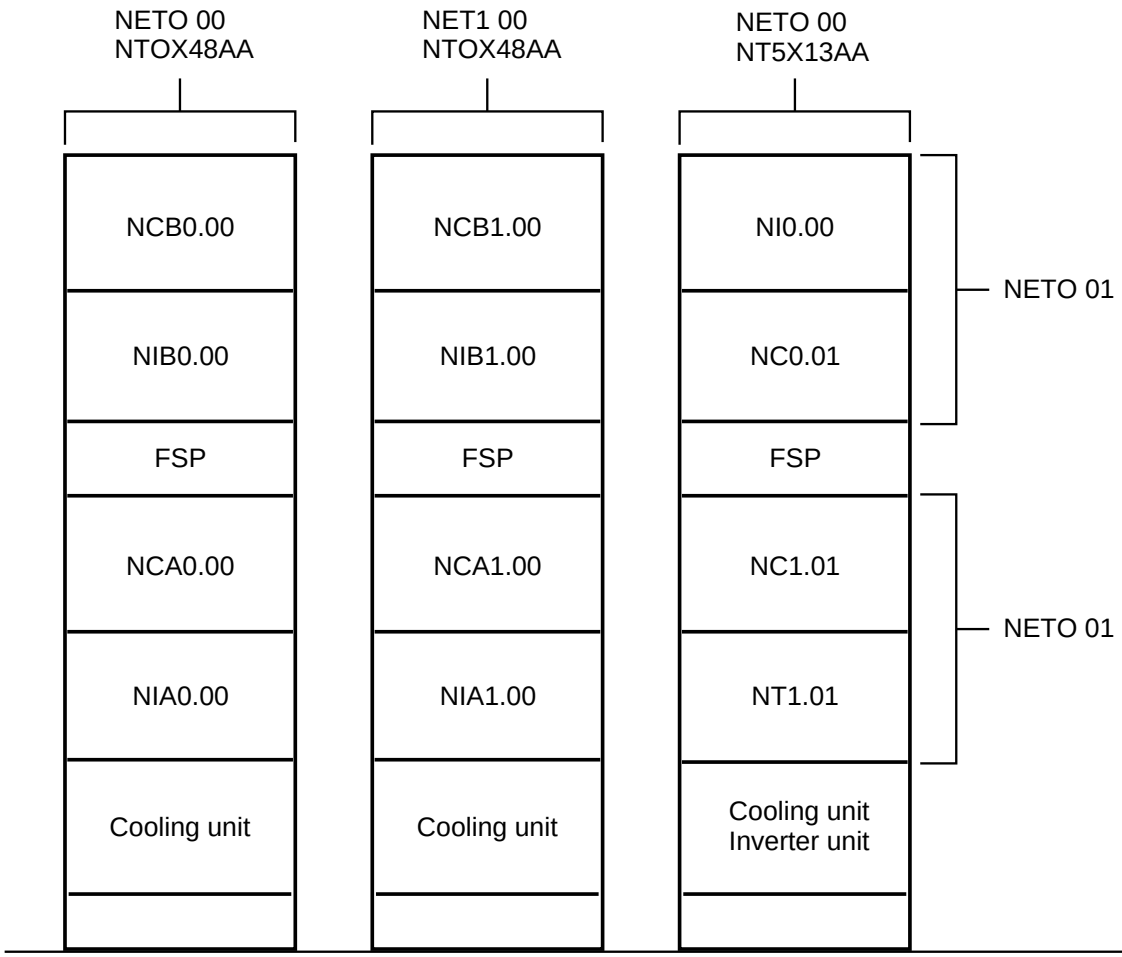
NT0X48 mounting frame

Each single-bay frame of the NT0X48 contains one NM. Therefore, each network plane requires from 1 to 32 frames to accommodate a complete set of NMs. Figure 11-4 shows an arrangement of one NM (frame) per plane.

The NT0X48 frames are identified, first by the plane, as NET0 or NET1, and then by the individual frame discrimination number, for example; NET0 00 and NET1 00. For a complete network, these identifications range up to NET0 31 and NET1 31.

The NM cards occupy four shelves in the frame. The FSP, which handles power distribution and alarms, occupies the center position.

Figure 11-4
NT0X48 and NT5X13 frame configuration



0 or 1 for the plane of the shelf

Each shelf serves A & B sides

NT0X48 frame:
NETO NET shelves, plane-0
NET1 NET shelves, plane-1

NT5X13 frame:
NETO NET shelves, plane-0
NET1 NET shelves, plane-1

Shelves:
NCA NET crosspoint, side-A
NIA NET interface, side-A
NCB NET crosspoint, side-B
NIB NET interface, side-B

Shelves:
NIO NET crosspoint, plane-0
NCO NET interface, plane-0
NC1 NET crosspoint, plane-1
NT1 NET interface, plane-1

Figure 11-5 shows a front view of the NM frame and identifies the card PECs and their slots. The shelves in the NT0X48 NET frame are identified according to the DMS-100 Family equipment location scheme. Each shelf is allotted a base mounting position number representing the location of the lowest mounting screws supporting the shelf in the frame. The range of base mounting holes is 00 to 77, with 00 at the bottom of the frame.

The shelves containing the cards for side-A of the NM are located in base mounting positions 18 and 32. The shelves containing the side-B components are in base mounting positions 51 and 65.

Shelves 32 and 65 contain the crosspoint cards which perform the TS functions. These shelves are referred to as the network crosspoint (NC) shelves, while shelves 18 and 32 contain the speech interface cards and are referred to as the network interface (NI) shelves. The NC shelf (32) for side-A is identified as NCA, followed by its plane and frame reference (for example, NCA0: 00). Similarly, the NI shelf for the same plane and side is identified as NIA0: 00. The same principle applies to the corresponding shelves in side-B and plane-1.

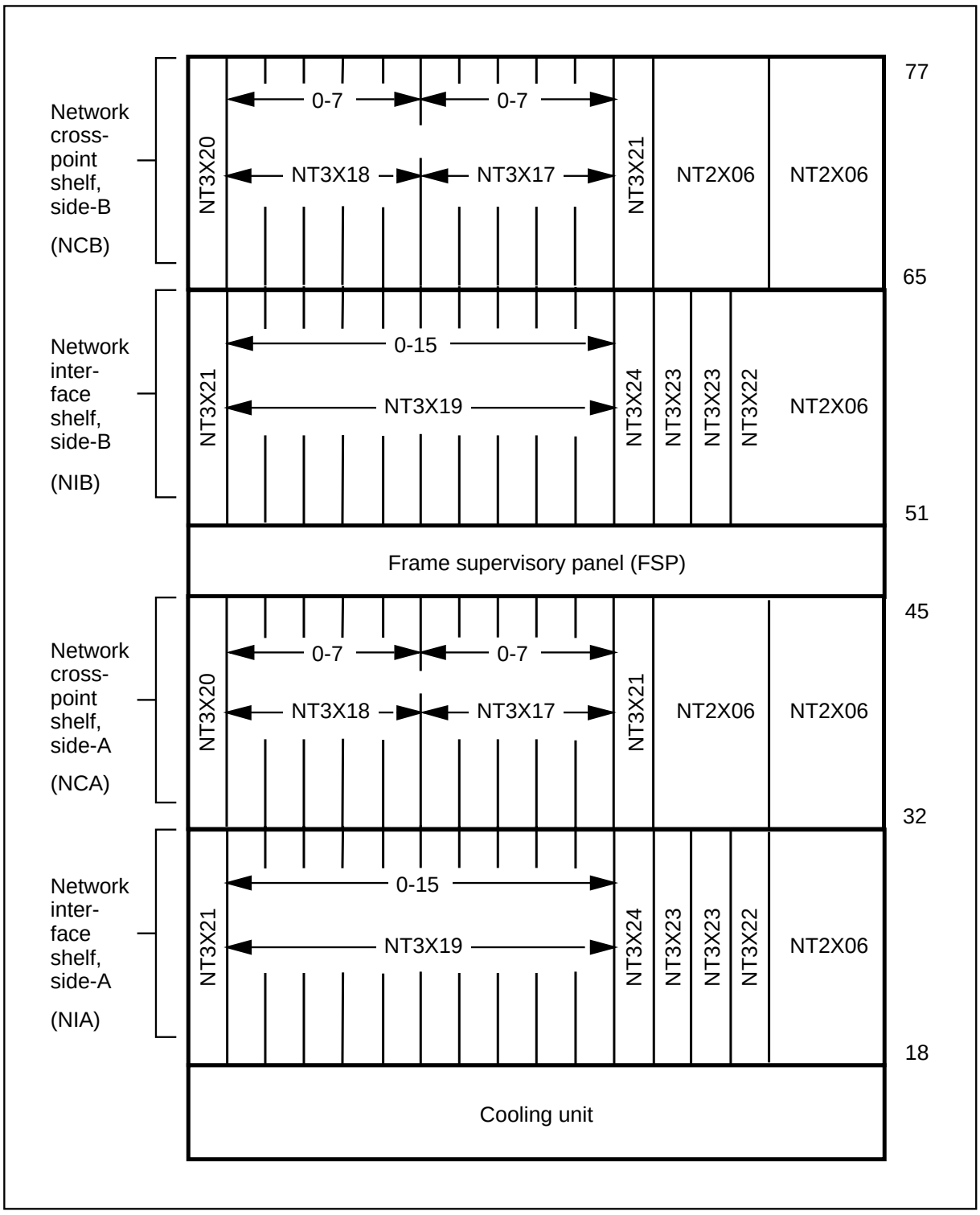
The network crosspoint shelf contains the incoming (IC) and outgoing (OG) crosspoint (XPT) time switch cards. There are eight IC XPT cards, identified as ICXPT-0 through ICXPT-7, and eight OG XPT cards, identified as OGXPT-0 through OGXPT-7, in each shelf. Each ICXPT card accepts a total of eight inputs from two IF cards (2x4), and each OGXPT card provides eight outputs to two IF cards. The eight ICXPT and eight OGXPT cards occupy sixteen locations in the center of the shelf. At the left end of the shelf is located the test access card, and at the right end of the shelf, a bus card which interfaces with the NMC circuits.

The configuration of the NC shelf is the same for both sides-A and -B. Shelf 32 is the NC shelf for side-A, while shelf 65 is the NC shelf for side-B.

Network interface shelf A is occupied mainly by the speech interface (IF) cards, of which there are sixteen, identified as IF-0 through IF-15 (Figure 11-5). Each IF card accepts four ports from the PM, giving a total of 64 ports (4x16) for the shelf. At the left end of the shelf a bus card interfaces with the test circuits and provides proper termination. At the right end of the shelf another bus card interfaces with the NMC circuits.

Network Interface Shelf B has the same arrangement of the speech interface cards as the NIA shelf, except that there is only one bus card at the left end of the shelf. The right end of the shelf contains the four cards which perform the NMC function.

Figure 11-5
NT0X48 NM frame and cards



NT0X48 NM cards

The main cards for a fully-equipped NM of an NT0X48 network are:

- NT3X17AA ICXPT cards
- NT3X18AA OGXPT cards
- NT3X19AA Speech interface cards

The following descriptions of the function of the cards apply to the receive side-A and the transmit side-B. The only difference is that in side-B the inputs arrive from another NM, or side-A of the same NM through the junctors, and the outputs connect to the PM. In side-A, the inputs arrive from the PM, and the outputs connect to the junctors.

NT3X17AA

The eight outputs from IF-0 and IF-1, each representing 32 channels of serial data, enter the incoming formatter and are converted to 32 sets of parallel data words, 10-bits per word, having 8 words per set.

NT3X18AA

An NM contains eight OGXPT numbered 0 through 7, each containing:

- a multiplexer (MUXER)
- a DM
- a CM
- an outgoing formatter (OFM)

All eight interswitch link buses from ICXPT-0 through -7 are connected to inputs -0 through -7 of the eight multiplexers. The bus from each ICXPT card is connected to the corresponding inputs on all of the OGXPT cards. That is, the output from ICXPT-0 is connected to the 0 inputs on OGXPT-1 through -7, and so on for the outputs from ICXPT -1 through -7.

The set of 8 multiplexers is referred to as the commutator. Each multiplexer output connects to a 256-word DM where each word is permanently assigned to one interswitch link port and channel. Samples are read out of the ICXPT DM and written into the OGXPT DM at the appropriate word location (address) and time that coincides with the existence of the assigned interswitch link bus.

The CM similarly has 256-word storage capacity where each word location is permanently assigned to a particular junctor port and channel. The CM is manipulated by a control message from the CC or the MS which assigns a free junctor and channel to the sample in the DM by writing the address of that sample into the free CM storage location. At the appropriate times, coincident with the assigned junctor ports and channels, the samples are read

out of the DM and enter the outgoing formatter, where the parallel data is converted back to serial format for transmission to the outgoing circuits of an IF card.

NT3X19AA

This contains decoders and buffers for the incoming circuits, and buffers and encoders for the outgoing circuits.

Incoming circuits

The decoders can accommodate four 32-channel ports (0-3) of incoming serial PCM at 2.56Mb/s, therefore, for the 64-port NM, 16 speech IF cards are required (designated IF-0 through IF-15). Each IF outputs four sets of 32-channel PCM samples which have been changed from the incoming pulse trains to serial data format by the decoder circuits. Test codes (TC) for maintenance are inserted and extracted at the IC buffers before the samples leave the speech card. All 16 IF cards operate similarly.

Outgoing circuits

Speech samples, in serial data format, re-enter the speech card from OGXPT-0. Internal messages are inserted at the OG buffers before the data passes to the encoder to be changed into a pulse train for outgoing transmission. Similar action occurs between OGXPT-1 through -7, and IF-1 through IF-15.

NT3X17AA activity

After leaving the incoming formatter, the parallel data is written into the DM. The DM stores up to 256 10-bit words, with each word location permanently assigned to a particular port and channel (the address). DM locations are identified by numbers 0 through 255. Thus, DM location 0 is assigned to port-0, channel-0, while location 255 is for port 7 channel 31.

The CM also has storage for 256 10-bit words (8 bits for data, 1 for busy/idle bit, 1 bit unused). Each storage location is permanently assigned to one of 256 10-bit parallel interswitch link buses to the OGXPT. A free interswitch link bus is assigned to any DM word through a control message from the CC or the MS. The address of the DM word IC port and channel number is written into the CM word location, representing the assigned interswitch link bus.

The complete NM of eight XPT can therefore accommodate 8 X 256 = 2048 speech channels and can switch them over eight interswitch link buses. The ICXPTs are identified as ICXPT-0 through -7. Internal messages (2 for each port) are extracted before the data leaves the DM.

Ports are identified by the absolute port number in the range of 0-63. Port-0 on ICXPT-0 has absolute port number -0, while Port-7 on ICXPT-7 has

absolute port number-63. All other port references are numbered accordingly.

NT0X48 NMC cards

All signaling and control messages between the CC or the MS and the NM pass through the NMC. The NMC is positioned on shelf 51 of the NET frame, and serves both the receive (A) and transmit (B) sides of the NM. The NMC cards of the NT0X48 are:

- NT3X20 (test access cards)
- NT3X21 (bus cards)
- NT3X22 (input/output interface (IF) cards)
- NT3X23 (input/output processor cards)
- NT3X24 (clock card)

NT3X20

NT3X20 tests the backplanes of NCB shelf 65 and NCA shelf 32, which are terminated at their distant ends. Each side of the NM contains an NT3X20 test access card. The side-A test access card is located on NCA shelf 32, and the side-B test card is on NCB shelf 65. The test access cards act as interswitch link bus terminators. One card provides the test access to the receive side and the other to the transmit side.

NT3X21

NT3X21 distributes to the NIA, NIB, and NCA, NCB shelf back planes the control signals generated by the input/output processor cards. The NT3X21 cards are located on shelves 65, 32, and 18. Shelf 51 receives control and timing signals directly. Two other NT3X21 bus cards are used at the far ends of shelves 51 and 18 for proper termination of the shelf backplanes.

NT3X22

NT3X22 interfaces the transmission of signaling and control messages to and from the CMC in the CCC or the MS in the DMS-SuperNode, and the two processors in the NMC. In the DMS-100 message handling system, handshake protocol is used. That is, no message sequence is initiated without receiving an acknowledgement from the receiver that it is ready to receive, and no sequence is completed without another acknowledgement after transmission that the reception is error-free.

NT3X23

NT3X23 communicates with the CC or the MS through the NT3X22 IF card. There are two processor cards. The processors manipulate the message data by routing the message to destinations, either within the NM (such as link or junctor connection commands, or to the address of a particular PM, instructing it to perform a call-processing or maintenance task.

One processor (NT3X23AA) handles all messages from the CMC or the MS, and is referred to as the C-side processor. Internal messages from the C-side processor, destined to the NM, are translated into control signals and routed to the NCA and NCB crosspoint cards. The C-side processor also receives internal messages from the PM which are extracted at the NT3X17 incoming XPT cards. Messages destined to a PM are routed to the P-side processor.

The other processor (NT3X23AB), referred to as the P-side processor, handles messages destined for a PM, which have been routed to it by the C-side processor. Messages destined to a PM are inserted into channel-0 of the appropriate outgoing port of the NT3X19 IF card, located on the NIA and NIB shelves to which the addressed PM is connected.

NT3X24

NT3X24 derives a 10.24 Mhz network clock pulse and a frame pulse (125 us) of data incoming from the CMC. All timing within the NM is controlled by the clock, and is also passed through the IF cards to the PM.

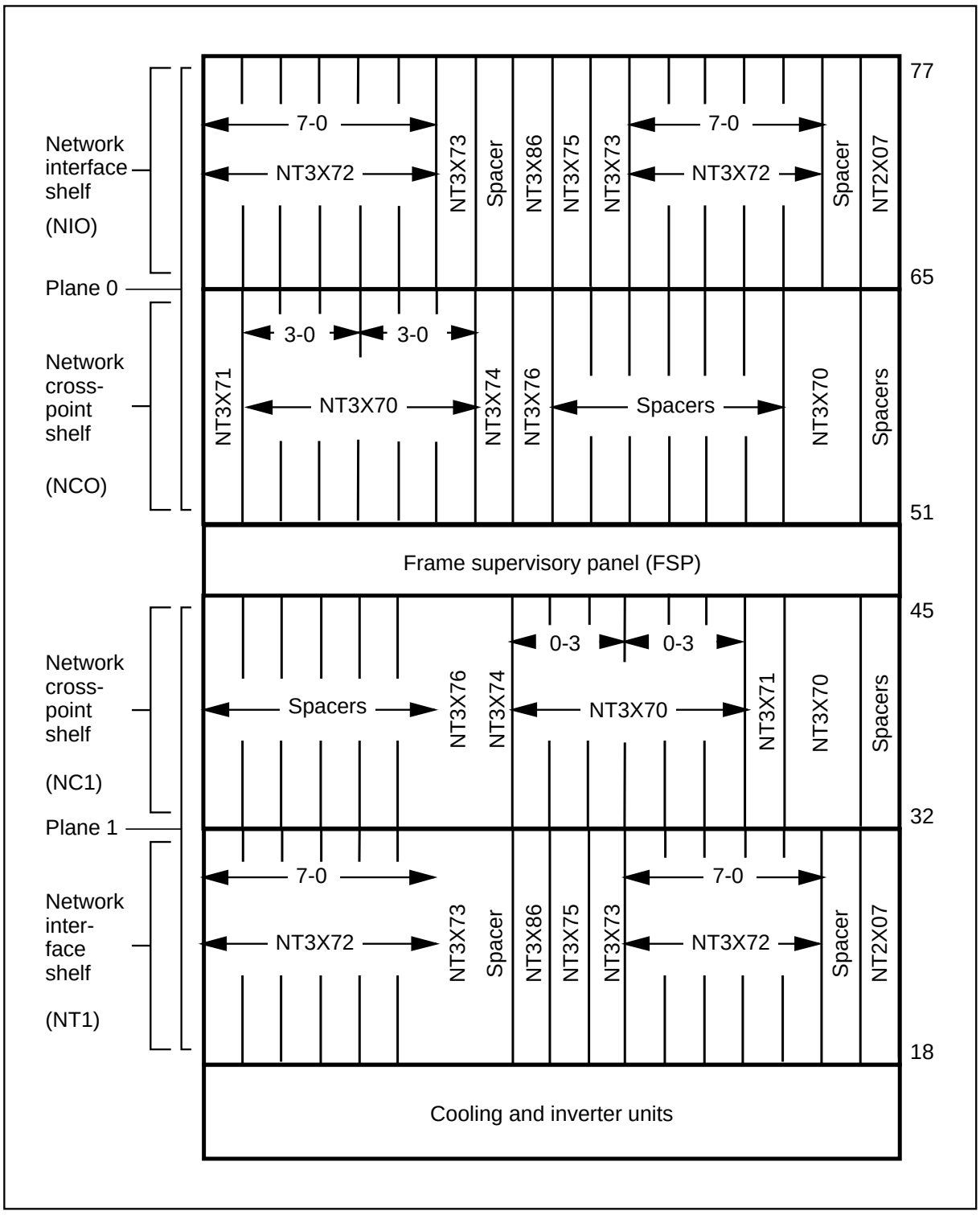
The CMC clock provides the common clock source for all networks. This allows the Networks to align their channels and firmware so that data can be switched across interswitch link buses going to and from the connecting DMs. Timing is also required in the PMs for similar reasons of synchronization.

NT5X13 description

The following paragraphs describe the configuration of the frame, the types of cards, and the function of the NT5X13. The NT5X13 has a single-bay Network (NET) frame, as shown in Figure 11-6.

The functions are performed by cards that are plugged into the four NET shelves. All shelves are equipped with power converters which are fed from the -48V office battery through the PDC and the FSP as described in *DMS-100F Power and Grounding Distribution Systems*, 297-1001-156 and in *General Specification Frame Supervisory Panel*, GS0X28, respectively.

Figure 11-6
NT5X13 NM frame and cards - fully equipped



NT5X13 mounting frame

Each single-bay frame of the NT5X13 contains two NMs as plane-0 and plane-1 respectively. A complete set of NM for both planes is accommodated in 32 frames (half the number required for NT0X48). Figure 11-6 shows an arrangement of one NM per plane.

The combined network frame is identified first as NETC, and then by the individual frame discrimination number, ranging from NETC 00 to NETC 31. In Figure 11-4 , the NT5X13 frame is identified as NETC 01.

The upper two shelves in the frame contain the NM cards for plane-0, while the lower two shelves contain the cards for plane-1. The FSP occupies the center position. Identification of NT5X13 is similar to that used for network NT0X48.

In Figure 11-7 the shelves in the NT5X13 NET frame are identified according to the DMS-100 Family equipment location scheme. Each shelf is allotted a base mounting number representing the location of the lowest mounting screws supporting the shelf in the frame. The range of base mounting holes is 00 to 77, with 00 at the bottom of the frame.

The NT5X13 frame contains equipment for two complete NM, one for plane-0 and the other for plane-1. The shelves containing the components for plane-0 are located in shelves 51 and 65. The plane-1 components are in shelves 18 and 32.

Shelves 65 and 18 contain the speech interface cards for planes-0 and -1, respectively. Shelf 65 is identified as the network interface shelf for plane-0 (NI0), while shelf 18 is the network interface shelf for plane-1 (NI1). Similarly, shelves 51 and 32 contain the network crosspoint cards for planes -0 and -1, respectively. Shelf 51 is identified as the network crosspoint shelf for plane-0 (NC0), while shelf 32 is the network crosspoint shelf for plane-1 (NC1).

Network interface shelf

Each NI shelf contains two sets of eight speech IF cards. Shelves NI0 (65) and NI1 (18) have identical configurations. One set interfaces with the junctors and the other set interfaces with the PMs by the P-side links. Both sets of cards are identified as IF-0 through IF-7. Each IF card accepts eight ports from the PM or junctors, giving a total of 64 ports (8x8) for the shelf.

Each side has an associated SP formatter and a PS formatter card. These cards are located between the IF cards for the two sides. The shelf also contains a P-side processor card which handles part of the NMC function involving messages between the NET and its associated PM.

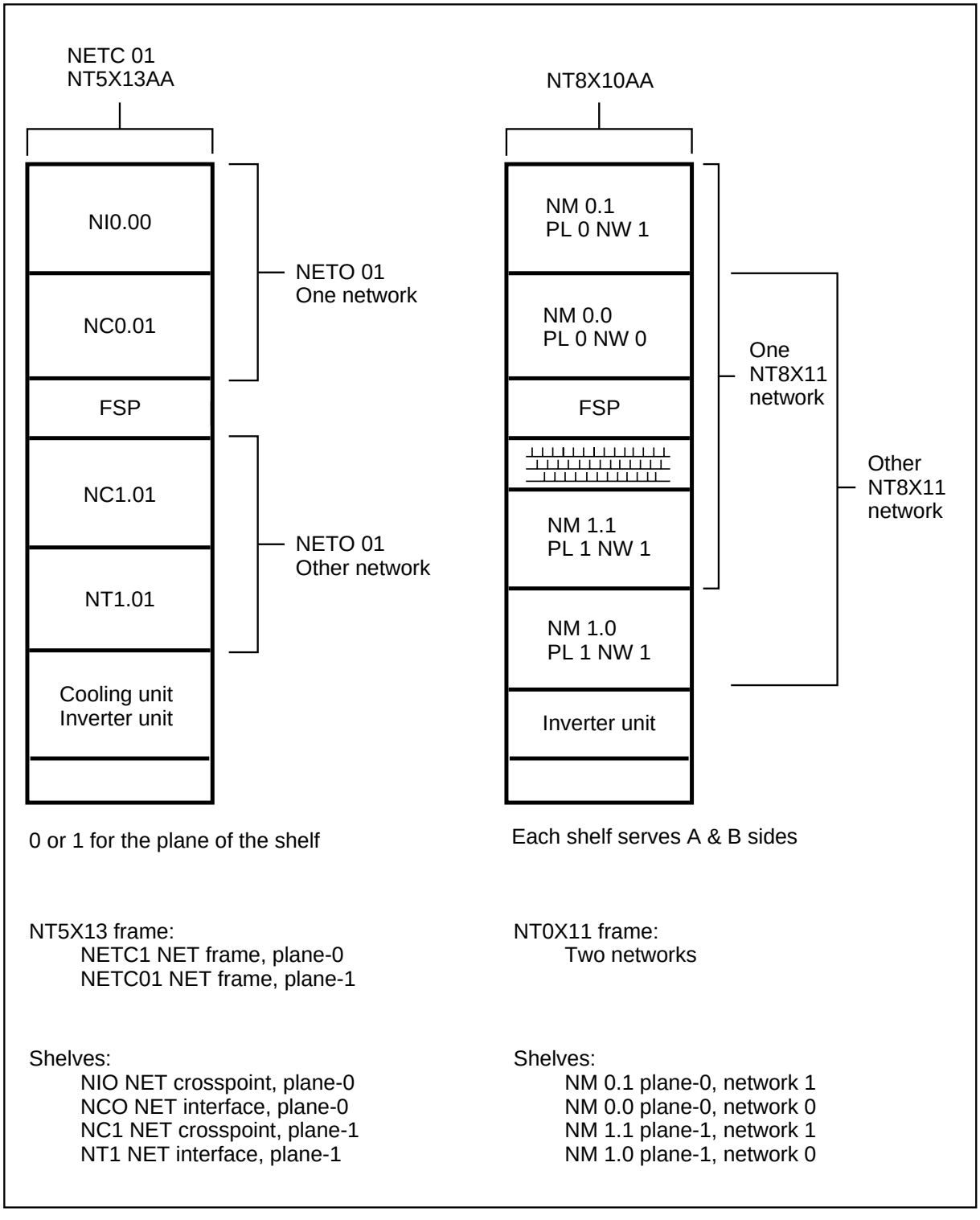
Network crosspoint shelf

Shelf 51 contains two sets of four crosspoint (XPT) cards, each performing both the incoming and outgoing crosspoint TS functions. The set at the left is used for side-A of an NM, and the set to the right is used for side-B. Both sets of cards are identified as XPT-0 through XPT-3.

Each XPT accepts 16 inputs from two IF cards, and provides 16 switched outputs to two IF cards. Inputs from the IF cards enter through the SP formatter, and outputs leave through the PS formatter. The total number of inputs and outputs for the four XPT cards is 64 (16x4).

The card positions for shelf 51, from left to right, are shown in Figure 11-7 . The remainder of the input side of the shelf is unused. Shelf 32 contains corresponding cards for plane-1 which are located in right to left configuration.

Figure 11-7
NT5X13 and NT8X11 frame nomenclature



NT5X13 NM cards

The main cards for a fully-equipped NM of an NT5X13 network are:

- NT3X70 Crosspoint cards
- NT3X71 Test code cards
- NT3X72 Serial port (speech) interface cards
- NT3X73 Serial-to-parallel (SP) formatter cards
- NT3X86 Parallel-to-serial formatter (PS) cards

The following description applies to the receive side-A and the transmit side-B. The only difference is that in side-B the inputs arrive from another NM, or side-A of the same NM, through the junctors, and the outputs connect to the PM. In side-A, the inputs arrive from the PM, and the outputs connect to the junctors.

NT3X70

This card contains the TS for 512 channels (one quarter) of one side of an NM. Speech data enters the XPT card in parallel format on a 10-bit wide bus carrying 512 channels. Since the format is parallel, the ports are separated in time, not in space. The data on this bus is written into the DM of the first-stage TS. The data in the DM is subsequently distributed to its own second-stage TS and to those on its three mate XPT cards through the interswitch link buses.

A space switching circuit known as a commutator is an integral part of the interswitch link buses. It creates a new 512-channel bus for the second-stage TS by selecting channels from its own first-stage TS and channels from each of the three mate XPT cards. The second-stage TS is identical to the first-stage TS. Speech data leaves the XPT card on a 10-bit wide bus.

Each TS has a DM and a CM. The DM does the actual time switching. During the instant assigned to the interswitch link bus, a speech sample is written into the DM at an address specified by a counter which repetitively cycles through the 512 active addresses of the memory, and a sample is read from the DM at an address supplied by the CM. It is this process which relocates the position of the channels in time on the parallel bus thereby performing a time switch function.

The CM holds information which sets the switching pattern. The switching pattern is written by the NCP in response to a control message from the CC or the computing module.

In addition to controlling the DM, the CM also:

- controls the space switching commutator on the interswitch links

- selects a digital pad which controls the level of the speech path following the outgoing time switch

NT3X71

The NT3X71 interfaces with a network control processor card (NT3X74) to allow the insertion and extraction of test code (TC).

NT3X72

This card provides eight bi-directional, 2.56 Mb/s serial port interfaces on shelf 18. Each card interface contains decoders and data alignment buffers for the incoming circuits, and encoders and buffers for the outgoing circuits.

Insertion of TC occurs only on the incoming speech path, while extraction occurs on either path.

Incoming Circuit

The decoders can accommodate eight 32-channel ports (0-7) of incoming serial PCM at 2.56 Mb/s from the PM, therefore, for a 64-port NM, 8 speech interface cards are required (designated IF-0 through IF-7). Each IF outputs eight sets of 32-channel PCM samples which have been changed from the incoming pulse trains to 10-bit serial data format by the decoder circuits.

The serial data stream from each decoder is paired with that from another port (for example, port-0 and port-1), and each pair of data streams is interleaved onto a 5.12 Mb/s serial (1 pair) bus to the SP formatter. Four 5.12 Mb/s serial buses (1 pair each) are used to carry the total of eight streams (four pairs) from IF-0 (ports 0-7) to the SP formatter.

A similar arrangement of four-pair 5.12 Mb/s serial buses carries data from IF-1 (ports 8-15) making a total of sixteen data streams (8 pairs) per couple of IF cards (IF-0, IF-1). The other ports (16-63) on IF-2 through IF-7 are similarly paired and also output 16 data streams per couple of IF cards.

Ports are identified by the absolute port number in the range of 0-63. Port-0 on IF-0 has absolute port number-0, while port-7 on IF-7 has absolute port number-63. All other port references are numbered accordingly.

Outgoing circuit

In the outgoing direction each IF card receives four 5.12 Mb/s binary serial speech buses, each carrying a pair of data streams from the PS formatter. The IF card demultiplexes these speech buses to the 2.56 Mb/s format and inserts internal messages. The data streams pass to the encoders to be changed into pulse trains for outgoing transmission through the appropriate ports.

NT3X73

An NT3X73 converts the incoming serial data received from the speech interface cards to the parallel format required for the crosspoint cards. The SP formatter consists of four identical sections. Each section is responsible for converting 16 ports (8 pairs) of speech data into a 512-channel, 10-bit parallel bus. Thirty-two (4 sections X 8 pairs) dual-port (1-pair) serial data buses from eight serial interface cards are received by the four SP formatter sections. It outputs four 10-bit parallel buses, one to each of the four crosspoint cards which comprise one side of an NM.

NT3X86

An NT3X86 converts parallel speech buses from the XPT cards to the serial format required by the serial port IF cards. The PS formatter consists of four identical sections. Each section is responsible for converting a 512-channel 10-bit parallel bus into sixteen (8-pairs) serial buses. Four parallel buses are received by the PS formatter, one from each of the four XPT cards which comprise one side of an NM. It outputs thirty-two (4 sections x 8 pairs) dual port (1-pair) serial data buses to eight serial IF cards.

NT5X13 NMC Cards

All signaling and control messages between the CC or the computing module and the NM pass through the NMC. The NMC consists of three cards, which are located on the NI and NC shelves, and serve both sides of their associated network plane. The NMC cards for plane-0 are on shelves 65 and 51, while the NMC cards for plane-1 are on shelves 32 and 18.

The NMC cards for the NT5X13 network are:

- NT3X74 Network control processor (NCP) card
- NT3X75 P-side processor card
- NT3X76 Network clock card

NT3X74

The NT3X74 card handles all messages from the CMC or the computing module, and performs the C-side processor function. Messages for the network are acted upon by the NCP itself, which has control buses to the XPT cards, the TC card, the clock card, and the P-side message processor. Network connections are established by writing DM addresses into the first- and second-stage TS CMs of both the A- and B-sides of the network.

The control bus to the TC card is used to specify the word locations and channels for TC insertion and extraction, and to return the extracted data to the control processor. Extracted TCs are held in registers in the TC card for access by the NCP. The NCP then reads the registers to check if a valid TC has been extracted.

The control bus to the clock card (NT3X76) performs various clock maintenance operations and accesses the network's transmission interface to the CC or the computing module.

The bus to the P-side message processor exchanges peripheral messages between the two processors. Messages addressed to the PM are routed to the P-side processor card for insertion into channel-0 of the appropriate port of the card to which the addressed PM is connected.

NT3X75

The NT3X75 handles message exchanges between an NM and its PM. The P-side of the processor is connected across the four parallel buses between the formatters and the XPT cards on the A- and B-sides of their peripheral faces. Messages from a PM are extracted at the output of the SP formatter, while messages to a PM are inserted at the input to the PS formatter. The processor is thus able to access all the channel-zero's going to and coming from the PM.

Four simultaneous message transactions can be handled, but only one at a time on each parallel bus. On its network side, the processor has access to a message buffer on the NCP card (NT3X74). Messages received from peripherals are deposited in this buffer to be relayed by the NCP to the CC or the computing module. The P-side processor also scans this buffer for outgoing messages. These are sent to the PM specified in the message headers.

NT3X76

This card interfaces the transmission of signaling and control messages to and from the CMS in the CC or the computing module in the DMS-SuperNode, and the two processors in the NMC. In the DMS-100 Family message handling system, handshake protocol is used. That is, no message sequence is initiated without receiving an acknowledgement from the receiver that it is ready to receive, and no sequence is completed without another acknowledgement after transmission that the reception is error-free. CMC or computing module messages carry only control data in serial format.

The network clock card for NT5X13 contains a circuit that generates a 10.24 Mhz clock pulse and a frame pulse (125us). The clock circuit periodically synchronizes itself with the frame pulse received from the incoming data from the CMC or the computing module. These clock and frame pulses control timing within the NM and, through the interface cards, to the PM.

NT7X27 and NT7X40 description

The NT7X27 and NT7X40 are specially packaged networks. They use similar types and cards but the cards are placed in different slots in their respective frames.

NT7X27

The NT7X27 has similarities to the NT5X13 but is mounted on only one shelf. The cards of the NT7X27 have the same function as the cards of the NT5X13 except that they are located in different slots in the shelves. Unlike the NT5X13, the NT7X27 cannot be expanded in the same manner. The NT7X27 has seven interface cards (numbered 0 to 6) at eight ports per card, therefore the quantity of ports per shelf is fifty-six (7x8). All of the ports are connected to P-side links. Also, the NT7X27 has a serial to parallel formatter for the A-side and a parallel to serial formatter for the B-side. All the junctors are parallel intra-junctors and inter-junctors. The NT7X27 has only two network configurations.

NT7X40

The NT7X40 is very similar to the NT5X13. It has two shelves per network plane and is used for SL-100.

For the description of the cards for the NT7X40, refer to the cards described in the section describing the NT5X13.

NT8X11 description

These paragraphs describe the configuration of the frame, the types of cards, and the function of the NT8X11. The NT8X11 has a single-bay network (NET) frame, as shown in Figure 11-7.

NT8X10 and DSNE

When two NT8X11 Networks are mounted in the same equipment frame, the frame is referred to as the NT8X10 or double shelf network equipment (DSNE).

The functions are performed by cards that are plugged into the four NET shelves. All shelves are equipped with power converters which are fed from the -48V office battery through the PDC and the FSP as described in *Power and Grounding Distribution Systems,* 297-1001-156 and in *General Specification Frame Supervisory Panel,* GS0X28, respectively.

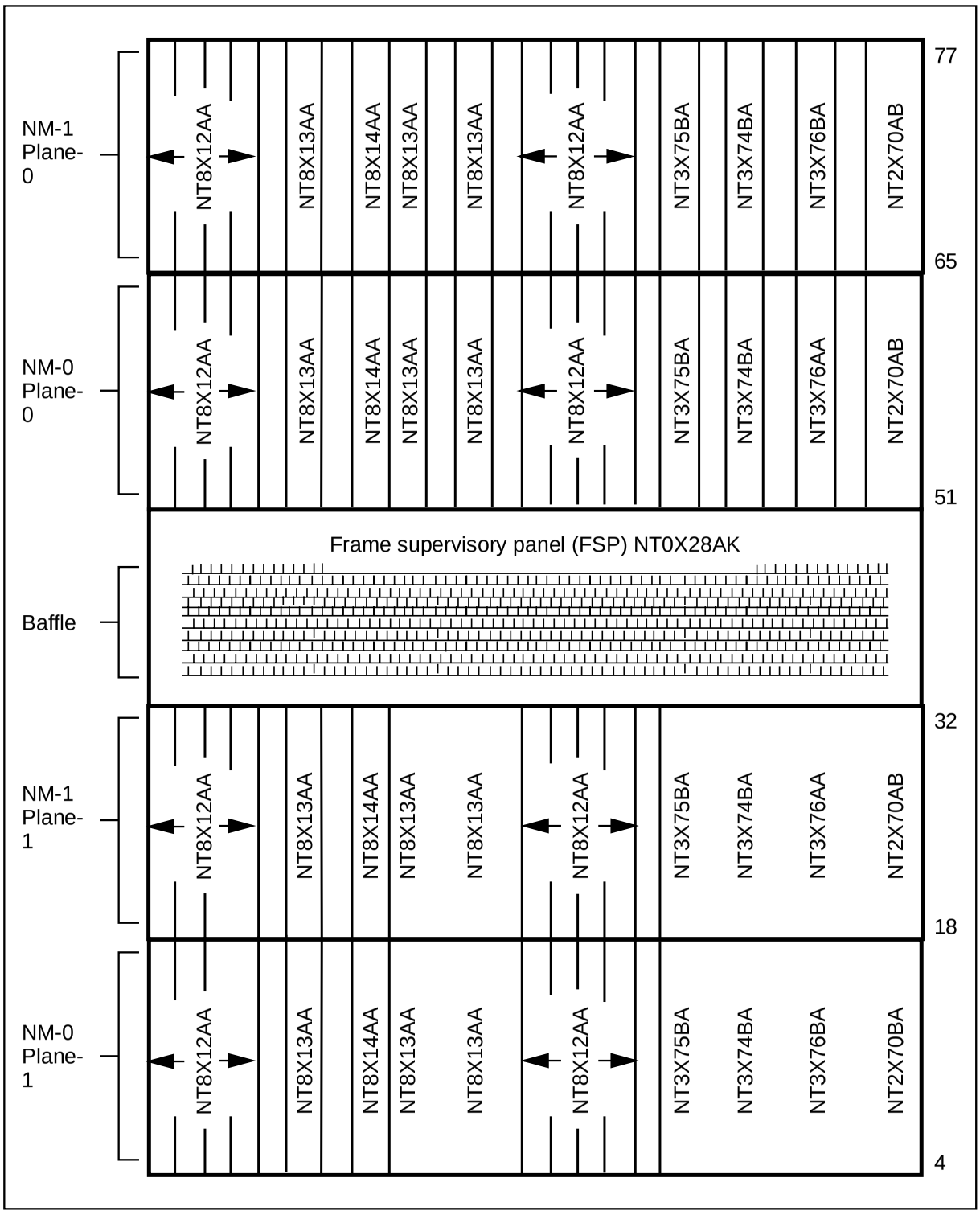
NT8X11 mounting frame

One single-bay frame of the NT8X11 contains two NMs as plane-0 and plane-1 respectively. A complete set of NMs for both planes is

accommodated in 16 frames (half the number required for NT5X13). Figure 11-8 shows an arrangement of one NM per plane per shelf. The combination of two NT8X11 Networks, the baffle, the different mounting positions, and the Inverter Unit in one frame is called the NT8X10 frame.

The network halves are identified as NET0 01 and NET1 01. NET0 01 has one shelf and NET1 1 has one half. For a comparison of the NT8X11 frame and the NT5X13 frame, see Figure 11-7. The upper two shelves in the frame contain the NM cards for plane-0, while the lower two shelves contain the cards for plane-1. The FSP occupies the center position.

Figure 11-8
NT8X11 NM frame and cards - two fully equipped networks



In Figure 11-8 the shelves in the NT8X11 NET frame are identified according to the DMS-100 Family equipment location scheme (described in *DMS-100F Equipment Identification,* 297-1001-120). Each shelf is allotted a base mounting number representing the location of the lowest mounting screws supporting the shelf in the frame. The range of base mounting holes is 00 to 77, with 00 at the bottom of the frame.

The NT8X10 frame contains equipment for four complete NMs, two for plane-0 and two for plane-1. The shelves containing the components for two plane-1s are located in shelves 51 and 65. The plane-0 components are in shelves 18 and 32.

Both the crosspoint and the interface cards are contained in one shelf, and each shelf contains one complete network. Therefore, one frame can contain two fully equipped network pairs.

The card positions for shelf 51, from left to right, are shown in Figure 11-8. The remainder of the input side of the shelf is unused. However, it allows heat to dissipate from the frame's equipment. Shelf 32 contains corresponding cards for plane-0 which are located in right to left configuration.

NT8X11 NM cards

The main cards for a fully-equipped NM of an NT8X11 network are:

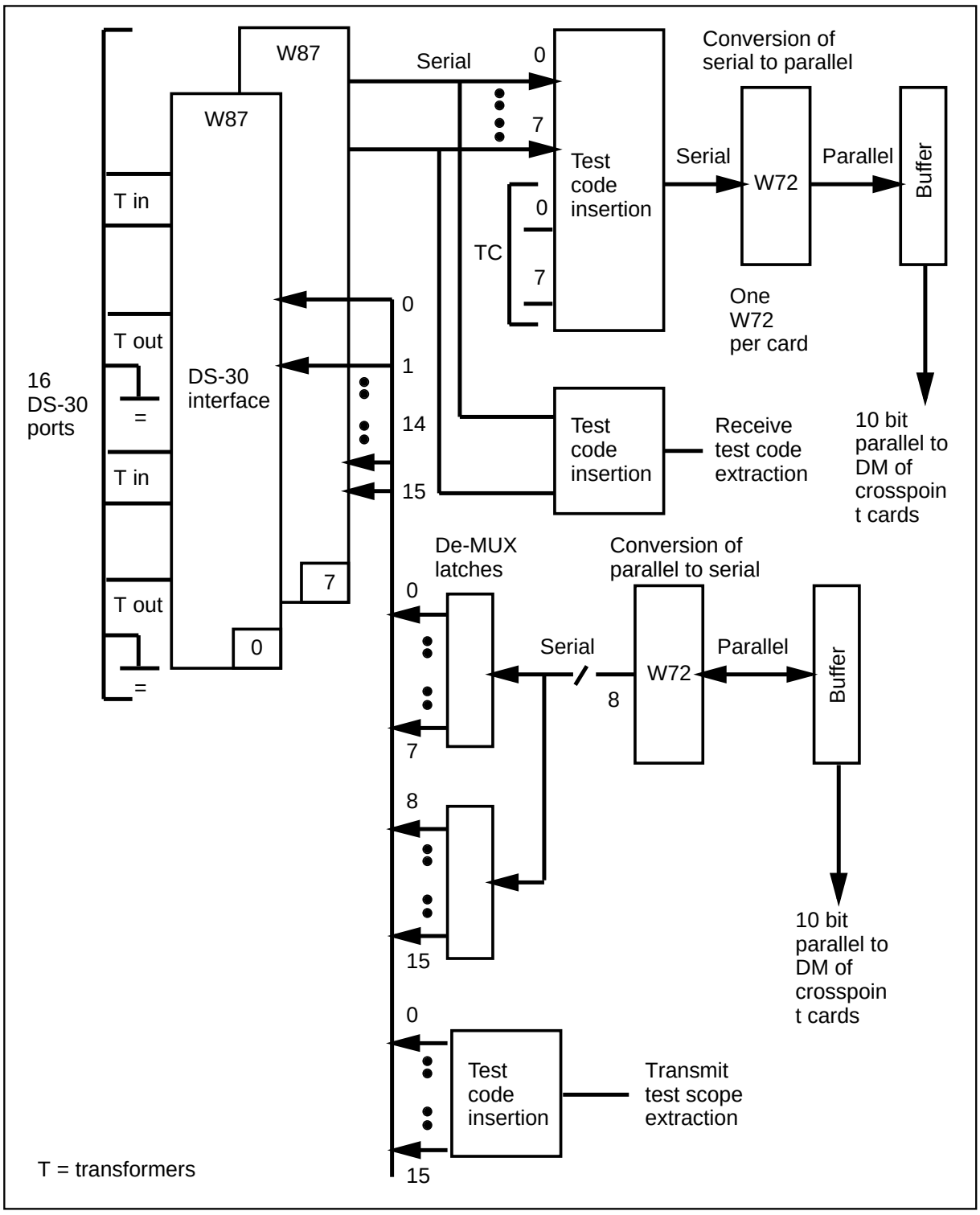
- NT8X12AA Interface cards
- NT8X13AA Crosspoint cards
- NT8X14AA Test code cards

The following description of the card functions applies to the receive side-A and the transmit side-B. The only difference is that in side-B the inputs arrive from another NM, or side-A of the same NM, through the junctors, and the outputs connect to the PM. In side-A, the inputs arrive from the PM, and the outputs connect to the junctors.

NT8X12AA

The interface card provides sixteen bi-directional, 2.56 Mb/s port interfaces for the DS-30 format of NMs or PMs and also provides the serial to parallel and parallel to serial formatter functions for interfacing with the NT8X13 crosspoint card. Each card has a W87 chip for the DS-30 conversion and a W72 chip for the serial and parallel conversions (Figure 11-9).

Figure 11-9
NT8X12 port card block diagram



The W87 has a 32-bit elastic buffer which allows a sufficient delay compensation so that a port card can be used on the peripheral side and the junctor side. The W87 also detects and decodes the clock, frame pulse, and data from the biphase signal. The sixteen serial data outputs from the W87s are multiplexed and input to the W72 chip, which formats and shifts the serial data into parallel format.

For the transmitting path, the 10-bit parallel data at 5.12 Mhz that is received from the crosspoint card is applied to the W72 chip. The W72 reformats and shifts the data into 8-bit serial data stream, each of which carries 64 PCM channels at 5.12 Mhz. The W87 demultiplexes the serial transmitting data from 5.12 to 2.56 Mhz.

The transmitted data is then passed to the biphase encoder where framing information is encoded into a DS-30 biphase format. The output of the biphase encoder is transmitted by a different line driver in the W87. A transformer provides DC isolation and rejects common mode signals.

The card provides sixteen ports and in a set of four provides sixty-four ports per NM. The NT8X12 card of the NT8X11 network replaces the functions of the NT3X72, NT3X73, and NT3X86 cards of the NT5X13 network.

Test Code

The card also handles the insertion and extraction of test code (TC) from card NT8X14. TC is inserted only on the port card in the speech channel immediately after the outgoing circuit. When TC is inserted, the speech bus is disabled for the involved port and channel.

TC is extracted from a port card:

- on the incoming side immediately after insertion
- on the outgoing side immediately before the W87 chips

Incoming Circuit

On each card, two formatter chips (W72) each converts sixteen serial ports to parallel or sixteen parallel ports to serial. The main function of these circuits is:

- to convert incoming data in the DS-30 format of transmission and convert it into PCM data, then send it to a NT8X13 crosspoint card
- to receive and to re-align incoming biphase data

Outgoing Circuit

On each card, eight DS-30 chips (W87) each provides two bidirectional interfaces to the DS-30 links that connect the NMs to the PMs. The main

function of these circuits is to convert outgoing PCM data from an NT8X13 crosspoint card into the DS-30 format for transmission over the DS-30 links.

NT8X13AA

The NT8X13AA card contains the TS for 2048 input channels and 1024 output channels. Two pairs of cards are required, one pair for switching from the peripheral input channels to the junctor output channels on the A-side, and one pair for switching from the junctor input channels to the peripheral output channels on the B-side.

The NT8X13 is identical for A- and B-side functions. When used in a time-slot for an A-side function, it outputs to the junctor cards; when used in a time-slot for a B-side function, its input is from the junctor cards. When only parallel junctors are used, the signal is sent directly from an A-side crosspoint card to a B-side crosspoint card.

Unlike the NT3X70 cards of the NT5X13 network, the NT8X13 crosspoint cards do not block the time switching. Any of the input channels are switched to any of the output channels without restrictions. The NT8X13 card is a single stage TS.

Each TS is a 2-way commutated, 2-way matrix that switches any one of the 2048 input channels to any one of the 2048 output channels. Each TS has two DMs with a capacity of one frame (125us) of PCM samples from each of two input buses. The DM does the actual time switching.

During the instant assigned to the interswitch link bus, a speech sample is written into the DM at an address specified by a counter which repetitively cycles through the 512 active addresses of the memory, and a sample is read from the DM at an address supplied by the CM.

The size of a DM is 1K at 10-bits wide and uses the same memory size as the NT5X13 (55 nanosecond 1K times 4 static RAMs) to construct the DM and CM.

Each DM is controlled by a CM which supplies its DM with the read addresses. The CM holds information which sets the switching pattern. It is written by the NCP in response to a control message from the CC or the computing module.

In addition to controlling the DM, the CM also:

- controls the space switching commutator on the interswitch links
- selects a digital pad which controls the level of the speech path following the outgoing time switch

NT8X14AA

This card interfaces the NM with the network control processor (NCP) card for the insertion and extraction of test code (TC) and for the testing of the digital pads. TC is used by the CC or the computing module to check the continuity of a PCM path. If the TC card does not trace the expected test code, the location is read by the NCP and sent to the CC or the computing module. A card list of suspected faulty card(s) is displayed at the MAP.

NT8X11 NMC Cards

The NMC cards for the NT8X11 network are:

- NT3X74BA Network control processor (NCP) card
- NT3X75BA P-side processor card
- NT3X76AA Network clock card
- NT3X76AC Network clock card for DMS SuperNode

NT3X74BA

The NT3X74BA network control processor card handles the following:

- all messages from the CMC or the computing module
- does the C-side processor function
- controls the network switching
- inserts or extracts TC in response to the CC or the computing module
- provides the message buffer for the P-side processor when a PM is to communicate with the CC or the computing module.

NT3X75BA

The NT3X75BA card handles message exchanges between an NM and its PM. The P-side of the processor is connected across the four parallel buses of the crosspoint cards on the A- and B-sides of their peripheral faces. Messages from a PM are extracted at the input of the crosspoint card, while messages to a PM are inserted at the output of the crosspoint card. The processor is thus able to access all the channel-0s going to and coming from the PM.

Four simultaneous message transactions can be handled, but only one at a time on each parallel bus. On its network side, the processor has access to a message buffer on the NCP card (NT3X74). Messages received from peripherals are deposited in this buffer to be relayed by the NCP to the CC or the computing module. The P-side processor also scans this buffer for outgoing messages. These are sent to the PM specified in the message headers.

NT3X76AA

The Network clock card (NT3X76) contains a circuit that generates a 10.24 Mhz clock pulse and a frame pulse (125us). The clock circuit synchronizes itself with the frame pulse received from the incoming data from the CMC or the computing module. These clock and frame pulses control timing within the NMs and, through the interface cards, to the PMs.

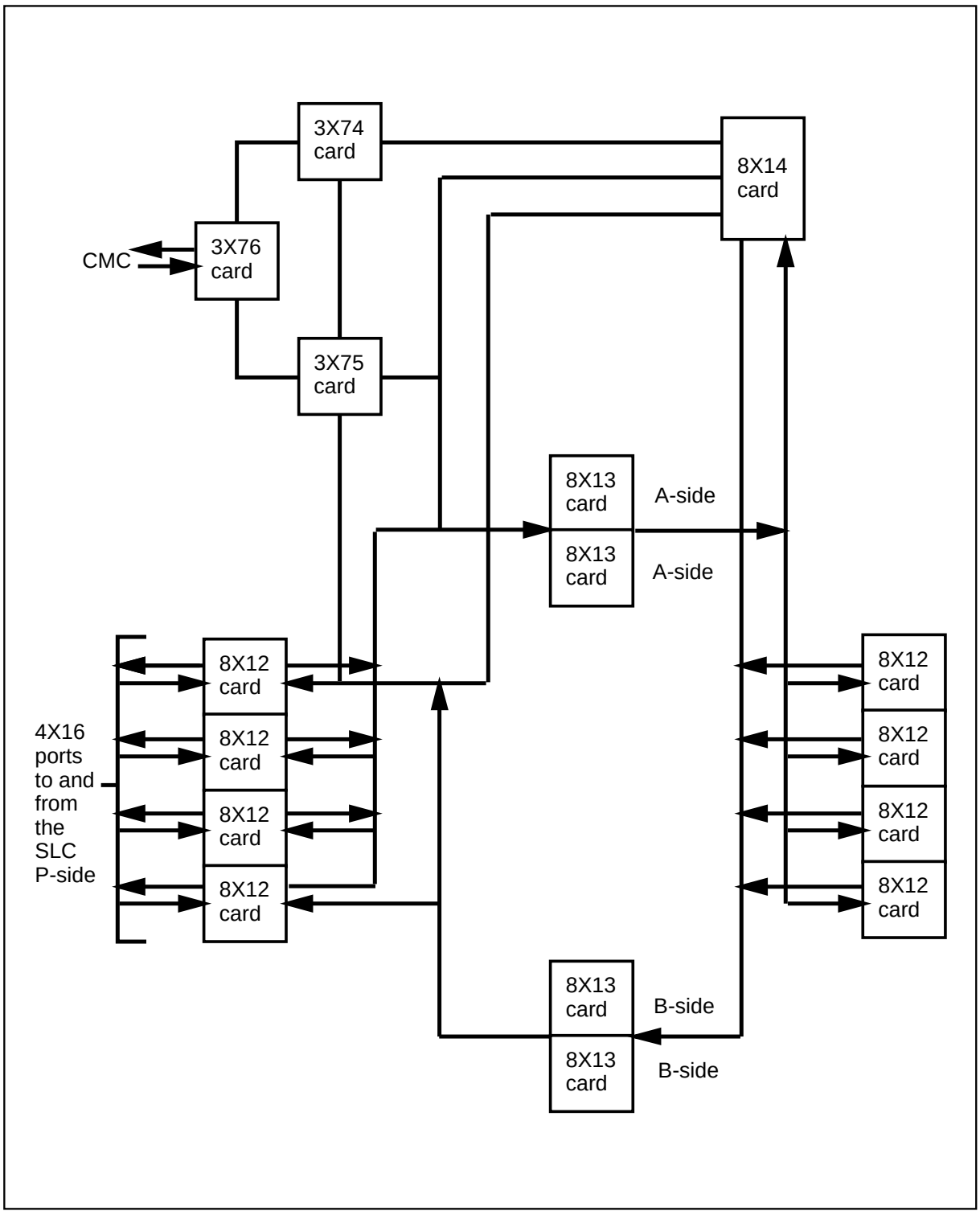
NT3X76AC

The NT3X76AC card is the same as the NT3X76AA card except that it is used with DMS SuperNode.

NT8X11 transmit and receive paths

The transmit and receive paths through the cards of the NT8X11 are shown in Figure 11-10 .

Figure 11-10
NT8X11 data transmit and receive paths

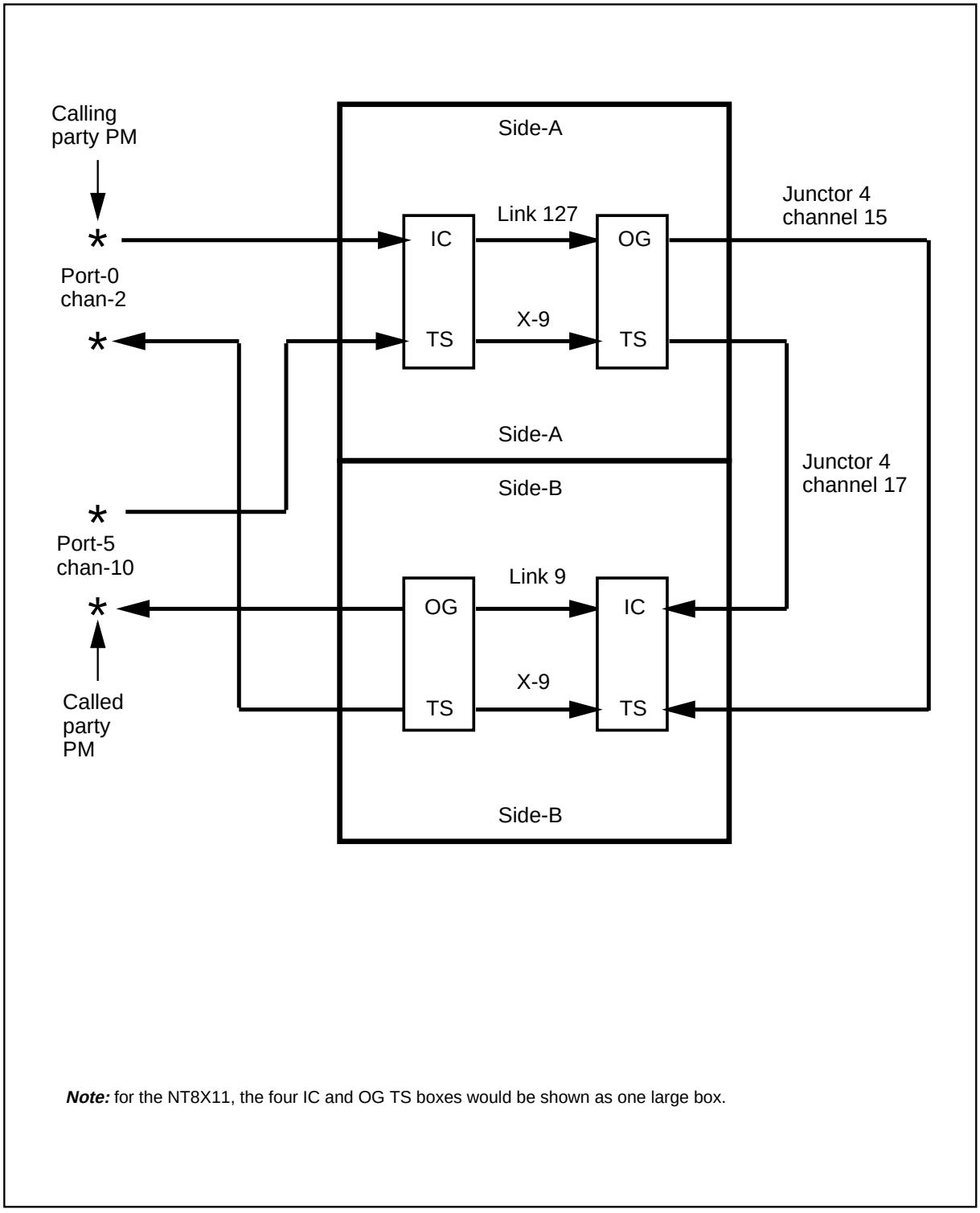


Complementing paths

The description of the NM covers one-half of the 4-wire transmission path provided for connections through the DMS-100 Family Network. In this half-path, a 2-wire unidirectional speech path exists from the calling party to the called party through the receive (A) side of an NM and the transmit (B) side of the same, or another NM.

There also exists concurrently the other path from the called party to the calling party through separate channels on the A- and B-sides of the same, or another NM. Figure 11-11 shows a 4-wire connection using both sides of the same NM. To minimize round-trip delay, the interswitch link buses and junctor channels for one half of the transmission path are automatically selected by CC or the MS to be the complements of those selected for the other half-path.

Figure 11-11
4-Wire Paths (complementing)



Note: for the NT8X11, the four IC and OG TS boxes would be shown as one large box.

The complement consists of subtracting the link bus and junctor channel number for the calling-to-called party path, from the total number of link bus channels and junctor channels available per TS. The total number of link bus channels available per TS depends on the type of NM, as follows:

NT0X48

Each TS card has 8 ports and 32 channels per port for a total of 256 channels. Two channels per TS are required to carry the two paths needed for each call connection. The total number of available interswitch link channels is therefore 128 (0-127) per TS.

NT5X13, NT7X27, NT7X40

Each TS card has 16 ports and 32 channels per port for a total of 512 channels. On the basis of two interswitch link channels per call, the total number of available interswitch link channels is therefore is 256 (0-255) per TS.

NT8X11

Complementing is not relevant to the NT8X11 because the network does not have interswitch links for its one-stage TS, but the junctors are still relevant to the NT8X11.

Separate junctors are used to carry each path, so the total number of available junctor ports is 32.

In the example, it is assumed that the CC or the MS is handling a calling party originating at port-0, on side-A of an NM, and that interswitch link 127 has been selected for the A-side connection. The digits of the called party have been translated as port-5, channel-10 on the B-side of the NM, and interswitch link-9 has been selected for the B-side connection to this port. Junctor-4, channel-15 has been selected to carry this path between sides.

The total number of available interswitch link channels is represented by n (where n is 127 or 255). The complementary link and junctor channels are assigned by the CC or the MS as follows:

Table 11-1
NT0X48, NT5X13, NT7X27, NT7X40 link bus channels

Calling party	Path	Side	Link	Junctor	Side	Link	Path	Called party
Port 0 Chan 2	IC	A	127	4 Chan 15	B	n-9	OG	Port 5 Chan 10
Port 0 Chan 2	OG	B	n-127	4 Chan 17 32-15	A	9	IC	Port 5 Chan 10

For the NT8X11, in the same example, there are no link assignments:

Table 11-2
NT8X11 link bus channels

Calling party	Path	Side	Junctor	Side	Path	Called party
Port 0 Chan 2	IC	A	4 Chan 15	B	OG	Port 5 Chan 10
Port 0 Chan 2	OG	B	4 Chan 17 32-15	A	IC	Port 5 Chan 10

The overall identification of link channels for all the TS in a fully-equipped NM (2048 channels) uses the link port (0-63) number, and link channel (0-31) numbering scheme. This scheme is used for maintenance to identify links on MAP displays and network Log reports (described in *DMS-100F Network Modules Maintenance,* 297-1001-514 and *DMS-100F Log Report Manual*, 297-1001-510 respectively).

The NT8X11 has only one TS per side, but the function is the same.

Junctor hardware

Connections to the junctor ports are organized by the digital network interconnecting (DNI) frame.

The DNI provides patching for the junctor cables from the A-sides of the NM, and for the cables to the B-sides of the NM. The frame houses connector panels mounted horizontally. The DNI frame is to provide means for flexibly arranging the patterns of junctor connections between NM in accordance with traffic requirements, and to enable expansion of the network to be performed with minimum effect on network operation. Refer to *General Specification Digital Network Interconnection Frame,* GS0X18 for a description of the DNI frame.

The NT7X27 and NT7X40 use special junctor cables to eliminate the need for a DNI.

Speech link hardware

Connections between the PM and the NM ports are organized by the speech link connecting (SLC) frame.

The SLC provides 4-wire patching for the speech link cables to and from the network and the peripheral module(s). The frame houses two groups of panels. The assignment of peripheral ports to network ports can be arranged at the SLC to obtain the most efficient use of the network, and to enable expansion to be performed with minimum effect on the system. Refer to *General Specification Speech Link Connector Frame,* GS0X56 for a description of the SLC frame.

Enhanced network (ENET)

Description

Enhanced network (ENET) is a single-stage, non-blocking, junctorless time switch that supports services requiring bandwidths greater than 64 kbits/sec. It is designed to interface with SONET/DMS (S/DMS) SuperNode system DMS-Core and DMS-Bus, the existing peripherals, and high speed interface (HSI) peripherals.

Enhanced networks, coupled with HSI peripherals, provide wideband services such as DSD-1 and fractional DS-1. The enhanced network, HSI peripherals, and integrated digital cross-connect features that support DS-0, n X DS-0 and DS-1. These connections allow the consolidation into the S/DMS SuperNode system traditionally stand-alone network elements such as multiplexers, digital signal cross-connect bays and digital cross-connect systems.

Modular growth

The enhanced network can be expanded from 4,000 channels to 128,000 channels in 2,000 channel increments with peripheral link paddle boards. Using cross-point circuit packs, the enhanced network can be expanded in 4,000 channel increments for the first 32,000 channels, and in 16,000 channel increments thereafter.

Optic fiber connections

The enhanced network and the S/DMS SuperNode DMS-Bus are interconnected by DS-512 optic fiber links. The multiplexed connections between the enhanced network and other peripherals can use either DS-30 copper links or DS-512 optic fiber links. The links are identical to those between the DMS-Core and DMS-Bus. Shared component

Shared technology

The enhanced network has its own internal 32-bit processor based on the Motorola MC68020 microprocessor, similar to that used in the S/DMS SuperNode system. Common circuit packs used in both S/DMS SuperNode and ENET include reset terminal interface (RTIF) NT9X26AA and power supplies NT9X30AA/NT9X31AA.

Switching plane selection

Peripherals have access to both planes of the enhanced network, which operate independently and in parallel. The active plane is selected on a pre-connection basis.

Connection commands

Enhanced network processors establish connections on command from DMS-Core and maintains these connections until the processor receives a disconnect command. The enhanced network also monitors for link errors, performs loop-back testing and checks test codes.

DMS SuperNode SE (SNSE) networks

The network used is either the existing JNET/DSN or the SNSE 16K ENET. The JNET is contained in a separate frame or frames. Up to eight network modules (NM) can normally be provisioned. This number is increased to ten in MSL applications. Note that SNSE is compatible with all existing JNET types; 0X--, 5X--, 7X--, and 8X--.

The SNSE network (16K ENET) is a junctorless, non-blocking dual plane network with each plane connected to both MS’s for control messaging. The rate of switching for this network is a 64-Kb/s channel. Each network plane provides up to 16K channels of non-blocking, constant delay switching.

The SNSE 16K ENET also provides the capability to support connections with rates greater than 64KB/s. This is accomplished by switching groups of multiple channels of the basic rate (n x 64 Kb/s0. The network achieves this

by providing a constant switching delay for all channels across the network which is identical to that provided by the DMS SuperNode 128K ENET

SNSE system interfaces

The SNSE utilizes the same type of interfaces used in DMS-SuperNode. Both copper (DS30) and optic fiber (DS512) interfaces are provided to connect from the ENET to peripheral modules. Optic fiber interfaces (SR128) are used to connect the CM to the MS and MS to the 16K ENET interface shelves. The capability to connect to CCS7 links via V.35 and DS0 links is provided exactly as done in DMS SuperNode.

DMS SuperNode compatible interfaces are also provided for connecting to the following:

- Input/output controller (IOC)
- Application processor (AP)
- High speed interface (HSI)
- Channel frame processor (CFP)
- Line trunk server (LTS)
- Link peripheral processor (LPP)

16K enhanced network (16K ENET) shelf

The 16K enhanced network (16K ENET) shelf utilizes DMS SuperNode mechanicals as shown in Figure 11-12. The shelf can be mounted in either the standard DMS SuperNode cabinet or in the SONET/digital multiplex system (S/DMS) cabinet. The 16K ENET shelf provides two planes of up to 16K channel enhanced network. Support for two provisionable LIUs is also provided. Existing DMS SuperNode packs for the 16K ENET shelf are listed in Table 11-3, while new SNSE hardware is listed in Table 11-4.

Figure 11-12xxx
NT9X0810 16K ENET shelf configuration

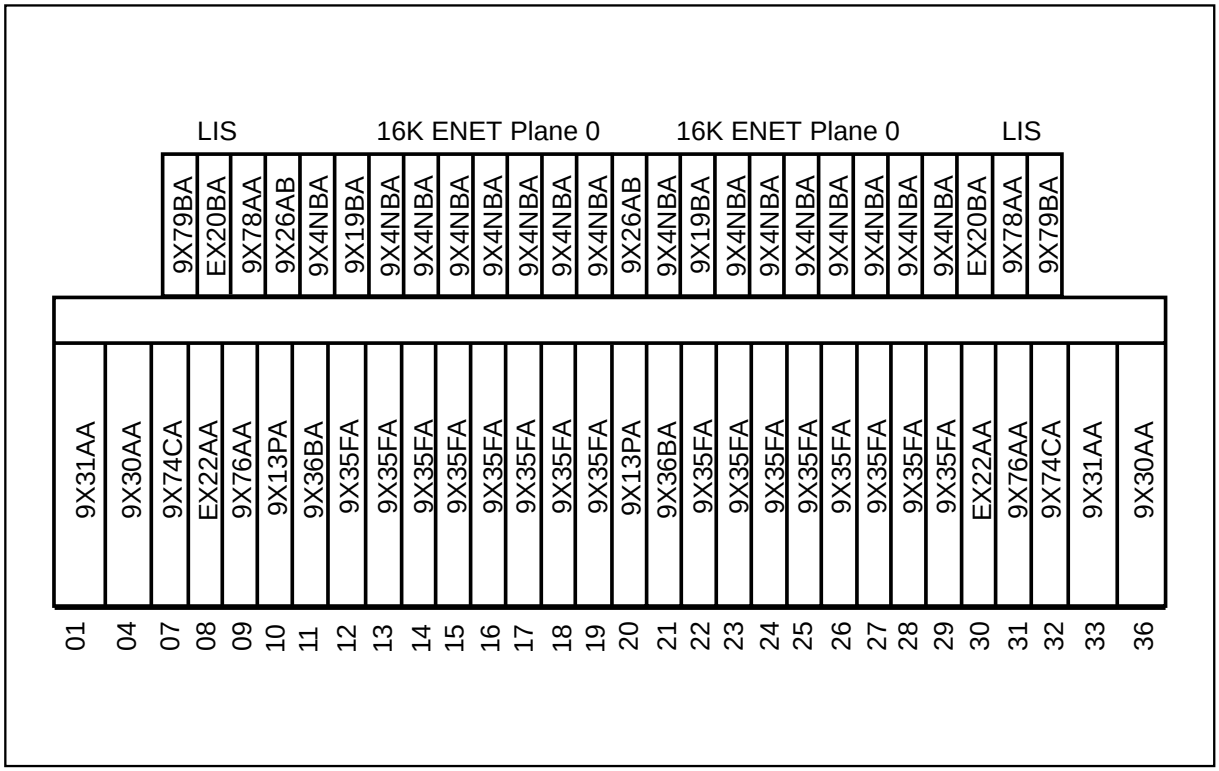


Table 11-3xxx
Existing DMS SuperNode packs for 16K ENET shelf

PEC	Description
NT9X30AA	+5 V power converter
NT9X31AA	-5 V power converter
NT9X36BA	ENET clock and message circuit pack
NT9X40BA	ENET link interface paddle board, 4DS512
NT9X41BA	ENET link interface paddle board
NT9X45BA	ENET link interface paddle board
NT9X26AB	Remote terminal interface paddle board
NT9X79BA	F-Bus interface paddle board
NT9X74BA	F-Bus repeater circuit pack
NT9X78BA	LIU link interface paddle board

-continued-

Table 11-3xxx
Existing DMS SuperNode packs for 16K ENET shelf (continued)

PEC	Description
NT9X76AA	LIU interface circuit pack
NTEX22AA	LIU processor circuit pack
NTEX20AA	LIU F-Bus A-terminator paddle board
NTEX20BA	LIU F-Bus B-terminator paddle board
NT9X19AA	CP filler pack
NT9X19BA	PB filler pack

End

Table 11-4xxx
New hardware for SNSE ENET shelf

PEC	Description
NT9X0810	16K enhanced network shelf assembly: Combines two planes of up to 16K channel ENET on a single shelf along with two link interface units (LIU).
NT9X35FA	Enhanced network crosspoint circuit pack: This circuit pack is based on the existing NT9X35 crosspoint pack, depopulated to provide 4K X 8K channel switching.
NT9X13PA	ENET processor circuit pack: This processor is based on the NT9X13FA ENET processor with SNSE specific firmware added.

Grade-of-service

The DMS-100 Family network meets North American grade-of-service objectives as follows:

Network Matching Loss Objectives:

DMS-200:
0.5% matching loss based on 10 HDBH
2.0% matching loss based on HDBH

DMS-100:
1.0% (OG) loss based on 1 ABSBH
2.0% (IC) loss based on 1 ABSBH
20.0% loss based on HDBH

Matching loss is defined as the average probability of a call not being completed due to congestion in the network and in line concentration.

Capacity

As a Class 5 office, DMS-100 is capable of terminating over 100,000 lines, while DMS-200 provides 60,000 trunk terminations. Network capacity is estimated to be 700,000 ABSBH equivalent Hundred Call Seconds (CCS).

Line peripheral capacity

Introduction

This chapter discusses capacity relating to peripherals containing line equipment that connects the subscriber to the DMS-100 Family switch.

Line capacity is usually measured in terms of the total number of lines that can be served and still meet an objective grade-of-service (GOS) established by the individual operating company. Grade-of-service as it applies to line peripherals usually refers to dial tone delay and matching loss. Dial tone delay is measured by the percentage of calls that do not receive dial tone in 3 seconds from the time the request for dial tone was made (receiver off hook). Matching loss refers to a call to an idle line that cannot complete because there is no available channel to the line.

The line peripheral capacity term CCS capacity refers to the total traffic, measured in centum call seconds (CCS), that the peripheral can process during a continuous 60-minute period and still meet an objective grade-of-service established by the operating company. The CCS capacity values are contained in engineering tables and are measured in a working switch by operational measurements designed for that purpose.

Grade-of-service indicators

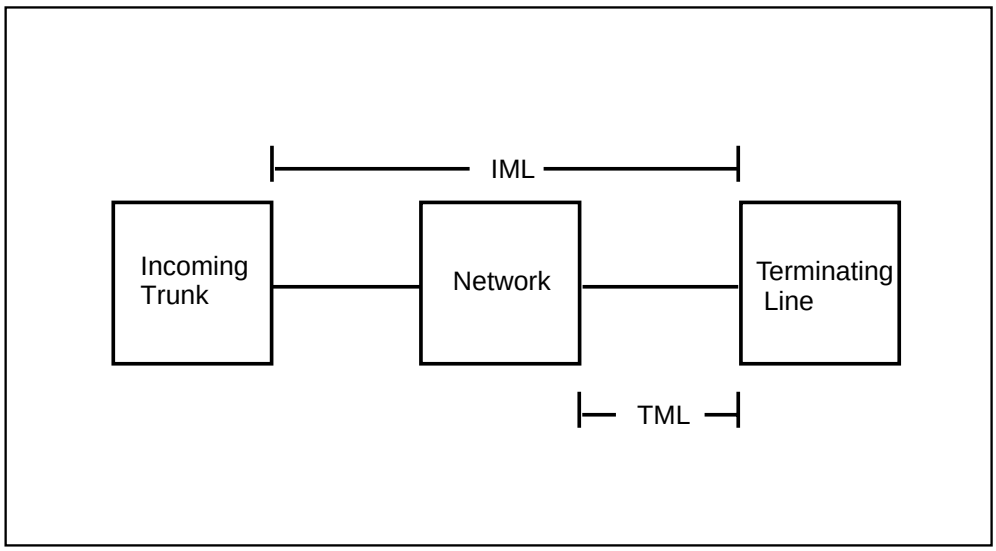
Monitoring the capacity of line concentrating modules includes the recording of certain performance indicator values, for example, matching loss, CCS per line, and dial tone delay.

Matching loss

Incoming matching loss

Incoming matching loss (IML) is the service measurement that is used in the engineering of line concentrating modules and is monitored to determine if the rate of IML is staying in the engineered and service objective limits. Incoming matching loss is compared to terminating matching loss (TML) in Figure 12-1. Incoming matching loss is the failure to find a path from an incoming trunk to an idle line. Table 12-1 lists the operational measurements and any associated logs that can be used to evaluate incoming matching loss.

Figure 12-1
Comparison of IML and TML



Terminating matching loss

Terminating matching loss is a failure to find an idle channel between the host network and an idle terminating line.

Matching loss evaluation

This factor is measured in terms of percentage of incoming matching loss, and is derived by dividing the total IML by the total number of terminating attempts and then expressed as a percentage. The grade-of-service for IML, as determined by the operating company, is the standard for evaluation. Table 12-1 contains the present existing matching loss standard and Table 12-2 contains the Northern Telecom recommended matching loss standards. These tables indicate the incoming matching loss percentage and expected level of loss from each source when measured during the average busy season busy hour (ABSBH) and high day busy hour (HDBH).

Table 12-1
Incoming matching loss - existing standard

Busy hour	Incoming matching loss	Peripheral	Network
ABSBH	2.0%	1.9%	0.1%
HDBH	20.0%	19.0%	1.0%

Table 12-2
Incoming matching loss - NTI recommended standard

Busy hour	Incoming matching loss	Peripheral	Network
ABSBH	2.0%	1.9%	0.1%
HDBH	5.0%	4.0%	1.0%

Calculations to evaluate matching loss

Incoming matching loss can be calculated using the following formula:

$$\% \text{ Incoming matching loss} = \frac{\text{OFZ_TRMMFL}}{\text{OFZ_INTRM}} \times 100$$

Terminating matching loss can be calculated using the following formula:

$$\% \text{ TML} = \frac{\text{OFZ_TERMBLK}}{\text{OFZ_INTRM}} \times 100$$

Usage (CCS) per line

Usage per line, usually referred to as CCS per line, is the actual or projected average usage (measured in CCS) per line served by the switch. The CCS per line value is derived by dividing the sum of the use of all line units by the number of lines and equivalent lines served by the switch.

Table 12-3 lists the operational measurements and any associated logs that can be used in the evaluation of CCS per line. Current line counts can be printed out using the BCSMON DUMP COUNTS command at the MAP For more information, refer to the *Nonmenue Commands Reference Manual*, 297-1001-820.

Table 12-3
Performance indicators for evaluating CCS per line

Operational measurements		Log reports
Group	**Register**	
LMD	LMTRU	None

Usage calculations

The CCS per line value can be calculated using the following formula:

$$\text{CCS per line} = \frac{\text{Total LMD_LMTRU}}{\text{Current total line count}}$$

How to evaluate CCS per line

The evaluation of CCS per line only requires that the current CCS per line be compared to the value used in the provisioning process to see if it is tracking with the forecast value. Tracking the CCS per line along with the forecast of line growth gives a clear indication if the end of design date for the switch is reasonably accurate. Any combination of higher than forecast values of line growth and CCS per line should be brought to the attention of the office provisioning engineers. Causes for increased or higher than forecast CCS per line can be determined by taking office counts of individual types of services and the number of features per line and comparing those totals with total features and services forecasts. Increases in lines that generate high use (for example, business lines) will raise the CCS per line value, as compared to POTS lines which are typically lower usage lines.

Messaging

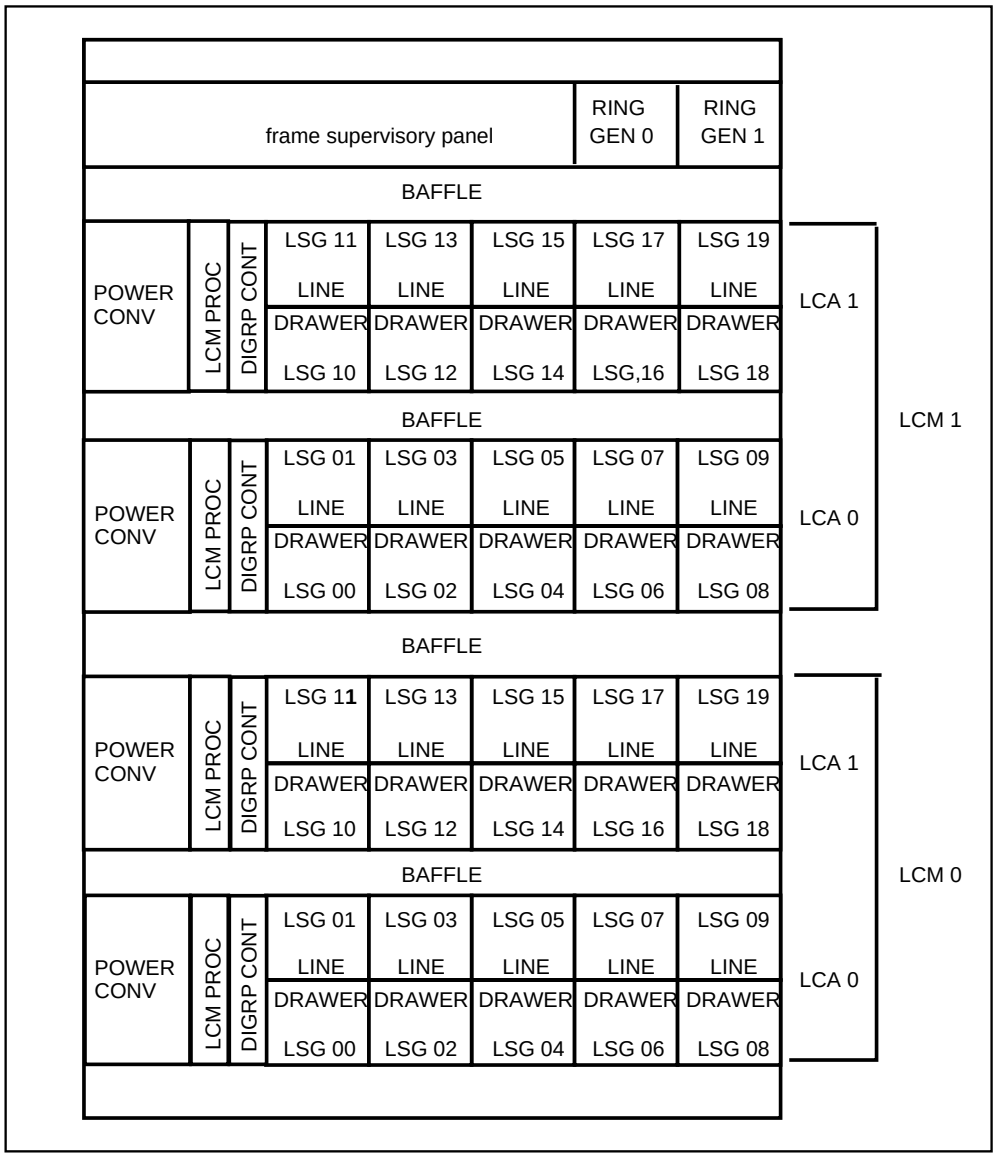
Features such as multiple appearance directory number (MADN) and custom local area signaling services/common channel signaling number 7 (CLASS/CCS7) produce an increased number of call processing messages that impact the real time of the LCM processor. For example, there are limitations on the number of MADN lines that may be served out of an LCM. Refer to the *Loading Administration Guide,* 297-1001-306 for MADN loading guidelines and *Residential Services Administration Guide,* 297-1401-300 for CLASS/CCS7 information.

Line concentrating module (LCM) capacity

Description

The line concentrating module (LCM) is a peripheral module (PM) that connects up to 640 lines to the DMS-100 switch. The LCM is connected to a controller PM using DS30A links.

Figure 12-2
Line concentrating equipment frame



Physical

The DS30a links from an LCM to its controller (XPM) include two channels (0and 16) that are used for maintenance functions. This allocation for maintenance leaves 30 channels for speech/data. However, each of the first two links from the LCM to its controller must use use an additional channel (channel 1) for messaging, leaving 29 channels for speech/data in those two links. The other links (3-6) have 30 channels for speech/data. The maximum number of channels available for speech/data for the different configurations are as follows:

2 links from the LCM to the XPM: 58 channels
3 links from the LCM to the XPM: 88 channels
4 links from the LCM to the XPM: 118 channels
5 links from the LCM to the XPM: 148 channels
6 links from the LCM to the XPM: 178 Channels

The use of channels for messaging for RLCM/OPMs is different because the remotes use DS1 facilities (24 channels for each link). Each of the first two links use one channel for messaging leaving 23 channels for speech/data. The other links (3-6) have 24 available channels. The maximum number of channels available for speech/data for the different configurations are as follows:

2 links from the RLCM/OPM to the XPM: 46 channels
3 links from the RLCM/OPM to the XPM: 70 channels
4 links from the RLCM/OPM to the XPM: 94 channels
5 links from the RLCM/OPM to the XPM: 118 channels
6 links from the RLCM/OPM to the XPM: 142 channels

Traffic

Tables 12-4 and 12-5 are examples of the capacity tables for the LCM; with Table 12-4 showing 20 P-side port configuration values, and Table 12-5 showing 16 P-side port configuration values. Complete sets of tables are contained in *DMS-100 Family Provisioning*, 297-1001-450, which should be used to determine capacity values. The tables are designed to show the LCM capacity for various configurations with different numbers of speech channels, and different levels of grade-of-service (GOS). A combination of the P-side ports, equipped channels, and objective grade-of-service (IML) for the LCM indicates the CCS load capacity for the high day busy hour (HDBH) and values for four different high day/average busy season (HD/ABS) ratios. For example, Table 12-4 shows that with 20 P-side ports and 5 LCM links, the high day busy hour capacity is 4066 CCS.

Table 12-4xxx
LCM high day and ABS capacity 20 P-side ports LGC/LTC

LCM links	HD/ABS ratio 1.1	HD/ABS ratio 1.15	HD/ABS ratio 1.2	HD/ABS ratio 1.3	HDBH
	IML = 0.003				IML =0.03
2	1393	1357	1316	1230	1607
3	2322	2263	2194	2050	2651
4	2786	2715	2633	2460	3249
5	3483	3394	3291	3075	4066
6	4644	4526	4389	4101	5422
	IML = 0.005				IML =0.05
2	1418	1383	1343	1260	1637
3	2363	2305	2238	2101	2708
4	2836	2766	2766	2521	3297
5	3545	3458	3458	3152	4125
6	4727	4610	4610	4203	5499
	IML = 0.007				IML =0.07
2	1429	1397	1360	1281	1654
3	2382	2329	2267	2135	2740
4	2859	2795	2721	2562	3326
5	3574	3494	3401	3203	4160
6	4765	4659	4535	4271	5545
	IML = 0.01				IML =0.1
2	1446	1415	1380	1304	1671
3	2411	2359	2300	2174	2772
4	2893	2831	2760	2609	3354
5	3616	3538	3450	3262	4194
6	4822	4718	4600	4349	5590
	IML = 0.02				IML =0.2
2	1477	1449	1417	1348	1697
3	2462	2416	2362	2247	2823

-continued-

Table 12-4xxx
LCM high day and ABS capacity 20 P-side ports LGC/LTC (continued)

LCM links	HD/ABS ratio 1.1	HD/ABS ratio 1.15	HD/ABS ratio 1.2	HD/ABS ratio 1.3	HDBH
4	2954	2899	2834	2697	3400
6	4924	4832	4724	4495	5666

End

Table 12-5
LCM high day and ABS capacity (carried load) 16 P-side ports LGC/LTC

LCM links	HD/ABS ratio 1.1	HD/ABS ratio 1.15	HD/ABS ratio 1.2	HD/ABS ratio 1.3	HDBH
	IML = 0.003				IML =0.03
2	1445	1427	1404	1346	1708
3	2329	2293	2247	2136	2709
4	3230	3172	3098	2927	3732
5	4137	4053	3950	3717	4769
6	5045	4935	4800	4506	5815
	IML = 0.005				IML =0.05
2	1500	1483	1459	1402	1784
3	2402	2366	2320	2209	2804
4	3316	3527	3185	3016	3842
5	4234	4152	4049	3823	4890
6	5153	5041	4914	4630	5946
	IML = 0.007				IML =0.07
2	1535	1517	1494	1436	1832
3	2447	2411	2365	2255	2864
4	3369	3311	3228	3073	3910
5	4294	4210	4112	3892	4965
6	5218	5112	4985	4709	6027

-continued-

Table 12-5
LCM high day and ABS capacity (carried load) 16 P-side ports LGC/LTC
(continued)

LCM links	HD/ABS ratio 1.1	HD/ABS ratio 1.15	HD/ABS ratio 1.2	HD/ABS ratio 1.3	HDBH
	IML = 0.01				IML =0.1
2	1572	1554	1531	1473	1882
3	2494	2458	2412	2303	2925
4	3424	3365	3295	3133	3980
5	4355	4274	4177	3953	5042
6	5287	5182	5051	4790	6108
	IML = 0.02				IML =0.2
2	1645	1627	1603	1545	1978
3	2585	2549	2503	2398	3040
4	3530	3471	3405	3253	4108
5	4474	4398	4307	4107	5180
6	5420	5324	5209	4954	6255

End

Line concentrating module/multiple directory appearance number (LCM/MADN) capacity

Introduction

Digital technology has made it possible for the development of advanced line features and products which can be used in the DMS-100 family of switches. These advanced features and products make it possible for telephone companies to provide enhanced operating characteristics to end user terminal equipment. Multiple appearance directory number, otherwise known as MADN, is one of these features.

The MADN feature is applied to Meridian Digital Centrex (MDC) lines, previously known as Integrated Business Network (IBN) lines. MADN can be assigned to typical telephone terminal equipment such as the 500/2500 sets as well as the electronic business set (EBS), better known as P-Phone. Line types required to support MADN include “A” for 500/2500 sets and “C” for the EBS. MADN is commonly used as a viable replacement for key system technology.

Planning for the installation of the MADN feature as a replacement of existing key system equipment can be a complicated task. This section addresses typical considerations when installing the MADN feature. In addition to the planning aspect, this document addresses the administrative requirements and strategy necessary once the feature is placed in-service.

Planning considerations

Multiple appearance directory number (MADN) is associated with features F1819, single call arrangement (SCA) and F1832, multi-call arrangement (MCA) which are resident in the NTX106AA software package. MADN can be used with Meridian Digital Centrex lines only. It is intended to be used as a replacement for key system technology while providing full feature functionality afforded by centrex applications.

MADN allows a directory number to be assigned to more than one set. The sets to which this directory number is assigned comprises a group. A maximum of thirty-two sets can be included in a group. Groups can be configured for either single call arrangement (SCA) or multiple call arrangement (MCA). As a reference, the single call arrangement most emulates key system technology. MADN also introduces the capability of assigning multiple directory numbers to a single line.

Single call arrangement allows only one set to be active in a particular MADN group, whether originating or terminating, at any given time. With the multiple call arrangement, more than one call can be active simultaneously. The number of simultaneous calls are limited only to the number of members in the group.

Introducing the MADN feature to a DMS-100 switch requires some assignment considerations. First, assignment of the lines associated with MADN must be distributed evenly throughout the office. This means that lines are distributed equally across all line concentrating modules (LCM) to the line subgroup (LSG) level. A LSG is half of a line drawer in the LCM which accommodates thirty-two line cards. There is a total of twenty LSGs in a LCM. Second, MADN group member assignment must adhere to the following engineering guidelines:

- the overall central office average number of secondary members should not exceed four per MADN group
- no ringing secondary members on any MADN add-on units
- a maximum of one member for each MADN group in each line drawer
- a maximum of eight members for each MADN group in each line concentrating module (LCM)
- a maximum of sixteen members for each MADN group in each line group controller (LGC)
- a maximum of thirty-two members in any MADN group

Note: All quantities of members above include the primary as well as secondary numbers.

Planning of the MADN feature is made easier by comparing key system operations with MADN application. The conversion of key system configurations or terminology to MADN concepts can be made easier by following defined guidelines.

First, consider conversion of a typical key system to MADN. The following model will be used for this conversion: (Figure 12-3)

- nine lines assigned
- each line has own directory number
- twelve sets associated
- line 1 appears on set 1, 2, 3, 4, 5
- line 2 appears on set 1, 2, 3, 4, 5
- line 3 appears on set 6, 7, 8, 9
- line 4 appears on set 6, 7, 8, 9
- line 5 appears on set 6, 7, 8, 9
- line 6 appears on set 10, 11, 12
- line 7 appears on set 10, 11, 12
- line 8 appears on set 1, 2, 3, 4, 5
- line 9 appears on set 1, 2, 3, 4, 5

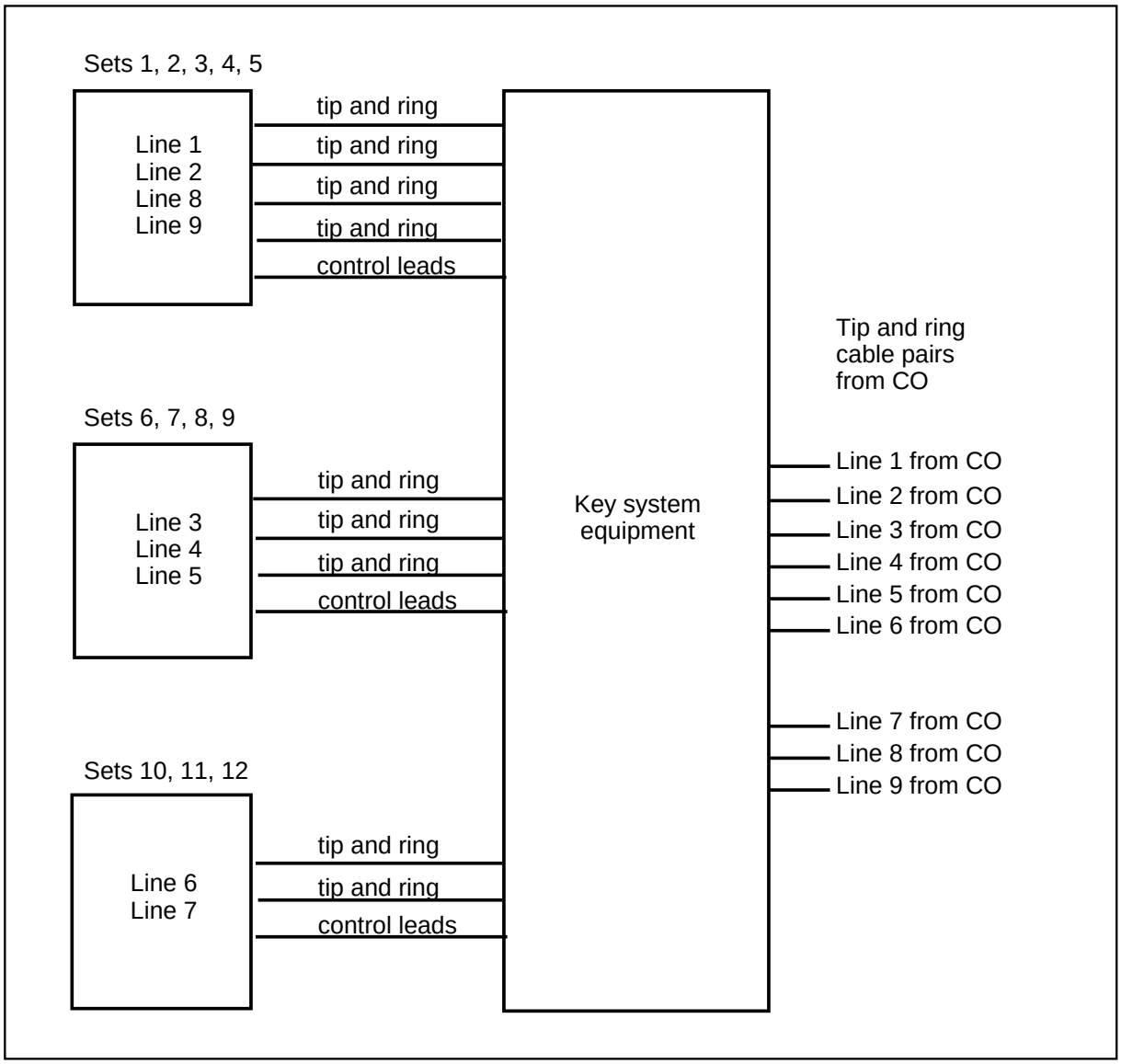
Key system technology dictates that each line have an associated directory number. Assignment of the directory numbers (lines) to any terminal set can be accomplished only via cross connections at the key equipment (KTU) location and individual copper wires to each of the sets. In the case of the model, this would require a separate pair of wires to each of the associated sets for each of the lines assigned as well as the necessary control leads.

The following depicts the tip and ring cable pair requirements for the model.

- set 1 requires four pairs for lines (1, 2, 8, 9)
- set 2 requires four pairs for lines (1, 2, 8, 9)
- set 3 requires four pairs for lines (1, 2, 8, 9)
- set 4 requires four pairs for lines (1, 2, 8, 9)
- set 5 requires four pairs for lines (1, 2, 8, 9)
- set 6 requires three pairs for lines (3, 4, 5)
- set 7 requires three pairs for lines (3, 4, 5)
- set 8 requires three pairs for lines (3, 4, 5)
- set 9 requires three pairs for lines (3, 4, 5)
- set 10 requires two pairs for lines (6, 7)

- Set 11 requires two pairs for lines (6, 7)
- Set 12 requires two pairs for lines (6, 7)

Figure 12-3
Typical key system representation



Associated with each line in the model is a group of terminal sets. Each group is unique unto itself and separate from all of the other groups. When converting this group information to MADN terminology, you would have the following:

- MADN group 1 is a five member MADN group (line 1)
- MADN group 2 is a five member MADN group (line 2)

- MADN group 3 is a four member MADN group (line 3)
- MADN group 4 is a four member MADN group (line 4)
- MADN group 5 is a four member MADN group (line 5)
- MADN group 6 is a three member MADN group (line 6)
- MADN group 7 is a three member MADN group (line 7)
- MADN group 8 is a five member MADN group (line 8)
- MADN group 9 is a five member MADN group (line 9)

Assignment of MADN groups on the sets would be reflected as indicated.

- set 1 has four MADN groups (1, 2, 8, 9)
- set 2 has four MADN groups (1, 2, 8, 9)
- set 3 has four MADN groups (1, 2, 8, 9)
- set 4 has four MADN groups (1, 2, 8, 9)
- set 5 has four MADN groups (1, 2, 8, 9)
- set 6 has three MADN groups (3, 4, 5)
- set 7 has three MADN groups (3, 4, 5)
- set 8 has three MADN groups (3, 4, 5)
- set 9 has three MADN groups (3, 4, 5)
- set 10 has two MADN groups (6, 7)
- set 11 has two MADN groups (6, 7)
- set 12 has two MADN groups (6, 7)

A general rule which can be applied to MADN application is that MADN members relate to sets while a MADN group relates to a directory number.

Assignment considerations

As indicated previously, MADN is the assignment of a directory number to more than one set. Each set in the identified group will have its own line equipment number (LEN) assigned. Assignment of the directory number to all LENs in the group is accomplished in software data fill tables (Figure 12-4).

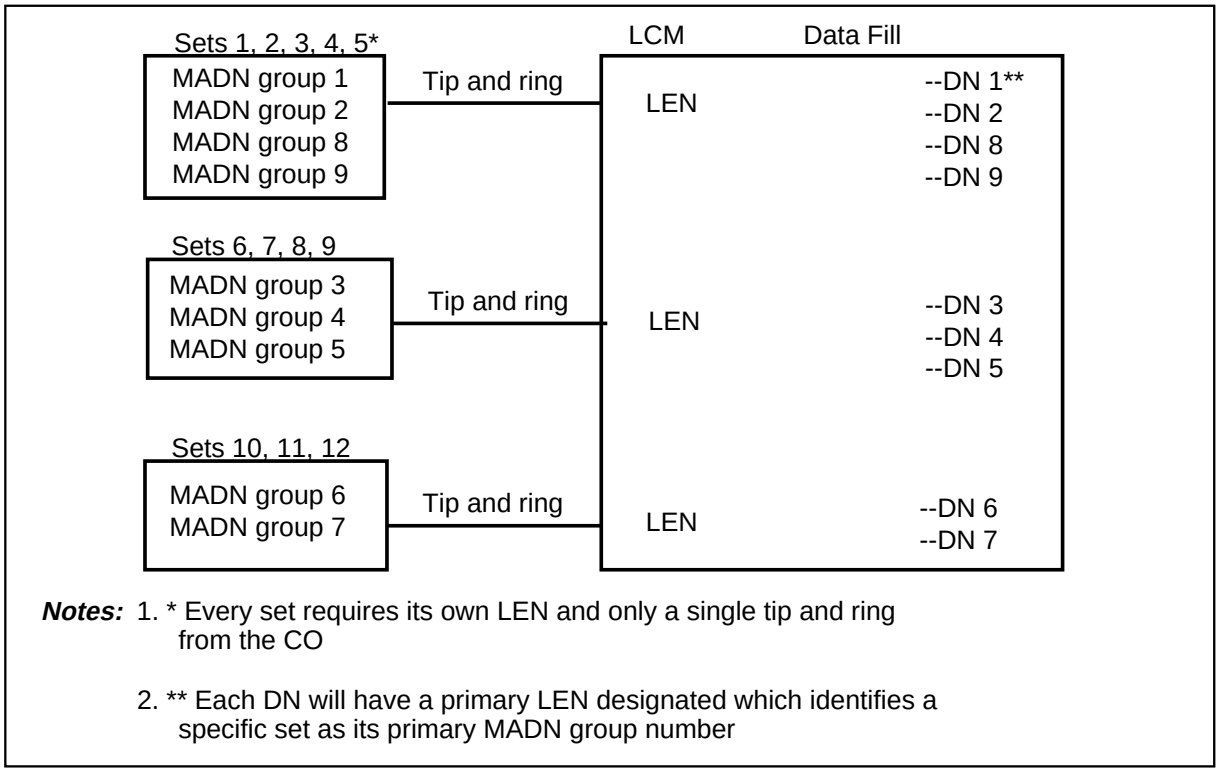
One set can accommodate more than one primary directory number and numerous secondary assignments. Actual assignment maximums are defined by data fill parameters. For purposes of this explanation there is one primary LEN assigned per directory number and a defined quantity of secondary LEN locations.

MADN application is structured to allow any one of the LENs associated with a MADN group to be designated the primary. A typical assignment of MADN to a group of sets could be as follows:

- MADN group 1 in the model has five members

- if set #1 is the primary location, then sets 2, 3, 4, 5 are designated as secondary locations

Figure 12-4
Typical MADN representation



Notes: 1. * Every set requires its own LEN and only a single tip and ring from the CO

2. ** Each DN will have a primary LEN designated which identifies a specific set as its primary MADN group number

Once the configuration of the MADN application has been determined, the next step is to assign the lines in their MADN groups. With the MDC lines evenly distributed throughout the LCMs, the second step is to evenly distribute the primary directory numbers as application requirements dictate. Keep the MADN groups as balanced across the LCMs as possible. If the groups are balanced on the LCMs, an overall office balance is achievable. This will minimize the chance of experiencing a service fault due to message congestion.

Next, the secondary members have to be assigned to their LEN. This activity must be monitored carefully to insure adherence to the engineering guidelines.

There are instances on record where there have been assignments of MADN to primary LENs without assigning secondary members. Although this saves administration time, it defeats the feature intent and increases real time requirements which, in turn, decreases maximum line capacity in peripherals (LCM, LGC, and so forth).

It is essential that the lines and also primary and secondary members assignments remain balanced throughout the office. Adherence to these rules will allow the switch to operate to the best of its design capabilities.

There are specific aspects associated with MADN which need to be addressed when assigning MADN in the switch. First, when the primary directory number is accessed, all sets will get a terminating indication if so specified. Secondary members have the option for ringing or non-ringing. Again this is an option in the datafill tables. Ringing secondary members require more peripheral processor time (real time) to handle the necessary operations.

Secondary members have the ability to answer the call. Operationally, there is not a substantial penalty associated with this activity. However, it requires more processor time (real time) to handle secondary answers. This is yet another aspect which has to be considered when assigning MADN.

The person answering the majority of the calls for the MADN group to be designated as the primary LEN. This action will minimize the use of processor time since it places the majority of the activity on the primary LEN.

Capacity analysis

Once the configuration of the office has been determined, the next step is to determine if the configuration can be handled by the processors in the switch. This process is referred to as real time analysis. There are two programs available to aid the operating company in real time analysis: REAL::TIME, the central processor prediction tool and PRTCALC, the peripheral processor calculation tool. Determining the real time balance of the processors will aid in the balance of the messaging associated with MADN. The real time programs take into account the processor time required to handle these messages.

Capacity analysis is extremely important for the total system. However, emphasis should be placed on the peripheral processors since MADN affects the peripherals more than the CPU.

There is a remote possibility that the processors can be real time balanced and still have messaging imbalance. This situation can be detected during in-service activities and will be covered in the in-service section of this document.

Analysis activities associated with planning

There are several cycles in the life of a switch which require analysis. For instance, planning activities require analysis of traffic, real time, and physical terminations in order to build an acceptable configuration. In-service analysis is required to insure that your planning information was

in fact close to what is required. Ongoing analysis of the switch is required to provide administration and growth planning for the switch.

Planning for the installation of a switch requires that you first satisfy the physical requirements. This addresses items such as number of lines by type, features for the lines, trunks, and service circuits. Molding these physical requirements with the traffic requirements allows you to configure a switch from the lines to the network.

Once the physical aspects of the configuration have been satisfied, it is required as part of the order capture process to conduct a real time study on the components of the switch. This includes the central controller (CC), peripheral controllers (XPM) and line concentrating modules (LCM). CC real time can be determined by using the capacity management tool REAL::TIME. The peripheral controllers and LCM can be determined by using PRTCALC.

Real time studies are an essential part of configuration verification to insure adherence to capacity management criteria as outlined in NT8620, Section 13. The information received from these studies is also used to establish a point of reference for comparing planning expectations with in-service measurements.

MADN has its greatest impact on the peripherals. As mentioned previously in this document, if real time in the LCMs is balanced, the chances are very good that the MADN operational characteristics will also be balanced. If LCM operations are balanced, the line group controllers will benefit from this balance as well as the CC. This concept applies to lines, traffic and call attempts.

Switch growth considerations

When additional LCMs and LGC have to be added to the office to accommodate growth requirements, every effort must be taken to assure an even balance of lines and load across the entire office. This dictates that loads in existing in-service LCMs be distributed across the added equipment. This action is the only way to attain an even line and load balance which, in turn, ensures an even MADN balance in the switch.

Load balancing

There are balancing guidelines to follow when attempting to balance the load on the peripherals (LCM, RLCM, OPM, and RSC) that connect lines to the switch. Lines should be distributed evenly across these modules by class of service. For example, 1FR, 1MR, PBX, coin service, and all centrex lines. With this procedure, it is assumed that lines with the same class of service generate approximately the same usage.

Lines that deviate from the average usage can be identified through line studies and moved to other line modules as appropriate, or the module may be administered with this deviation taken into consideration. In a mechanized line assignment environment, the usage from these lines is automatically taken into consideration as lines are made available for assignment from the lowest loaded modules.

Load balancing does not appear to be as critical when a new switch is cut into service or a relief job has just been completed. This is especially true if the switch has been engineered with a substantial amount of capacity provided for growth. However, it is a good practice to keep the load evenly distributed at all times so that when the switch approaches capacity, line transfers for balance purposes are kept to a minimum.

Multiple appearance directory number (MADN) balancing

Lines that have the multiple appearance directory number (MADN) feature should also be spread across all line modules down to the line subgroup (LSG). There may be up to twenty LSGs for each LCM. This feature affects the terminating load on the line modules and the number of call processing messages that are generated.

The MADN feature allows a directory number to be assigned to more than one telephone set. The sets to which this number is assigned comprise a group. A maximum of 32 sets can be included in a group. Groups can be configured for either single call arrangement (SCA) or multiple call arrangement (MCA).

The SCA allows only one set to be active in a particular MADN group at any one time, whether placing or receiving a call. With MCA, more than one call can be active simultaneously. The number of simultaneous calls is limited only by the number of members in the group.

The MADN operations within the switch generate numerous messages associated with call processing and signaling. Therefore, the following assignment guidelines should be observed to distribute the message load:

- The switch’s average number of members, including the primary, should not exceed four in each MADN group.
- A maximum of one member in each MADN group should be assigned in each line subgroup.
- A maximum of eight members, including the primary, in each MADN group should be assigned in each line concentrating module.
- A maximum of 16 members, including the primary, in each MADN group should be assigned in each line group controller.
- A maximum of 32 members, including the primary, may be assigned in each MADN group.

Line group controller (LGC) capacity

The line group controller (LGC) uses a common core of features that is also used in the line trunk controller (LTC), and the digital trunk controller. These features include the following:

- a duplicated (duel-shelf) configuration allowing either control complex to control all processing in the PM
- DS30 interface processing enabling the 3 through 16 C-side ports to service DS30 links to the network
- a control complex comprising: a master processor, messaging and signaling processors, and associated memory
- a standard shelf and panel arrangement and naming convention

Additional features can be added to produce a peripheral module that is tailored for a special function. The features that can be added are:

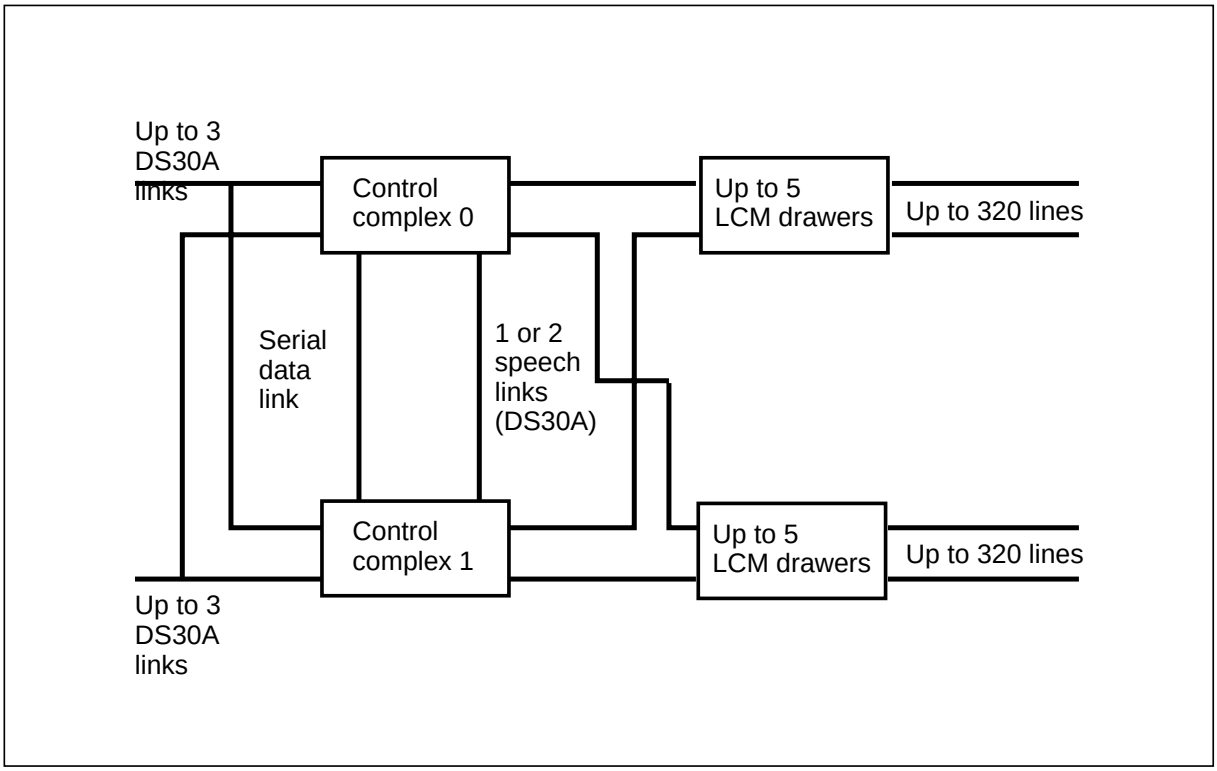
- DS-1 interface processing, to allow the P-side ports to service DS-1 trunks
- DS-1 interface processing, to allow P-side ports to service DS-1 links to a remote PM
- DS30A interface processing, to allow the P-side ports to service DS30A links to a local PM
- digit collection processing, to allow the PM to collect and report digits to reduce the call processing load on the central control complex
- ring processing, to provide a remote PM with PCM ringing instructions
- pad processing, to attenuate speech samples before they are passed to the remote PM
- additional signaling processing, to maintain a DS-1 link with remote subscriber carrier equipment
- special tone detection, to allow the PM to detect and report re-originations, special information tones (SIT), audio tone detection (ATD), and call progress tones

Description

The line group controller (LGC) is designed to support the line concentrating module (Figure 12-5). The LGC performs high-level functions as follows:

- call coordination
- provision of the different tones required

Figure 12-5
Duplication within the line concentrating module



Physical

The line group controller consists of the common core of features listed above and the addition of the following:

- DS-1 interface cards, to allow the LGC to service links to a remote peripheral (RLCM or RCC/LCM)
- DS30A interface cards to allow the LGC to service DS30A links to the local PM
- Universal tone receiver (UTR) cards (optional) to allow the LGC to collect and report digits. Each UTR can collect digits from up to 30 channels at one time. An LGC can include up to two UTR cards. The UTR can be provisioned in either slot 15 or 16, with one UTR on each shelf.
- Class modem resource card is an optional card used to implement the class calling number delivery (CND) features for residential enhanced service (RES) subscribers

Two class modem resource cards must be equipped in an LGC to provide the CND feature. One card is located in slot 13 of unit 0 and the other is located in slot 13 of unit 1. The CMR card has the resources to monitor 32 CND

calls for ringing while simultaneously transmitting CND information for another 32 CND calls (a total of 64 CND calls).

Figure 12-6 shows an LGC equipped to service DS-1 links or DS30A links and its DS30 links to both network planes. Figure 12-7 shows the shelf layout for the LGC/LTC/DTC.

Figure 12-6
Line group controller configuration

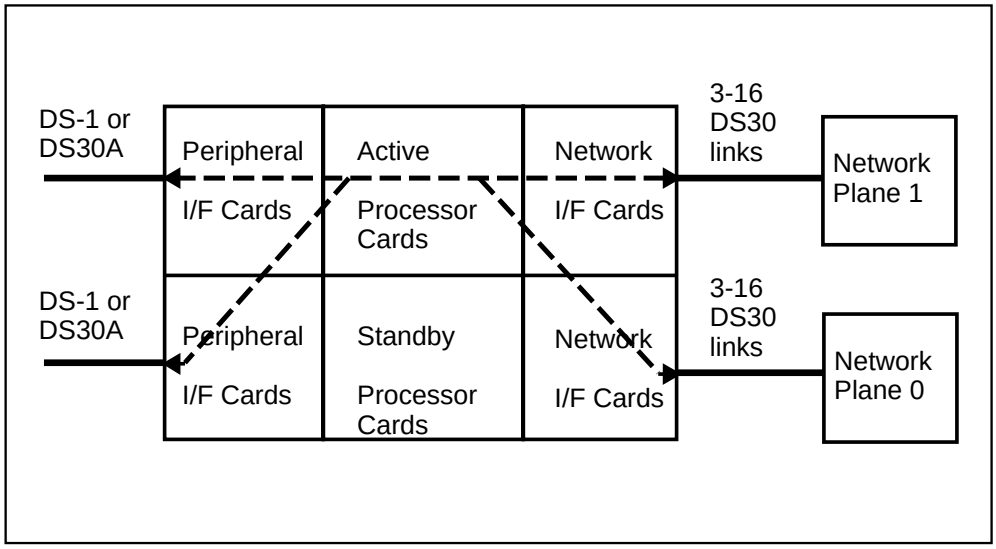
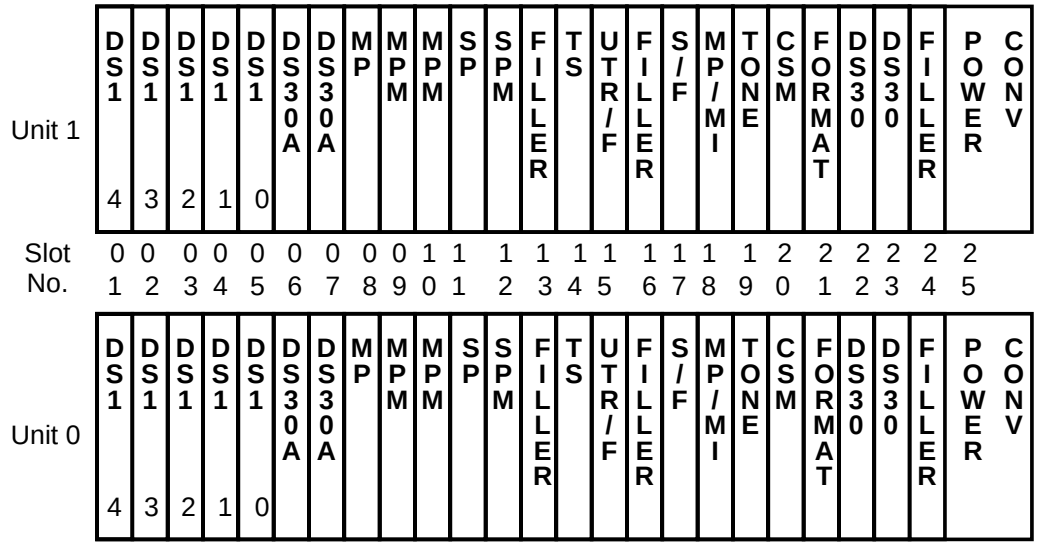


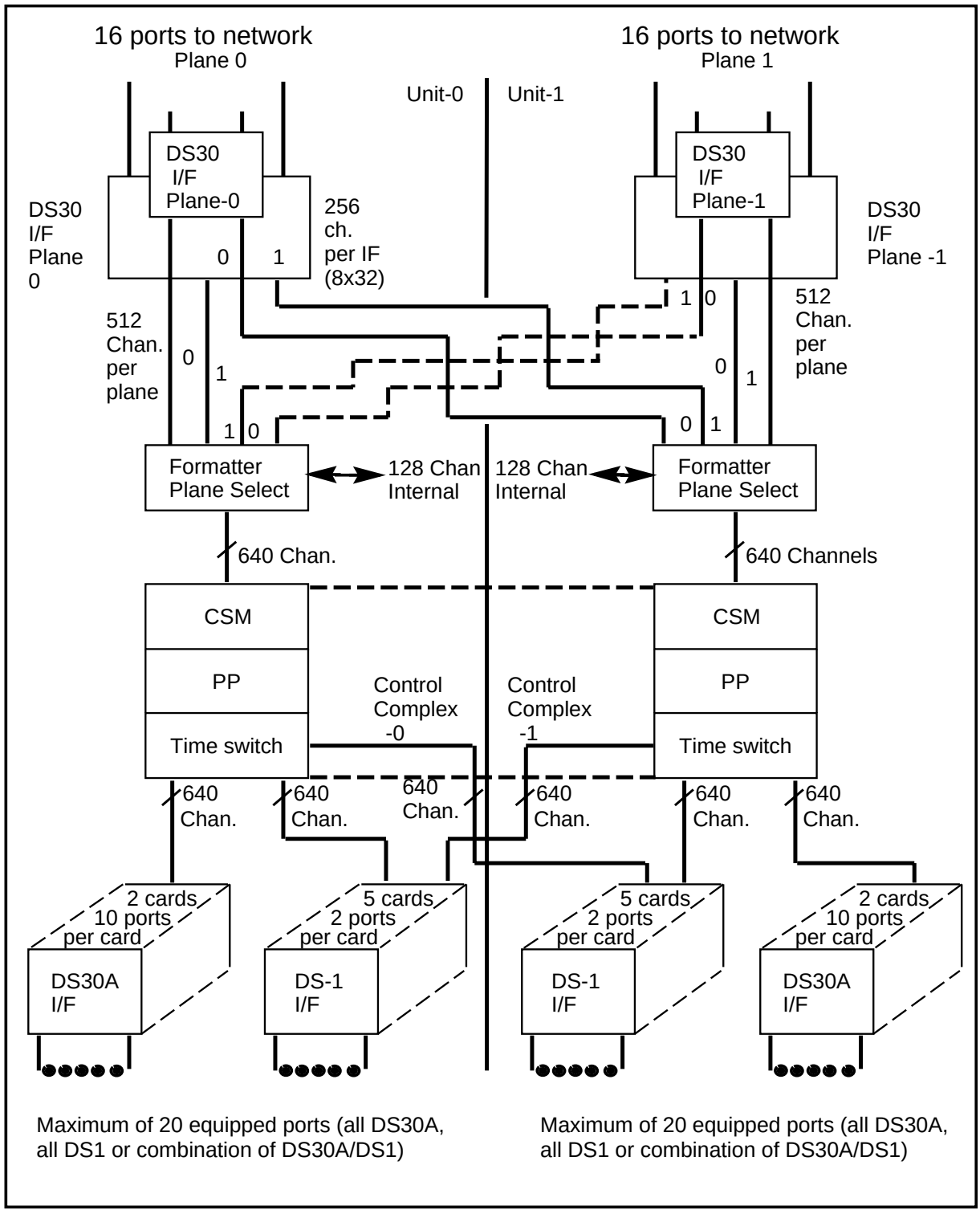
Figure 12-7
LGC/LTC/DTC shelf layout and card complement (T6X02)



Slot	Abbreviation	Description
01-05	DS-1	DS-1 interface (max. 5 cards)
06-07	DS30A	DS30A interface (max. 2 cards in LTC and LGC)
08	MP	Master processor
09-10	MPM	MP memory
11	SPM	SP memory
12	SP	Signaling processor
13	-	Filler panel or continuity tone detector or modem resource card
14	TS	Time switch
15-16	UTR/F	Universal tone receiver (max. 2 per XPM) or filler panel
17	S/F	Specialized tone receiver (max. 2 per DTC only) or filler panel
18	MP/MI	Message protocol circuit or message interface card
19	Tone	Tone generator
20	CSM	Channel supervision message
21	-	Formatter
22-23	DS30	DS30 interface (8-port)
22	DS30	DS30 interface (16-port) If this card is provisioned, slot 23 is not used.
24	-	Filler panel
25	-	Power converter

Note: If slot 22 is provisioned, slot 23 is not provisioned.

Figure 12-8
LGC/LTC/DTC block diagram



Traffic

No LGC capacity tables are used by the provisioning engineer. The capacity is derived using an engineering algorithm. The engineered CCS per LGC should be available from the provisioning engineer.

Monitoring LGC capacity

No operational measurements are directly associated with LGCs. Therefore, to determine how much of the LGC capacity is being used at a particular time, the administrator must gather data from the individual line units that the LGCs serve. The sum of the individual CCS loads being offered to the LGC can be compared to the engineered LGC capacity This will provide the percentage of use at any given time. The line units served by an LGC include the following;

- mono remote switching center
- dual remote switching center
- line concentrating module
- remote line concentrating module
- outside plant module

Note: All RSC sites with CDO/PBX trunks are connected to an LTC.

Table 12-6
LGC capacity indicators

Operational measurements		Log reports
Group	**Register**	
LMD	LMTRU	None
LMD	NORIGATT	None
LMD	ORIGBLK	NET130
LMD	TERMBLK	NET130

Performance evaluation calculations

The calculation used to determine the LGC percentage of capacity use follows:

$$\% \text{ LGC capacity use} = \frac{\text{Sum of LMDTRU (all line units served by the LGC)}}{\text{LGC engineered capacity}} \times 100$$

Note: LGC engineered capacity = the sum of the capacities of the line units served by the LGC

How to evaluate LGC capacity factors

As the LGC capacity used approaches 100 percent, the grade-of-service objectives for lines served by that LGC may not be met. This condition may become apparent by the percentage of blockages encountered, especially if the rate is significantly higher through one LGC when compared to the others. Blockage rates that are exceeding the engineered limits in all LGCs is an indication of an overload and additional equipment is required.

If there is a blockage problem only in a particular LGC(s), and no maintenance problems are in evidence, and the maximum number of links have been installed; the offered load to the LGC should be reduced by moving lines to other line units served by other LGCs. This process should be continued until the blockage rate is within the objective range.

Line trunk controller (LTC) capacity

A line trunk controller (LTC) is a fully duplicated peripheral module (PM) used to connect line equipment PMs and digital trunks to the DMS-100 network. The LTC (refer to Figures 12-7 and 12-8) can be thought of as an integrated line group controller (LGC) and digital trunk controller (DTC).

Load service relationships and limiting items are dependent on the use of the LTC. In general, the LTC engineering limits are a combination of the limits set for an LGC and DTC applications. Operational measurements are obtained by a summation of the measurements associated with the peripherals and trunks connected to the LTC.

Trunk peripheral capacity

Trunk module capacity

Trunk peripherals in the DMS-100 include the trunk module (TM), the digital trunk controller (DTC), and the line trunk controller (LTC). The LTC is described in Chapter 7, Line Peripheral Capacity.

Because the trunk peripherals have as many paths outgoing as incoming, there is no concentration; therefore, there is no blocking encountered due to the unavailability of paths. Since there is no blocking, this chapter only describes the physical capacity of the trunk modules.

Administration of capacity beyond the limitation of the physical terminations of the trunk modules is in the area of trunk servicing, which is an operating company function and administered under operating company grade of service guidelines (for example, blockage probability rates of P.01 or P.001). The operational measurement group TRK provides information on each trunk group in the form of seizure attempts, seizure failures, total trunk usage, and busy state usage.

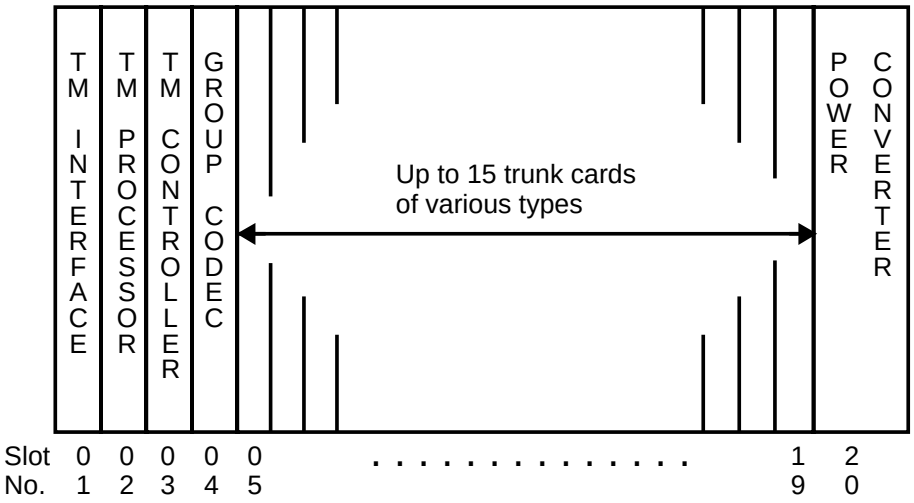
Trunk module

The trunk module is an equipment shelf, located in a trunk module equipment frame, which provides speech and signaling interfaces between one network port and thirty analog trunks. The trunk module contains common speech and data buses which carry 30 channels of speech and data converted from analog signals.

Physical

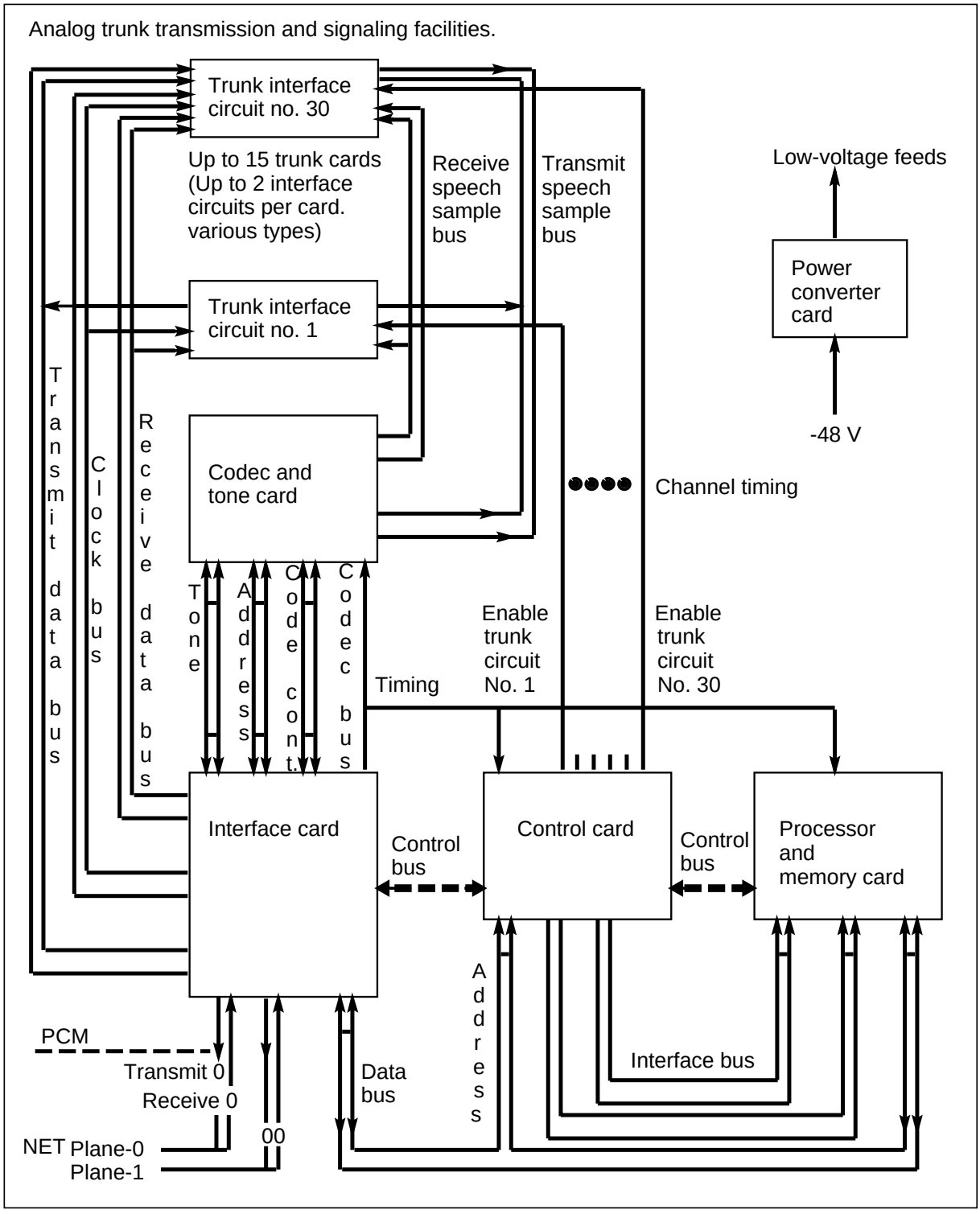
The trunk module contains a common control section and up to 15 interchangeable trunk interface cards of various types (Figures 13-1 and 13-2). Each trunk card contains one or two trunk interface circuits, which are selected to match the speech transmission characteristics and signaling methods of the trunk facility connected to the card.

Figure 13-1
Trunk module shelf layout and card complement (front view)



Slot	NT PEC	Remarks
01	2X45AB	TM interface (to network)
02	0X70AA	TM processor
03	2X53AA	TM control
04	2X59AA	Group CODEC
05	-	
to	-	
19	-	Trunk circuit cards
20	2X09AA	Power converter

Figure 13-2
Trunk module block diagram



Digital trunk controller (DTC)

The digital trunk controller (DTC) is a peripheral that replaced the digital carrier module (DCM). The DTC is a fully duplicated peripheral module used to connect digital trunks. The DTC connects a minimum of one (24 channels) to a maximum of twenty (480 channels) digital carrier systems. The network side of the DTC is connected with a minimum of four (120 channels) to a maximum of sixteen (480 channels) DS30 links.

Physical

Because the DTC has 480 channels incoming and outgoing, it is non-concentrating. Provisioning is based on physical trunk terminations. However, if the majority of the calls processed have a very short holding times, and the call rate is high, the DTC can become real-time limited. When the capacity is attempt-limited (or real-time limited) the total number of trunks that can be served is reduced to a number less than the 480 physical trunk termination capacity.

Message switch and buffer (MSB)

Introduction

The message switch and buffer (MSB) is a peripheral module which, along with a signaling terminal (ST), is used to interface and operate within a common channel signaling environment. The MSB supports the ST and routes the messages received by the ST through the network module to the digital trunk controller. The MSB also receives messages sent from the central control and routes them to the signaling link through the ST. There is a different configuration of the MSB for each of the two protocols used to implement common channel signaling; the message switch and buffer 6 (MSB6) for CCITT6 and CCIS6 protocol, and the message switch and buffer 7 (MSB7) for CCS7 signaling protocol. MSB7 and CCS7 are discussed in the following paragraphs.

Common channel signaling number 7 (CCS7)

Common channel signaling number 7 (CCS7) is a system providing all signaling for a number of voice paths over one channel, instead of within each channel. CCS7 can be regarded as a data communications system for various types of signaling and information transfer between processors. Its' goal is to provide a standardized common channeling signaling system which meets the following objectives.

- Is optimized for operation in digital networks in conjunction with stored program controlled exchanges.
- Can meet present and future requirements of information transfers for interprocessor transactions for call control, network database access, and network management.
- Provides a reliable means of information transfer in correct sequence, without loss or duplication.

CCS7 network architecture definitions

The following paragraphs provide definitions of, and the associated functions of, the components of the system (Figure 13-3).

Signaling point (SP)

The signaling point (SP) is a node in the CCS7 network which either originates or receives CCS7 messages, or transfers CCS7 messages from one signaling link to another, or both.

Service switching point (SSP)

The service switching point (SSP) is a feature that allows an SP to interface with service control points (SCCPs) and associated databases using CCS7. Usually, the SSP function will be performed by an access tandem (AT). However, end offices (EOs) generating high volumes of database services can be expected to serve as SSPs.

Signaling transfer point (DMS-STP)

A signaling transfer point (DMS-STP) is a node in the CCS7 network with the function of transferring signaling messages from one signaling link to another.

Service control point (SCCP)

The service control point (SCCP) is a node in the CCS7 network that provides a centralized information database from which responses are provided to queries originated by SSPs

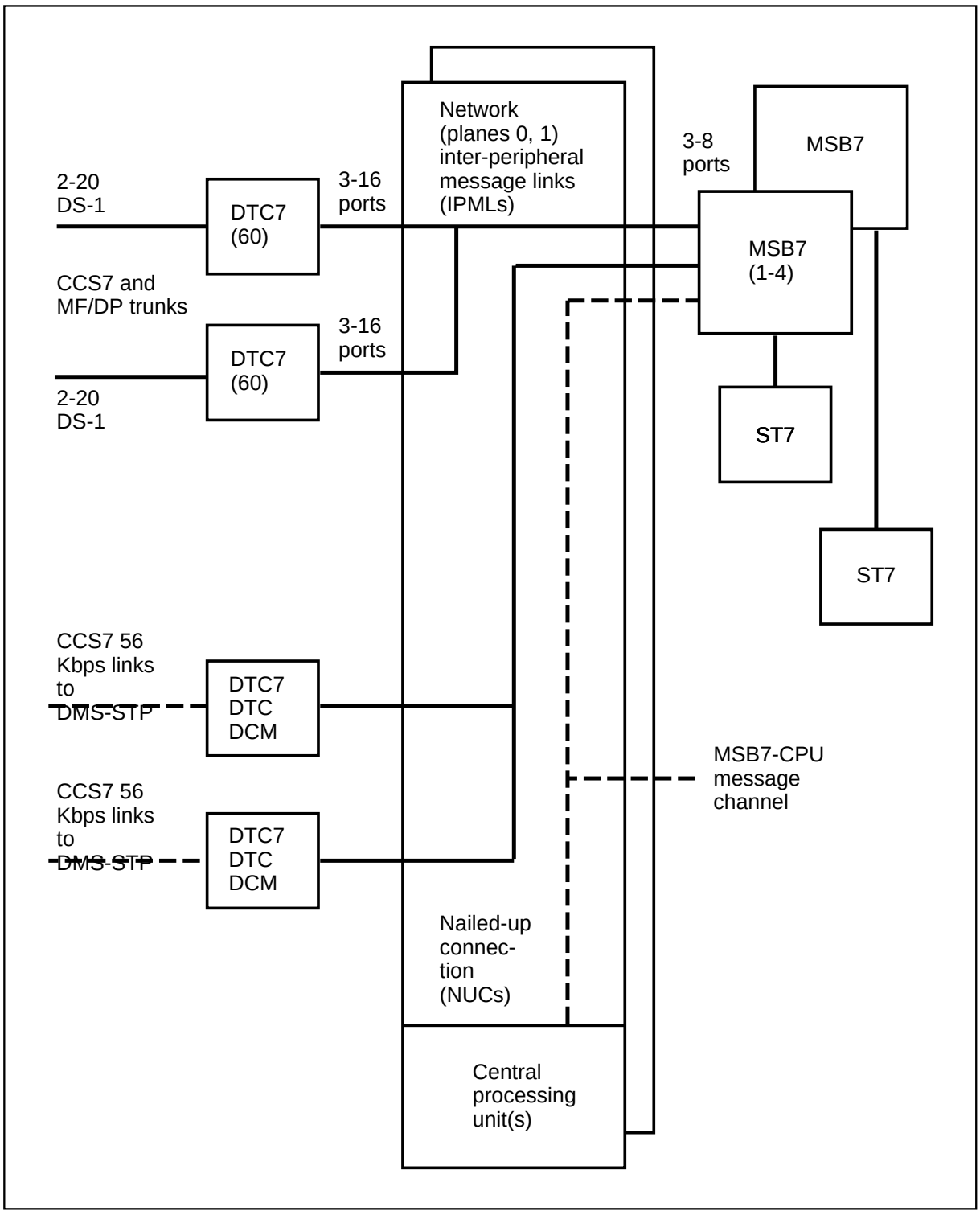
Associated signaling

Associated signaling is a mode where messages for a signaling relation involving two adjacent signaling points are conveyed over a directly connected signaling link.

Quasi-associated signaling

Quasi-associated signaling is a non-associated mode of signaling in which the signaling message route is determined for each signaling message by information contained in the message (namely, its routing label). Quasi-associated signaling is prevalent throughout the United States DMS-STP based inter- and intra-LATA networks.

Figure 13-3
MSB7 based CCS7 hardware architecture



Operation modes

Network planners and standard bodies have defined two modes of operation for CCS7.

Database query

Database query is a mode which allows multiple central offices to use centralized databases such as E800 service or private virtual network (PVN) to assist in call routing and handling. This mode is also referred to as transaction capabilities application part (TCAP) signaling.

Trunk signaling (ISUP)

Trunk signaling is a mode which replaces the current per trunk signaling (PTS) with common channel signaling (CCS). This provides the means for greater information exchange between offices, allowing network-wide services that are currently available only to subscribers within a single office. It also serves as the transport for integrated services digital network (ISDN).

Equipment description

Line and trunk hardware

The external interface at a DMS-100 family switching office for MSB7 bases CCS7 signaling links, to and from paired signal transfer points, is a DS-1 channel in a digital trunk controller (DTC) or a digital carrier module (DCM). External demultiplexing using a channel bank equipped with a digital data services plug-in is required to obtain the single channel used for the 56 Kbps signaling link.

The CCS7 signaling links terminating on DTCs or DCMs are connected to signaling terminals (ST7s) by nailed-up connections (NUCs) in the network and MSB7. CCS7 messaging traffic is load balanced across the linkset using a signaling link sharing (SLS) load sharing scheme.

The interface for CCS7 trunks must be a digital trunk controller #7 (DTC7), as neither DCMs or non-enhanced DTCs can support CCS7 trunks. Each DTC7 equipped with CCS7 trunks requires two nailed-up inter-peripheral message links (IPMLs) through the network for each MSB7. These links must be separate from the nailed-up MSB7 connecting links.

Digital trunk controller number 7 (DTC7)

A prerequisite for CCS7 trunk signaling is that the peripheral equipment capable of supporting CCS7 trunks are digital trunk controllers #7 (DTC7s). The DTC7 must be equipped with extended memory and enhanced messaging to support the inter-peripheral message link between the DTC7 and the MSB7.

When equipped for CCS7, the DTC7 can support both CCS7 and multifrequency/dial pulse (MF/DP) trunks over the same T-1 span, provided

the CCS7 and MF/DP trunks are not mixed in the same trunk group. It is recommended that DTC7s are dedicated to 100 percent ISUP trunking to ensure maximum performance. The mixing of ISUP and per trunk signaling (PTS) trunks on the same DTC7 is supported, with the inherent memory and real time constraints due to the processing overheads associated with MF A/B-bit scanning.

A maximum of 60 DTC7s, equipped for CCS7 trunks, are supported by the MSB7 based CCS7 system.

Network specifications

The quantity of nailed-up connections (NUCs and IPMLs) required for a specific application equals the number of CCS7 signaling links or signaling terminals (ST7s), times the quantity of MSB7s, plus two for each DTC7 equipped with CCS7 trunks, times the quantity of MSB7s. This physical maximum of nailed-up connections for each DMS-100 is given in the following formula.

72 ST7s (links) x 4 MSB7s = 288
60 DTC7s x 2 IPMLs x 4 MSB7s = 480
Total = 768

Ten percent or less of the total network paths should be utilized for nailed-up connections to ensure that degradation of network throughput does not occur.

A minimum of three network ports is used for each MSB7 to provide high MSB7 availability. A maximum of eight network ports can be provisioned for each MSB7. Communication between the MSB7 and the central control complex (CCC) is carried on messaging channels through the network (channel 0 of port 0 and channel 0 of port 2).

The switch connection is made through the network based on the call setup information received over the CCS7 data links; on the inter-peripheral signaling between an MSB7 and the DTC7s, and on the communication link between the MSB7 and the CCC.

Message switch and buffer number 7 (MSB7)

The MSB7 is a duplicated extended peripheral module (XPM) operating in the warm standby mode. Only one of the duplicated controllers, units 0 or 1 is designated as active at any point in time. A duplicated MSB7 occupies two shelves of equipment in a message switch #7 equipment (MS7E) frame.

The MS7E frame contains two signaling terminal array (STA7) shelves, as well as supervisory and ventilation equipment.

Each STA7 shelf holds one of the duplicated MSB7 units, and up to four signaling terminal #7 (ST7) circuit packs.

Signaling terminal number 7 (ST7)

Up to 16 additional ST7s can be mounted on an optional signaling terminal shelf (ST7G) when more than 8 ST7s are required. If more than 24 ST7s are required, a signaling terminal equipment (ST7E) frame can be supplied to provide an additional 48 ST7s, using three ST7G shelves. One MSB7 can therefor serve a physical maximum of 72 ST7s, subject to performance guidelines and limitations.The physical maximum does not imply that MSB7 processor capacity can handle 72 ST7s. In most applications, one MSB7 will probably serve six or less originating links.

The MSB7 communicates with the ST7 through shared memory that resides on the ST7 card.

One ST7 is required for each of the 56 Kbps CCS7 data links. The CCS7 signaling data links (SDLs) share the message traffic load (one to each of the paired DMS-STPs) unless a data link fault or DMS-STP failure causes one to be taken out of service. This leaves the entire message traffic load to be carried on the remaining data link. Pairs of data links (link-pairs) are therefore provisioned as if they were a single link. To keep delays in data transfer to a minimum, the current practice is to keep link loading to a level of 80 percent (0.8 Erlang) or less of the maximum link capacity when in the failure mode.

XPM channel mapping

The MSB7 is used to originate and terminate CCS7 messages. In MSB7 based service switching points (SSPs), the CCS7 links are connected to the system by a DTC, DTC7 or DCM and like voice trunks have dedicated ports on the switch network. Unlike trunks, the CCS7 links are nailed-up through the switch network to the MSB7. Each CCS7 link has a dedicated ST7.

Care should be taken when initially assigning and administering DTC7-MSB7 link assignment. The internal mapping of XPM P-side ports to C-side ports in a DTC7 requires attention to ensure that CCS7 link assignments are not made on a single network module.

In Tables 13-1 and 13-2, each entry denotes the XPM DS-1 port and channel assignment respectively for the corresponding DS-30 port and channel. For example, the entry for DS-30 port 8 channel 31 is 12-24. This means that DS-30 port 8 channel 31 maps to DS-1 port 12 channel 24.

Table 13-1xxx
XPM channel mapping DS-30 C-side ports 0-8

0	1	2	3	4	5	6	7	8	DS-30 channel
*	*	*	*	*	*	*	*	*	channel 0
1-1	2-1	3-1	4-1	6-1	7-1	8-1	9-1	11-1	channel 1
0-1	1-2	2-2	3-2	5-2	6-2	7-2	8-2	10-2	channel 2
4-2	0-3	1-3	2-3	9-2	5-3	6-3	7-3	14-2	channel 3
3-3	4-3	0-4	1-4	8-3	9-3	5-4	6-4	13-3	channel 4
2-4	3-4	4-4	0-5	7-4	8-4	9-4	5-5	12-4	channel 5
1-5	2-5	3-5	4-5	6-5	7-5	8-5	9-5	11-5	channel 6
0-6	1-6	2-6	3-6	5-6	6-6	7-6	8-6	10-6	channel 7
4-6	0-7	1-7	2-7	9-6	5-7	6-7	7-7	14-6	channel 8
3-7	4-7	0-8	1-8	8-7	9-7	5-8	6-8	13-7	channel 9
2-8	3-8	4-8	0-9	7-8	8-8	9-8	5-9	12-8	channel 10
1-9	2-9	3-9	4-9	6-9	7-9	8-9	9-9	11-9	channel 11
0-10	1-10	2-10	3-10	5-10	6-10	7-10	8-10	10-10	channel 12
4-10	0-11	1-11	2-11	9-10	5-11	6-11	7-11	14-10	channel 13
3-11	4-11	0-12	1-12	8-11	9-11	5-12	6-12	13-11	channel 14
2-12	3-12	4-12	0-13	7-12	8-12	9-12	5-13	12-12	channel 15
*	*	*	*	*	*	*	*	*	channel 16
1-13	2-13	3-13	4-13	6-13	7-13	8-13	9-13	11-13	channel 17
0-14	1-14	2-14	3-14	5-14	6-14	7-14	8-14	10-14	channel 18
4-14	0-15	1-15	2-15	9-14	5-15	6-15	7-15	14-14	channel 19
3-15	4-15	0-16	1-16	8-15	9-15	5-16	6-16	13-15	channel 20
2-16	3-16	4-16	0-17	7-16	8-16	9-16	5-17	12-16	channel 21
1-17	2-17	3-17	4-17	6-17	7-17	8-17	9-17	11-17	channel 22
0-18	1-18	2-18	3-18	5-18	6-18	7-18	8-18	10-18	channel 23
4-18	0-19	1-19	2-19	9-18	5-19	6-19	7-19	14-18	channel 24
3-19	4-19	0-20	1-20	8-19	9-19	5-20	6-20	13-19	channel 25
2-20	3-20	4-20	0-21	7-20	8-20	9-20	5-21	12-20	channel 26
1-21	2-21	3-21	4-21	6-21	7-21	8-21	9-21	11-21	channel 27

(continued)

Table 13-1xxx
XPM channel mapping DS-30 C-side ports 0-8 (continued)

0	1	2	3	4	5	6	7	8	DS-30 channel
0-22	1-22	2-22	3-22	5-22	6-22	7-22	8-22	10-22	channel 28
4-22	0-23	1-23	2-23	9-22	5-23	6-23	7-23	14-22	channel 29
3-23	4-23	0-24	1-24	8-23	9-23	5-24	6-24	13-23	channel 30
2-24	3-24	4-24	0-1	7-24	8-24	9-24	5-1	12-24	channel 31

Note:
DS-1 ports are numbered 0-19; DS-1 channels (trunks) are numbered 1-24

End

Table 13-2xxx
XPM channel mapping DS-30 C-side ports 9-15

9	10	11	12	13	14	15	DS-30 channel
*	*	*	*	*	*	*	channel 0
12-1	13-1	14-1	16-1	17-1	18-1	19-1	channel 1
11-2	12-2	13-2	15-2	16-2	17-2	18-2	channel 2
10-3	11-3	12-3	19-2	15-3	16-3	17-3	channel 3
14-3	10-4	11-4	18-3	19-3	15-4	16-4	channel 4
13-4	14-4	10-5	17-4	18-4	19-4	15-5	channel 5
12-5	13-5	14-5	16-5	17-5	18-5	19-5	channel 6
11-6	12-6	13-6	15-6	16-6	17-6	18-6	channel 7
10-7	11-7	12-7	19-6	15-7	16-7	17-7	channel 8
14-7	10-8	11-8	18-7	19-7	15-8	16-8	channel 9
13-8	14-8	10-9	17-8	18-8	19-8	15-9	channel 10
12-9	13-9	14-9	16-9	17-9	18-9	19-9	channel 11
11-10	12-10	13-10	15-10	16-10	17-10	18-10	channel 12
10-11	11-11	12-11	19-10	15-11	16-11	17-11	channel 13
14-11	10-12	11-12	18-11	19-11	15-12	16-12	channel 14
13-12	14-12	10-13	17-12	18-12	19-12	15-13	channel 15
*	*	*	*	*	*	*	channel 16

-continued-

Table 13-2xxx
XPM channel mapping DS-30 C-side ports 9-15 (continued)

9	10	11	12	13	14	15	DS-30 channel
12-13	13-13	14-13	16-13	17-13	18-13	19-13	channel 17
11-14	12-14	13-14	15-14	16-14	17-14	18-14	channel 18
10-15	11-15	12-15	19-14	15-15	16-15	17-15	channel 19
14-15	10-16	11-16	18-15	19-15	15-16	16-16	channel 20
13-16	14-16	10-17	17-16	18-16	19-16	15-17	channel 21
12-17	13-17	14-17	16-17	17-17	18-17	19-17	channel 22
11-18	12-18	13-18	15-18	16-18	17-18	18-18	channel 23
10-19	11-19	12-19	19-18	15-19	16-19	17-19	channel 24
14-19	10-20	11-20	18-19	19-19	15-20	16-20	channel 25
13-20	14-20	10-21	17-20	18-20	19-20	15-21	channel 26
12-21	13-21	14-21	16-21	17-21	18-21	19-21	channel 27
11-22	12-22	13-22	15-22	16-22	17-22	18-22	channel 28
10-23	11-23	12-23	19-22	15-23	16-23	17-23	channel 29
14-23	10-24	11-24	18-23	19-23	15-24	16-24	channel 30
13-24	14-24	10-1	17-24	18-24	19-24	15-1	channel 31

Note:
DS-1 ports are numbered 0-19; DS-1 channels (trunks) are numbered 1-24

End

MSB7 signaling equipment performance

Maximum MSB7 throughput

The maximum (non-rated) throughput of a single MSB7 is 160 messages each second (Msg/s) on a bi-directional basis for trunk signaling (ISUP) messages and/or 36 Msg/s for transaction capabilities application part (TCAP) messages for applications such as E800 or automatic call back (ACB). The DMS-100 will support a maximum of four MSB7s.

The MSB7 provisioning guidelines reflect two capacity boundaries. First, there is an MSB7 limitation imposed by the XPM signal processor (SP) real time. This is determined by the relative processing times in the signal processor for ISUP and TCAP messages.

The second MSB7 capacity boundary is the limitation imposed by the capacity of the message channel between the MSB7 and the CPU to handle long TCAP messages (ISUP traffic does not use this resource).

The multiple MSB7 maximum capacities for two, three, and four MSB7s are as follows:

- ISUP: 222, 365, and 512 Msg/s
- TCAP: 50, 82, and 115 Msg/s

These rates are non-linear across multiple MSB7s due to one-link-down provisioning requirements and the limitation of the single MSB7 maximum messaging rate of 160 Msg/s. For example, a single MSB7 could accommodate two links running at a maximum rate of 80 Msg/s each. In the two MSB7 configuration, the total signaling traffic could be spread across four links (two links for each MSB7). In this configuration, if a single link on one MSB7 were to fail while running at 80 Msg/s, and the two links on the second MSB7 were also running at 80 Msg/s, the second MSB7's offered traffic would then exceed the single MSB7 maximum of 160 Msg/s.

In the two MSB7 scenario, each link could carry a 55 Msg/s traffic load. If a single link in that configuration were to fail, the remaining three links could each assume approximately one-third of the failed link's traffic and the other MSB7 could absorb the additional 18 Msg/s and not exceed the single MSB7 capacity of 160 Msg/s.

The ISUP throughput capacity is are based on two signaling links. For short ISUP messages, an MSB7 loses capacity as the number of links increases above six; with the impact being a throughput reduction of two percent for every five additional ST7s in service.

Rated MSB7 throughput

The rated, or engineered throughput of a single MSB7 is 135 messages each second (Msg/s) on a bi-directional basis for ISUP and 30 Msg/s for TCAP. This is approximately an 85 percent engineering factor for MSB7 capacity determined through testing to account for minor variations in message size and/or message rate.

Tables 13-3 through 13-6 illustrate both the maximum and rated (engineered) capacities for one through four MSB7s in messages each second (Msg/s) and messages for each call attempt (Msg/CA).

Table 13-3
Maximum capacity for 100 percent trunk signaling (ISUP)

Quantity		6 Msg/CA	12 Msg/CA
MSB7s	Msg/s	HDBHCA	HDBHCA
1	160	96,000	48,000
2	222	133,200	66,600

Table 13-3
Maximum capacity for 100 percent trunk signaling (ISUP)

MSB7s	Msg/s	HDBHCA	HDBHCA
3	365	219,000	109,500
4	512	307,200	153,600

Table 13-4
Rated engineering capacity for 100 percent trunk signaling (ISUP)

Quantity		6 Msg/CA	12 Msg/CA
MSB7s	Msg/s	HDBHCA	HDBHCA
1	135	81,000	40,500
2	189	113,400	56,700
3	310	186,000	93,000
4	435	261,000	130,500

Table 13-5
Maximum capacity for 100 percent long messages (TCAP)

Quantity		2 Msg/CA	4 Msg/CA	13 MSG/CA
MSB7s	Msg/s	HDBHCA	HDBHCA	HDBHCA
1	36	64,800	32,400	9,969
2	50	90,000	45,000	13,846
3	82	147,600	73,800	22,707
4	115	207,000	103,500	31,846

Table 13-6
Rated engineering capacity for 100 percent long messages (TCAP)

Quantity		2 Msg/CA	4 Msg/CA	13 MSG/CA
MSB7s	Msg/s	HDBHCA	HDBHCA	HDBHCA
1	30	54,000	27,000	8,300
2	42	75,600	37,800	11,630

-continued-

Table 13-6
Rated engineering capacity for 100 percent long messages (TCAP) (continued)

MSB7s	Msg/s	HDBHCA	HDBHCA	HDBHCA
3	69	124,200	62,100	19,107
4	97	174,600	87,300	26,861

End

MSB7-CPU TCAP messaging packetization

The DMS-100 capacity for MSB7 TCAP services is limited by the message channel size of the MSB7 C-side links. In the MSB7 bases SSP, TCAP messages which exceed 40 bytes in length must be packetized into individual packets of approximately 40 bytes each to pass through the network (junctored network or J-Net) to the MSB7.

There is a minor CPU real time cost (less than +0.5 Msg/s) associated with sending these packetized messages from the CPU to the MSB7, using DS-30 protocol. The impact of TCAP message packetization on XPM signal processor real time is also accounted for in the MSB7 provisioning formulas.

Trunk signaling message models (ISUP)

Northern Telecom system engineering uses the following models for evaluating CCS7 trunk signaling applications. Customers may wish to vary these models as their individual applications dictate.

E800 and EABS database query messages

The enhanced 800 (E800) and exchange alternate billing service (EABS) database queries require two messages. These are database “query” and database “response” messages.

Private virtual network (PVN) messages

PVN calls not requiring a personal identification number (PIN) to be entered require two TCAP messages. PVN messages requiring a PIN to be entered require four TCAP messages.

CLASS feature messages

Custom local area signaling services (CLASS) features, calling number delivery (CND), and calling number delivery blocking (CNDB) do not require TCAP messages. These features use ISUP messages for feature application.

The CLASS features automatic call back (ACB) and automatic recall (AR) require an average of thirteen TCAP messages and two TCAP messages, respectively.

Ring again messages

All area wide centrex (AWC) features except ring again (RAG) only require ISUP messages for feature application. The RAG feature also requires four TCAP messages.

Link capacity versus MSB7 capacity

Each CCS7 link operates at 56 Kbps, in each direction, and is provided in mated pairs to meet the dual DMS-STP routing in the CCS7 network.

Link pairs load share the message traffic unless there is a link or DMS-STP failure forcing one of the links to handle the load. Link pairs are engineered as a single link with capacity limited to 80 percent (0.8E under single link fault conditions). This results in the following octet (8 bit byte) throughput.

56 Kbps X two directions = 112 Kbps

$$\frac{\text{112 Kbps}}{\text{8 b/octet}} = \text{14,000 octets per second (Oct/s)}$$

14,000 Oct/s X 0.8E = 11,200 Oct/s

The following formulas illustrate link capacity in Msg/s for ISUP and TCAP messages.

ISUP messages at 25 average octets for each message:

$$\frac{\text{11,200 Oct/s}}{\text{25 Oct/msg}} = \text{448 ISUP Msg/s}$$

TCAP messages at 80 average octets for each message

$$\frac{\text{11,200 Oct/s}}{\text{80 Oct/msg}} = \text{140 TCAP Msg/s}$$

These relationships indicate that the MSB7 is the capacity consideration, as a single pair of links have greater throughput capacity than a single MSB7 for both ISUP and TCAP messaging traffic.

CPU and DTC real time

The impact of CCS7 on the CPU and DTC can be forecasted using REAL::TIME and PRTCALC tools which contain the latest base call timings and call timing additives for CCS7 traffic.

DMS signaling transfer point (DMS-STP)

Introduction

Northern Telecom's DMS signaling transfer point (DMS-STP) provides signaling system No. 7 (SS7) message throughput and signaling data link

capability. These capabilities allow the operating company to develop SS7 networks providing network services such as integrated services digital network (ISDN), custom local area signaling service (CLASS), data base access, and 800 service.

DMS-STP components include microprocessor support for each signaling link. These distributed processors enable each link interface unit (LIU7) of each link peripheral processor (LPP) to process instructions while performing global title translation (GTT) on all SS7 messages.

As a stand-alone unit, the DMS-STP provides connections between the signaling points in an SS7 network. Installed as a node in a DMS SuperNode switch, the DMS-STP shares a DMS-Core and DMS-Bus with multiple DMS SuperNode applications.

Common channel signaling

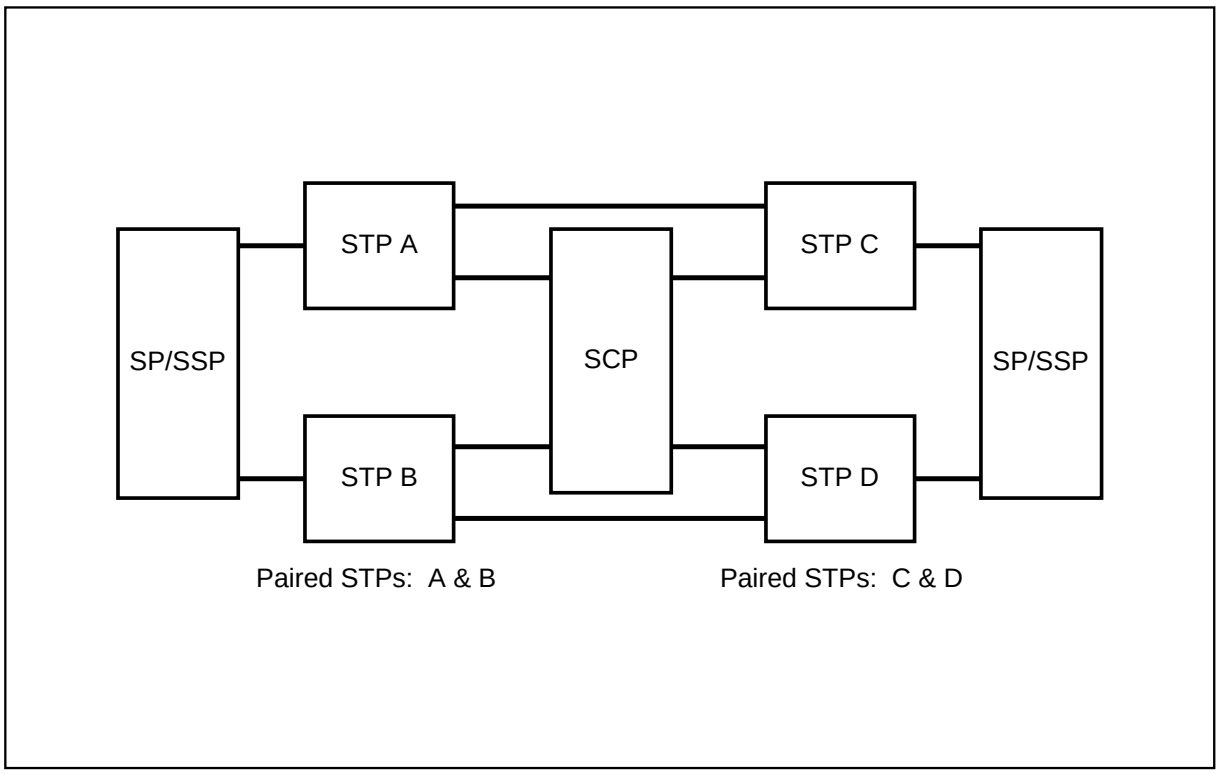
Common channel signaling (CCS) represents an evolution of trunk signaling from the predominantly in-band, channel associated mechanisms employed in the existing trunk network to an exchange of messages over an out-of-band data channel which may contain signaling for hundreds of analog or digital trunk circuits

CCS system No. 7 (CCS7)

CCS system No. 7 (CCS7) is the most recent in a series of common channel signaling protocols, defined according to established layering concepts, to provide this capability. CCS7 is specifically designed to support the rapid transfer of signaling information between end points within a CCS7 network. CCS7 also provides additional scope for the exchange of messages which are unrelated, or only indirectly related, to the control of trunk circuits.

In North America, CCS7 based signaling networks take full advantage of the increased availability of high bandwidth digital channels, initial at 56Kbits/sec and ultimately at 64Kbits/sec. A basic CCS7 based network consists of several distinct types of communicating entities, or nodes, as shown in Figure .

Figure 13-4xxx
CCS7 network nodes



CCS7 nodes are referred to as signaling points (SP) and are interconnected by signaling links (SL). An SP is any entity at which signaling network functions, such as message routing, are provided. Moreover, each signaling node has a unique point code (PC) identified with it.

The major role of the SP is a source/sink (or transfer) for CCS7 messages associated with trunk circuits terminating within the same switching office (SO). In quasi-associated signaling, an SP may act as a tandem or transfer point for CCS7 messages related to circuits which do not terminate on, or pass through, the SP.

A service switching point (SSP) is a node which has the capability to accept, format, and forward inquiries or directions to an SCCP; and to accept and deliver responses to other nodes. A signaling transfer point (DMS-STP) provides a message switching function between nodes in a CCS7 network. A service control point (SCCP) provides other nodes with access to information related to circuit establishment or one of the transaction oriented services supported by CCS7.

Scope

This section discusses the DMS implementation of a CCS7 service switching point for the North American market utilizing the DMS link peripheral processor (LPP). Major topics discussed include the following:

- system architecture
  - System architecture includes the functional and physical architecture of the LPP in SSP applications.
- features and hardware
  - Feature description includes relationships between this implementation of CCS7 and existing CCS7 standards. Hardware description identifies the major features and appropriate details of LPP on SSP hardware components.
- performance
  - The discussion of performance quantifies the performance of LPP on SSP in terms of call capacity impact from a messaging perspective.

LPP concept

The LPP (also referred to in the DMS-STP program as the link interface module or LIM) is an alternative to, or a replacement for the message switch buffer No.7 and signaling terminal No. 7 (MSB7/ST7) based signaling processor/service switching point (SP/SSP) product. The MSB7 is a Series II XMS based peripheral module (XPM) providing CCS7 capabilities. The LPP is a support operating system (SOS) based peripheral module providing CCS7 capabilities on a DMS SuperNode base as shown in Figure 13-5.

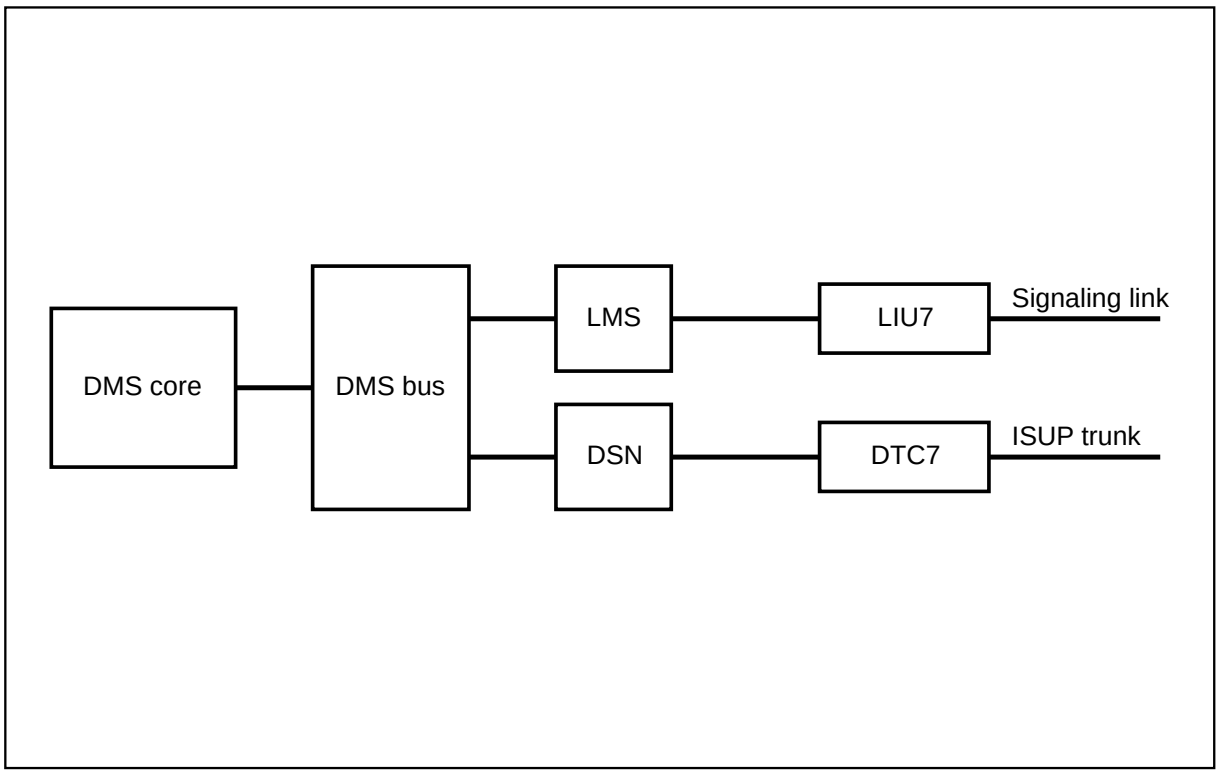
At a switching office, this node will be a host to one or more user applications such as ISUP call processing or database access operating as a source or sink of messages. As an service switching point (SSP), this node will act as an interface into the CCS7 network for end offices without CCS7 capability.

The DMS LPP based SSP is founded on the hardware and software developed for the DMS-Bus and DMS-Core within the DMS SuperNode program, the existing XPM based DTC7 and the DMS LPP.

CCS7 signaling links are terminated on individual CCS7 link interface units (LIU7) which are contained in a link peripheral processor frame. The LIU7 implements the CCS7 protocol transport layers. CCS7 ISUP (ISDN user part or trunk signaling trunks terminate on the XPM based DTC7

Incoming messages from a signaling link, terminating at a LIU7, pass through the local message switch (LMS) to the DMS-Bus message switch and are destined for a TCAP based application in the the DMS-Core, or to ISUP in the DTC7 terminating the ISUP trunk referenced in the message by the dual shelf network (DSN). The DMS-Core supports CCS7 network management and system control and maintenance functions.

Figure 13-5xxx
Conceptual view of the CCS7 LPP based SSP



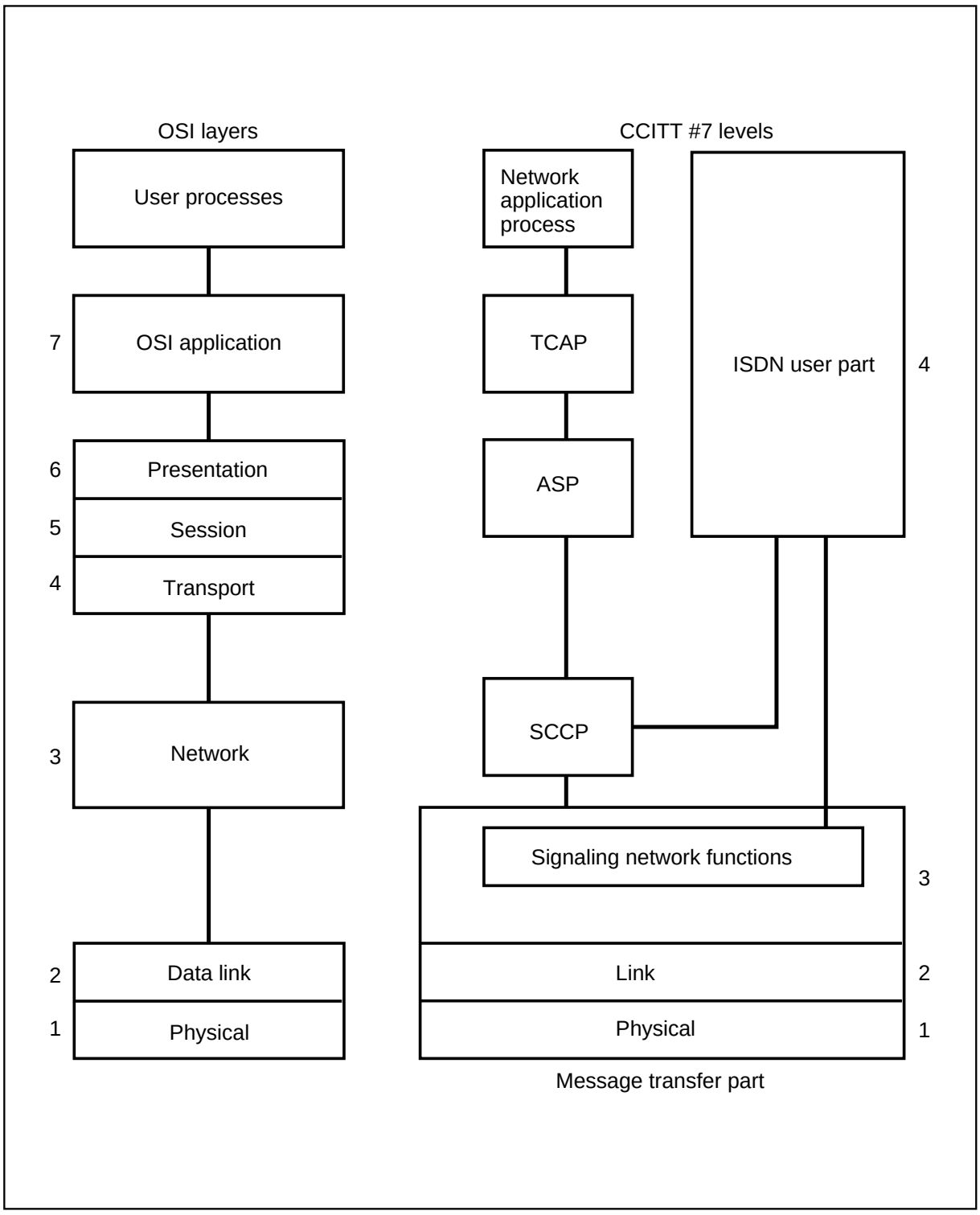
System architecture

LPP based SSP functional architecture

In its implementation of CCS7 signaling and control functions, the DMS SSP conforms to CCS7 partitioning into message transfer part (MTP), signaling connection control part (SCCP), transaction capabilities application part (TCAP), and ISDN user part (ISUP).

The MTP is comprised of open systems interconnecting (OSI) levels 1, 2, and 3. The function of the MTP is to serve as a connection-less transport system providing a reliable transfer of signaling messages between physically separated communicating users or application functions. In this context, “user” refers to a functional entity that utilizes the basic transport capability provided by the MTP (Figure 13-6).

Figure 13-6xxx
CCS7 4-level reference model versus OSI 7-layer model



The signaling connection control point (SCCP) completes layer 3 of the OSI architecture. This functional block, situated above the MTP, provides additional functions to the MTP for connection-less services as well as CCS7 network, point code, and subsystem management. The combination of the MTP and SCCP is known as network service part (NSP).

The integrated services digital network user part (ISUP) is one user of MTP and potentially SCCP. ISUP provides inter-exchange signaling to support trunk setup, ISDN access signaling and specialized subscriber facilities.

The application service part (ASP) builds on the service fo the MTP and SCCP by providing additional functions to meet the needs of the signaling network. The ASP has no functionality for the current CCS7 applications. An “application” is an entity that utilizes the capabilities of the MTP, SCCP, and ASP.

The transaction capabilities application part (TCAP) is an application layer protocol. TCAP provides services to support non-circuit related transaction oriented applications such as database dependent 800 services and calling card services.

Signaling link terminology

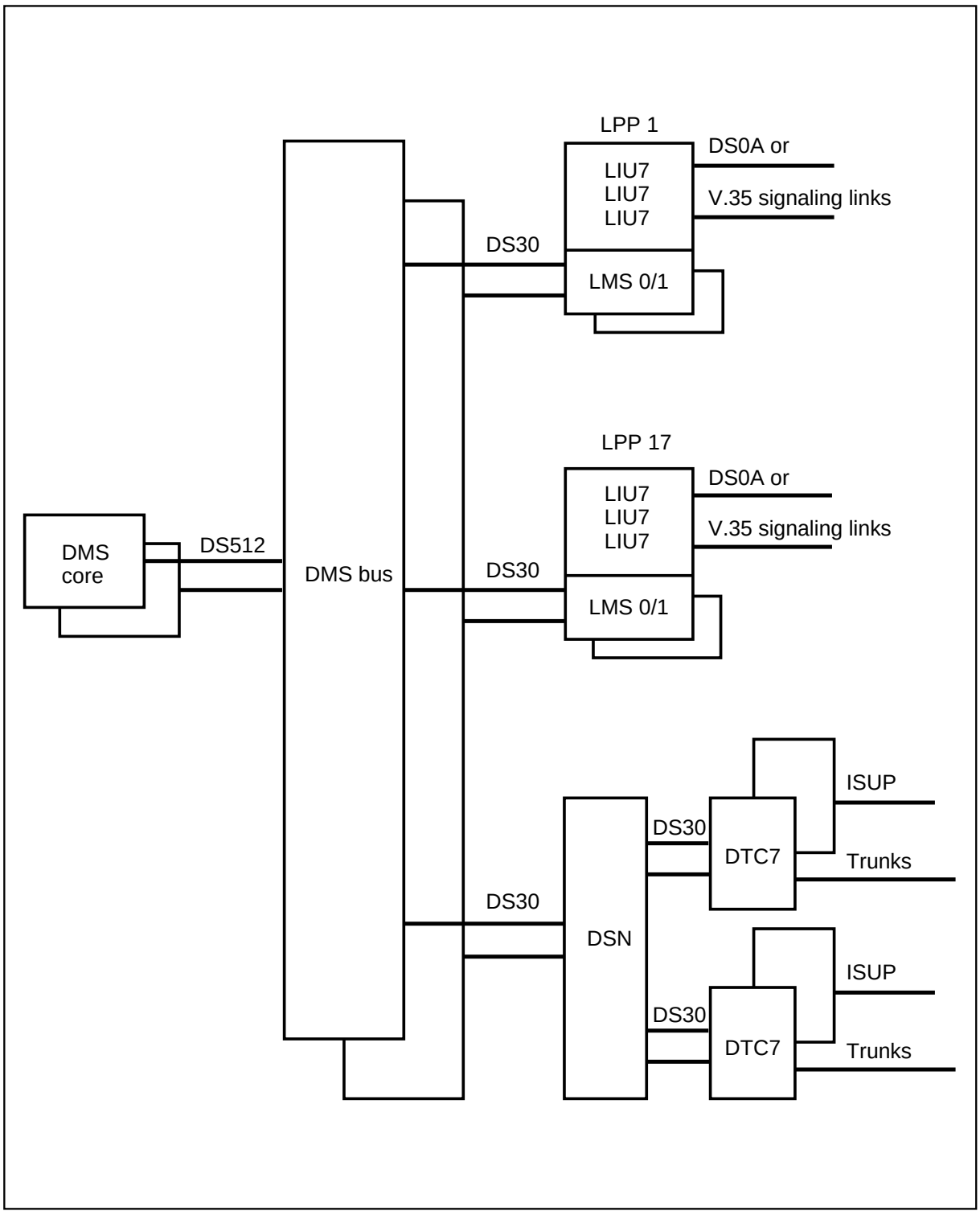
Signaling links (SLs), also interchangeably referred to as signaling data links (SDLs), are the inter-connections between CCS7 nodes. They comply with the following standard naming convention:

- A (access) links connect SSPs, SCCPs, and SPs to DMS-STPs.
- B (bridge) links are link quads which fully inter-connect DMS-STP mated pairs to other DMS-STP mated pairs.
- C (cross) links which join two DMS-STPs to form mated pairs.
- D (diagonal) links are quad links interconnecting a primary (regional) DMS-STP pair with a secondary (LATA) DMS-STP pair.
- E (extended) links access links to a remote DMS-STP pair other than the “home” DMS-STP.
- F (fully associated) links are associated signaling links interconnecting two SPs excluding DMS-STPs.

Hardware architecture

The hardware architecture block diagram is provided in Figure 13-7, and discussed in the following paragraphs. A CCS7 signaling link, conforming to DS-0A or V.35 specifications, terminates on one of the individual link interface units (LIU7s) in a link peripheral processor. The number of LIU7s in an LPP is either 24 (with the 3 slot for each LIU7 shelf), or 36 (with the 2 slot for each LIU7 shelf). They are commonly referred to as LIU shrink or DMS-STP GA in BCS31; or SSP GA in BCS32.

Figure 13-7xxx
Hardware architecture



The composition of an LIU7 is also dependent on its size. Each 3 slot LIU7 is comprised of the following components:

- a paddle board (paddle board) which physically and electrically terminates the link
- a signaling terminal (ST)
- a link general processor (LGP)
- an F-Bus interface circuit pack (PFI)

Each 2 slot LIU7 is similarly constructed, except that the LGP and PFI are combined into a single unit, thus reducing space and allowing for the 2 slot configuration.

A single link interface shelf (LIS) is comprised of the following components:

- up to 8 or 12 LIU7s (3 or 2 slot LIU7s, respectively)
- two power convertors
- two F-Bus repeater circuit packs
- two F-Bus extenders
- two intra-F-Bus terminator paddle boards.

The top shelf of an LPP contains a duplicated local message switch (LMS) which links individual LIU7s with the DMS-Core through the DMS-Bus in a fully redundant manner. An LPP is connected to each side of the DMS-Bus by four 4-wire 2.56 Mbit/sec DS30 links.

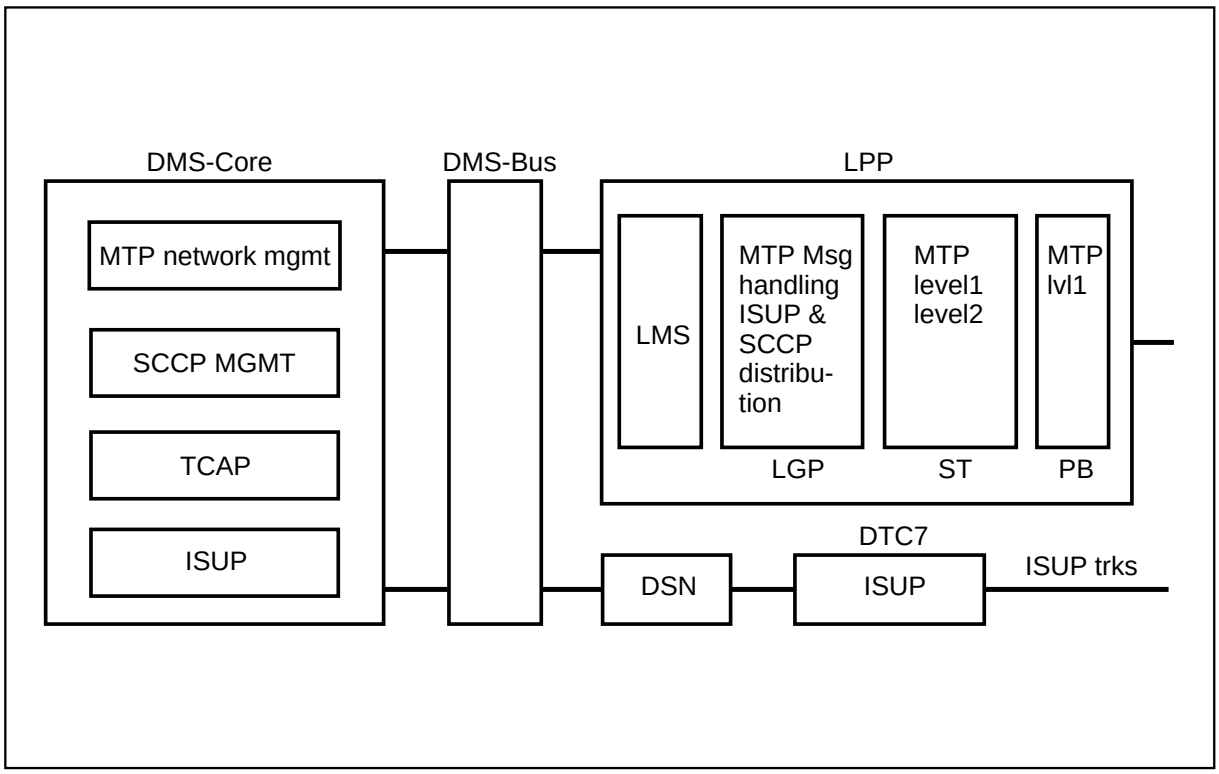
The DMS-Core operates in a fully redundant hot standby mode. The DMS-Bus operates in a load-sharing mode, with each plane capable of handling the entire load. A pair of optic fiber based 152 Mbit/sec DS512 ports provide a communication link between the DMS-Bus and the DMS-Core. The DMS-Bus also houses common memory and processing elements which provide DMS-Bus control and maintenance. The dual shelf network (DSN) is connected by DS30 to the DMS-Bus.

The DTC7, a member of the XPM family of peripherals, is a fully duplicated processor operating in an active/warm standby mode. The DTC7 is connected to the DSN by four 16 network ports and terminates the ISUP trunks.

Mapping functional onto hardware architecture

Figure 13-8 shows the mapping of functional CCS7 hardware, consisting of MTP (levels 1, 2, and 3), SCCP, TCAP, and ISUP onto DMS hardware architecture.

Figure 13-8xxx
Functional to physical mapping



Software and firmware implementing level 1 and 2 of the MTP reside in the interface paddle board and ST of each LIU7. Level 3 of the MTP and those portions of the SCCP which are link specific are implemented in the LGP. Link maintenance and related functions such as statistics gathering are shared between the LGP of the link and the DMS-Core.

Those portions of the MTP and SCCP which involve the control and management of linksets or combined linksets, or other combinations of links such as changeover/changeback management, or point codes and subsystems reside in the DMS-Core. TCAP is completely resident in the DMS-Core.

ISUP functions are split between the LIU7, the DTC7, and the DMS-Core. The majority of call processing messaging is performed at the peripheral level. ISUP distribution of messages to the appropriate DTC7 is performed in the LIU7. Real time intensive call processing functions such as translations and network connection startup are delegated to the DMS-Core.

A signaling message from the CCS7 network follows a path through the SSP in the following manner:

1 The CCS7 signaling link, conforming to DS-0A or V.35 interface specifications, is physically and electrically terminated on the paddle board in accordance with the MTP signaling data link level (level 1).

2 The MTP signaling link level function (level 2) within the ST assembles the bits into a CCS7 message signaling unit (MSU) or message, checking for transmission and protocol errors. Signaling link alignment and flow control are also performed by the ST.

3 Fill-in signal units (FISUs) are discarded at the ST. Correctly received messages other than FISUs are passed from ST to the MTP level 3 signaling message handling function in the LGP by the processor bus (P-Bus).

4 The message handling function includes message distribution by point code analysis, message distribution to the designated MTP user (including the SCCP and ISUP), and routing of outgoing messages to the appropriate link.

5 Messages destined for the ISUP call processing application are sent to the ISUP distributor in the LIU7. This function maps the originating point code (OPC) and circuit identification code (CIC) of the message to a given ISUP trunk and the DTC7 that terminates the trunk. The message is then sent to the DTC7 to be processed.

6 ISUP, in the DTC7, processes the message

7 Messages destined for SCCP subsystems are sent to the SCCP distributor in the LIU7. The SCCP distributor examines the SCCP called party address (CDPA) to determine the ultimate destination of a message; a TCAP subsystem or SCCP management (SCMG). The message is sent to its destination, usually resident in the DMS-Core.

8 Messages destined for MTP signaling network management are sent to the MTP signaling network management distributor in the LIU7 which forwards the message to the MTP signaling management function in the DMS-Core for processing.

9 Messages destined for the CCS7 network are routed by a local routing function in the originating node (DTC7 or DMS-Core) which selects the appropriate route and link into the network. The message is then sent to the LIU7 terminating the chosen link. Basic checks are performed in the LIU7 to ensure that the chosen link is still available for signaling traffic. If not, the message is given to the router in the LIU7 which chooses an alternate route and link.

10 The message is sent from the LGP of the LIU7 to the ST of the LIU7 by the P-Bus. The ST performs the MTP level 2 functions required to transmit the message onto the link.

MTP signaling network management functions for traffic, link, and route management are distributed between the LGP and the CM, and are implemented by an exchange of system messages.

SCCP routing control (SCRC) and connection-less control (SCLC) functions reside in the LGP, providing global title translation at the individual link level and subsystem routing.

SCCP management control (SCMG), which supports point code and subsystem status management, is implemented in the DMS-Core.

Feature description

Software requirements

The following paragraphs describe the major software design units in the CCS7 implementation. The description of each unit includes a general overview, a brief description of the functional areas of the unit, and a statement of the objectives of the DMS implementation of the unit.

These software units are as follows:

- message transfer part (MTP) levels 1, 2, and 3
- signaling connection control part (SCCP)
- transaction capabilities application part (TCAP)
- ISDN user part (ISUP)

Message transfer part (MTP)

The overall function of the MTP is to serve as a transport system providing reliable transfer of signaling messages, in correct sequence without loss or duplication, between the signaling points of the network.

The MTP is separated into three functional levels:

- signaling data link
- signaling link
- signaling network

Signaling data link level (level 1)

The signaling data link level is concerned with the raw transmission of bits over a communication channel; defining the physical, electrical, and procedural characteristics of a signaling data link and its interface.

A signaling data link is a bi-directional transmission path for signaling, comprising two data channels operating together in opposite directions at the same data rate.

MTP level 1 is a hardware function under software control. Digital operation at 56 Kbit/sec is supported. The standard bit rate can evolve to 64 Kbit/sec

with clear channel capability. Digital operation at lower rates is possible by a V.35 interface. Analog operation is not supported.

Signaling link level (level 2)

MTP level 2 is responsible for providing a reliable channel or link to the MTP level 3 for transfer of variable length signaling units (messages or packets) between directly connected signaling points.

The major functions performed at this level are as follows:

- signaling unit alignment and delimination
- error detection and correction
- signaling link alignment (synchronization and failure detection)
- signaling link error monitoring
- flow control

The objectives of the implementation of MTP level 2 are as follows:

- support signaling link speeds of 56 or 64 Kbits/sec
- support message traffic at 80 percent (0.8 erlang) link occupancy
- minimize the delay of messages through the level 2 layer
- support the transfer of variable length messages with a maximum of 279 octets (8 bit bytes)

Signaling network function (level 3)

MTP level 3 is responsible for the reliable transfer of messages between signaling points in the signaling network. Level 3 must ensure reliable transfer even in the event of signaling link and signaling transfer point failures. This level therefore includes the appropriate functions to inform remote parts of the signaling network of the consequences of a fault and to reconfigure the routing of messages through the signaling network.

MTP level 3 functional areas can be best described in two categories:

- signaling message handling
- signaling network management functions

Signaling message handling

Signaling message handling functions ensure that a message originating at an MTP user at the originating signaling point is sent to the destination MTP user at a destination signaling point code.

Signaling message handling is divided into 3 functional units:

- message discrimination
- message distribution
- message routing

Message discrimination

The message discrimination function determines whether a message received from MTP level 2 is destined for an MTP user at this point code, or destined for another signaling point in the network.

Message distribution

If the message is destined for the node, it is passed to the message distribution function which delivers the message to the appropriate MTP user.

Message routing

If the message is destined for another node, it is transferred to the message routing function which determines the outgoing route to the destination on which the message must be sent. Signaling traffic generated at the node is also delivered to the message routing function for transfer on the appropriate link towards the destination signaling point.

Signaling network management functions

Signaling network management functions provide actions to restore normal signaling conditions in the event of failures or of reduced accessibility due to congestion.

Signaling network management is partitioned into 3 functional units:

- signaling traffic
- signaling link
- signaling route

Signaling traffic management

Signaling traffic management takes actions upon changes in the status of signaling links and routes, diverting traffic on failures and temporarily reducing traffic on congestion.

Signaling link management

Signaling link management controls locally connected linksets initiating actions to restore link availability in the event of failures.

Signaling route management

Signaling route management maintains information on changes in the availability or the congestion status of signaling routes.

LPP implementation

Consistent with the MSB7/ST7, LPP implementation divides MTP level 3 into two functional areas:

- routeset
- linkset

Routeset management

Routeset management is responsible for transferring messages over the CCS7 signaling network and for maintenance of the network. This includes signal message handling, signaling traffic, and route management.

Linkset management

Linkset management is responsible for maintaining signaling service at the point code and restoring signaling service in the event of link failures or other disruptions in the signaling links. This function involves signaling link management.

DMS implementation of MTP level 3

The objectives of DMS implementation of MTP level 3 are support for a wide range of potential users and coexistence with other signaling systems to allow a smooth transition from older signaling technologies.

The following criteria have been met in MTP level 3 implementation:

- Link groups (links of different characteristics mixed in the same linkset) are not supported by the DMS LPP.
- Individual links are not assigned different priorities within a linkset. All links within a linkset in a loadbearing state of service loadshare the traffic assigned to a linkset.
- Signaling terminals (ST) associated with unsuccessfully restored or activated signaling links cannot be used by another link.
- Automatic uninhibiting of links in a linkset is supported
- Routing based partly on service indicator is not supported. Routing is based on destination point code (DPC) and signaling link selection (SLS).
- Parallel linksets are not supported. The number of linksets connecting two signaling points is limited to one.
- When a signaling link test fails, the test is repeated once. If the repeated test fails, the link is taken out of service regardless of the initiation method (manual or part of the signaling link activation or restoration).

Signaling connection control part (SCCP)

CCS7 provides support for advanced features including transaction capabilities for services such as database access in addition to basic circuit switched call control signaling. Signaling connection control part (SCCP) provides a portion of the functionality required to support these capabilities. SCCP services facilitate circuit related and non-circuit related signaling data transfer and the monitoring of subsystem availability. SCCP services enhance MTP services, creating a network service part (NSP) which provides greater functionality to the application.

SCCP is divided into four functional units:

- SCCP routing control (SCRC)
- SCCP connection-less control (SCLC)
- SCCP connection oriented control (SCOC)
- SCCP management control (SCMG)

SCCP routing control (SCRC)

SCCP routing control (SCRC) routes messages delivered by the MTP to local subsystems and routes messages originating at local subsystems (SCCP users) by SCLC. SCRC also routes messages originating at local subsystems into the CCS7 network by MTP. A message destination is given in the called party address supplied by the application which can contain any combination of point code (PC), subsystem number (SSN), or global title (GT). A global title is an application address such as dialed digits which is translated by SCRC into a CCS7 network address of DPC and/or SSN to be used for MTP and SCCP routing respectively.

SCRC is implemented so that a minimum of undeliverable messages are sent from the SCCP into the CCS7 network by MTP, thus preventing unnecessary congestion. Furthermore, detection of most routing problems occur in the SCCP so that messages with return option can be returned to the application and not lost at the MTP level.

SCCP connection-less control (SCLC)

SCCP connection-less control (SCLC) provides the SCCP user interface to the two protocol classes of SCCP connection-less service; class 0 basic and class 1 sequenced. SCLC is responsible for formatting user data into SCCP messages of the appropriate class, transferring these to SCRC for routing to the appropriate local subsystems, and for the message return procedure invoked on detection of a routing failure.

SCCP connection oriented control (SCOC)

SCCP connection oriented control (SCOC) provides for three additional classes of connection oriented services which are not supported in the DMS-STP at this time.

SCCP management control (SCMG)

SCCP management control (SCMG) is divided into two functions; point code status management and subsystem status management. SCMG updates routing and translation information based on information of PC/SSN failure, recovery, and congestion. This function allows alternate routing to available backups.

Transaction capabilities application part (TCAP)

CCS7, besides providing basic circuit switched call control signaling, provides capabilities to support transactions such as database access. SCCP

provides a portion of the functionality to support these services; and transaction capabilities application part (TCAP) supplies another.

Transaction capabilities are functions, within the CCS7 protocol, which control non-circuit related information exchanges between two or more signaling nodes by the CCS7 network. TCAP provides a framework for a common approach to new services within a network by providing a set of procedures which can be used for a variety of services. This avoids creating new procedures for each new application.

TCAP functionality is divided into two portions:

- transaction
- component

Transaction

The transaction portion identifies each TCAP message and the contained components as belonging to a particular application process transaction. Transaction association allows linking a query with a response and identifies the context to help interpret a broader group of components contained in one or more TCAP messages.

Component

The component portion provides an application process with the capability to invoke an operation at a remote application process and receive a response. A TCAP may carry multiple components.

Each component corresponds to a single operational protocol data unit (OPDU) as follows:

- invoke
- return result
- return error
- reject

ISDN user part (ISUP)

The objectives of DMS implementation of ISDN user part (ISUP) are as follows:

- provide inter-office POTS calls by call setup signaling and basic call supervision
- provide basic maintenance functions necessary to support call processing
- support enhanced office maintenance capabilities to enable alignment of near-to-far, data, and trunk states
- provide a base upon which networked ISDN can be implemented.

ISDN user part uses the CCS7 signaling system to provide enhanced trunk call processing capabilities. ISUP combines the advantages of faster call

setup times and shorter holding times (on unsuccessful call attempts) with the ability to carry both voice and data.

When used in association with ISDN access terminals, or between Meridian terminals, ISUP has the ability to provide the following features:

- closed user group
- user access to calling party address information
- user access to called party address information
- redirection of calls
- connect where free and waiting allowed
- completion of calls to busy subscribers
- network access to calling party address identification
- screening list entry validation
- end-to-end signaling

The intent is to create a network over which subscribers with ISDN capability can communicate and use custom features without the restriction of both subscribers being located on the same local end office.

ISUP functions are call setup and end-to-end trunk state alignment in the ISDN network. ISUP is therefore divided into two functional areas as follows:

- call processing
- trunk maintenance

Call processing

Call processing involves the basic procedures of call setup and call takedown and the handling of irregularities of both. Like other CCS systems, this is accomplished by the exchange of messages carrying the information required by dedicated signaling links and the supporting signaling network.

In order for this transfer of messages to occur, each physical voice trunk is given a signaling address consisting of network identifier, destination point code, and trunk circuit identification code. The signaling network uses this signaling address to route the messages for that particular trunk. ISUP uses the MTP for message routing, and therefore, call processing.

Trunk maintenance

Trunk maintenance operations are divided into two categories:

- system maintenance
- manual maintenance

System maintenance

System maintenance operations are initiated automatically by system software. These operations may be triggered periodically, on the basis of a pre-defined condition, or directly from call processing software.

Manual maintenance

Manual maintenance operations are initiated at a maintenance and administration position (MAP) by a craftsperson. The include such functions as manually busying a trunk, manually returning a trunk to service, or manually performing a trunk circuit test.

Hardware description

The following paragraphs provide a brief description of the major hardware entities in the CCS7 service switching point (SSP), including link peripheral processor (LPP) and digital trunk controller (DTC7).

Link peripheral processor (LPP)

The link peripheral processor (LPP) is comprised of two basic subsystems; the link interface units (LIU7s) and the local message switch (LMS).

Link interface unit for CCS7 (LIU7)

Each LIU7 consists of two or three distinct circuit packs (2-slot and 3-slot LIU7s respectively), and a single paddle board. The following paragraphs describe the physical and functional characteristics of these circuit boards.

DS-0 interface paddle board

Each signaling link conforming to DS-0A interface specifications terminates on a DS-0 paddle board which extends from the back fo the LIU7 shelf. The DS-0A signal consists of a 6 wire interface, 4 for data and 2 for composite clock. The composite clock provides bit and byte synchronization for the DS-0A data stream. The byte boundary indicated by a bipolar violation every eighth pulse. The composite clock is provided by a timing supply generator (TSG) as in the building integrated timing supply (BITS) concept. This concept calls for the establishment of a single master timing supply for each building which is directly synchronized to an inter-building synchronization network. The maximum cabling distance between the composite clock source and the DS-0A equipment must not exceed 1500 feet.

V.35 interface paddle board

The V.35 interface paddle board provides the LIU7 with a V.35 interface in accordance with CCITT recommendations. This paddle board can operate in either data terminal equipment (DTE) or data communication equipment (DCE) configuration. This is controlled through datafill and switches on the paddle board itself.

When configured in the DTE mode, the paddle board receives the clock from the modem or data unit and can operate at the following speeds:

- 2.4khz
- 4.8khz
- 9.6khz
- 19.2khz
- 56khz
- 64khz

This is configured during LIU7 datafill. In DCE mode, the paddle board can only operate at 56 Kbits/sec as the paddle board can only supply the 56 khz clock to the equipment.

The V.35 is a differential interface and can operate at a distance of up to 1000 feet between the modem/data unit and the LIU7. The V.35 signals are grouped under data transfer and status signals.

Signaling terminal circuit pack

The LPP signaling terminal (LPP-ST) circuit pack is functionally similar to the circuit pack which performs the ST function in the MSB7/ST7 implementation of a CCS7 SP. The LPP-ST is a dual processor unit with an 8085A based master processor (MP) and an 8031 based data link processor (DLP) on a single circuit pack.

The MP communicates with the DLP by shared memory with the capability of resetting the DLP. A high level data link controller (HDLC) is associated with the DLP and in combination; these devices ensure fast response to the signaling link while the MP performs less real time critical tasks, including communication with the LGP by a 32 bit processor bus (P-Bus).

Incoming messages destined for further (level 3) processing and outgoing messages are exchanged with the link general processor (LGP) by the P-Bus.

Link general processor (LGP)

The NT9X13CA link general processor (LGP) is only used in the 3-slot LIU7.

The LGP is the 4Mbyte DRAM memory version of the basic NT9X13DA 68020 based CPU. The LGP communicates with the LPP-ST by the P-Bus. The only significant difference between the two versions (CA and DA) is the amount of memory provisioned on the circuit pack. Outgoing CCS7 messages on this link and system messages directed to the LGP, as well as processed messages directed to the DMS-Bus CM for routing to the appropriate LIU7 and system messages directed to the CM, are passed to the LPP frame transport bus (F-Bus) by the F-Bus interface.

Processor F-Bus interface circuit pack

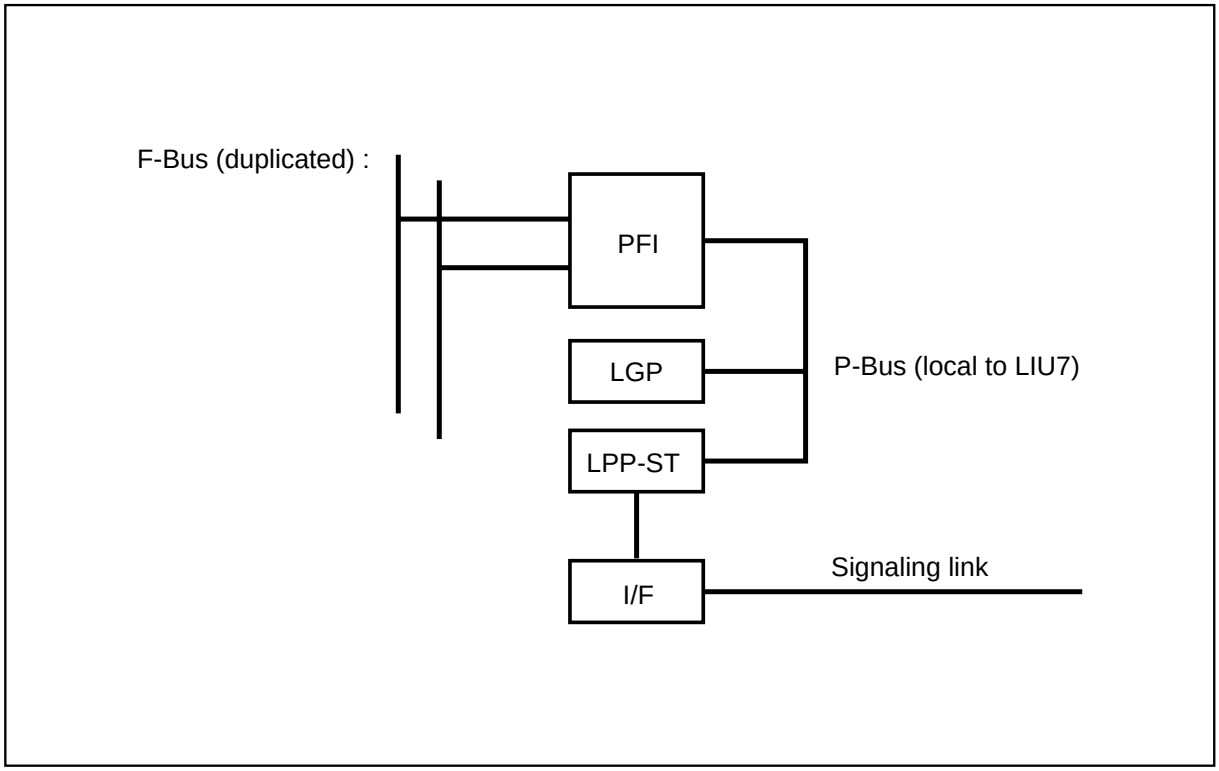
The processor F-Bus interface (PFI) is used only in the 3-slot LIU7. LIU7 interconnections are shown in Figure 13-9.

The PFI allows for the exchange of messages between the F-Bus and the P-Bus. The F-Bus is similar to the transaction bus (T-Bus) of the DMS-Bus.

The main difference is that the F-Bus is 8 bits wide versus the 32 bit T-Bus. Identical clock rates result in an F-Bus capacity of 32 Mbit/sec versus 128 Mbits/sec for the T-Bus.

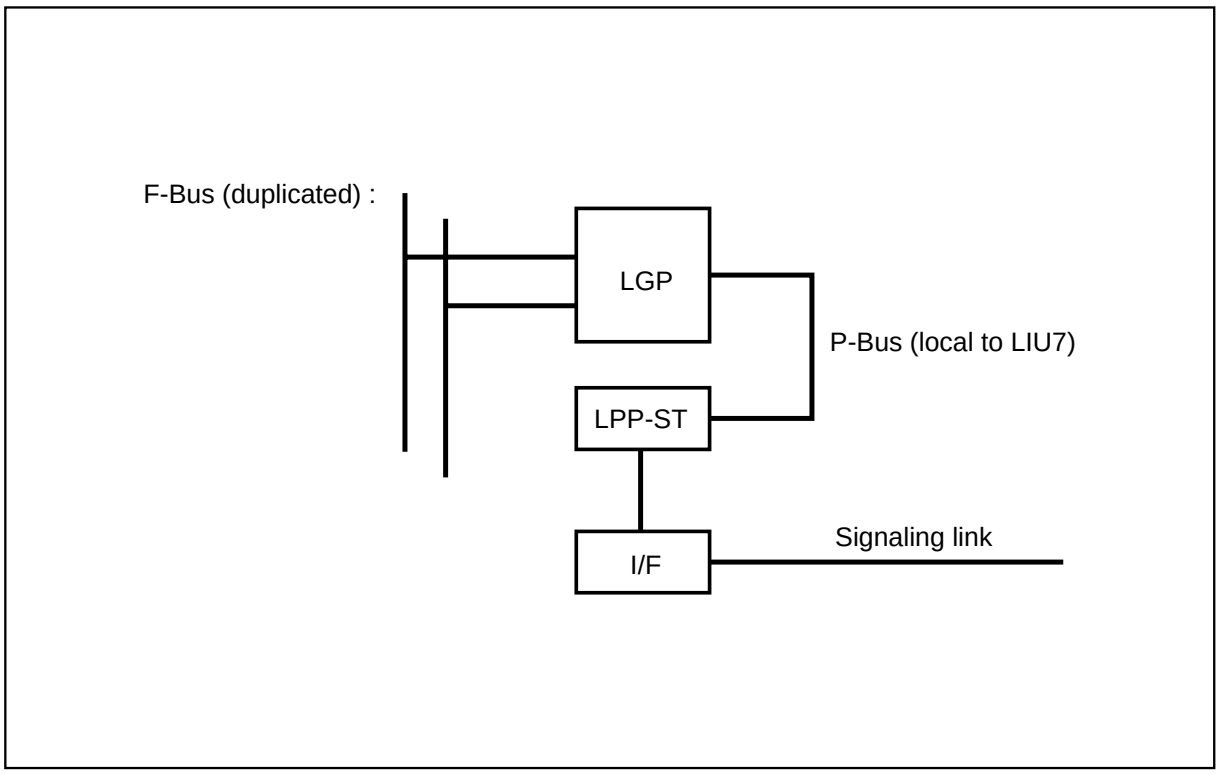
The F-Bus is duplicated on the LPP shelf backplane and duplicate interfaces are provided on the PFI. Minor differences in control signals to provide bus arbitration and LIU7 reset are incorporated in the F-Bus.

Figure 13-9xxx
Interconnections within a 3-slot LIU7



The NTEX22AA LGP circuit pack is the processor used only in the 2-slot LIU7 (Figure 13-10). It provides a Motorola 68030 processor, 4Mb DRAM, dual F-Bus interfaces, and a P-Bus interface. The main components of the board are the micro controller subsystem (MCS) and the F-Bus interface controllers (FICs).

Figure 13-10xxx
Interconnections within a 2-slot LIU7



The MCS offers the following features:

- 20 Mhz 68030 processor
- 4 Mbyte DRAM
- DRAM access protection
- system ROM
- programmable timers
- interrupt controller
- ASIC test interface

Surface mount technology is utilized to fit the MCS onto a daughter-board no larger than 4.5 by 7.5 inches.

The FIC is an application specific integrated circuit (ASIC) that is composed of direct memory access (DMA) engines that transmit and receive messages between the F-Bus and buffer structures in a local RAM (LRAM). There are two FICs on the NTEX22AA, one for each F-Bus. They share the LRAM, communicating with it over a bus known as the L-Bus. There is also an interface between the P-Bus and the L-Bus to allow the processor (or any other P-Bus master) to enqueue and dequeue messages from the LRAM

buffer structures. The NTEX22AA LIU7 can be used in either the 2-slot or 3-slot LPP cabinet.

F-Bus terminator circuit pack

The F-Bus terminator/repeater (FBT) circuit pack electronically terminates the F-Bus and provides a signal repeater function between the LIU7 shelves within a single LPP. FBT circuit packs occupy the extreme left and right slot positions in each LIU7 shelf. Each FBT serves one of the duplicated F-Bus paths on a single LIU7 shelf backplane.

Each FBT reclocks and repeats all the F-Bus signals from the inter-shelf differential F-Bus to the intra-shelf single ended F-Bus. Each FBT has the circuitry to drive one F-Bus and to terminate the other. The repeater card also has extra functionality to provide loopback on both the intra- and inter-shelf F-Bus for better fault isolation.

F-Bus extender paddle board

The F-Bus extender (FBE) paddle board is used to extend the F-Bus between shelves and serves as a connection point for duplicated F-Bus cabling. FBEs are also duplicated and are located behind each FBT circuit pack position. Two versions are required to provide resistive termination for the B-Bus in the top and bottom shelves of the LPP, and no termination in other shelves.

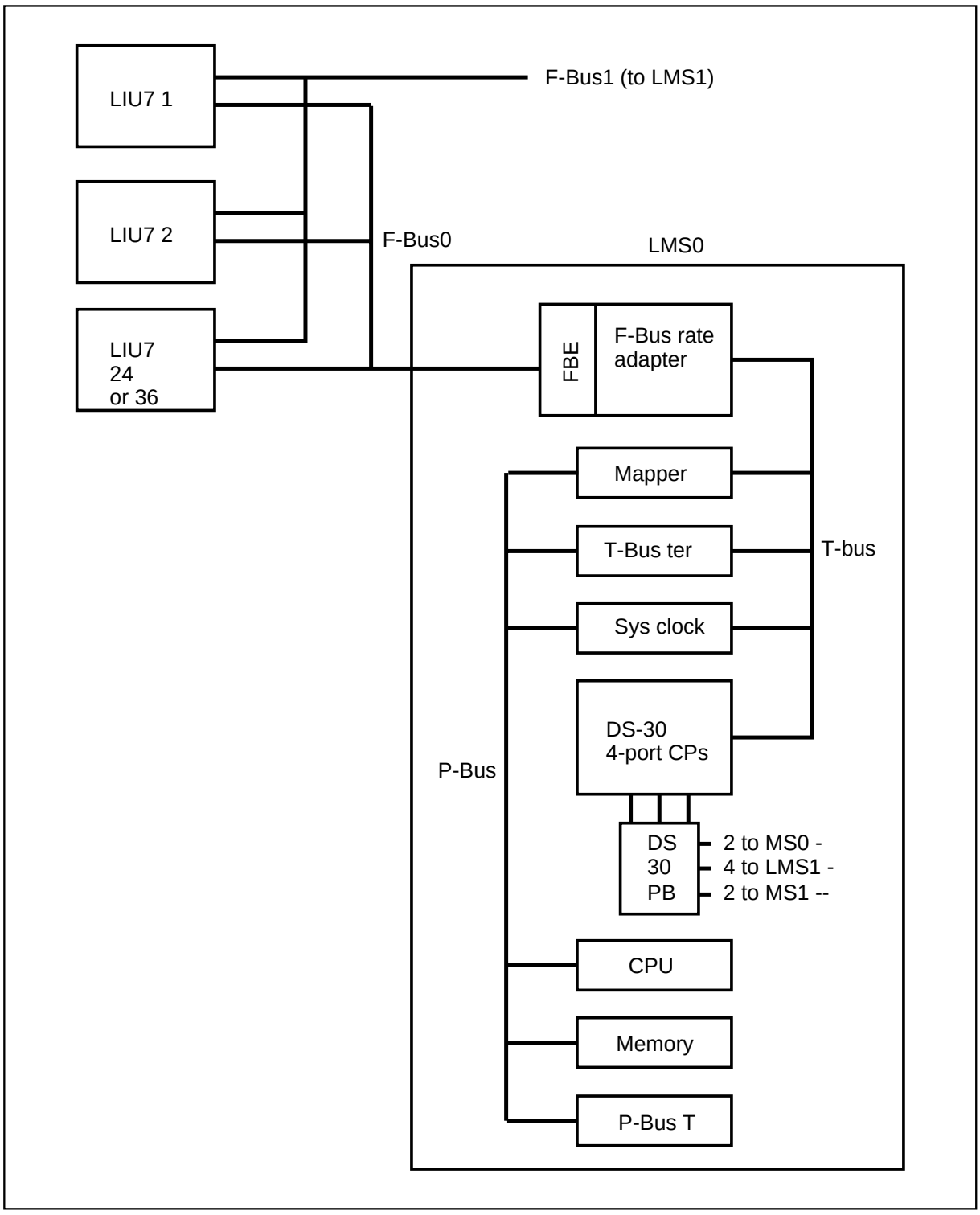
F-Bus termination paddle board

Each intra-shelf segment of each F-Bus must be electrically terminated. This function was originally performed by the F-Bus repeaters. Each repeater terminated the near end of the F-Bus it was driving and the far side of the other. The new terminating paddle boards were introduced to provide far end termination to their respective F-Buses. With the far end termination removed from each repeater, the independence of the F-Buses to single pack removals and failures is enhanced.

Local message switch (LMS)

The local message switch (LMS) represents the first level of the two-level message switching hierarchy. The LMS also provides the interface between the F-Bus seen by individual LIU7s and non-channelized DS-30 links to the DMS-Bus (Figure 13-11).

Figure 13-11xxx
LMS-LIU7 interconnection within the LPP



The LMS is duplicated; LMS0 and LMS1 interface to F-Bus 0 and F-Bus 1 respectively. This serves to loadshare the 24 or 36 LIU7s in a fully equipped LPP.LIU7 to F-Bus mapping is determined by datafill and message routing. Each LMS plane connects to each side of the DMS-Bus in a fully redundant manner.

Each LMS plane is comprised of a maximum of thirteen circuit packs and paddle boards and occupies one-half of the top shelf of the LPP. The majority of the circuit boards are identical to those employed in the DMS-Bus. Hardware fo the LMS includes the F-Bus rate adaptor circuit pack and the F-Bus extender paddle board. The latter is the same paddle board employed at the LIU7 shelf level.

The following paragraphs discuss the configuration and application of this hardware within the LPP.

The LMS is comprised of four main elements:

- F-Bus rate adaptor (RA) circuit pack
- F-Bus extender paddle board
- DS-30 4-port circuit pack
- DS-30 4-port paddle board

F-Bus rate adaptor (RA) circuit pack and F-Bus extender paddle board

The F-Bus rate adaptor (RA) circuit pack accepts input from a single F-Bus plane by the F-Bus extender paddle board. The F-Bus rate adaptor buffers and retransmits messages onto the higher rate LMS T-Bus. In the other direction, messages directed to specific LIU7s are received from the T-Bus, buffered and retransmitted at the lower F-Bus rate.

DS-30 4-port circuit pack and 4-port paddle board

The DS-30 4-port cp provides a link handler function between messages on the LMS T-Bus originating at individual LIU7s, or at the LMS CPU, and four DS-30 links supported by the 4-port paddle board. A fully equipped LPP (24 LIUs) requires a two 4-port circuit pack/paddle board combination for each LMS plane, with all DS-30 ports in use. Of the eight available links, four are connected to the DMS-Core message switches (two to each plane). The remaining links are used to cross-connect the LMSs. The link handler implements the full duplex DMS-Y protocol.

LMS CPU circuit pack and reset paddle board

The inter-connection between circuit packs and paddle boards within the LMS and between individual LIU7s and the LMS is shown in Figure 13-11.

The LMS CPU, supported by up to 1 Mbyte of co-resident memory and 6 Mbytes of memory resident on associated memory circuit packs, has four main functions:

- Performs diagnostic and routine maintenance functions related to individual LIU7s; and to the LMS for the LPP on which it resides.
- Accepts program and database updates and reloads from the DMS-Core by the DMS-Bus and delivers these in a controlled fashion to individual LIU7s.
- Performs certain operational measurements (OMs) related to message flow, internal and signaling link occupancy, and processor load in conjunction with the LGP of individual LIU7s.
- Configures and maintains the mapper circuit pack, 4-port circuit pack, and the F-Bus rate adaptor.

The reset paddle board supports a terminal interface which will permit a remote reset of the associated LMS CPU circuit pack.

Memory circuit pack

Each memory circuit pack contains 6 MBytes of random access memory. A single memory circuit pack is required for each LMS plane.

Mapper

The mapper examines the heading which forms part of every message inserted on the T-Bus. When the header contains a logical message destination address, but no physical destination address, the mapper inserts the appropriate physical address. In this application, all CCS7 messages which flow through the LMS will undergo logical-to-physical address mapping.

System clock

The system clock circuit pack provides the 10.24 Mhz and 16.384 Mhz system clocks for the LPP. The clock reference is provided from the DS-30 link interface paddle board over a backplane signal.

T-Bus terminator circuit pack

The T-Bus access circuit pack provides CPU access to the transaction bus and terminates this bus.

P-Bus terminator circuit pack

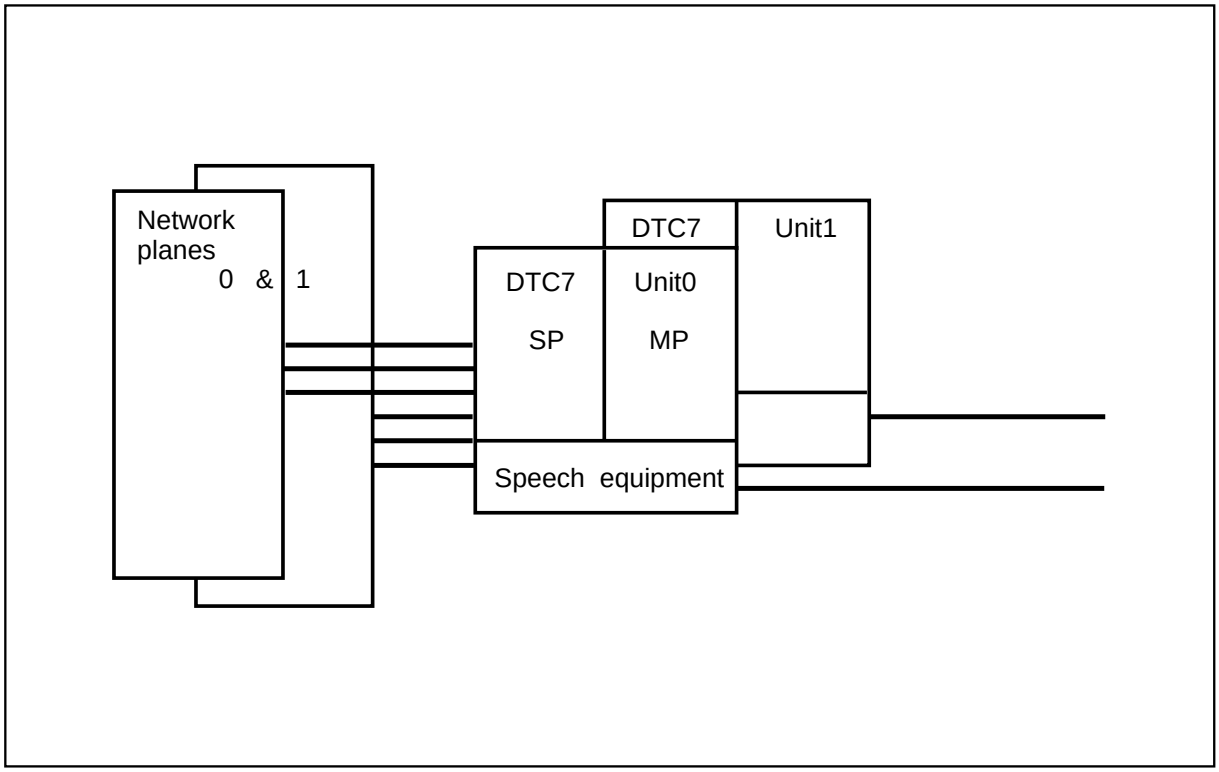
The P-Bus terminator terminates the processor bus.

Digital trunk controller (DTC7)

The digital trunk controller (DTC7) is a member of the XPM family of peripherals. A block diagram of the DTC7 used in LPP is shown in Figure 13-12. The DTC7 is fully duplicated, operating in an active/warm standby mode. Each unit consists of two processors and a master processor (MP)

responsible for logical call processing functions; and a signaling processor (SP) responsible for all low level C-side and P-side interface functions.

Figure 13-12xxx
DTC7 block diagram



On the C-side, the DTC7 can use 4 to 16 network ports in increments of blocks of 4. On the P-side, the DTC7 may be equipped with 1 to 10 T1 cards in increments of 1. Each T1 card interfaces 2 T1 spans. Thus a DTC7 can interface a maximum of 20 T1s. Each T1 contains 24 time slots; therefore the DTC7 can accommodate a maximum of 480 trunks.

ISUP trunks interface with a DTC7. As a result, ISUP trunks must be digital. Analog trunks must be interfaced with channel banks.

It is recommended that DTC7s be dedicated to 100 percent ISUP trunking to ensure maximum performance. The mixing of ISUP and per trunk signaling (PTS) trunks on the same DTC7 is supported, however with the inherent memory and real time constraints due to the processing overheads associated with multi-frequency (MF) A/B-bit scanning.

The DTC7s supporting the ISUP trunks must be equipped with extended memory boards on the MP and SP, and messaging cards with tone circuits.

Detailed performance

CCS7 link capacity (3-slot, 68020)

LPP based CCS7 data links (single LIU7s) are traffic provisioned. Each link operates at 56 Kbits/sec, in each direction, and is provided in mated pairs to meet the dual STP routing in the CCS7 network. Northern Telecom's 3-slot LIU7s will support a full 0.8 Erlang traffic load for the ISUP call model using a 25 octet average message length under "non-catastrophic, single failure" conditions. Catastrophic failure is considered to be more than one simultaneous system component failure. When the link is running at 0.8 Erlang, this is a single failure condition and any further component failure is considered catastrophic and not supported.

The two CCS7 links load share the message traffic unless there is a link or STP failure forcing one of the links to handle the entire load. To keep delays at a minimum, in a link failure mode, the link pairs (two LIU7s for each link pair) are engineered as if they were a single link at 80 percent of its maximum capacity (0.8 Erlangs). Therefore, each link of a link pair operates at 0.4 Erlangs under normal operating conditions.

Once the message each second requirement has been determined, the number of links required to support that level of messaging is provisioned. The number of LPPs required to support that number of links is then determined. To begin link analysis, link physics and octet throughput should be considered.

TR-317 (intra-LATA) versus TR-394 (inter-LATA) signaling

The link analysis presented in this document is presented from a TR-317 (intra-LATA signaling) perspective (DMS to DMS). Fundamental link analysis does not change when reviewing a TR-394 (inter-LATA) application. However, when considering specific link performance characteristics in a TR-394 environment, minor messaging changes and additions occur from TR-317.

First, certain messages such as IAM involved in inter-LATA trunk signaling are slightly longer owing to an increase in data necessary for carrier and trunk selection. Current intra-LATA link capacity and processor performance projections for the LIU7 are calculated using a 25 byte average ISUP message size.

Next, there are three new messages that may require consideration depending on the switching configuration under study.

These new messages are:

- exit message (EXM)
- circuit reservation message (CRM)
- circuit reservation acknowledgement (CRA)

Changes to simple link analysis may occur if the decision is made that an average ISUP call attempt involves seven messages in a TR-394 environment, or if the average ISUP message should be longer that 25 octets. ISUP call attempts in this document are considered to involve six messages for each CCS7 trunk connection. Figures 13-13 through 13-16 show connectivity in a CCS7 to CCS7 and CCS7 to MF inter-LATA trunk signaling environment.

Figure 13-13xxx
End office to inter-exchange carrier (100 percent CCS7)

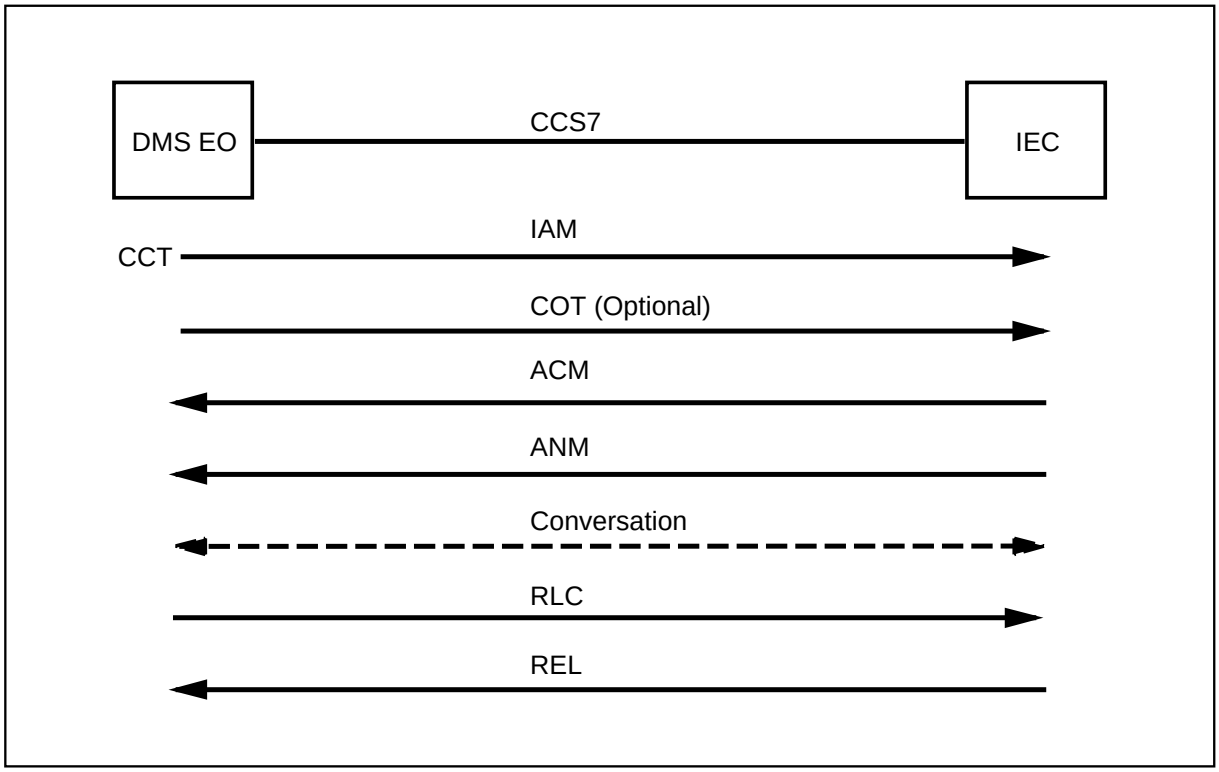


Figure 13-14xxx
End office to access tandem to inter-exchange carrier (100 percent CCS7)

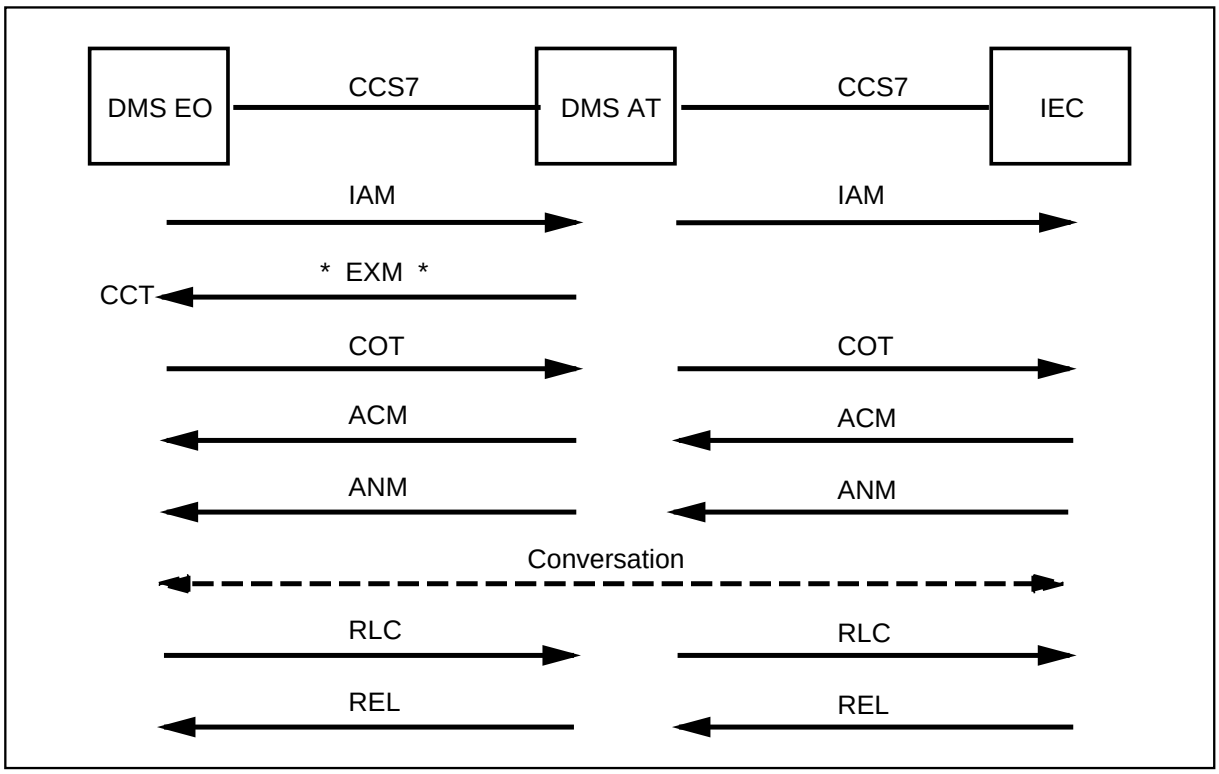


Figure 13-15xxx
End office to access tandem to inter-exchange carrier (CCS7 - MF)

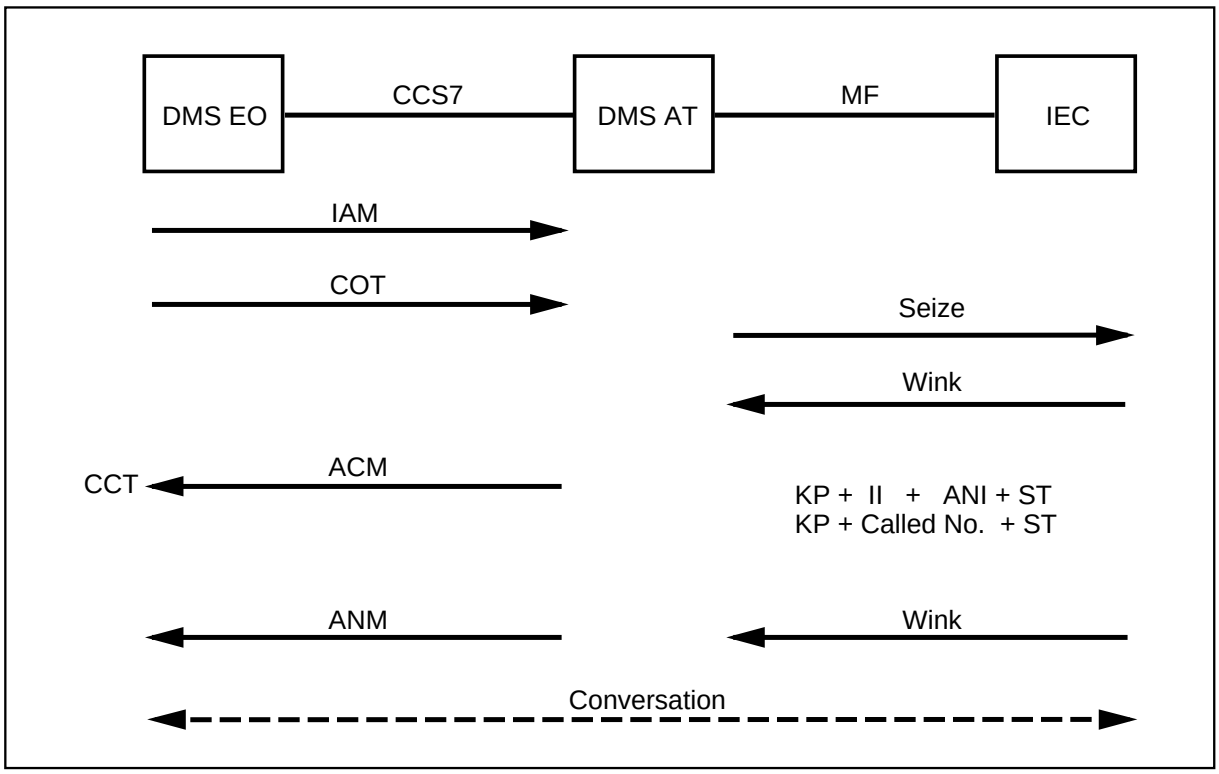
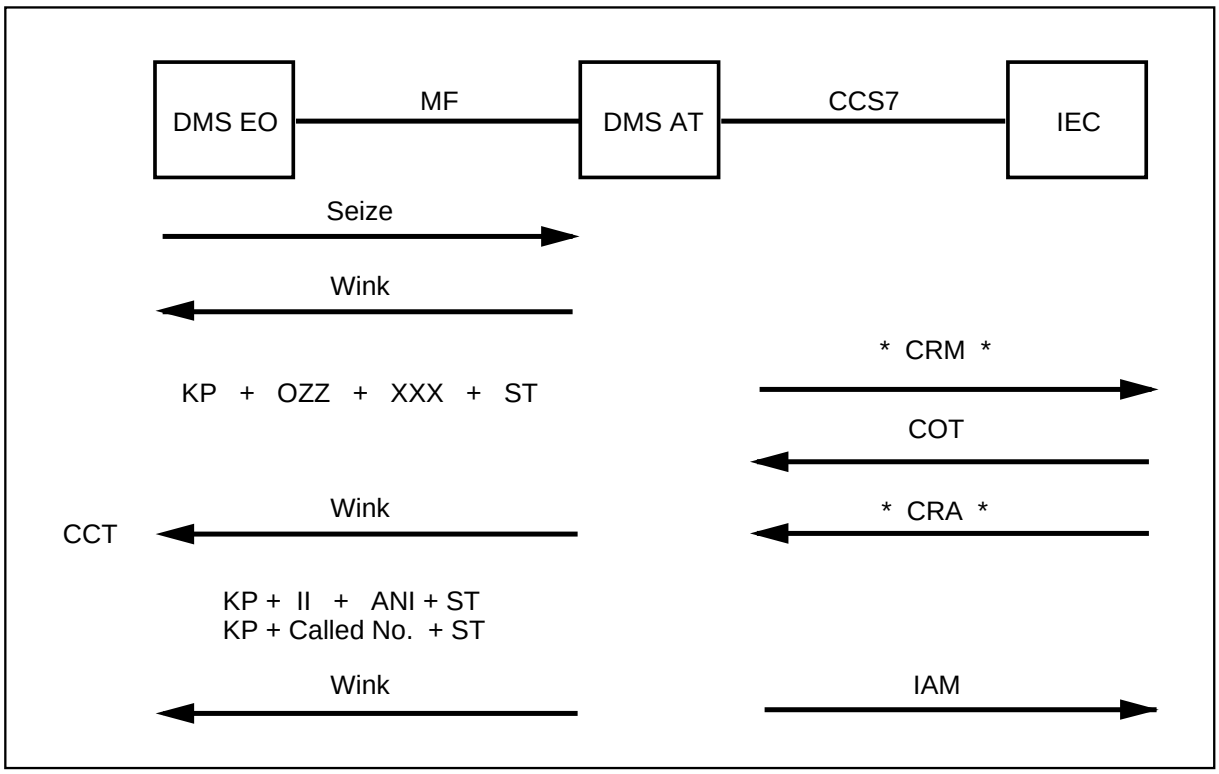


Figure 13-16xxx
End office to access tandem to inter-exchange carrier (MF - CCS7)



Link physics

56 Kbits/sec X 2 (bi-directional traffic) = 112 Kbits/sec

$$\frac{\text{112 Kbps}}{\text{8b/octet}} \text{ X 0.4E = 5,600 Octets/sec (1 link: normal)}$$

$$\frac{\text{112 Kbps}}{\text{8b/octet}} \text{ X 0.8E = 11,200 Octets/sec (1 link: failure)}$$

The following given average message sizes for trunk signaling (ISUP) and TCAP queries may be considered customer definable for individual site analysis. Twenty-five and eighty octets for each message are the Northern Telecom system engineering models.

Givens:	Average ISUP message size:	25 octets/message
	Average TCAP message size:	80 octets/message

Maximum link messaging rates

$$\frac{5600 \text{ octets/sec}}{25 \text{ octets/msg}} = 224 \text{ messages/sec (maximum 100 percent ISUP 0.4E)}$$

$$\frac{5600 \text{ octets/sec}}{80 \text{ octets/msg}} = 70 \text{ messages/sec (maximum 100 percent TCAP 0.4E)}$$

$$\frac{11200 \text{ octets/sec}}{25 \text{ octets/msg}} = 448 \text{ messages/sec (maximum 100 percent ISUP 0.8E)}$$

$$\frac{11200 \text{ octets/sec}}{80 \text{ octets/msg}} = 140 \text{ messages/sec (maximum 100 percent TCAP 0.8E)}$$

Northern Telecom engineered (rated) link messaging rates

The following rated capacities may be considered customer definable for individual site analysis. Eighty-five percent is the de-rating factor for link messaging capacity used by Northern Telecom system engineering to account for minor variations in message size.

ISUP: 448 X 0.85 = 381 messages/sec (1 link 0.8E or 2 @ 0.4E)

TCAP: 140 X 0.85 = 119 messages/sec (1 link 0.8E or 2 @ 0.4E)

Link capacity as call attempts/hour (ca/hr)

ISUP

SSP EO: 381 msgs/sec X 3600 s/hr X 1 ca/6msgs = 228,600 ca/hr

SSP AT: 381 msgs/sec X 3600 s/hr X 1 ca/12msgs = 114,300 ca/hr

ISUP example

To express two LIU7's messaging throughput in terms of call attempts/hour of 100 percent trunk signaling (ISUP messaging) in an end office (EO) SSP:

As previously calculated:

$$\frac{381 \text{ msgs/sec X } 3600 \text{ sec/hr}}{6 \text{ msgs/call attempt}} = 228{,}000 \text{ call attempts/hour}$$

To express two LIU7's messaging throughput in terms of call attempts/hour of 100 percent trunk signaling (ISUP messaging) in an access tandem (AT) SSP:

As previously calculated:

$$\frac{381 \text{ msgs/sec X } 3600 \text{ sec/hr}}{12 \text{ msgs/call attempt}} = 114{,}300 \text{ call attempts/hour}$$

Therefore, two LIU7's message throughput capacity in terms of CCS7 ISUP trunk supported at an average of 14 ca/hr for each trunk of 100 percent ISUP messaging:

EO

$$\frac{228{,}600 \text{ ca/hr}}{14 \text{ ca/hr/trunk}} = 16{,}329 \text{ CCS7 trunks}$$

AT

$$\frac{114{,}300 \text{ ca/hr}}{14 \text{ ca/hr/trunk}} = 8{,}164 \text{ CCS7 trunks}$$

TCAP

Query: 140 msgs/sec X 3600 s/hr X 1 ca/2msgs = 252,000 ca/hr

Transaction capabilities application part (TCAP) example

Assume that an access tandem (AT) SSP office serves 20,000 high day busy hour call attempts (HDBHCA) of E800 service calls.

Each E800 call attempt generates two messages (one out and one back) of approximately 80 octets each.

Using the algorithm:

$$\frac{\text{HDBHCA X octets/msg X number of msgs/attempt}}{\text{3,600 sec/hr}} = \text{octets/sec}$$

Substituting the previous assumptions:

$$\frac{\text{20,000 HDBHCA X 80 octets/msg X 2 msgs/attempt}}{\text{3,600 sec/hr}} = \text{899 octets/sec}$$

Since each pair of CCS7 data links is capable of carrying 11,200 octets/sec (or X = 9520 octets/sec), it can be seen that a single pair of links can easily accommodate this application.

Service circuit capacity

Introduction

Service circuits are those switch components that are provisioned on an office basis and are in a common pool to serve all subscribers. The circuits discussed in this chapter include the following:

- receivers (MF, DTMF, and UTR)
- three-port/six-port conference circuits
- special tones
- announcements

Monitoring service circuit capacity factors

Table 14-1 lists the operational measurements used to evaluate receiver capacity. These OM group RCVR applies to both the MF and Digitone receivers. A separate OM Group (UTR) applies to the universal tone receivers. Sufficient studies should be taken to assure that the holding times and occupancy rates developed are not the result of any unusual occurrence in the office traffic load.

Table 14-1xxx
Capacity indicators for DTMF, MF, and UTR receiver capacity

Operational measurements Group	Register	Log reports
RCVR	RCVMBU	None
	RCVOFL	None
	RCVQOCC	None
	RCVQOVFL	None
	RCVSBU	None
	RCVSZRS	None
	RCVTRU	None
UTR	UTRLDLYP	None
	UTROVFL	None
	UTRQOCC	None
	UTRQOVFL	None
	UTRRADA	None
	UTRSZRS	None
	UTRTRU	None
	UTRUDLYP	None

In addition to the OMs associated with receiver capacity performance, receivers are measured for dial tone delay by the dial tone speed recording (DTSR) OM group and incoming start-dial-delay by the ISDD OM group. From the DTSR, dial tone delay (over 3 seconds) percentages are obtained. In a similar fashion, incoming start-dial-delay (over 3 seconds to attach a receiver) percentages are produced. Both of these measurements can be used to determine if receiver capacity is adequate to meet service objectives for current traffic and projected loads to the end of design date.

Service circuit occupancy

In all cases, occupancy on individual groups of service circuits, such as receivers, tone circuits, conference circuits is limited to 75 percent on an HDBH load level basis. The requirements are expected to be controlling requirements for large groups of service circuits. For smaller groups of service circuits, the following definitions provide the basis for service circuit delay and blocking capacity.

In general, the quantities of these system components are engineered to cause very little blocking or delay to customers and to cause minimal queueing even under peak loads. Central processor usage for each call does not increase substantially during peak load conditions. The service circuits grade-of-service based on blocking and delay criteria are shown in Table 14-2.

Table 14-2
Service circuits blocking and delay criteria

Service circuit	Criteria	ABSBH	HDBH
DTMF receiver	DTD > 0 seconds DTD > 3 seconds	1 percent 0.1 percent	5 percent 1 percent
MF receiver	DTD > 0 seconds DTD > 3 seconds	1 percent 0.1 percent	5 percent 1 percent
Announcement circuits	Blocking	1 percent	5 percent
Tone circuits	Blocking	1 percent	5 percent
Conference circuits	Blocking	1 percent	5 percent

Note: UTR receiver uses similar grade-of-service as DTMF or MF receivers

Receivers

Service circuits in the DMS-100 Family system are common equipment units which include dual-tone multifrequency (DTMF) receivers, multifrequency (MF) receivers, and universal tone (UT) receivers. The DTMF receiver is used to convert dual tone multi-frequency address signals from the customer to machine readable codes. The DTMF receiver connection is from a customer line; through an LCM/LGC, and then through the network to a DTMF receiver on a trunk module (TM) or maintenance trunk module (MTM).

The multifrequency (MF) receiver is used to convert multi-frequency signals over a trunk to a machine readable code.The MF receiver connection is from an incoming trunk (through a digroup or trunk module); then through the network to an MF receiver on a TM or MTM.

The universal tone receiver (UTR) is used to collect and decode both DTMF and MF address signals and to report the decoded address digits to the central control by means of the peripheral signalling processor. It eliminates the need to establish a network path to a DTMF or MF receiver in an MTM. The UTR is located in the LGC, LTC, DTC, or RSC peripheral.

Two connection attempts will be made on randomly chosen DTMF or MF receivers, mounted on an MTM, if blocking occurs. The length of time taken to establish a connection to a receiver determines its delay criteria. To minimize blocking probability, the receivers are spread over the available TMs and MTMs.

Receiver capacity

Holding times and percent occupancy are the most significant capacity factors of receivers. These factors should be studied on a regular basis to determine if the holding times are in the expected values used for

provisioning the office. Significant increases are usually due to unanticipated changes in the call mix. Occupancy rates that exceed the forecast are usually due to calling growth rates increasing faster than expected. Holding times and occupancy rates that exceed the forecast reflect an increase in the number of delays greater than 3 seconds.

Evaluating performance

Receivers should be studied during the component busy hour. Incoming and outgoing calls may have separate busy hours if the office traffic loads are affected by factors such as a business that receives large numbers of incoming calls due to the nature of the business.

Calculations used to evaluate performance

In addition to holding time determination, calculations are included here to determine the percentage of the receiver capacity used and the overflow rates during the study period. These calculations apply to both MF and Digitone receivers and are the most significant measurements for the evaluation process as these are the measurements on which the engineering capacity tables are based. The DTS and ISDD percentages of delay results are computed automatically and require no further calculations.

$$\text{Digitone receiver holding time (in seconds)} = \frac{\text{RCVTRU (Digitone)} \times 10}{\text{RCVSZRS}}$$

Note: RCVTRU is a fast scan (10 second) register

$$\text{MF receiver holding time (in seconds)} = \frac{\text{RCVTRU (MF)} \times 10}{\text{RCVSZRS}}$$

Note: RCVTRU is a fast scan (10 second) register

$$\text{\% of receiver capacity used} = \frac{\text{Sum of the RCV traffic use)}}{\text{Engineered (MF or Digitone)capacity}} \times 100$$

$$\text{\% receiver overflow} = \frac{\text{RCVQOVFL}}{\text{RCVSZRS}} \times 100$$

Note: RCVSZRS does not include calls abandoned while in queue.

$$\text{\% UTR overflow} = \frac{\text{UTRQOVFL}}{\text{UTRSZRS}} \times 100$$

Note: UTRSZRS does not include calls abandoned while in queue.

$$\text{UTR holding time (in seconds)} = \frac{\text{UTRTRU} \times 10}{\text{UTRSZRS}}$$

Note: UTRTRU is a fast scan (10 second) register

Multifrequency and Digitone receivers

The NT2X48 circuit card is supplied to meet two requirements, as a multifrequency (MF) receiver or as a Digitone receiver. The circuits used for the two applications are identical, only the firmware is different which allows them to perform different functions.

The purpose of the MF and Digitone receivers is to receive MF and Digitone tones respectively in pulse code modulation (PCM) format and produce a

decoded 8-digit binary output. This method is used to pass signals and dialed digits necessary for call processing.

In addition to being used for regular call completion, Digitone receivers are used to support mechanized calling card service (MCCS). When used for this purpose, a separate group of Digitone receivers is engineered and dedicated for MCCS calls.

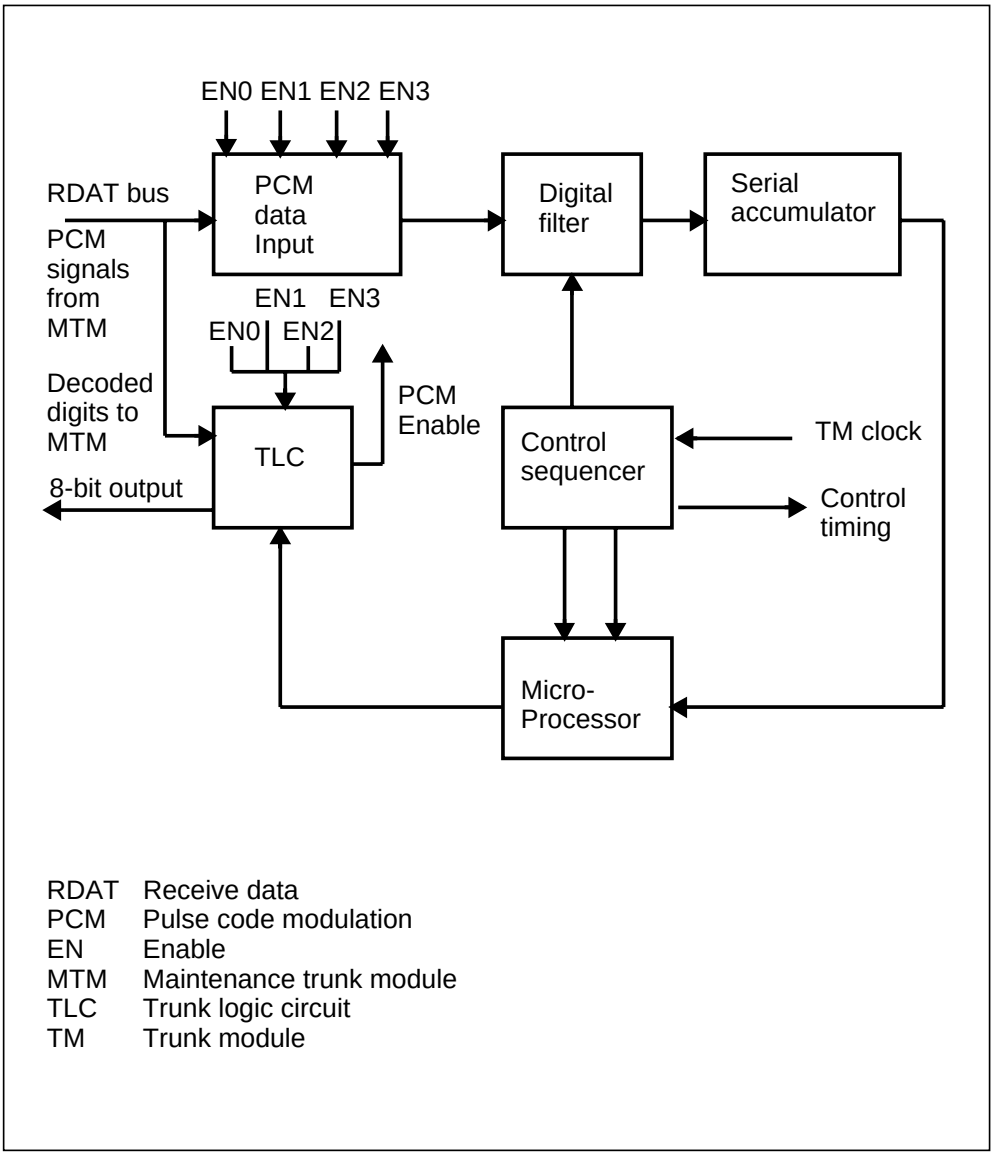
Physical capacity

The receivers each occupy either a two-card or single card position and can be mounted in either a maintenance trunk module (MTM) or Trunk Module (TM) of the DMS-100 Family. The number of cards used will depend on job engineering requirements.

Versions of the cards that are available include the following:

- NT2X48AA Digital 4 Channel MF Receiver (2-card position)
- NT2X48AB Digital 4 Channel Receiver (Digitone 2-card position)
- NT2X48BA Digital 4 Channel MF Receiver (single card position)
- NT2X48BB Digital 4 Channel DTMF Receiver (single card position)
- NT2X48CA A-law MF receiver (international 2-card position)
- NT2X48CB DT (Digitone) Receiver (British Telecom 2-card position)

Figure 14-1xxx
MF and Digitone receivers block diagram



Traffic capacity

The MF receivers and Digitone receivers are provisioned based on holding times and the selected probability of delay greater than 3 seconds. Northern Telecom holding times are shown in Tables 14-3 through 14-6. Holding times reflect call mix (call type and number of digits expected), as they are a weighted average (in proportion to the volume of calls offered in each category) of all the holding times. Significant increases in holding times due to changes in call mix may result in receiver shortages. Some operating companies do not use holding times, but use Poisson tables for provisioning purposes.

Table 14-3
Digitone receiver holding times

Calls	Holding times
0 operator	2.3 seconds (1)
3-digit service code	3.1 seconds
7-digit number	7.9 seconds (2)
10-digit number	11.3 seconds (2)
False attempt	3.0 seconds

Notes:
Note: When special toll call ((0+) service is provided, add 4 seconds holding time to operator calls for the time-out feature used to discriminate between ((0+) and (0-) calls.
Note: Add 0.8 seconds for each digit dialed for toll call prefixes.

Table 14-4
MF receiver holding times

Call type	4 digit	Additional digit
Incoming MF call (all types)	1.9 seconds	0.14 seconds
Key pulsing switchboard	5.7 seconds	0.60 seconds

Note: Add 0.9 seconds for MF incoming calls and 2.32 seconds for DP incoming calls outpulsing ANI information.

Table 14-5
MF receiver - CCS capacity

Number of receivers	HT = 7 seconds		HT = 8 seconds		HT = 9 seconds	
	0.001	0.01	0.001	0.01	0.001	0.01
4	36	60	30	52	26	47
8	143	184	126	168	115	157
12	269	318	244	297	226	282
16	402	386	371	431	348	413

Table 14-6
Digitone receiver - CCS capacity

Number of receivers	HT = 7 seconds 0.001	0.01	HT = 8 seconds 0.001	0.01	HT = 9 seconds 0.001	0.01
4	23	42	22	40	21	39
8	102	43	98	138	94	134
12	204	260	197	253	191	247
16	318	386	308	376	300	369
20	439	516	426	505	416	495
24	565	648	549	636	537	624
28	694	756	676	756	661	756
32	825	864	805	864	788	864
36	957	972	936	972	918	972
40	1080	1080	1068	1080	1049	1080
44	1188	1188	1188	1188	1188	1188
48	1296	1296	1296	1296	1296	1296
52	1404	1404	1404	1404	1404	1404

Universal tone receivers

The universal tone receiver (UTR) is an optional card in the PM. If the UTR is not included in a specific PM, the central control can establish a network connection between that PM and one that has a UTR.

The UTR is a 32-channel tone receiver. Thirty channels detect a variety of tones, including dual-tone multifrequency (DTMF) for lines and multifrequency (MF) for trunks. Tone samples are switched onto the parallel speech bus by the time switch and are collected by the UTR at the appropriate time slots. The UTR analyzes the samples and identifies the tones. The results are then sent to the signaling processor.

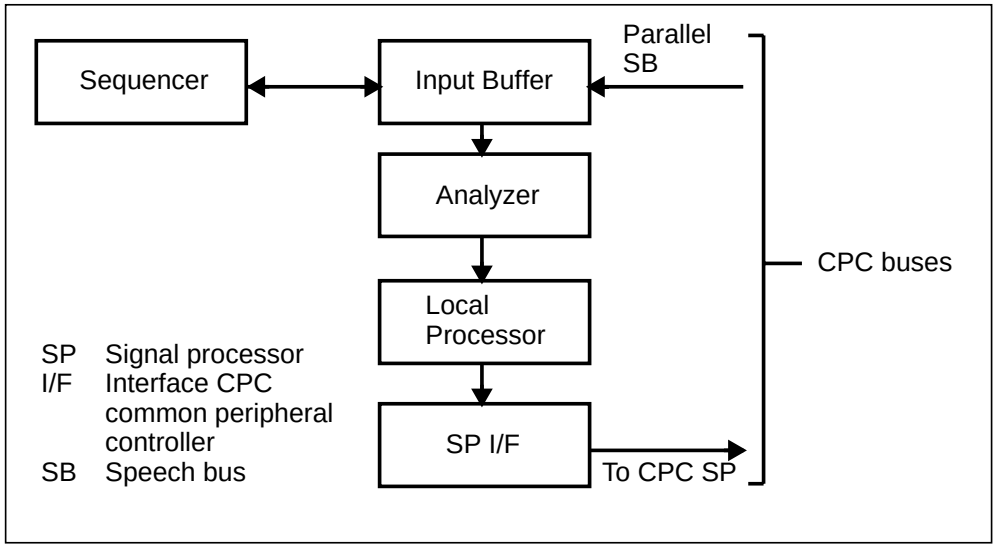
The UTR plugs into designated slots in any of the following configurations of the common peripheral controller shelves:

- LGC - line group controller
- LTC - line trunk controller
- DTC - digital trunk controller
- IDTC - international digital trunk controller

Physical capacity

Universal tone receivers (Figure 14-2) are provisioned on the basis of either one or two cards for each equipped peripheral module (30 or 60 channels).

Figure 14-2xxx
UTR block diagram



Conference circuits

Conference circuits in the DMS-100 include three-port and six-port configurations. The three-port circuits are used for three-party conference functions. The six-port circuits provide a conference facility on a single card. Up to five conference circuits can be connected in tandem to permit conference connections for 3 through 26 parties.

Features that use three-port conference circuits include the following:

- MDC features:
  - call transfer
  - add-on
  - three-way call chaining
- POTS features:
  - three-way calling
  - local coin overtime
  - three-way call chaining
- TOPS features:
  - automated alternate call billing (AABS)
  - automatic coin toll services (ACTS)

Physical capacity

The three-port card occupies one card position in the maintenance trunk module (MTM) or trunk module (TM) and requires 6 trunk appearances. The six-port card also requires one card position in the MTM or TM and requires six 4-wire PCM trunk appearances.

Traffic capacity

Three-port conference circuit provisioning is based on average busy season busy hour CCS expected load. The blocking probabilities are operating company defined (for example, P.01, P.001).

Six-port conference circuit provisioning is based on the expected number of high day simultaneous conferences.

Monitoring conference circuit capacity factors

The capacity factors related to conference circuits are the number of overflows when the queues are full and the conference circuit usage measured in CCS values (scan rate 10 seconds).

Overflow rate

Table 14-7 lists the operational measurements used to determine the overflow rate for 3-port conference circuits and 6-port conference circuits.

Table 14-7xxx
Performance indicators for conference circuit capacity

Operational measurements		
Group	**Register**	**Log reports**
CF3P	CNFOVFL	None
CF3P	CFNSZRS	None
CF6P	CF6OVFL	None
CF6P	CF6SZRS	None

Conference circuit use

Table 14-8 lists the operational measurements used to determine and evaluate conference circuit use.

Table 14-8xxx
Performance indicators for conference circuit use

Operational measurements		
Group	**Register**	**Log reports**
CF3P	CNFTRU	None
CF3PT	CNFTRUT	None
CF6P	CF6TRU	None

Evaluating conference circuit use

The operating company sets the acceptable rates of overflow for conference circuits. The administrator needs to know this information to make comparisons of these acceptable rates with the actual rates recorded during the study period.

Calculations used to evaluate performance

The following calculations are used to determine the overflow rates for three-port and six-port conference circuits:

$$\% \text{ 3-port overflow} = \frac{\text{CFNOVFL}}{\text{CFNSZRS}} \times 100$$

$$\% \text{ 6-port overflow} = \frac{\text{CF6OVFL}}{\text{CF6SZRS}} \times 100$$

Tone circuits

The DMS-100 provides a wide variety of tone treatments. These tones are typically provided in the peripheral modules (for example, the MTM). Tone generator circuit cards provide the tones as required; for example, the NT3X68 card provides tones for general purposes that include the following:

- permanent signal
- conference calling
- dual-tone multifrequency (DTMF) signaling
- call waiting

Each of the tone cards are provisioned based on calculations contained in *DMS-100F Provisioning*, 297-1001-450. In general, it is expected that if sufficient tone capacity is provided, then no shortage will exist and no overflows would be encountered under normal circumstances. To determine which tones are provided, refer to the translations tables: TONES, STN (special tones), and SVRCKT (service circuits).

Operational measurements are provided for tones and special tones (Table 14-9). Some of the tone types are registered in both OM groups. Tones that reside in an MTM are measured in OM group STN and may also score registers in the TONES OM group.

Table 14-9xxx
Tones and operational measurements

OM Group	Tones measured
STN	• Call waiting (CWT) • Distinctive call waiting (DISCWT) • Executive busy override (EBOT) • Expensive route warning (ERWT) • IBN busy verification (BVTONE) • Off-hook queuing (OHQT) • Preset conference normal notification (PCNOR) • Preset conference precedence notification (PCALR) • Receiver off-hook (ROH)
Tones	• IBN busy verification (BVTONE) • Call waiting (CWT) • Distinctive call waiting (DISCWT) • Executive busy verification (EBOT) • Enhanced call waiting tone for the first secondary directory number (ENHCWT1) • Enhanced call waiting tone for the second secondary directory number (ENHCWT2) • Enhanced call waiting tone for the third secondary directory number (ENHCWT3) • Expensive route warning (ERWT) • Digital outpulsing circuit (SVDTMF) • Off-hook queuing (OHQT) • Preset Conference Normal Notification (PCNOR) • Preset conference precedence notification (PCALR) • Receiver off-hook (ROH) • R-2 inter-register signaling circuit (SVMFC) • Service observing circuit (SVOBSV)

***Note*:** The STN OM group provides information about special tones that are broadcast from trunk cards in the maintenance trunk modules. Some counts are duplicated in the STN and TONES OM groups.

Physical capacity

The physical capacities for tone cards may vary and the number of circuits provided for each card should be determined by reference to *Provisioning,*

297-1001-450. In addition, each of the controllers have 4 ports (of the 20 ports available) that are dedicated to tones.

Traffic capacity

Tone generators requirements are determined by a variety of calculations which are described in *Provisioning*, 297-1001-450.

Monitoring tone capacity factors

Because overflows to tone circuits are not expected, tones are only monitored to become aware of any unusual condition that would cause overflows to occur. Tone circuit capacity is usually engineered based on Poisson table capacity values with acceptable overflow rates determined by the operating company.

Tone overflow rate

The rate at which requests for tones are sent to an overflow condition is determined by the OMs shown in Table 14-10.

Table 14-10xxx
Performance indicators for tone circuit capacity

Operational measurements

Group	Register	Log reports
TONES	TONEATT TONEOVFL	None
STN	STNATTS STNOVL	None

Calculations used to evaluate performance

The following calculations are used to evaluate tone overflow performance:

$$\% \text{ tone overflow} = \frac{\text{TONEOVFL (designated tone)}}{\text{TONEATT (designated tone)}} \times 100$$

or

$$\% \text{ tone overflow} = \frac{\text{STNOVFL (designated tone)}}{\text{STNATT (designated tone)}} \times 100$$

Announcement circuits

Announcement circuits for the DMS-100 are provided through the use of a special equipment shelf containing a digital recorded announcement machine (DRAM) located in a maintenance trunk module (MTM). The announcements are recorded on three different types of speech cards. The DRAM description and administration procedures are found in the *Digital Recorded Announcement Machine Administration Guide,* 297-1001-316.

Physical capacity

The DRAM shelf can contain various mixtures of the recorded announcement cards, but the total number of cards cannot exceed eight cards. Each of the cards can record approximately 31 seconds of speech. In most offices (without RES features), one DRAM unit is sufficient. A second DRAM is recommended for reliability.

A DRAM can accommodate a maximum of 8 RAM or EEPROM cards or a combination of both. A fully equipped DRAM can store up to 30 messages with a combined total length of up to 248 seconds recorded.

Residential services features that require pre-recorded DRAM messages include the following:

- call forwarding remote activation
- customer originated trace (COT)
- automatic call setup (AR/ACB)
- screening list editing (SLE) services

Custom local area signaling system (CLASS) features use both standard and custom announcements. Calling Number Delivery (CND), Calling Number Delivery Blocking (CNDB), and Customer Originated Trace use standard announcements (DRMTRK) that are broadcast announcements for up to 255 simultaneous connections from one access circuit. Automatic Recall (AR) and Automatic Callback (ACB) use custom announcements (DRMUSER) that are nonbroadcast. Custom announcements require provisioning access circuits on a usage basis. The number of DRAMS required for standard CLASS announcements is the greater of the following:

$$\frac{\text{Total announcements}}{30} = \text{Number of DRAMs (round up)}$$

$$\frac{\text{Total seconds of recording}}{248} = \text{Number of DRAMs (round up)}$$

$$\frac{\text{Total usage (CCS)}}{\text{Traffic capacity (CCS) per DRAM}} = \text{Number of DRAMs (round up)}$$

An office requires three additional DRAM shelves and a total of 12 PROM cards to support the custom announcements of the Phase 2 selective screening features. If the maximum size of the screening lists is kept to 12 directory numbers (instead of 31), then only 2 shelves and 8 prom cards are required. More detailed information can be obtained in the *Residential Services Planning and Engineering Guide*, 297-1401-110 and *Residential Services Administration Guide*, 297-1401-300.

Traffic capacity

The announcements that are broadcast onto the network and the number of simultaneous connections allowed is a datafilled value in Table ANNS. The maximum number of simultaneous connections for any one announcement is 255.

Monitoring announcement capacity factors

When a call is directed to the DRAM, availability of the proper announcement is the most important measure of the announcement capacity. Therefore, attempts to connect to an announcement and any resulting overflows are significant indicators of how well the announcements are providing the required information to the subscribers.

Announcement overflows

Announcement overflow counts are part of the OM group ANN. The OM group and related registers are shown in Table 14-11.

Table 14-12xxx
Announcement circuit capacity indicators

Operational measurements

Group	Register	Log reports
ANN	ANNATT TONEOVFL	LINE 138 TRK 138
ANN	ANNOVL	None

Performance calculations

The calculation required to determine the percentage of announcement overflow is as follows:

$$\text{Announcement \% overflow} = \frac{\text{ANNOVFL}}{\text{ANNATT}} \times 100$$

Integrated services digital network (ISDN)

Introduction

This section provides the necessary engineering algorithms required to engineer the performance sensitive components of the ISDN node.

In addition, information is included which provides:

- an ISDN overview
- a description of ISDN calls and signaling
- an ISDN system description
- an ISDN components BCS migration overview

This section is especially useful for readers that have working knowledge of the DMS-100, but lack an understanding of the ISDN. It is assumed that the reader has had experience calculating real time requirements in existing non-ISDN peripheral processors.

The manual calculation process supplied for real time engineering in this document have been incorporated into existing real time calculation tools.

ISDN overview

Voice and data communications both have long established traditions and have followed separate evolutionary paths. But the increasing demand for new telecommunication services coupled with the complexity and cost of providing dedicated lines to each new service have created an urgent need for customers, as well as network providers, to look for means by which these services can share access lines.

ISDN forms the backbone of a single all-digital communications network that allows single-plug access to voice, data, texts, network signaling, and image communications. This access is one of the key features of, and motivation behind, the integrated services digital network or ISDN, hence the “integrated services” part of the name. It had been made feasible by digitization, in which all information is transported as look-alike 0 and 1 bits in the digital language of computers. It is precisely because the information

is coded and transmitted in a uniform manner that different services can share the same lines and network resources.

Users of ISDN enjoy uniform access through standard access interfaces which provide B and D-channels. The B-channel is a 64 kbps bi-directional information "pipe" which can carry any digital information such as digitized voice or data. The D-channel is a signaling channel for controlling the B-channels and can also be used to support low speed packet data.

Through the ISDN, users can access the following standard interfaces:

- interface to customer premises equipment (CPE) such as computers, telephones, and facsimile machines through basic rate interface (BRI)
- interface to digital private branch exchanges (PBX), host computers, and local area networks (LAN) through primary rate interface (PRI)
- trunk-side interface to the public switched network (PSN) through Common Channel Signaling No. 7 (CCS7)
- access to local packet-data terminals and the public packet-switched network (PPSN) through X.25 and X.75/X.75' packet services

Two ISDN interfaces, BRI and PRI are defined in the following paragraphs.

Basic rate interface

An ISDN basic rate interface (BRI) loop from a customer's premises has two B-channels at 64 kbps each plus one D-channel at 16 kbps giving a total of 144 kbps. It gives the user the capability of using three channels and is commonly called 2B+D.

The 2B+D interface is configured as follows.

B-channel

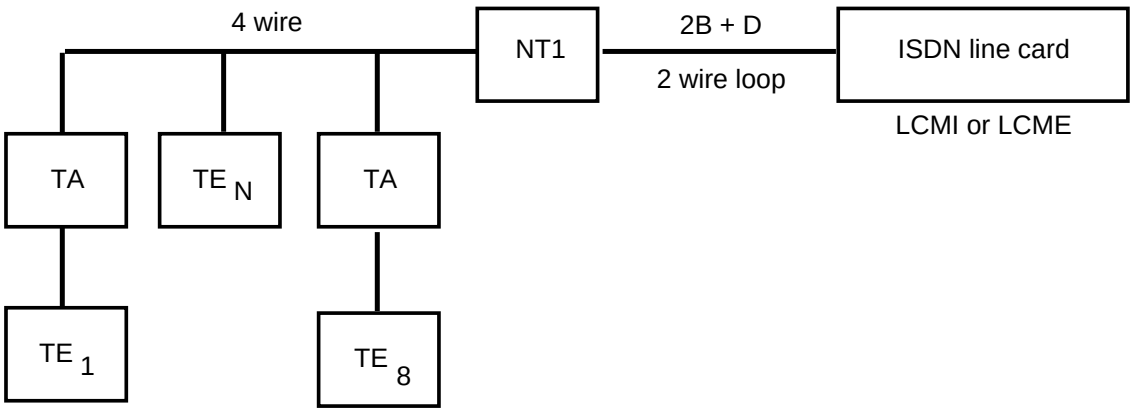
The two 64 kbps B-channels can be used for circuit switched voice/data or high-speed packet switched data. The two channels not only can be used for two separate calls, but also independently and simultaneously for two connections pertaining to the same call. This would apply, for example, to a call between two voice/data terminals requiring separate connections for voice and data transmission.

D-channel

One 16 kbps channel carries signaling and control information for the B-channels and may also be used to interleave low-speed packet data with this information. By its ability to support low-bit-rate data in packet mode, this channel can serve the so-called telemetry services such as meter reading and alarm monitoring.

Access termination for 2B+D loops is provided by ISDN line cards housed in ISDN line concentrating modules (LCMI/LCME) as shown in Figures 15-1 and 15-2.

Figure 15-1
ISDN basic rate interface loop (2B + D)



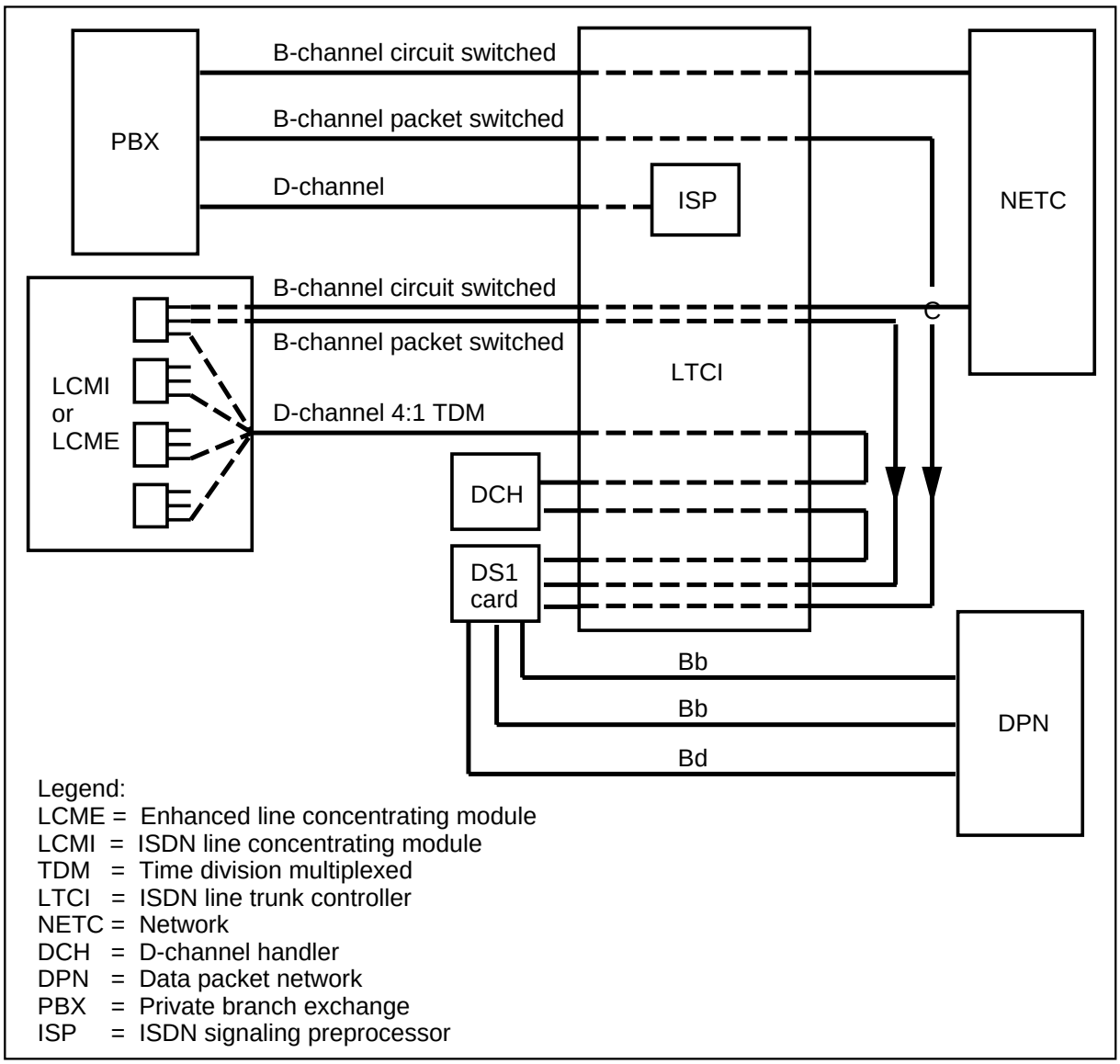
Legend:

NT1 = network termination
1
- Maintenance
- Timing
- Power transfer
- Multiplexing
- Interface termination

TA = terminal adaptor

TE = terminal equipment

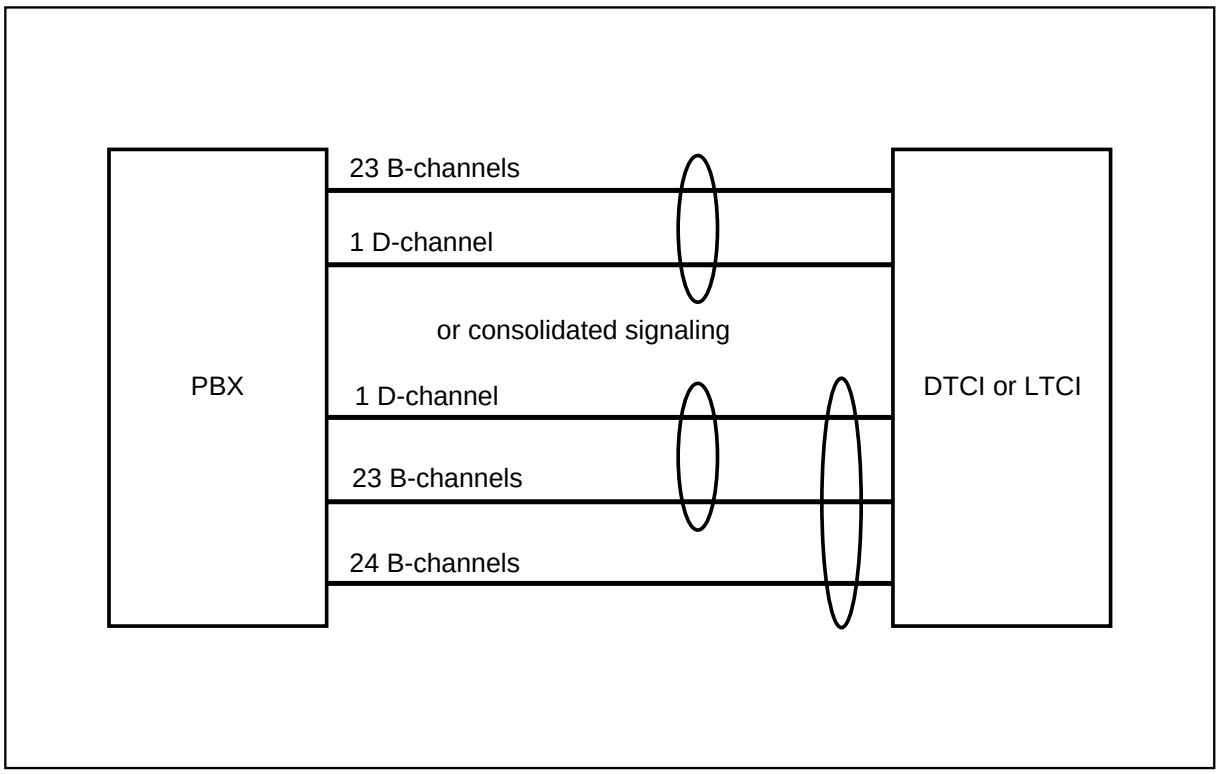
Figure 15-2
LTCI basic rate/primary rate interface functional diagram



Primary rate interface

Primary rate interface (PRI) carries nB+D-channels over a digital DS-1 facility (23B+D in North America and 30B+D in Europe) (Figure 15-3). It is used to link private networking facilities such as private branch exchanges (PBXs), local area networks (LANs), and host computers with a standardized architecture acting as the bridge between private switching equipment and the public network.

Figure 15-3
ISDN primary rate interface (23B+D)



23B+D is configured just like the BRI with the following exceptions:

- D-channel low-speed user packet data is not supported.
- D-channel is 64 kbps rather than 16 kbps.

Access termination at the DMS-100 is provided via ISDN digital trunk controller (DTCI) and ISDN line trunk controller (LTCI).

Since low-bit-rate data packet is not supported on the D-channel, the D-channel is then relegated to call control signaling associated with the B-channels.

Although PRI is defined as 23B+D, one D-channel has the capability to provide signaling for up to 479 B-channels, provided all DS-1 facilities are located on the same ISDN controller.

20 DS-1 x 24 channels per DS-1	= 480 channels
D-channel for call signaling	= -1 channel
Possible B-channels	= 479 B-channels

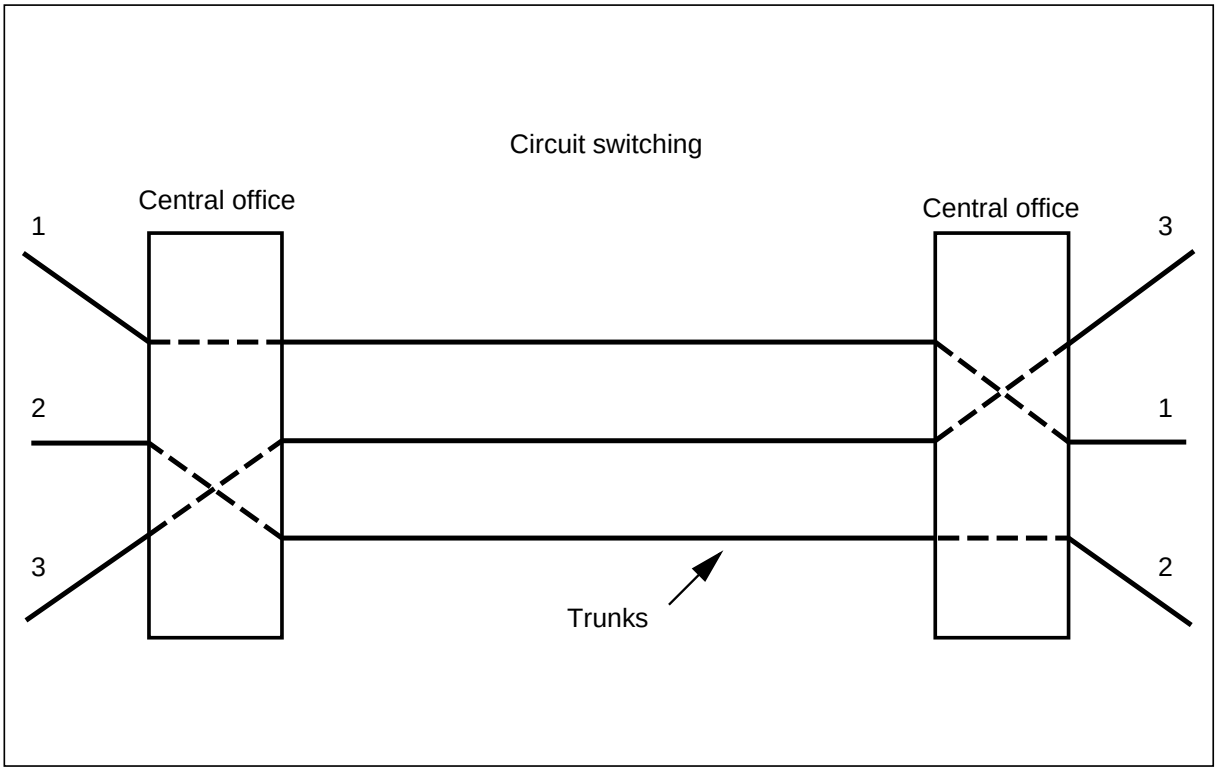
This is referred to as consolidated signaling and is shown in Figure 15-3.

Switching

Circuit switched

When a circuit switched call is set-up, a fixed path is reserved through the network between two users for the entire duration of the call (Figure 15-4). Two examples of circuit switching are the telephone and facsimile networks.

Figure 15-4
Circuit switching

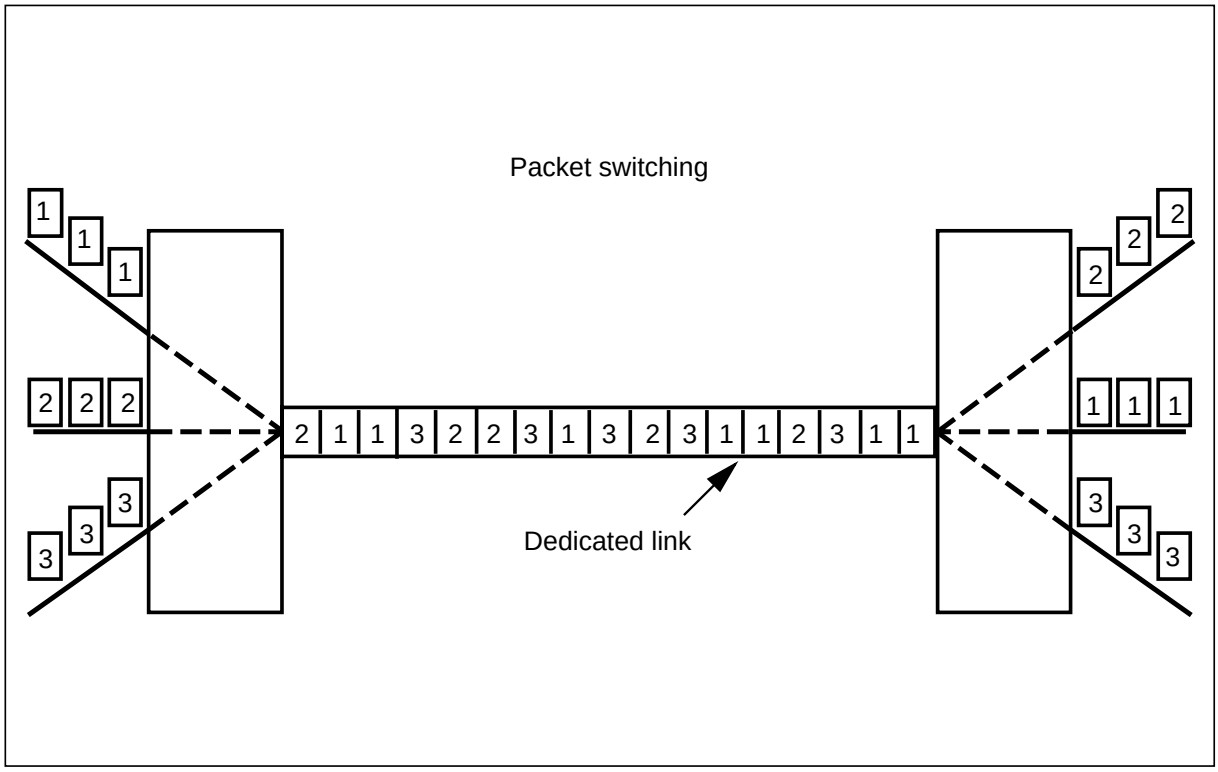


Access to circuit switched calls is provided over the B-channels in ISDN. These B-channels are connected through the LTCI/Network as with standard telephony in existing DMS-100 products.

Packet switched

In a packet switched call, the information sent by a user is split into small packets that are routed independently through the network, possibly over different paths, intermingled with packets pertaining to other calls involving different users (Figure 15-5).

Figure 15-5
Packet switching



Packet switching is mainly used for data traffic and is especially beneficial for conversational applications in which actual data are separated by relatively long periods of silence because more efficient use is made of network resources.

Packet switched calls can be provided access over the B-channels as well as the D-channels and are connected through the LTCI/DCH destined for the packet handler (DPH) totally bypassing the DMS-100 network.

Signaling

For a POTS telephone in the existing network, the switch does most of the work involved in interpreting the signaling information. The telephone merely indicates an off-hook state and sends information concerning the digits that have been dialed or keyed.

Because ISDN terminals have more intelligence than their predecessors and can therefore support more functions, designers have more flexibility over how responsibility for specific functions should be apportioned; although they ultimately had to decide whether the terminal or the switch should be responsible for each stage of the process. Such a range of options led to the development of two forms of signaling known as stimulus and functional.

Stimulus

In this form, a protocol has been defined which replicates the process used in the POTS environment so that action at the terminal generates a message. The message is then interpreted by the switch the same way as indications from a POTS set are interpreted. This form of signaling has been given the name stimulus because each action at the terminal stimulates a message.

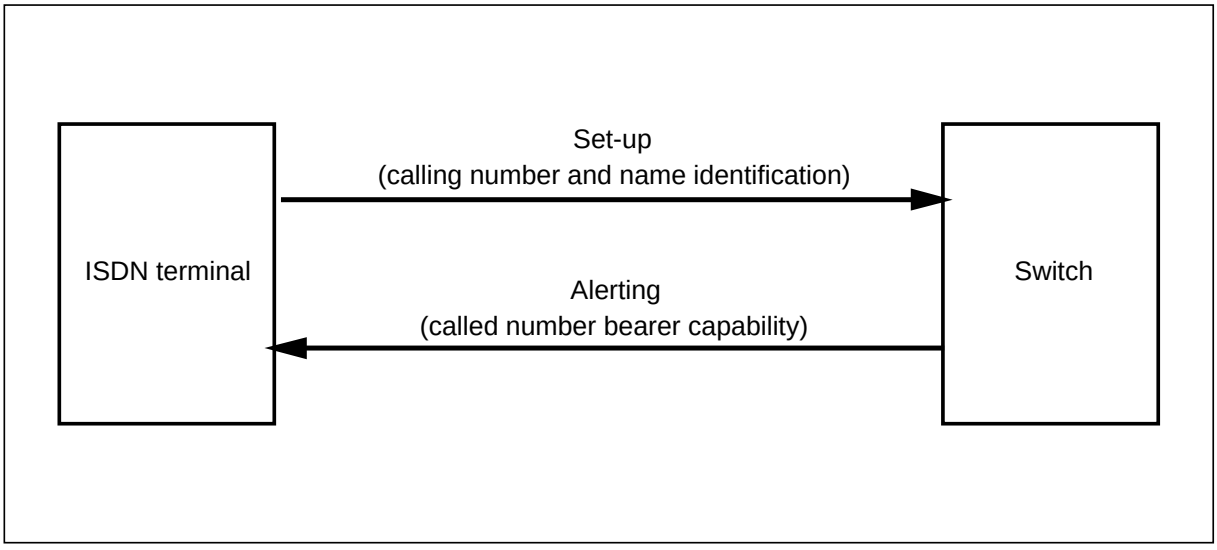
Using stimulus signaling, the switch must know the functions that the terminal supports in order to send it specific display information. This information is encoded in the switch by assigning specific values to line subscription parameters.

Functional

In this form, procedures were defined in which the switch and the terminal behave as equals, rather than master and slave. As a result, the terminal and the switch can negotiate with each other when allocating resources for each call.

With functional signaling, information can be added to messages between the terminal and the switch to help the user access specific network capabilities. An example of such information is the calling number and caller's name which can be included in the set-up message for an incoming call (Figure 15-6).

Figure 15-6
Functional signaling



In addition to signaling for call control, the functional and stimulus signaling procedures can also be used for controlling custom calling features such as MDC. With stimulus signaling, key strokes on the terminal stimulate the generation of feature activation messages which are interpreted by the

switch into indications of specific features. The mapping between a feature and the feature activator is handled through SERVORD tables. With functional signaling, however, a message (or sequence of messages) always relates to a specific feature since the terminal is eliminating the need for any mapping in the switch. Consequently, a sequence of messages always represents activation of a specific feature for one or many terminals.

In BCS31, Meridian feature transparency (MFT) was introduced to allow functional signaling sets to access MDC feature seven before these features are fully standardized to comply with ISDN. Thus, users of ISDN functional sets that are assigned MFT are offered the same feature-rich environment as Electronic Business Set (MBS) users that apply MDC.

Open system interconnection (OSI) seven-layers model

In the traditional telephone network, signaling information for call set-up and release is carried by the same circuits as voice information or by channels associated one-to-one with these circuits. This is referred to as in-band-signaling and is limited to essential information such as the called number and busy signals.

In the ISDN, the signaling information for an entire group of circuits is carried by a separate high speed data channel. This is referred to as common channel signaling and can accommodate a much wider range of information such as the calling party identification, call re-direction, and user-to-user information. As a result, individual ISDN subscribers are able to access a variety of voice and data features through a single standard telephone jack.

Access to ISDN is gained through a small set of standard multi-purpose access interfaces governed by protocols. The structure of these protocols is based on the seven-layer OSI reference model with each layer in this model communicating with adjacent layers through closely defined standard interfaces.

The lower four layers provide for transfer of data between users. They are, in ascending order:

- physical
- data link
- network
- transport

On the other hand, the top three layers are related to the purpose and use of the data transfer. Starting from the fifth layer, they are:

- session
- presentation
- application

For the purposes of this document, the first three layers are described in more detail.

Physical (layer one)

This layer defines the physical link channel structure; namely, BRI or PRI. BRI channel structure consists of two 64 kbps B-channels and one 16 kbps D-channel (2B+D). PRI, however, consists of multiple 64 kbps B-channels and one 64 kbps D-channel (23B+D in North America and 30B+D in Europe) and is commonly referred to as nB+D.

Data link (layer two)

The second layer is concerned with data link control and especially with ensuring that data is transported and received correctly over the physical link. This is achieved by a special framing structure and use of error detection and correction coding referred to as cyclic redundancy check (CRC).

Layer two protocol for the D-channel has been standardized as line access protocol D-channel (LAPD) as defined in Consultive Committee on International Telegraphy and Telephony (CCITT) recommendations Q.920(I.440) and Q.921(I.441).

LAPD allows multiple terminals to communicate over logical link connections using a shared physical D-channel. It uses a high-level data link control (HDLC) frame format with an address consisting of two fields; the service access point identifier (SAPI) and the terminal endpoint identifier (TEI).

While the SAPI is a unique identifier that indicates the type of access system for a terminal (Layer 3 target)), the TEI is a non-unique identifier that indicates the individual terminal device being addressed. Some access services defined are:

- SAPI 0 for call control processing
- SAPI 16 for packet data services
- SAPI 17 for user-to-user loop signaling
- SAPI 63 for TEI management

TEI assignments take different forms however,and could vary depending on the application. One possible assignment to each LEN is as follows:

- TEI 1, 2 for packet switched terminals B1, B2
- TEI 3, 4 for circuit switched terminals B1, B2
- TEI 21-28 for packet switched D terminals
- TEI 127 for message broadcasting/terminal maintenance

Two types of LAPD information transfer procedures exist:

- unacknowledged (no error correction)
- multi-frame (full error protection and recovery)

In general, point-to-point links utilize multi-frame procedures and point-to-multipoint links (broadcast) use unacknowledged procedures.

Broadcast capability is another feature of LAPD addressing which allows a layer three entity to communicate with all terminals on an ISDN loop. This capability however, is supported only on basic rate interface (BRI).

Layer two protocol for the B-channels complies with the standard protocol of the service being accessed; circuit or packet switched services. For example, if a B-channel is providing access to a X.25 packet terminal, then LAPB is used at the data link layer.

Network (layer three)

This layer provides for routing and delivery of signaling messages to the correct destination. Each signaling message includes routing information that defines the origination and destination signaling points.

This layer operates on the D-channel in ISDN, as defined in CCITT recommendations Q.931(I.451) for message oriented signaling and X.25 for low speed packet data on BRI D-channels only. These message based protocols provide call control that governs the negotiating, setting-up, and taking down of various types of B-channel connections (circuit switched voice/data resides in both the ISP and DCH cards resides in both the ISP and DCH cards calls, and packet switched data calls). They also govern the packet switched D-channel data calls as well as the user-to-user signaling on a D-channel not necessarily associated with a B-channel connection.

One feature of the D-channel layer 3 protocol is its ability to multiple several calls over a single logical link (layer 2) connection

ISDN terminal identifications

Traditionally, in the DMS-100 network, there has been one terminal for each loop or line equipment number (LEN). The LEN was sufficient to identify the loop, the telephone set, its directory number (DN) and related information.

In the ISDN environment, where the BRI can support up to eight terminals on each loop, the LEN is not sufficient to identify all the characteristics of the terminal on the line. Therefore, the concept of logical terminal identifier (LTID) was introduced.

The LTID defines the characteristics of a service for each terminal on a LEN such as circuit switched B-channel terminal, packet switched D-channel and

so forth. Since multiple terminals may exist on each LEN, a terminal endpoint identifier (TEI) is assigned to each terminal. The TEI is unique only to one LEN and could be reused on another LEN. A range of 0-127 is used for TEIs.

Each LTID is unique to the exchange termination (ET) which can have a maximum of 32,704 LTIDs and is also unique to the access module (AM) since one AM can only serve one ET.

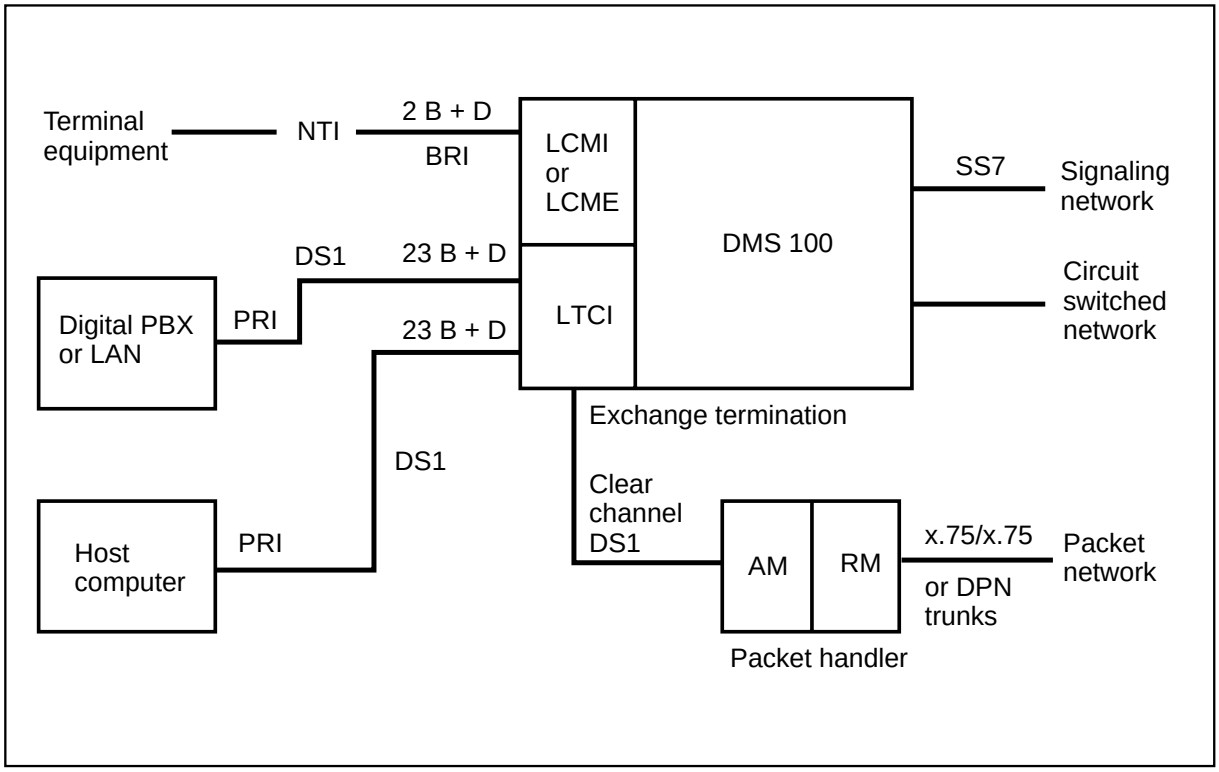
Likewise, multiple AMs can be served by one packet handler's remote module (RM), which makes the LTID non-unique to the packet handler (PH). The LTID is used by the PH to identify terminals on each ET. The ET, however, uses the LENs and TEIs to identify different terminals.

The D-channel handler (DCH) performs an LTID to TEI and LEN conversion upon receiving a packet from the PH destined to an ISDN terminal (or TEI and LEN to LTID conversion for a packet sent in the opposite direction). A further discussion of this subject is provided in the DCH section.

System description

This section provides a system overview of the ISDN node. The ISDN node supports ISDN interfaces such as BRI and primary rate interface (PRI), and provides the users access to both circuit-switched and packet-switched networks. It consists of two functional components; the exchange termination (ET) and the packet handler (PH) (Figure 15-7).

Figure 15-7
DMS-100 ISDN node



The ET and PH are linked by clear-channel B8ZS-coded DS-1 interfaces that are provisionable based on the traffic flow between the two components. B8ZS is the CCITT approved method which allows PCM 24 channel systems to operate at 64 kbps clear. Since T-carrier repeaters cannot tolerate 15 zeros in a row without losing synchronization, the B8ZS technique substitutes a string of eight zeros with a special bit string containing ones.

Exchange termination

The ET represents the functional part of the ISDN node that performs circuit switching operations and is the gateway to the circuit-switched and signaling networks.

The ET's main components are:

- network termination one (NT1)
- ISDN line card (ISLC)
  - U line card
  - S/T line card
- ISDN-LCM
  - LCMI (AMI)

  - LCME (2B1Q)
- ISDN Controller
  - LTCI
  - LGCI
  - DTCI
  - RCCI
- network and core

It is assumed that the reader has a working knowledge of the basic DMS-100 architecture and therefore a description of standard, non-ISDN, components such as network and core is not provided. The specific ET components pertaining to ISDN are described.

Network termination one

The network termination one (NT1) is a layer one device that resides at, and is part of, the customer premises. It provides the interface between the two-wire 2B+D U-interface originating at central office line card and the four-wire S/T interface serving the ISDN terminals located at the customer premises. Consequently, the NT1 consists of two sides: a terminal side (S/T interface) and a network side (U-interface).

ISDN line card

U line card

The U-ISLC is used by outside plant subscribers to access the ET. It connects the NT1 via the U-interface, providing the ET with access to the four-wire S/T interface that serves the ISDN terminals.

The U-ISLC inserts into a standard line drawer occupying two physical slots in the LCMI's drawer and one physical slot in the LCME's enhanced drawer.

The main functions of the U-ISLC include the following:

- AMI or 2B1Q encoding and decoding
- local echo cancellation
- automatic line build-out and equalization
- clock recovery
- frame synchronization
- bipolar violation monitoring
- scrambling of the data stream toward the NT1
- descrambling of the data stream away from the NT1
- full frame loopback with or without echo cancellation circuitry active

S/T line card

The S/T-ISLC is the main access vehicle in the BRI to the network. It provides the same four-wire S/T bus interface as the NT1 for connection to the customer's ISDN terminals and provides a direct connection to the ET. As a consequence, it eliminates the need for the NT1 and the U-interface.

The S/T-ISLC is typically associated with applications where the ET is located on the customer premises due to distance restrictions on the ISDN loop.

The S/T-ISLC inserts into a standard ISDN-LCM line drawer and occupies two physical slots. It performs the following functions:

- interfaces the ISDN terminals via the four-wire S/T bus
- supports many types of loop configurations such as point-to-point and point-to-multipoint
- provides protection to the ET from outside plant voltages
- interfaces the BIC via the L-bus serving in transmission and reception of B1, B2, and D-channels to/from the ISDN terminals
- provides processing of maintenance functions such as CRC generation and checking as well as processing of ISDN messages from the network

ISDN line concentrating module

The ISDN line concentrating module (LCM) has a flexible architecture which permits the system to support up to eight line drawers in a dual shelf arrangement. The architecture is also able to support D-channel multiplexing and demultiplexing to maximize bandwidth utilization.

The ISDN LCM is a design evolved from the standard LCM. Its main hardware elements are:

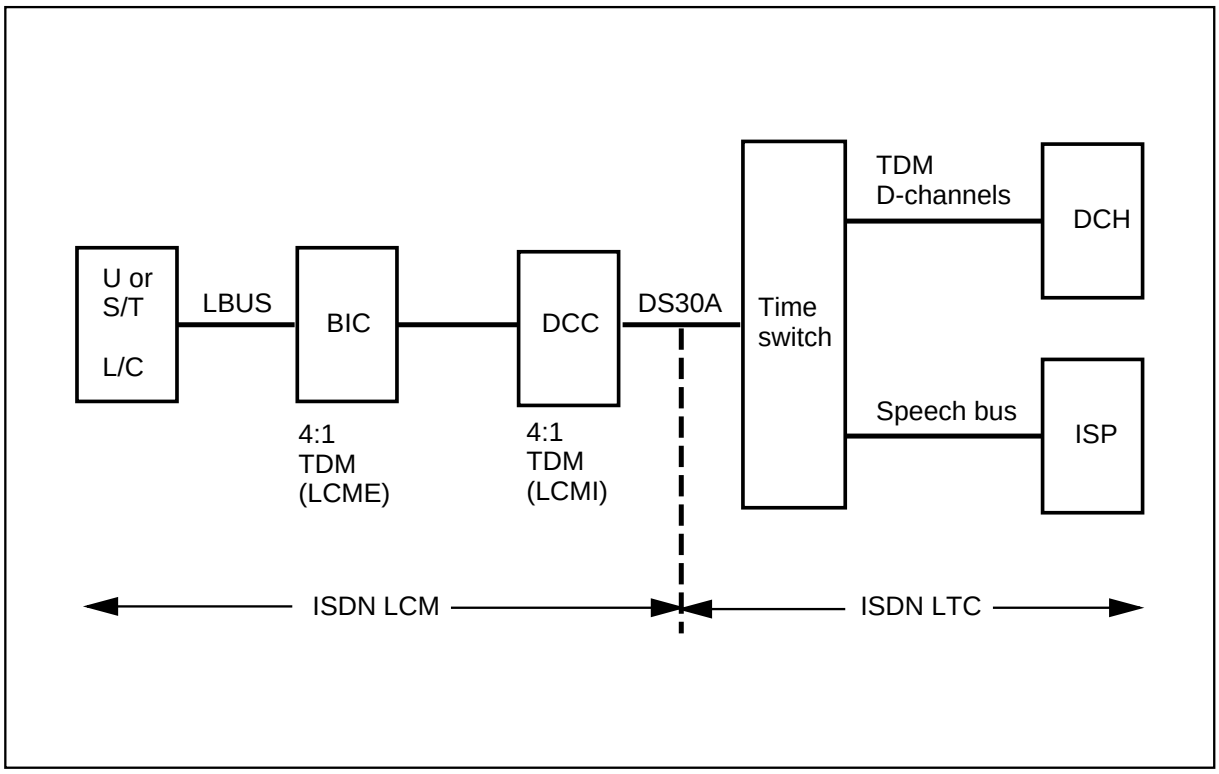
- the digroup controller card (DCC)
- the processor card
- the bus interface card (BIC)
- a range of line cards (U, S/T, Electronic Business Set, datapath, POTS)
- the power supply card

The DCCs are duplicated (one per shelf) and operate in hot standby mode. If one fails, activity is dropped at that shelf and the card on the mate shelf takes over activity for both shelves. The processor cards however, are paired and loadshare, so if one in the pair fails, the other assumes the full load for both shelves.

BRI subscriber lines terminate on ISDN line cards housed in the ISDN-LCM line drawers. These line cards transfer all three channels (2B+D) to the BIC via the L-bus (Figure 15-8). At the BIC, the three subscriber loop channels are transferred to the DCC via the scan chips (X24 in LCMI, S14 in LCME).

Once inside the DCC, the pulse code modulation (PCM) streams are moved to the incoming time switch where they are switched as appropriate into DS30A links destined for the ISDN line trunk controller (LTCI).

Figure 15-8
Basic rate interface data flow



For maximum bandwidth utilization, the 16 kbps D-channels are multiplexed in a ratio of four to one (4:1) into a single C-side directed 64 kbps DS30A link. This process is called time division multiplexing (TDM). TDM connection procedures are DCC based in the LCMI but migrate to become BIC based in the LCME. These procedures are allowed in reverse direction (looking outward to the line card from the DS30A link) where the D-channels are presented to the DCC's outgoing time switch and are either demultiplexed into 16 kbps streams back into the BIC (in the LCMI) or passed on as 64 kbps streams to the BIC for demultiplexing in the LCME.

The ISDN LCM is housed in pairs in the standard DMS-100 equipment frame yielding a total of sixteen drawers per frame. Each individual ISDN LCM provides a maximum of eighteen, and a minimum of two DS30A C-side ports (or links) to the network.

The two types of ISDN LCMs, LCMI and LCME, are discussed in the following paragraphs.

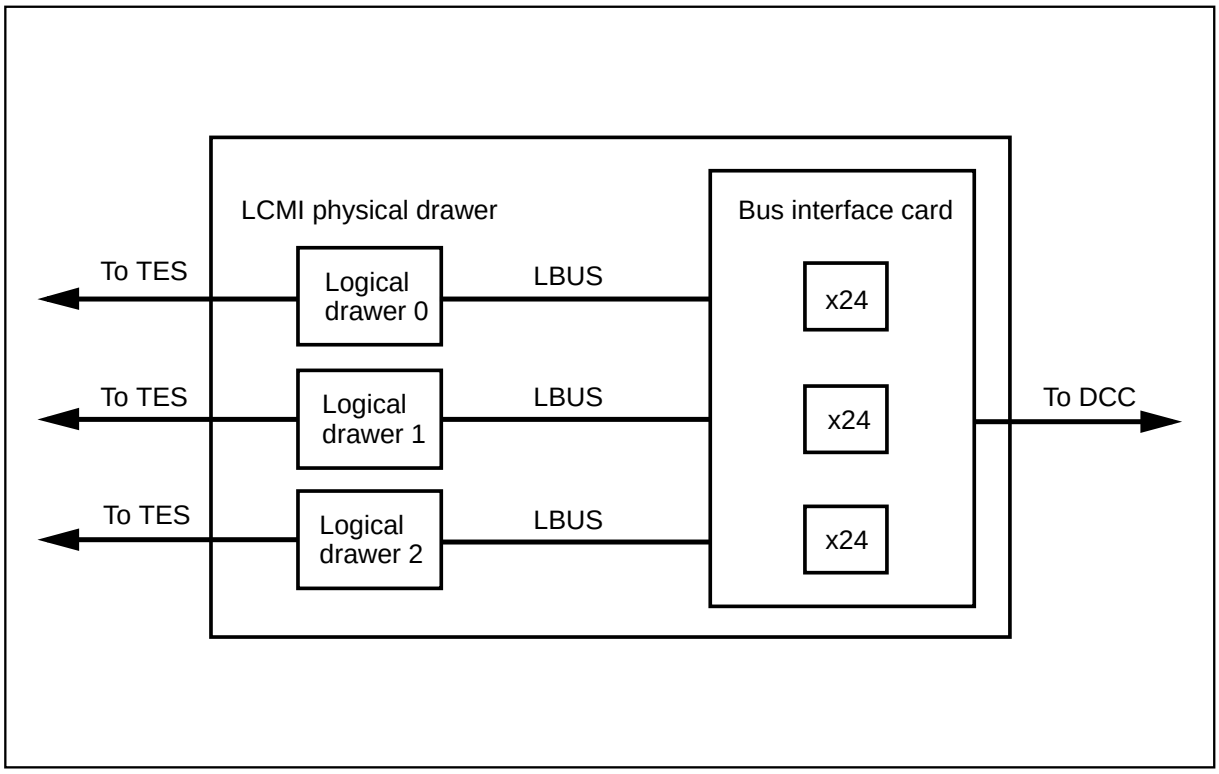
LCMI (AMI)

For basic rate interface to ISDN features and services, the LCM-ISDN or LCMI provides support to a mixture of ISDN, business voice and data lines within its drawers. The line types can be mixed on one module with the maximum system capacity dependent on BCS release, line type, and mixture ratio.

The LCMI houses eight physical drawers with three logical drawers per each physical drawer; yielding a maximum of twenty-four logical drawers per LCMI (Figure 15-9). There are a number of benefits to be derived from such an arrangement.

- If one logical drawer fails during call processing, it does not affect the others.
- Operations, administration, and maintenance activities on one logical drawer have no bearing on the other two.
- Line types can be mixed within the same logical and physical drawers as long as ISDN type cards such as U and S/T are not mixed with non-ISDN types.

Figure 15-9
Relationship between physical and logical drawers in LCMI



Mixed line types consisting of ISDN, Electronic Business Set, Datapath, and POTS are supported on the module (BCS 28 and above) with maximum LCMI capacities as follows:

- 160 U line cards (NTBx25AA/AB)
- 192 S/T line cards (NTBx26AA)
- 192 circuit-switched datapath line cards (NT6x71AA/AB)
- 384 Electronic Business Set line cards (NT6X21AC)
- 384 POTS line cards (NT6X17AA/AB)

A mixture of the above types results in a maximum number of lines that lie somewhere between the above limits due to power and thermal limitations.

The LCMI houses U line cards that apply alternate mark inversion (AMI) line coding and does not support the new 2B1Q lines.

The LCMI has the capability to support totally non-blocking service. This architecture is realized by the DCCs and the BIC where the latter eliminates all digroup blocking first such as BIC to DCC. The DCC's operation incorporates the 4:1 TDM for the D-channels.

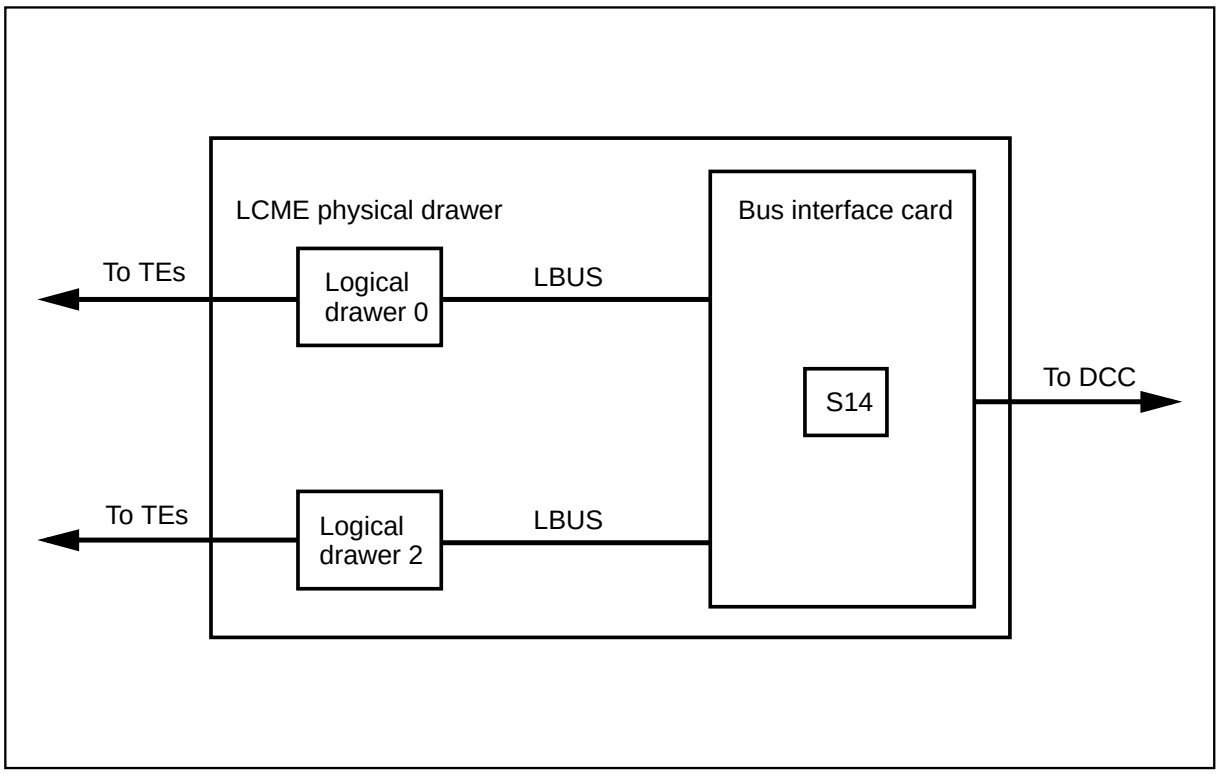
LCME (2B1Q)

The enhanced LCM or LCME replaces the LCMI in housing the ISDN 2B+D BRI line cards. The main reasons for this replacement are:

- to comply with ANSI line coding standard 2B1Q (two binary to one quaternary) for the U-loop interface
- to increase the module's ISDN lines capacity and provide simpler mixing and provisioning rules
- the need for a single slot ISDN line card and a more flexible TDM connection control for the D-channels

The LCME houses eight physical line drawers with two logical drawers per physical drawer (Figure 15-10), yielding a maximum of sixteen logical drawers per module. Each physical drawer, however, has a capacity of sixty single slot line cards which gives the LCME the ability to house 480 line cards.

Figure 15-10
Relationship between physical and logical drawers in LCME



The LCME supports mixed line types consisting of ISDN, datapath, Electronic Business Set, and POTS with maximum capacities as follows:

- 480 ISDN-2B1Q U Line Cards (NTBx27AA)
- 240 ISDN S/T line cards (NTBX26AA)
- 240 circuit-switched datapath line cards (NT6X71AA/AB)
- 208 AIM datapath line cards (NT6X76AA)
- 1 IBERT datapath line card (NTX99AA)
- 480 Electronic Business Set line cards (NT6X21AC)
- 480 POTS A line cards (NT6X17AA/AB)
- 472 POTS message waiting line cards (NT6X19AA/AB)

A combination of the above cards is allowed without any mixing restrictions at BCS32 and above.

At its introduction (BCS31) the LCME supported only ISDN lines, with ISDN and non-ISDN mixing starting at BCS32.

The following line types are not supported:

- POTS B line cards (NT6x18AA/AB) due to their analog noise

- ISDN-AMI U line cards (NTBx25AA/AB) due to their line coding

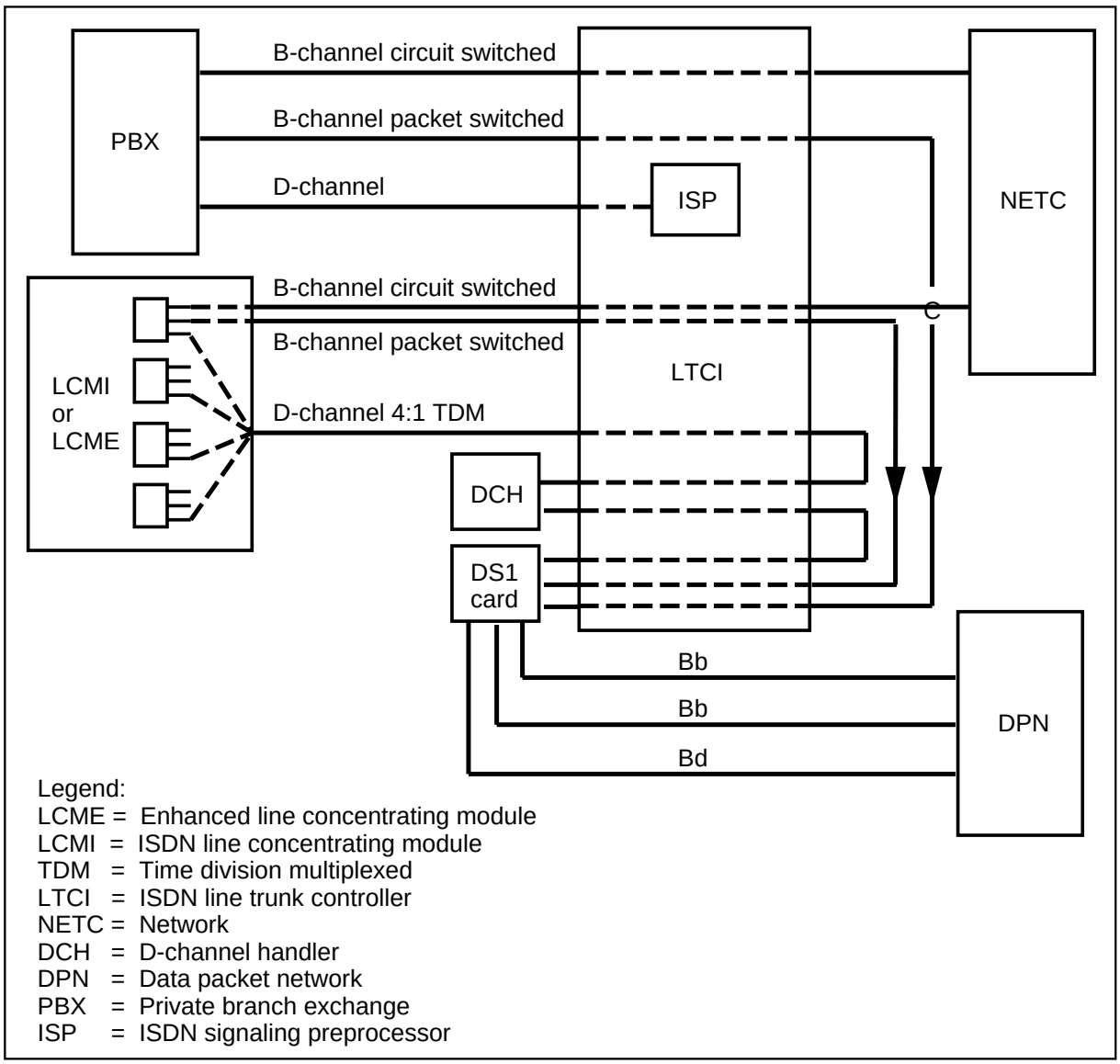
The LCME is a design evolved from the LCMI with capability to support non-blocking service for up to 320 ISDN loops per module. Refer to the traffic tables for details.

The LCME architecture is described in the ISDN-LCM section with the imported TDM functionality removed from the DCC to become BIC based. This migration enables the BIC to provide TDM to all ISDN line cards housed in one physical drawer; an improvement from LCMI architecture where the DCC provided TDM for only ISDN lines housed in the same logical drawer.

ISDN line trunk controller

BCS28 marked the introduction of the line trunk controller (LTCI) providing D-channel support to subscriber lines that use BRI via the ISDN-LCMs. The combined support of BRI and PRI on the LTCI was provided at BCS31 software release. Refer to Figure 15-11.

Figure 15-11
LTCI functional diagram



Based on the line group controller and line trunk controller design for the DMS-100 family, the LTCI incorporates a D-channel handler (DCH) and an ISDN signaling processor (ISP) as well as new software release for handling functions specific to ISDN. Both the DCH and ISP are described in greater detail following this section.

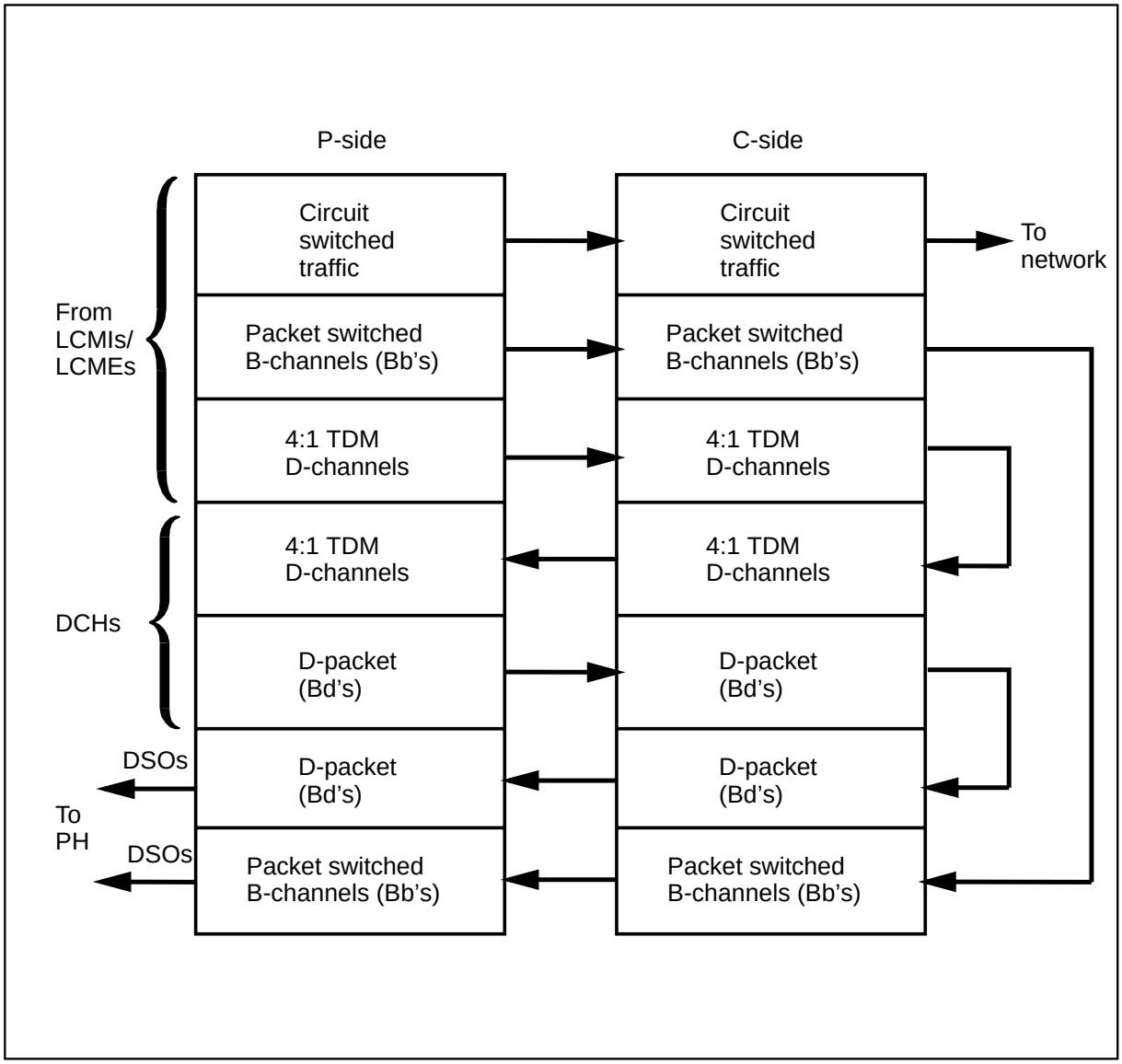
The LTCI may be retrofitted from a standard LGC or LTC and contains the usual complement of DS30, DS30A, and DS1 interfaces; time switch, master processor and memory, message card, channel supervision messaging, and universal tone receiver. Since the overall architecture of the

LCTI is similar to that of the LGC and LTC, it also uses a single equipment frame to house two logical modules consisting of four physical shelves, a cooling unit, and a frame supervisory panel.

The LCTI is a two-stage switching system. The outer side (P-side) has 20 ports that may be configured in DS30A and/or DS1 formats supporting LDMIs, LCMEs, LCMs, DCHs, and T1 trunks. The inner side (C-side) has 480 channels (16 DS30 interfaces) available for switched connections used for circuit-switched traffic, or nailed-up connections used for packet switched traffic.

The DS30 interfaces on the LTCI are divided into two parts. The first, a multiple of 24, is reserved for T1 channels. The second is a shared pool of channels used to carry the switched B-channels of ISDN loops as well as circuit-switched traffic as well as other circuit-switched traffic (Figure 15-12).

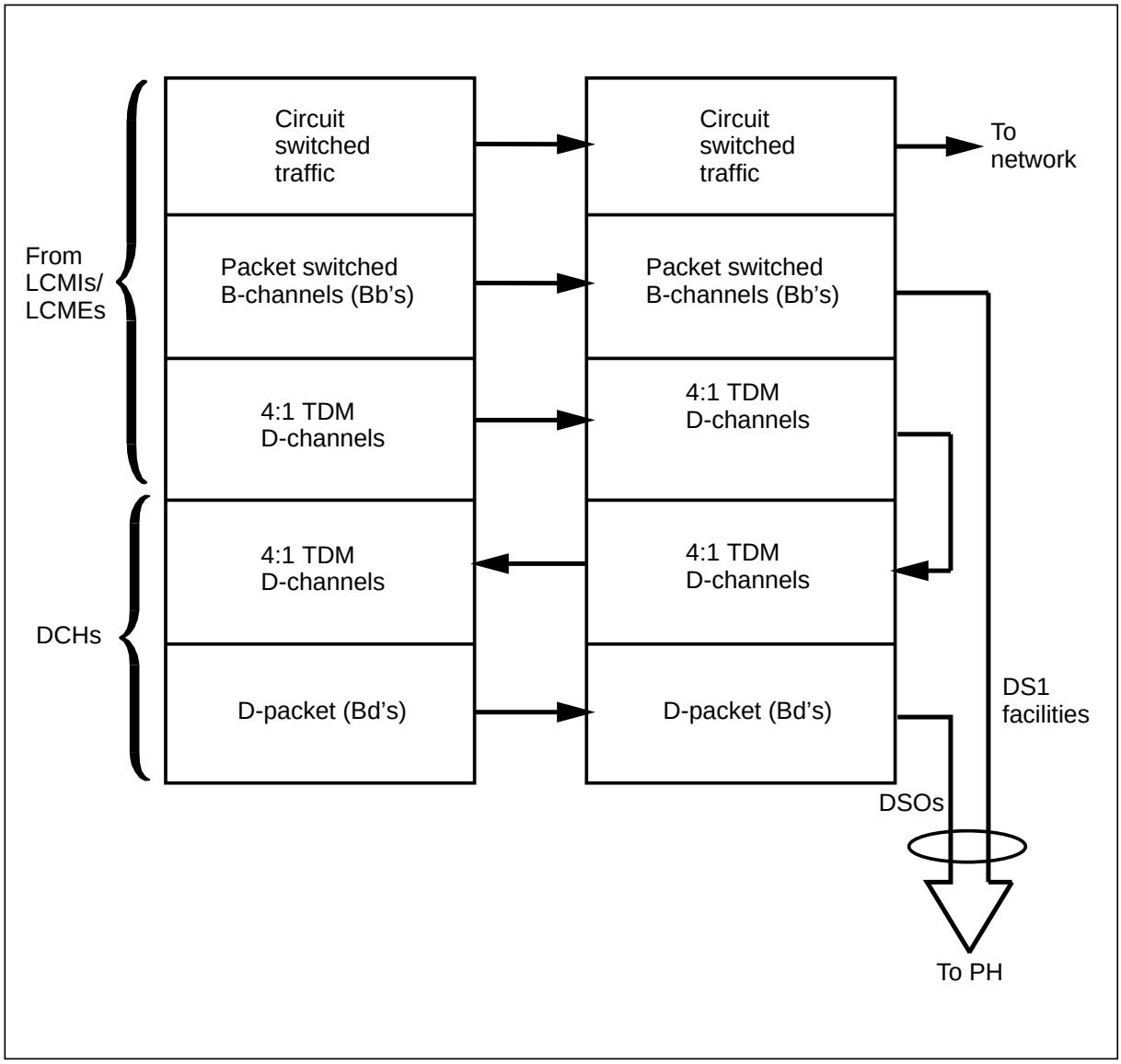
Figure 15-12
P-side connection to PH channel allocation



The 4:1 TDM D-channels, transported to the LTCI via DS30A interfaces from ISDN-LCMs, and the packet-switched B-channels are nailed-up across the C-side and looped back to access the packet handler (PH) from the P-side.

Currently, the packet handler is connected to the LTCI's P-side via DS1 interfaces(s). A C-side connection was released at BCS32, resulting in saving of both P and C side channels (Figure 15-13).

Figure 15-13
C-side connection to PH channel allocation



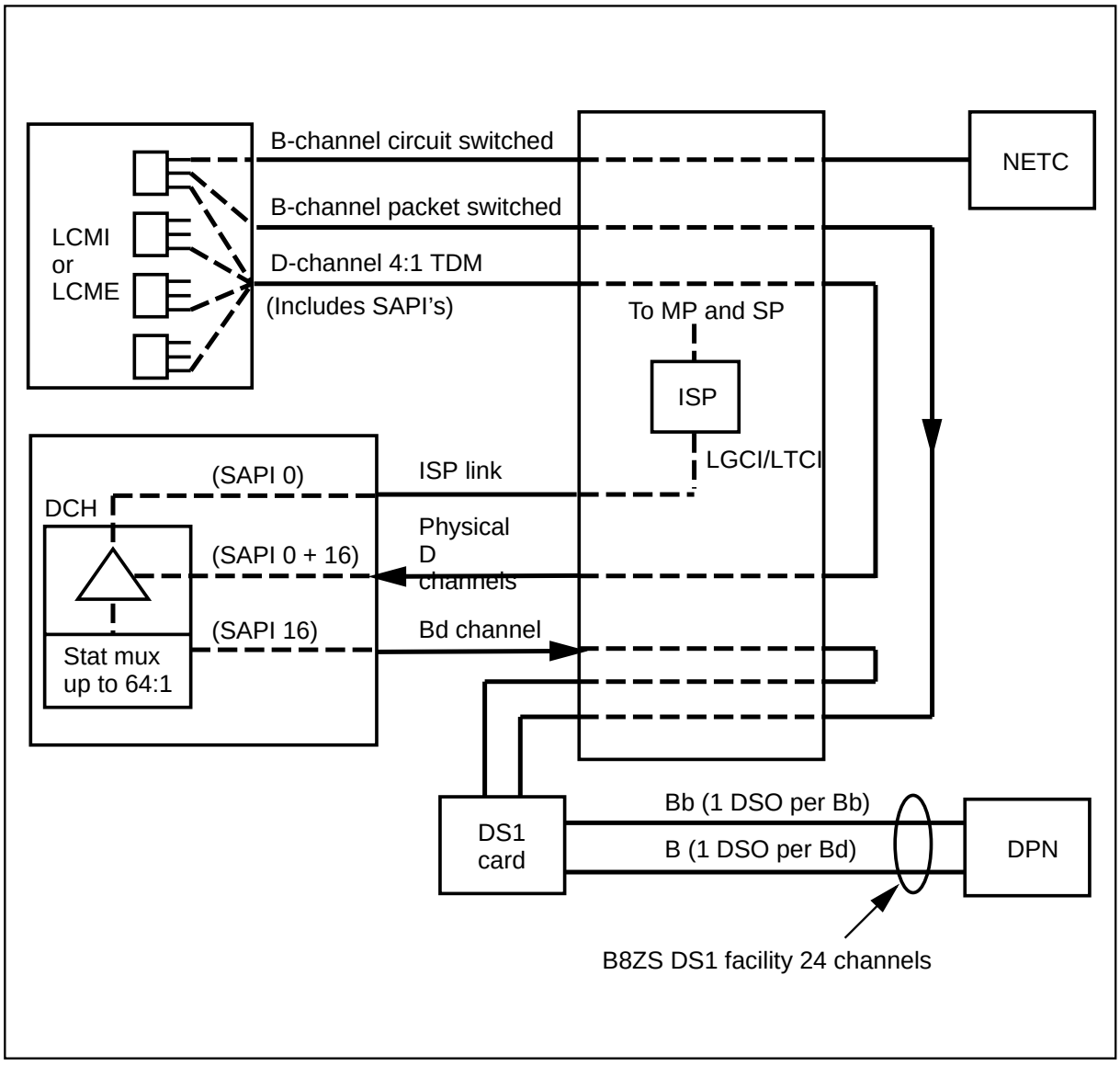
D-channel handler (DCH)

The DCH provides the main interface to all BRI D-channels that are time division multiplexed in a ratio of 4:1 at the ISDN-LCMs and routed via DS30A interfaces to the LTCI (or LGCI).

Once at the DCH, all LAPD frames are sorted according to their SAPI values. For SAPI 0 and SAPI 63, the DCH acts as termination point for the logical links. SAPI 0 frames are routed to the master processor (MP) via the ISDN signaling pre-processor (ISP), and SAPI 63 frames are handled within the DCH along with interactions from higher layers in the MP. Similarly,

SAPI 17 frames are handled by the DCH and are returned to the originating ISDN loop with the appropriate commands, or response bits, inserted in the address field sets. SAPI 16 frames, however, are statistically multiplexed over Bd channels and sent directly to the packet handler along with packet-switched B-channels data (Bb) via clear channel B8ZS-coded DS-1 interface (Figure 15-14).

Figure 15-14
LGCI D-channel handler functional diagram



The number of clear channel DS-1 interfaces to the packet handler is dependant on the number of Bd and Bb channels required.

Each DCH card occupies a P-side DS-1 slot on the LTCI, and uses one port per slot. The number of DCHs required in an LTCI is based on the number of ISDN loops, number of D-channel terminals per each loop, the packet data requirement of these terminals, and the STAT-MUX ratio applied.

The maximum DCH cards installed per module is ten, with a minimum of two cards per LTCI (or LGCI). In the DTCI, however, DCH cards are not required since the ISP card handles all PRI D-channels.

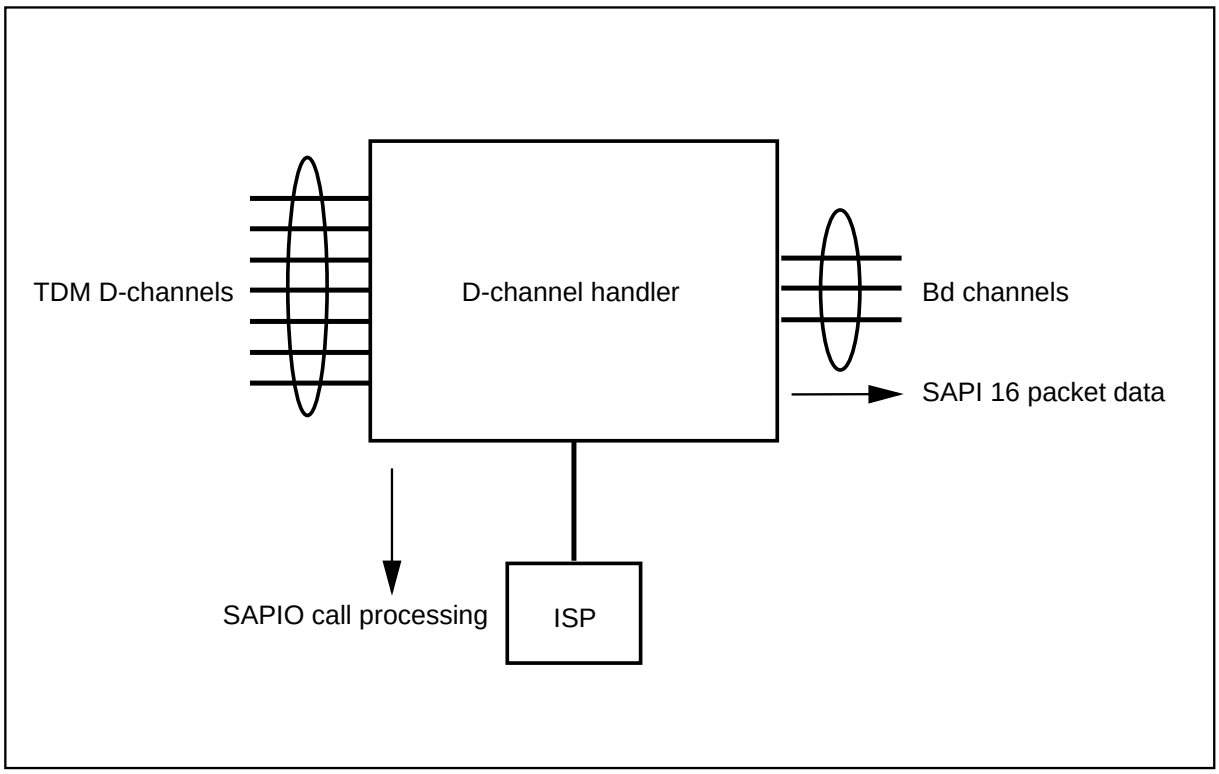
An N+1 sparing technique is used on the DCH; the reason being that at least two cards are installed per module, where one card acts as a standby spare. Thus, whenever a DCH failure is detected on an active card, the spare is automatically brought into service to replace it.

To minimize LTCI (or LGCI) C-side channel utilization, the spare DCH only utilizes the channels upon a detected principle DCH failure. On the P-side, however, all DCHs including the spare are connected to ports.

The DCH card is a 32 channels device with a bandwidth of 64 kbps per channel. Three types of channels are supported as shown in Figure 15-15:

- BRI TDM D-channels
- Bd channels
- single ISP channel

Figure 15-15
DCH channel allocation



The BRI D-channels are TDM in a 4:1 ratio at the ISDN-LCMs and transported to the LTCI (or LGCI) via DS30A interfaces. Thus, if 27 TDM D-channels are terminated on the DCH, the actual number of physical D-channels would be 108 (4*27).

The Bd channels are used to carry statistically multiplexed SAPI 16 traffic to and from the packet handler. The statistical multiplexing of data is done in a ratio over the Bd channel. This ratio defines the maximum number of D-channel packet terminals that can send/receive data over a single Bd channel to and from the packet handler. It is recommended that the highest STAT-MUX ratio be always used since it allows the most efficient use of Bd link resources, such as more terminals per Bd link. Presently, the highest STAT-MUX ratio used is 64:1.

Thus, for an application where the DCH terminates 27 TDM D-channels (108 physical D-channels), and a 64:1 STAT-MUX ratio is used, only 2 Bd channels will be required to support traffic sent or received by one packet terminal for each physical D-channel.

The single ISP channel is used as a messaging link between the DCH and ISP. It carries SAPI 0 traffic used for call processing associated with the B-channels.

An internal table index called the logical terminal index table (LTIDX), used for data storage, resides in both the ISP and DCH cards. Each entry in the table contains information pertinent to the logical terminal including:

- D-channel
- TEI
- available services (circuit switched, D packet-switched and so forth)
- associated Bd channel
- logical terminal identifier (LTID)

The frame routing in the DCH involves taking a received frame, converting its external frame address (TEI channel or LTID-channel) into its associated LTIDX, and forwarding the frame to its SAPI destination with the new external frame address inserted in the address field. For example, a SAPI 16 frame may be received on a BRI D-channel with a TEI channel address.This would then need to be translated into the associated LTIDX. The DCH would check whether SAPI 16 traffic is allowed for the logical terminal by checking the datafill in the table. Once the information is confirmed, the frame addressing would be changed to the format required by the packet handler (LTID based) and the frame would be queued for transmission on the appropriate Bd channel.

The DCH performs additional tasks such as:

- flag detection
- zero insertion/detection
- CRC checking

In PRI, the need for the DCH is eliminated and all 64 kbps D-channels associated with DS-1 interfaces, and carrying SAPI 0 traffic, are handled by the ISP card.

ISDN signaling pre-processor (ISP)

The ISDN signaling pre-processor (ISP) acts as a go-between the DCH and MP in BRI and a main interface to D-channels carrying call control messages in PRI.

The ISP uses LAPD in communicating with the DCH over a 64 kbps HDLC channel in BRI, and accesses the MP through common memory. It also provides maintenance functions to the DCH and the single link between them.

Messages with call processing service destination (SAPI 0) are routed between the DCH and MP, via the ISP, destined for their layer 3 (Q.931) target. An acknowledgement (RR) is sent back to the logical terminal for each message received by the ISP as part of the LAPD protocol. Moreover, a similar acknowledgement is exchanged between the ISP and DCH for messages received. Messages coming from the MP are not acknowledged since LAPD is not used between it and the ISP.

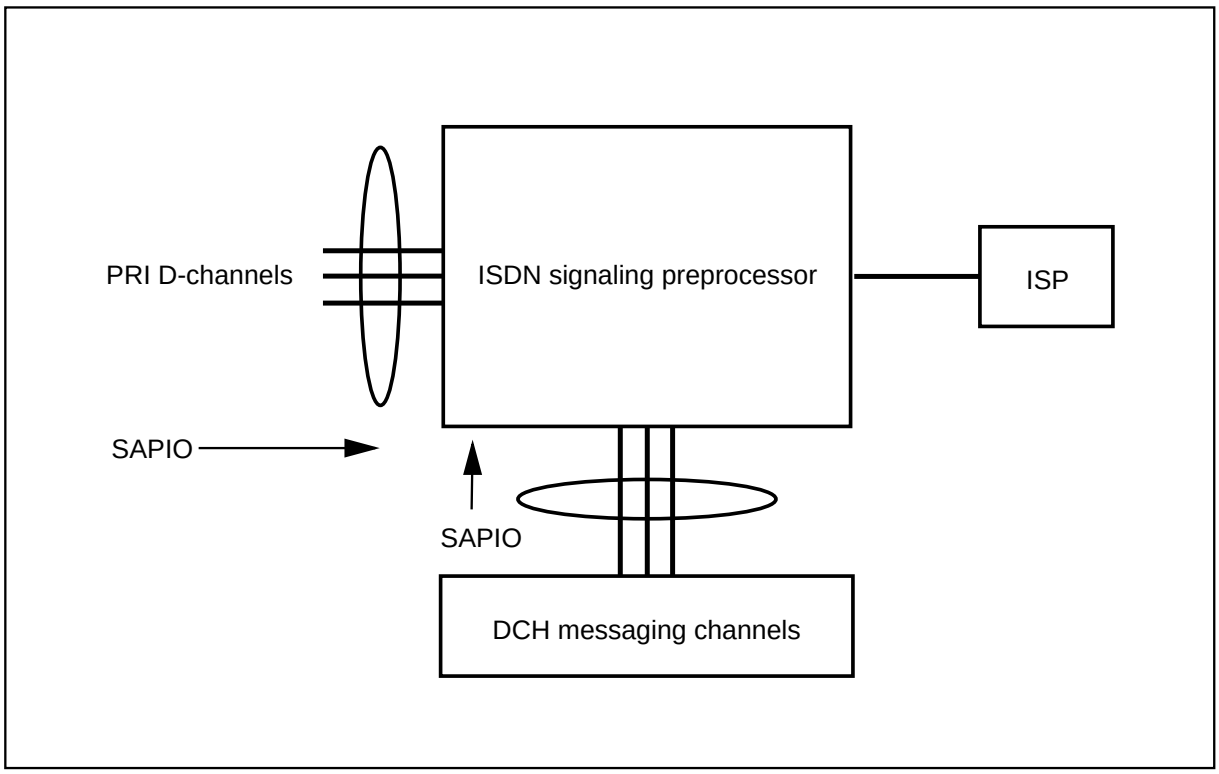
Two ISP cards are installed in each ISDN peripheral; one per shelf. Only one card, however, can be active at a time and the duplication is used for reliability.

The ISP card can support a maximum of 32 channels, each of which provides a 64 kbps datapath. Two types of channels are supported:

- DCH messaging channels used to carry call processing frames associated with BRI B-channels (SAPI 0)
- D-channels used to carry call processing messages associated with PRI B-channels (SAPI 0)
- a combination of the above types

A maximum of ten channels is provided for DCH cards interface in BRI; thirty-two for physical D-channels in PRI, and a combination of both in a mixed application (Figure 15-16).

Figure 15-16
ISP channel allocation



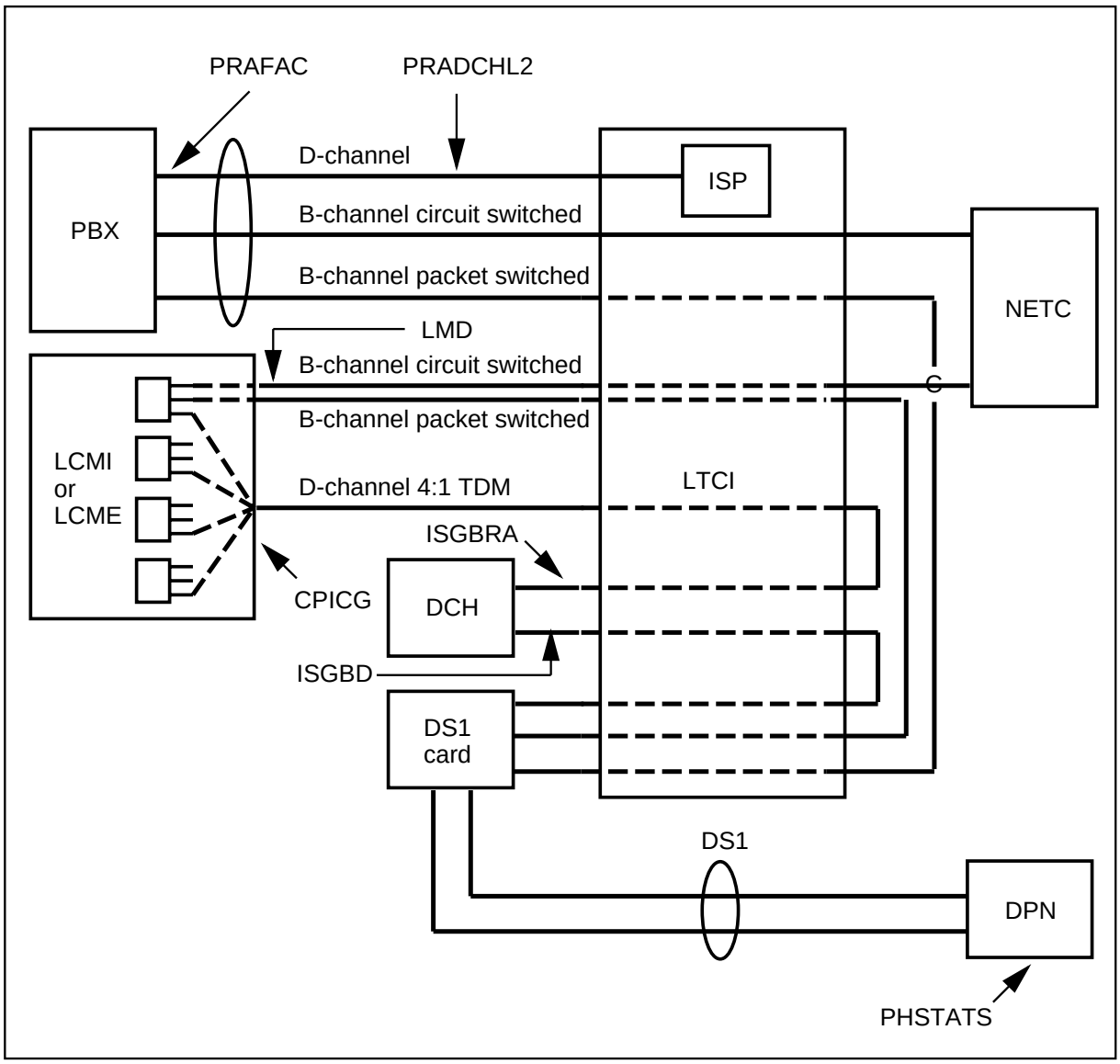
ISDN line group controller (LGCI)

BCS27 marked the introduction of the line group controller (LGCI). The LGCI is retrofittable from a standard (non-ISDN) LGC and has the same architecture as the LTCI. It performs the following call processing functions:

- B-channel circuit switched voice/data support to LCMs, LCMIs, and LCMEs
- dedicated B-channel high speed packet service support via DS30A links to the LCMIs, and LCMEs
- D-channel packet service and call signaling associated with circuit switched B-channels via DS30A links to the LCMIs, and LCMEs
- discrimination of D-channel data as either call signaling or user packet data performed by the DCH portion of the LGCI
- handoff of circuit switched B-channel calls to the network
- handoff of dedicated B-channels data to the packet handler via Bb links
- handoff of D-channel packet data to the packet handler via a statistically multiplexed Bd link

The LGCI component migration from a BCS perspective is described in further detail in the section “ISDN Product Migration Overview.” The LGCI is configured as shown in Figure 15-17.

Figure 15-17
LGCI configuration



ISDN digital trunk controller (DTCI)

BCS30 marked the introduction of the ISDN digital trunk controller (DTCI). It is a new version of the DTC with the additional capability provided to support ISDN PRI. The DTCI is retrofittable from a standard (non-ISDN) DTC. It performs the following tasks:

- B-channel circuit switched voice/data functions to digital PBXs via DS1 links
- dedicated B-channel high speed packet service via DS1 links to digital PBXs, LANs, and host computers
- D-channel call signaling associated with circuit switched B-channels via DS1 links to the PBXs. Low speed packet data, however, is not defined/supported for PRI
- integrated A/B bit trunk signaling support via DS1 links to the PBXs
- handoff of circuit switched B-channel calls and A/B bit trunk calls to the network
- handoff of dedicated B-channels packet data to the packet handler via Bb links

The ISDN DTC can support a limit of 20 DS1s, imposed by the number of its P-side ports; thus enabling the DTCI to support up to 20 unique PRIs with each requiring one D-channel to carry call signaling for the circuit switched B-channels.

One D-channel in one DTCI can serve the call signaling function for multiple DS1s to one PBX.

ISDN remote cluster controller (RCCI)

The ISDN remote cluster controller (RCCI) is the ISDN version of the RCC. Its design is based on the existing RCC with the following inclusions:

- ISDN signaling pre-processor (ISP)
- D-channel handler (DCH)

It has the ability to support a large number of access services such as:

- line concentrating module (LCM)
- remote line concentrating module (RLCM)
- ISDN line concentrating module (LCMI)
- extended line concentrating module (LCME)
- outside plant module (OPM)
- private branch exchange (PBX)
- community dial office (CDO) trunks
- subscriber module remote (SLC96) (SMSR)
- P-side packet handler connectivity options

- C-side packet handler connectivity options

The RCCI will be able to support both AMI and 2B1Q BRI lines but is not designed to support PRI. It is also retrofittable from a regular RCC starting at BCS31.

Basic ISDN emergency stand-alone (ESA) and non-ISDN ESA services are supported. Packet handler links can be established by nailed-up connections to the host LTCI, or by remote connections to the RCCI. Packet services are maintained during ESA only if a packet handler is co-located with the RCCI in a remote site.

An enhanced time switch is being developed for remote products under the S/RSC program, previously referred to as common peripheral module (CPM). It will enable direct P-side to P-side connections for TDM D-channels, Bd channels, and Bb channels. This will increase the capacity of the RCCI since many C-side channels will be freed for use.

In addition, the RCCI provides the following capabilities:

- intra-switching for line-to-line, with the exception of:
  - feature activated lines
  - MADN terminations on secondary members
  - packet-switched ISDN call
  - data unit with other than data unit
- intra-switching for dynamic trunks
  - line to dynamic trunk
  - dynamic trunk to line
  - dynamic trunk to dynamic trunk
- dual RCCI is supported (that is, interconnection of two RCCIs, or one RCC and one RCCI)
- interswitching for line-to-line and dynamic trunks (the same restrictions are placed as with the intra-switching feature listed above)
- intra-switching on a trunk group basis (that is, trunk groups cannot be spread across the two RCC/RCCIs)
- support to:
  - POTS
  - Electronic Business Set
  - Datapath
  - CLASS
  - MDC
  - ISDN BRI (functional and stimulus signaling lines)

- B-channel circuit switched voice/data support to LCMs, LCMIs, and LCMEs
- dedicated B-channel high speed packet service support via DS30A links to the LCMIs,and LCMEs
- D-channel packet service and call signaling associated with circuit switch B-channels via DS30A links to the LCMIs,and LCMEs
- discrimination of D-channel data as either call signaling or user packet data (performed by the DCH portion of the LGCI)
- handoff of dedicated B-channels data to the packet handler via Bb links
- handoff of D-channel packet data to the packet handler via a statistically multiplexed Bd link

The RCCI component migration from a BCS perspective is described in further detail in the section “ISDN Product Migration Overview.”

Packet handler

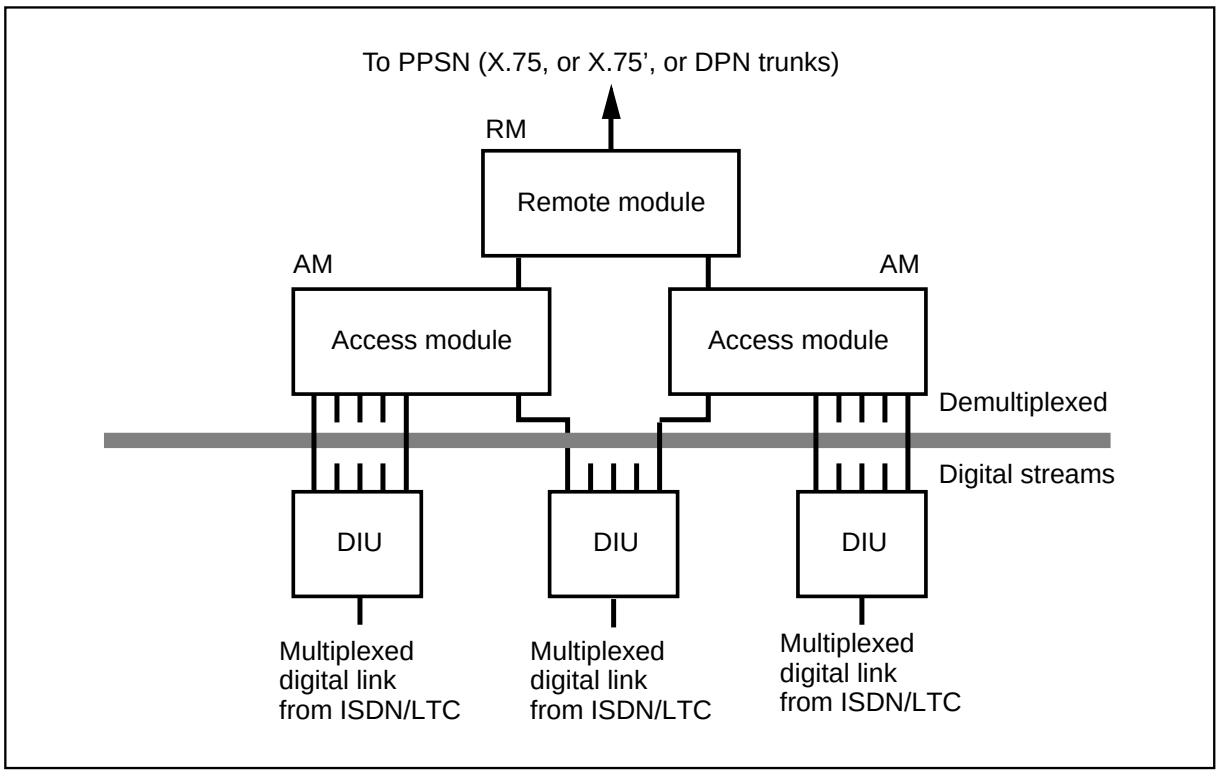
The packet handler (PH) component to the ISDN node is based on DPN packet switch technology and provides packet switched data transport services to ISDN terminals that are connected to the ET.

Each PH DPN has three shelves, and can house the following discrete elements:

- digital interworking unit (DIU)
- access module (AM)
- resource module (RM)

Figure 15-18 illustrates the packet handler configuration.

Figure 15-18
Packet handler configuration



Digital interworking unit (DIU)

The digital interworking unit (DIU) is responsible for multiplexing/demultiplexing high speed serial links into individual 64 kbps serial data channels (DS1 or T1 channels) and mapping them to the appropriate ports on the access module.

The DIU shelf has provisionable slots for T1 interface module (TIM) cards and their associated serial interface module (SIM) cards. One TIM supports a single clear channel DS1 interface with a maximum of three TIMs per DIU shelf. The rest of the 16 available slots are used to house SIM cards, with each handling a maximum of 8 DS0 channels (Bd or Bb channels). Thus, for each fully utilized clear channel interface, one TIM and three SIMs are required. Each DPN cabinet houses a minimum of one DIU shelf.

Access module (AM)

The access module (AM) is the access protocol element within the packet handler. The AM terminates all the subscriber access lines and carries out the processing necessary to support access protocols. Some of the packet mode capabilities supported are listed below:

- BRI D-channel packet data for X.25 terminal equipment using LAPD (per Q.921) at layer 2 and X.25 facilities at layer 3
- B-channel packet data for X.25 terminal equipment using LAPB at layer 2 and X.25 facilities at layer 3
- B-channel packet mode access for host and terminal equipment with synchronous data link control (SDLC) at layer 2, operating at 56 kbps or 64 kbps
- X.75/X.75' access protocols for PSPDNs and PPSNs

The AM uses distributed processing architecture based on a duplicated common bus and two independent common memories. Connected to the common buses are processing elements (PEs) which inter-connect by sending messages to each other via the common memories. Each PE may have associated with it one or more peripheral interface (PI) cards which terminate access lines from the ET, or network links from RMs or AMs.

Two PEs are reserved for common AM functions and for terminating load shared network links and are called master PEs. Extra network links can be added as required in addition to access lines. They are both terminated using the remaining service PEs.

Each AM contains duplicate hard disks connected to the master PEs and used for storing software and service parameters locally. New software and service data is downloaded through the network to the AM, and saved on the local disks. Service parameters are loaded into a particular PE to provide support to the above mentioned protocols.

The PI cards terminate the access lines routed from the DIU. In the ISDN, they are in the form of DS0 channels. Each PI card can terminate up to two DS0 channels, one on port 1 and the other on port 3. For the access lines, one PI is always associated with a single PE.

A single-shelf AM can support up to 14 PEs, while the double-shelf AM can support up to 28 PEs. A DPN cabinet can have a combination of both.

Several AMs are typically configured with one RM to constitute a single packet switch. Moreover, AMs can be packaged together with the RM in a DPN cabinet, or separately for remote concentration.

Resource module (RM)

The resource module (RM) carries out a number of functions. The most important ones are listed below:

- PH switch control
- call routing
- network feature provisioning
- system operation
- administration and maintenance
- X.75/X.75' gateways for interworking with PSPDN or PPSN
- DPN trunking as an alternate to X.75/X.75' gateways for inter-packet handler network communication

The RM architecture is very similar to that to the AM where multiple processors communicate over dual common buses and common memory. The primary difference are in the enhancements to the common memories and the dual bus which provide the additional capacity needed in the switch core.

The RM uses the same PE as the AM, except that in the RM each PE is assigned one of three basic processor functions:

- switch master
- trunk or network link controllers
- servers

Two PEs are permanently designated as the switch masters; one being a backup that recovers the functions incase of the primary PE's failure. The remaining PEs are used as trunk controllers, or network link servers as required.

The processes that run on the master PE are essential to the packet switch operation and include:

- loading software
- detecting and reporting failures
- initiating recovery
- managing the disks and file system on the RM
- centralizing the determination of optimal packet path
- making these routes available to other switches in the network

Inter-switch packet communications is handled by the universal trunk protocol PEs, a patented DPN trunk processor designed for high-speed packet transport between DPN RMs. Other trunk controller PEs provide X.75/X.75' gateways for interworking with PSPDN and PPSN and connect the RM to the network control system (NCS).

Trunk controller PEs are responsible for the following functions:

- maintaining packet priority on the trunks
- invoking congestion control when appropriate
- monitoring trunk quality
- periodically report trunk and throughput statistics to network control system (NCS)

Each PE can support two 56 kbps trunks or a single 192 kbps trunk.

Network PEs connect the AM(s) to the RM and perform a function similar to that of the trunk PEs. They are architecturally similar and support the same link performance.

Server PEs, however, support various functions related to call establishment, the AMs directly connected to their RM, and optionally for other switches in the network. The primary processes associated with the RM server PEs are as follows:

- source and destination call routers
- network user identification (NIU) process
- call redirection process

ISDN components migration overview

This section defines the design evolution of the ISDN product from a BCS perspective. The changes identified are those which impact capacity management.

The peripheral component evolutionary paths discussed in this section are:

- LCMI/LCME
- LGCI/LTCI
- DTCI
- RCCI

The OAMP and DCH component evolutionary path is discussed in the following paragraphs.

ISDN line module evolutionary path

Pre-BCS28 LCMI

- supports Electronic Business Set and Datapath line cards
- supports ISDN AMI U line cards
- maximum lines per LCMI
  - 100% ISDN 160
  - 100% Electronic Business Set 384

  - 100% Datapath 192
- combination of line types yields a maximum lines per LCMI that falls somewhere between the above limits.
- ISDN lines mix with non-ISDN is not allowed on the same logical drawer
- B-channels provisioned based on traffic requirement
- D-channels are TDM at 4:1 ratio onto single 64 kbps DS30A links to LGCI/LTCI

BCS28 and above LCMI

- supports new ISDN 2B1Q U line card
- maximum 192 ISDN S/T lines supported
- ISDN U AND S/T line mix allowed on same logical drawer
- supports POTS line cards with restrictions (see pre-BCS28 LCMI description)
- supports AILC required for DIALAN service
- maximum of 384 POTS lines per LCMI

BCS31 LCME

- supports new ISDN 2B1Q line card
- supports old ISDN S/T line card
- does not support ISDN AMI U line card (LCMI version)
- ISDN lines mix is allowed on same logical and physical drawers
- maximum ISDN lines per LCME are as follows:
  - 100% 2B1Q U lines 480
  - 100% S/T lines 240
- combination of the two yields a maximum per LCME that falls somewhere between the two limits
- 2 to 18 DS30As per LCME
- B-channels provisioned based on traffic management
- D-channels are TDM at 4:1 ration onto single 64 kbps DS20A links to LGCI/LTCI
- up to 320 ISDN 2B1Q lines per LCME can be provisioned with virtually no blocking

BCS32 and above LCME

- Datapath, Electronic Business Set, and POTS line cards can be mixed with ISDN lines on the same logical drawers
- coin lines (B type) not supported on the LCME
- maximum non-ISDN lines per LCME are as follows:

- 100% Datapath 240
- 100% Electronic Business Set 480
- 100% POTS 480

ISDN controller evolutionary path

BCS27 LGCI

- supports BRI
- supports LCMI and standard LCM
- maximum number of ISDN lines is provisionable based on traffic
- terminates D-channels on frame integrated DCH cards
- number of ISDN lines per DCH card is provisionable based on logical D-channel packet terminal per ISDN loop requirement
- maximum STAT-MUX ratio of 32:1 for Bd channels
- number of Bd channels for each LGCI is provisionable based on number of DCH cards times the number of Bd channels per card
- maximum number of logical D-channel packet terminals for each LGCI is provisionable based on DCH provisioning
- DS1 links to the packet handler are provisionable based on Bd and Bb channel requirements

BCS28 LTCI/LGCI

- LTCI is introduced with the same functionality as the LGCI
- supports universal tone receiver (UTR)
- supports N+1 sparing for DCH cards
- supports DS1 digital trunks using A/B signaling (LTCI only)
- provides ISP audit enhancements
- supports non-ISDN remotes (RCCs)

BCS29 LTCI/LGCI

- maximum STAT-MUX ratio of 64:1 for Bd channels
- support is provided to PERFORM tool for the DCH and ISP processors
- supports functional and stimulus signaling on same BRI loop
- supports MADN single call arrangement on functional signaling terminals
- DCH link throttling is introduced to minimize traffic overflow and link congestion

BCS30 LTCI/LGCI

- overload controls for BRI are provided to insure controller’s stability during circuit switched traffic overload situations

BCS30 DTCI

- replaces IAC in terminating PRI trunks
- terminates up to 20 DS1 PRI (maximum 480 channels)
- supports consolidated signaling (479 B-channels with one D-channel
- supports circuit and packet switched B-channels
- DS1 links to the packet handler are provisionable based on Bb channel requirements. Connects the PH from the P-side
- terminates PRI D-channels on ISP card
- supports A/B signaling over DS1 digital interfaces
- supports inverted HDLC link format
- supports flexible trunking for PRI channels through integrated services access (ISA). ISA dynamically reconfigures PRI designated channels assigned to the following based on customer's needs:
  - Foreign exchange
  - W ATS lines
  - DID
  - DOD OUTW ATS
  - INW ATS trunks into TIE trunks
- retrofittable from regular DTC

BCS31 LTCI

- supports PRI in addition to BRI
- overload controls for PRI are provided to insure controller's stability at heavy traffic loads
- supports Meridian feature transparency (MFT) signaling

  Note: MFT allows functional signaling terminals to access Electronic Business Set features as they become available. It allows Centrex customers to upgrade to ISDN without losing access to Electronic Business Set feature functionality.

- supports ISDN and non-ISDN remotes (RCCIs and RCCs)

BCS31 DTCI

- overload controls for PRI are provided to insure controller's stability at heavy traffic loads

BCS31 RCCI

- retrofittable from a regular RCC
- supports ISP and DCH cards
- supports ISDN BRI via LCMI/LCME but does not support PRI trunks

- supports intraswitching with a single controller configuration (RCCI) and interswitching with a dual controller configuration (DRCCI)
- supports ESA for stimulus and functional signaling types as well as ESA for other lines supported
- supports XPM PERFORM tool
- supports optional C-side PH connection
- supports remote RLCMs and OPMs
- supports dynamic trunking

BCS32 LGCI/LTCI/RCCI

- DCH overload controls are provided to stabilize component in high traffic applications

  Note: DCH will become capable of prioritizing SAPI 0 over SAPI 16 traffic. This is a software feature that requires no hardware changes to the DCH.

BCS32 DTCI/LTCI

- supports backup D-channel for PRI

  Note: Backup D-channel takes over signaling functions at time of primary D-channel failure, enhancing call control reliability.

- provides D-channel backup verification
- provides PRI/SS7 access transport

BCS34 RCCI

- new time switch is introduced under S/RSC program that allows P to P-side connectivity and C-side PH connection

ISDN OAM processor evolutionary path

BCS29

- integrates service provisioning for packet terminals into the DMS-100 SERVORD system
- upload/download PH MCF used for service provisioning
- co-exist with NAS for X.25 service provisioning functions
- provides NCS passthru from MAP to allow hardware maintenance commands to be issued

BCS30

- provides PH alarms on DMS alarm banner
- provides a single LOG stream for ISDN

BCS31

- enhances SERVORD capabilities enabling a total bypass of NAS

- provides capability to POST OAMP from MAP
- provides X.25 LAPB/LAPD PE/PI configuration MAP

BCS32

- provides 2B1Q loop maintenance functions
- consolidates basic PH OMs into DMS stream

BCS33

- allows protocol analyzer digital connection with IDSN via MAP (Digital Test Access Maintenance)

BCS34

- provides single stream billing record for both circuit switched and packet switched calls sorted by type of call.

ISDN peripheral real time engineering

Introduction

This section provides ISDN peripheral real time engineering guidelines, providing discussion of the following areas:

- a synopsis of what peripheral components require real time engineering
- identification of which ISDN and non-ISDN call types impact specific peripheral processors
- tables required for calculation of real time requirement in identified peripheral peripheral processors
- sample calculations
- blank calculation worksheets
- real time call attempt capacity models

The peripheral real time calculation tool PRTCALC mechanized real time engineering of the following:

- LCMI
- LGCI for BRI
- LTCI for BRI

Issue 2E of the tool added LCME and provided full support to BRI and PRI on the LTCI, PRI on the DTCI, and BRI on the RCCI/DRCCI.

Methodology synopsis

Real time engineering methodology of ISDN type peripherals is identical to that of standard, non-ISDN peripheral processors. Reference should be made to the latest issues of *New Peripheral Processor Occupancy and Call Timing Tables*, SEB 88-11-003, for manual calculation of call attempt capacity of new peripheral controllers, and to *New Peripheral Manual Method For Capacity Determination and Verification,* SEB 86-10-003 for guidelines on real time engineering since this document does not provide a detailed explanation of this engineering discipline.

This section will detail information which is required to overlay ISDN specific call types onto the existing framework of peripheral real time engineering.

Requirement synopsis

This section is an overview of identified peripheral components which require real time engineering. In addition, specific call types (both ISDN and non-ISDN) which impact each peripheral are identified.

The pertinent peripheral processors are as follows:

- LCMI and LCME
- LGCI
  - master processor (MP)
  - signal processor (SP)
- LTCI
  - master processor (MP)
  - signal processor (SP)
  - ISDN signal pre-processor (ISP)
- DTCI
  - master processor (MP)
  - signal processor (SP)
- RCCI
  - master processor (MP)
  - signal processor (SP)
  - ISDN signal pre-processor (ISP)

LCMI

Real time engineering of the LCMI is required and becomes increasingly important as the number and types of physical line cards supported increases on a BCS basis.

One item of note: assignment of the multiple appearance directory number (MADN) feature to an ISDN line has little to no impact on real time utilization in the LCMI processor. Yet, non-ISDN line types such as EBS, Display EBS, and MDC still have a substantial LCMI call timing additive associated with assignment of the MADN feature.

LCME

The same emphasis is placed on real time engineering for the LCME as the type of lines supported increased at BCS32 to include EBS, Datapath, and POTS in addition to ISDN.

LGCI

Real time engineering for the LGCI MP was a requirement from its introduction at BCS27 onwards.

The LGCI SP is not considered real time limiting since call attempt capacities exceed those of the LGCI MP. Real time engineering, however, can be applied since SP call timings are provided in this document.

Currently, real time engineering of the LGCI ISP is not viewed as a requirement. For typical applications, ISP real time utilization does not exceed 40 percent.

Real time engineering for the LGCI DCH is only a requirement for D-channel packet switched calls (SAPI 16) and is currently viewed as not required for circuit switched calls.

LTCI

Real time engineering for the LTCI MP and SP was a requirement from its introduction at BCS28 onwards.

For BRI applications only, real time engineering for the LTCI ISP is not viewed as a requirement. ISP real time utilization does not exceed 40 percent for a typical BRI application.

When the LTCI supports PRI, real time engineering becomes necessary as the ISP will handle messages associated with ISDN circuit switched calls for both BRI and PRI interfaces.

Real time engineering for the LTCI DCH is only a requirement for D-channel packet calls (SAPI 16) and is currently viewed as not required for circuit switched calls.

DTCI

Real time engineering for the DTCI MP and SP was a requirement from its introduction at BCS30 onwards.

Currently, real time engineering of the ISP is not viewed as necessary due to traffic tests revealing real time utilization of the processor not exceeding 40 percent for a typical application.

RCCI

Real time engineering for the RCCI MP and SP was a requirement from its introduction at BCS31 onwards.

Real time engineering for the RCCI DCH is only a requirement for D-channel packet calls (SAPI 16) and is currently viewed as not required for circuit switched calls.

Real time engineering impacts by call type

The call types which must be considered when calculating real time requirements in affected ISDN related processors are as follows:

- existing non-ISDN (POTS, MDC, EBS, and so forth)
- ISDN B-channel circuit switched voice and data
- ISDN B-channel dedicated high speed packet data (Bb)
- ISDN D-channel call signaling associated with the B-channel
- ISDN D-channel low speed packet data (Bd)

Refer to Table 15-1 for call type impact on real time utilization of previously identified processors.

Table 15-1
Processor real time engineering impact by call type

Call type	CPU	LCMI LCME	LGCI	LTCI	DTCI	RCCI
Existing non-ISDN	Y	Y	Y	Y	Y	Y
B-channel circuit switched voice/data	Y	Y	Y	Y	Y	Y
Dedicated B-channel packet data (Bb)	N	N	N	N	N	N
D-channel packet data (SAPI 16)	N	N	Y	Y	N/A	Y
D-channel signaling (SAPI 0)	Y	N	Y	Y	Y	Y

Not all of the above mentioned call types impact all processors. For example, ISDN B-channel dedicated high speed packet data via a Bb link does not contribute to any processor real time utilization except at the establishment of the Bb's nailed-up path.

When considering real time engineering call type impacts, it is important to note the following:

- Packet services via either the B or D-channel do not contribute to real time utilization of the CPU.
- Although the D-channel call signaling associated with the B-channel impacts real time utilization as noted, the capture of its component increment is achieved in the call timing associated with the B-channel circuit switched call.

ISDN-LCM real time engineering algorithm

As stated in previous sections, real time engineering methodology for ISDN type peripherals is identical to that of existing peripheral types with the exception being the addition of unique ISDN call types.

Manual calculations of real time utilization of the LCMI is not required since the current issue of PRTCALC mechanizes the process. Discussion of manual calculation is included for the LCME and could be applied for LCMI in case the reader wants to be familiarized with the process utilized in the PRTCALC program.

As shown in Table 15-1, only circuit switched calls,whether ISDN or non-ISDN, contribute to real time utilization of the LCMI and LCME processors. Packet switched calls, both B and D-channel, do not require LCMI/LCME resources and therefore are not considered when performing real time engineering of the LCMI/LCME.

For non-ISDN lines, call timing calculation is identical to that of existing LCMs.

Calculation of call timing for ISDN lines is the same as for non-ISDN lines with the following exception: that is, there is no additive to an ISDN circuit switched call timing in the LCMI/LCME for the application of the MADN feature.

Table 15-2 illustrates the LCMI/LCME processor occupancy allocation for the HDBH call processing area. Table 15-3 provides the associated call timings for the LCMI; while Table 15-4 provides preliminary call timings for the LCME.

Table 15-2xxx
LCMI and LCME processor occupancy allocations

Buffer	Available for call processing
25 percent	75 percent

Table 15-3xxx
LCMI call timings

POTS	535
MDC without MADN MDC with MADN	535 535 * formula 1
EBS without MADN EBS with MADN	535 535 * formula 2
Display EBS without MADN Display EBS with MADN	735 735 * formula 2
ISDN circuit switched	
B-channel terminal without MADN B-channel terminal with MADN	550 550
ISDN packet switched	
B-channel terminal D-channel terminal	no impact no impact

Note: Adjustments: Custom call feature additive = 1 percent for every 10 percent featured lines

Note: Formula 1 = [1+P (% TERM * G)]

Note: Formula 2 = [1+p [(% orig *.1G)] + (% TERM * G)]]

Where:

P = percent MADN penetration

G = Average number of secondary members in each MADN group

%TERM = percent terminating traffic

% ORIG = percent originating traffic

Note: There is no additive for assignment of the MADN feature to an ISDN line.

Table 15-4xxx
LCME call timings

Call type	**Call timings in msec**
POTS	535
MDC without MADN MDC with MADN	535 535 * formula 1
EBS without MADN EBS with MADN	535 535 * formula 2

-continued-

Table 15-4xxx
LCME call timings(continued)

Call type	Call timings in msec
Display EBS without MADN	735
Display EBS with MADN	735 * formula 2
ISDN circuit switched	
B-channel terminal without MADN	375
B-channel terminal with MADN	375
ISDN packet switched	
B-channel terminal	no impact
D-channel terminal	no impact

Notes:
Note: Adjustments: Custom call feature additive = 1 percent for every 10 percent featured lines

Note: Formula 1 = [1+P (% TERM * G)]

Note: Formula 2 = [1+p [(% orig *.1G)] + (% TERM * G)]]

Where:

P = percent MADN penetration

G = Average number of secondary members in each MADN group

%TERM = percent terminating traffic

% ORIG = percent originating traffic

Note: There is no additive for assignment of the MADN feature to an ISDN line.

Note: Timings for LCME are preliminary

End

LGCI BRI real time engineering algorithm

Manual calculation of real time utilization of the BRI in the LGCI is not required since the current issue of PRTCALC mechanizes the process. Discussion of manual calculation for the BRI LTCI is included, however, and can be applies on the BRI LGCI for the sake of familiarizing the reader with the process used in the PRTCALC program.

As shown in Table 15-5, real time utilization of the BRI LGCI is impacted by the following call types:

- ISDN B-channel circuit switched voice and data
- existing non-ISDN circuit switched voice and data
- D-channel call control signaling

Table 15-5xxx
LGCI/LTCI real time impacts

Component	Impact	OM	Resident tool	Engr/Plan tool
B-channel circuit switched	yes	LMD RTLTSUM	PERFORM	PRTCALC

Real time engineering of the signal processor (SP) and ISDN signal pre-processor (ISP) on the LGCI are currently viewed as not required because their call attempt capacity exceeds that of the master processor (MP).

Real time engineering of the D-channel handler is not required for call control signaling associated with B-channel circuit switched calls (SAPI 0).

The following tables provide data for the BRI LGCI calculation input.

- Table 15-6 provides the BRI LGCI MP occupancy allocations for the HDBH call processing area.
- Table 15-7 provides the BRI LGCI SP occupancy allocations for the HDBH Call Processing Area.

Table 15-6xxx
LGCI/LTCI master processor occupancy allocations

Overhead	Buffer	Available for call processing
54 percent	10 percent	36 percent

Table 15-7xxx
LGCI/LTCI signal processor occupancy allocations

Overhead	Buffer	Available for call processing
54 percent	10 percent	36 percent

LTCI BRI and PRI real time engineering algorithm

Manual calculation of real time utilization of the BRI in the LTCI is not required since the current issue of PRTCALC mechanizes the process. The PRTCALC tool does not support primary rate interface on the LTCI and therefore manual calculation of real time utilization is required. Discussion of manual calculation for basic and primary rate interfaces in the LTCI are included in this section.

A blank work sheet is provided in this section and should be used for manual calculations.

Real time utilization of the LTCI is impacted by the following call types:

- ISDN B-channel circuit switched voice and data
- existing non-ISDN circuit switched voice and data
- D-channel call control signaling

Real time engineering of the MP, SP, and ISP in the LTCI is required when this controller is used to support both BRI and PRI, Otherwise, real time engineering is required for only the MP and SP.

Real time engineering of the D-channel Handler is not required for call control signaling associated with B-channel circuit switched calls (SAPI 0).

The following tables provide data for the PRI LTCI calculation input.

- Table 15-8 provides the LTCI MP occupancy allocations for the HDBH call processing area.
- Table 15-9 provides the LTCI SP occupancy allocations for the HDBH call processing area.
- Table 15-10 provides the LTCI ISP occupancy allocations for the HDBH call processing area.
- Table 15-11 provides the associated call timings for the LGCI/LTCI master processor.
- Table 15-12 provides the associated call timings for the LGCI/LTCI signal processor.

Table 15-8xxx
LGCI/LTCI ISDN master processor occupancy allocations

Overhead	Buffer	Available for call processing
17 percent	20 percent	63 percent

Table 15-9xxx
LGCI/LTCI ISDN signal processor occupancy allocations

Overhead	Buffer	Available for call processing
54 percent	10 percent	36 percent

Table 15-10
LTCI ISDN signal pre-processor occupancy allocations

Overhead	Buffer	Available for call processing
15 percent	20 percent	65 percent

Table 15-11xxx
LGCI/LTCI BRI call timing table for master processor

Call type	Per call timing in msec Originating	 Terminating
POTS DP	144	84
ADJUSTMENTS		
MDC	--	+ 12
DT W/O UTR	+ 27	--
DT W/ UTR	+ 11	--
MADN no ring	--	--
MADN ring	--	+29 / MEM
MADN 2nd mem answer	--	+ 64
EBS or Data Unit	+ 12	+35
MADN no ring	+ 14 / MEM	+ 14 / MEM
MADN ring	+ 14 MEM	+ 29 / MEM
MADN 2nd mem answer	--	+ 64
ISDN circuit switched		
B-channel terminal	220	163
MADN no ring	+ 15 / MEM	+ 15 / MEM
MADN ring	+ 15 MEM	+ 31 / MEM
MADN 2nd mem answer	--	+ 64
ISDN packet switched		
B-channel terminal	no impact	no impact
D-channel terminal	no impact	no impact

ADJUSTMENTS: Custom call feature additive = 1 percent for every 10 percent featured lines.

Table 15-12xxx
LGCI/LTCI BRI call timing table for signal processor

Call type	Per call timing in msec Originating	 Terminating
POTS DP	85	52
ADJUSTMENTS		
MDC	+ 12	+ 5
DT W/O UTR	+ 18	--
DT W/ UTR	+ 5	--
MADN no ring	--	--
MADN ring	--	+ 35 / MEM
MADN 2nd mem answer	--	+ 35
EBS or Data Unit	+ 12	+ 23
MADN no ring	+ 5 / MEM	+ 5 / MEM
MADN ring	+ 5 MEM	+ 41 / MEM
MADN 2nd mem answer	--	+ 41
ISDN circuit switched		
B-channel terminal	60	86
MADN no ring	+ 15 / MEM	+ 15 / MEM
MADN ring	+ 15 MEM	+ 31 / MEM
MADN 2nd mem answer	--	+ 64
ISDN packet switched		
B-channel terminal	no impact	no impact
D-channel terminal	no impact	no impact

ADJUSTMENTS: Custom call feature additive = 1 percent for every 10 percent featured lines.

LTCI real time engineering blank work sheet

The following work sheet is to be used to calculate real time utilization of the LTCI master processor (MP)0. The same procedure can be applied in calculations of SP and ISP real time and therefore only the MP work sheet is shown. Additional information on manual calculation of processor real time capacity for DMS peripheral can be found in the latest issues of *New Peripheral Manual Method for Capacity Determination/Verification,* SEB 86-10-003, and *New Peripheral Processor Occupancy and Call Timing Tables,* SEB 88-11-03.

Procedure 15-1xxx
LTCI BRI master processor HDBH real time utilization calculation work sheet

Step	Action
1	Complete processor profile section
2	Complete HDBH real time requirement section • Segregate lines by call type. For ISDN B-channel terminals with or without MADN, each ISDN line card can have 2 B-channel terminals assigned. • Input 2-way HDBH call rate. For ISDN B-channel terminals with or without MADN, the call rate specified is for each B-channel. • Perform arithmetical function by call type, as shown on work sheet, to calculate 2-way HDBH attempts for each call type. • Input featured call timing by call type. Call timings with associated feature additives are provided in Table X-X. Methodology for manual calculation of call timings is provided in *New Peripheral Manual Method for Capacity Determination/Verification,* SEB 86-10-003. • Perform arithmetical function by call type, as shown on work sheet, to calculate total HDBH msec requirements by call type. • Add all call types associated with “total 2-way HDBH call attempts” and input total in (A). • Add all call types associated with “HDBH millisecond requirements” and input total in (B).
3	Complete HDBH LTCI master processor real time utilization section.

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LTCI BRI Master Processor HDBH real time Utilization

Processor Profile Section

1	Processor type	_____
2	BCS	_____
3	Application	_____
4	Number of wired lines for each LTCI	_____
5	Number of equipped lines for each LTCI	_____
6	Number of In-service lines for each LTCI	_____
7	Percent originating traffic	___%
8	Percent terminating traffic (100-Step 7)	____%
9	Average number of secondary members for each MADN group (default = 4)	_____
10	Percent MADN ringing secondary members (default = 50 percent)	____%
11	Percent probability of MADN secondary member answer (default = 50 percent)	___%

HDBH real time Requirement Section

Line Types	**Line quantIty HDBH call rate**		**2-way line call attemp t**		**2-way HDBH timing in (msec)**		**Call Req**		**HDBH (msec)**
ISDN lines									
B-channel terminal without MADN	_____	X	____	=	____	X	___	=	____
B-channel terminal with MADN	_____	X	____	=	____	X	__	=	____
Non-ISDN lines									
POTS	_____	X	____	=	____	X	___	=	____
EBS without MADN	_____	X	____	=	____	X	___	=	____
EBS with MADN	_____	X	____	=	____	X	___	=	____
Display EBS without MADN	_____	X	____	=	____	X	___	=	____
Display EBS with MADN	_____	X	____	=	____	X	___	=	____
Data Unit	_____	X	____	=	____	X	___	=	____
TOTALS			(A)		____		(B)		____

HDBH LTCI MP Processor Utilization

1	Total HDBH msec requirement (from adding values B and E of HDBH real time requirement sections BRI and PRI).	____
2	Total HDBH msec available for call processing	2,268,000

Total HDBH msec requirement

---------- X 100 = percent Utilization

Total HDBH msec available

Note: HDBH call processing real time utilization should not exceed 95 percent at pre-inservice and 100 percent at inservice.

Prepared by:

Name:_____ Date:_____ Tel. No._____

Procedure 15-2
LTCI PRI master processor HDBH real time utilization calculation work sheet

Step	Action
1	Complete processor profile section
2	Complete HDBH real time Requirement section · Calculate total 2-way HDBH call attempts for ISDN PRI circuit switched trunk. · Calculate total HDBH msec requirement for PRI circuit switched call attempts.
3	Complete HDBH LTCI master processor real time utilization section

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LTCI PRI Master Processor HDBH real time Utilization

Processor Profile Section

1	Processor type	_____
2	BCS	_____
3	Application	_____
4	Number of wired wired PRI trunks for each LTCI	_____
5	Number of equipped PRI trunks for each LTCI	_____
6	Number of In-service PRI trunks for each LTCI	_____
7	Percent originating traffic	___%
8	Percent terminating traffic (100-Step 7)	____%

Note: Number of PRI trunks is same as number of PRI circuit switched B-channels

HDBH real time Requirement Section

PRI Trunks	**Trunk quantlty HDBH call rate**		**2-way trunk call attempt total**		**2-way HDBH timing (msec)**		**Call Req (msec)**		**HDBH (msec)**
Circuit switched B-channels	_____	X	____	=	____	X	___	=	____
TOTALS			(D)		____		(E)		____

HDBH LTCI MP Processor Utilization

1 Total HDBH msec requirement (from adding values B and E of HDBH real time Requirement sections BRI and PRI). ____

2 Total HDBH msec available for call processing 2,268,000

Total HDBH msec requirement

---------- X 100 = percent Utilization

Total HDBH msec available

Note: HDBH call processing real time utilization should not exceed 95 percent at pre-inservice and 100 percent at inservice.

Prepared by:

Name:_____ Date:_____ Tel. No._____

DTCI real time engineering blank work sheet

The following work sheet is to be used to calculate real time utilization of the DTCI master processor (MP). The same procedure can be applied in calculations of SP and ISP real time and therefore only the MP work sheet is shown. Additional information on manual calculation of processor real time capacity for DMS peripheral can be found in the latest issues of *New Peripheral Manual Method for Capacity Determination/Verification,* SEB 86-10-003, and *New Peripheral Processor Occupancy and Call Timing Tables,* SEB 88-11-003.

Procedure 15-3xxx
DTCI PRI master processor HDBH real time utilization calculation work sheet

Step	Action
1	Complete processor profile section
2	Complete HDBH real time requirement section · Calculate total 2-way HDBH call attempts for ISDN PRI circuit switched trunk. · Calculate total HDBH msec requirement for PRI circuit switched call attempts.
3	Complete HDBH LTCI master processor real time utilization section

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DTCI PRI Master Processor HDBH real time Utilization

Processor Profile Section

1	Processor type	DTCI MP
2	BCS	_____
3	Application	PRI
4	Number of wired wired PRI trunks for each LTCI	_____
5	Number of equipped PRI trunks for each LTCI	_____
6	Number of In-service PRI trunks for each LTCI	_____
7	Percent originating traffic	___%
8	Percent terminating traffic (100-Step 7)	____%

Note: Number of PRI trunks is same as number of PRI circuit switched B-channels

HDBH real time Requirement Section

PRI Trunks	**Trunk quantlty HDBH call rate**		**2-way trunk call attempt total**		**2-way HDBH timing (msec)**		**Call Req (msec)**		**HDBH (msec)**
Circuit switched B-channels	_____	X	____	=	____	X	___	=	____
TOTALS			(D)		____		(E)		____

HDBH DTCI MP Processor Utilization

1 Total HDBH msec requirement (from value E of HDBH real time Requirement section). ____

2 Total HDBH msec available for call processing 2,160,000

Total HDBH msec requirement

---------- X 100 = percent Utilization

Total HDBH msec available

Note: HDBH call processing real time utilization should not exceed 95 percent at pre-inservice and 100 percent at inservice.

Prepared by:

Name:_____ Date:_____ Tel. No._____

ISDN line concentrating module (LCMI) capacity

The ISDN line concentrating module (LCMI) is a dual unit peripheral module that terminates ISDN, POTS, electronic business set (EBS), and Datapath lines, and provides access to the ISDN B-, D-, and C-channels. The LCMI supports, without D- or B-channel blocking, a maximum of 192 ISDN-only lines (S/T-type), or a mixture of ISDN, EBS, and Datapath lines. (Table 15-13 and Table 15-14.)

Table 15-13
LCMI cards and PECs

Card name	PEC
ISDN U-line card	NTBX25AB
ISDN S/T-line card	NTBX26AA
Datapath line card	NT6X76AA
IBERT (for Datapath testing)	NT6X99AA
POTS/EBS line cards	NT6X17AA, NT6X17AB, NT6X17AC, NT6X18AA, NT6X18AB, NT6X19AA, NT6X20AA
Ringing Generator Card (for POTS)	NT6X30AA
Bus interface cards (BICs)	NTBX36AA
Digroup Controller cards (DCCs)	NTBX35AA
LCMI processor card	NTBX34AB
Power converter	NT6X53EA
Power converter	NT6X53BA
Filler plate for unequipped line drawers	NT6XO5AX

Table 15-14
LCMI line card provisioning

Card name	Type	Cards/logical drawer	Cards/physical drawer	Cards/LCMI
ISDN U-line card	double-slot	(notes)	20	160
ISDN S/T-line card	double-slot	8	24	192
Datapath line card	double-slot	8	24	192
POTS line card	single-slot	16	48	384
EBS line card	single-slot	16	48	384

Notes:

1 Only 20 U-line cards are permitted in each physical drawer, because of restrictions for heat dissipation. The U-line cards are distributed across the three logical drawers. For further information, refer to 297-2401-516.

2. An IBERT line card can replace a Datapath line card for testing purposes.

DS-30A links connect the C-side of the LCMI to a controller PM. This controller PM is either an ISDN line group controller (LGC), or an ISDN line trunk controller (LTC). On instruction from the LGC or LTC, the LCMI associates a DS-30A channel with a subscriber line to allow circuit-switched voice and data calls to be placed or received. (The ISDN D-channel and B-channel packet-switched services use dedicated connections.)

This chapter provides the specification for, and the configuration of, the LCMI. The tasks that are performed by each component of the LCMI are discussed in the configuration section. LCMI maintenance tasks are described separately, as is LCMI call routing.

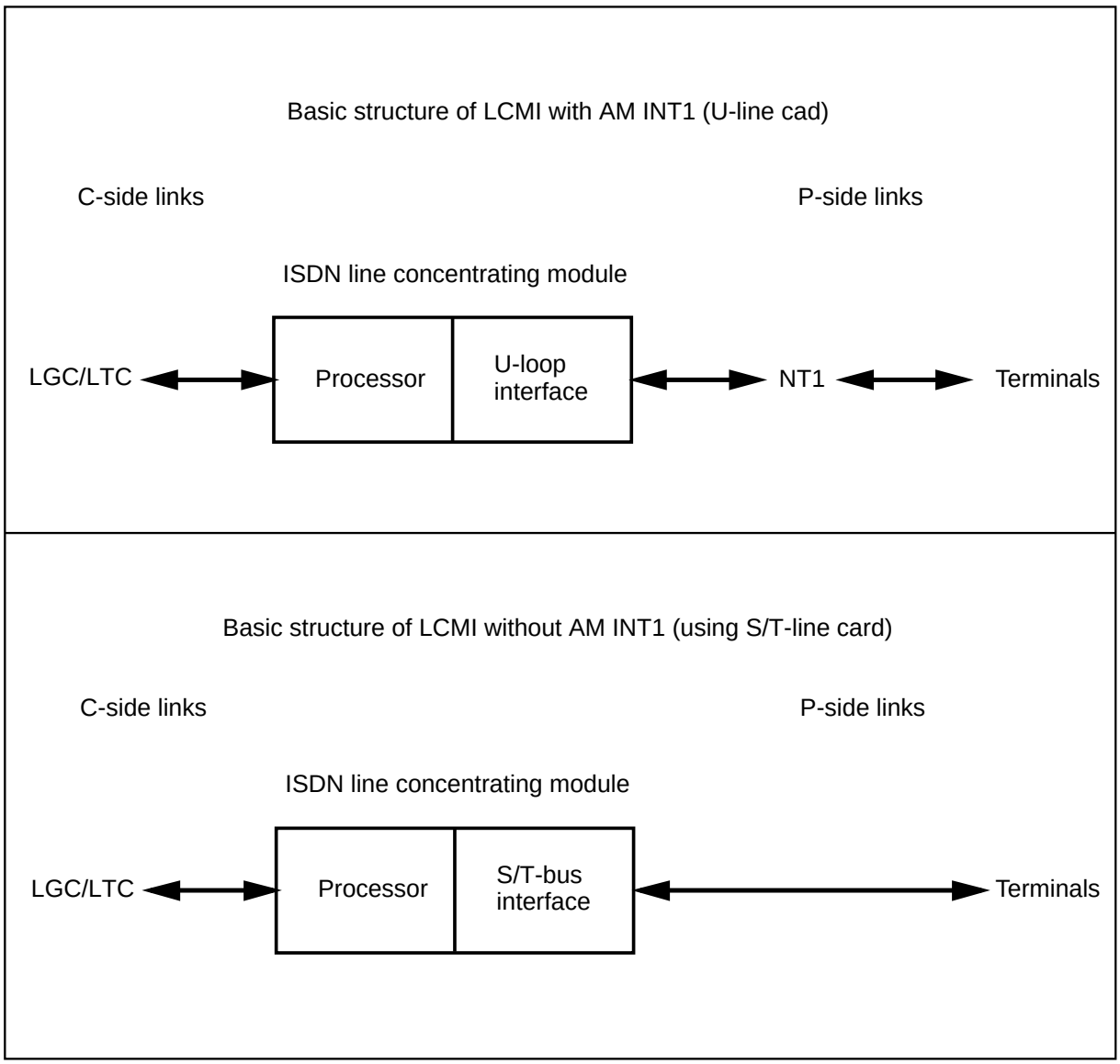
LCMI Specification

The link characteristics and structure of the LCMI are summarized in Table 15-15 and Figure 15-19.

Table 15-15
LCMI characteristics

Minimum	Maximum	Link type	Channels	Remarks
C-side links				
2	18	DS30-A	32	Access to LGC/LTC. Links time switched by DCCs to 12 P-side digroups of 32 channels each.
P-side links				
0	160	U-loop	2 B,D,C	Single cable pair connecting LCMI to AMI NT1. Link exists when AMIU line card is used.
0	192	S/T-bus	2 B,D,Q/S	8-wire interface between (up to) eight ISDN terminals and LCMI. Link exists when S/T line card is used.

Figure 15-19
LCMI structure



LCMI configuration

As shown in Figure 15-20, a typical DMS frame houses two LCMIs and two ringing voltage generators to supply ringing voltages to POTS line cards.

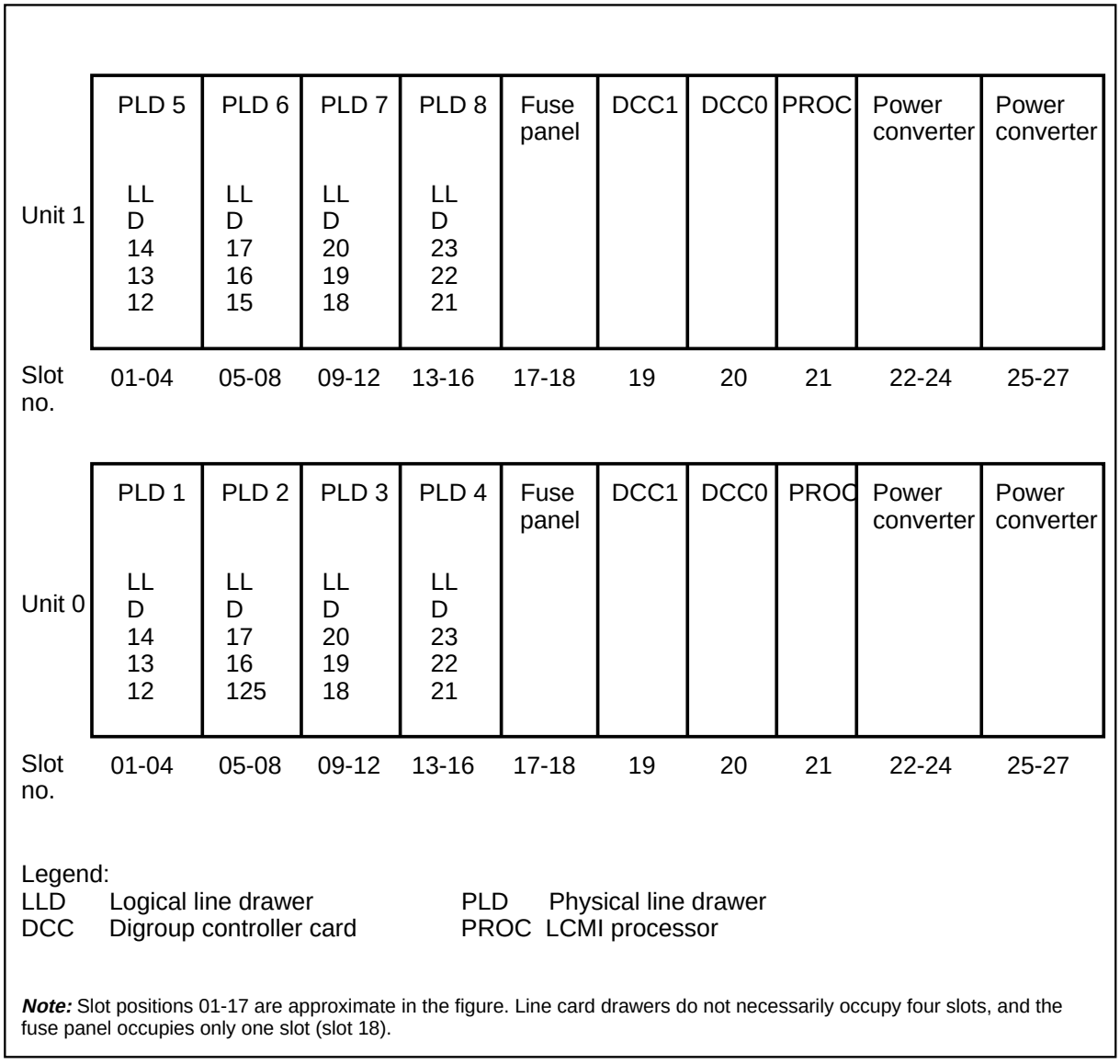
Each LCMI consists of two units or line concentrating arrays (LCAIs). Each LCAI occupies a separate shelf and consists of the following components:

- four physical line drawers, each providing space for up to 48 line cards (equipped depending on the line types installed)
- four ISDN bus interface cards (BICs) inside the line drawers

- two ISDN digroup controller cards (DCCs)
- one LCMI processor card
- two power converters
- one to nine DS-30A links for connection to the LGC/LTC

Table 15-13 lists the product engineering codes (PECs) for each card. Figure 15-20 illustrates the arrangement of the cards in the LCMI shelves.

Figure 15-20
LCMI shelf card locations



Note: Slot positions 01-17 are approximate in the figure. Line card drawers do not necessarily occupy four slots, and the fuse panel occupies only one slot (slot 18).

LCMI Line drawer

Each ISDN, POTS, EBS, or Datapath subscriber line terminates on a line card in the line drawer of the LCMI. The line cards transmit and receive messages and data between the ISDN line and the bus interface card.

The LCMI has eight physical line card drawers (four for each LCAI), each with space for up to 48 single-slot line cards. Each physical line drawer is divided into three logical line drawers. Each logical line drawer has 16 single-line card slots, as shown in Figure 15-21).

Each logical drawer connects to an X24 scan chip, and can be maintained individually. Failure of one logical drawer does not affect the operations of the other logical drawers. Operations on a logical drawer can be executed independently.

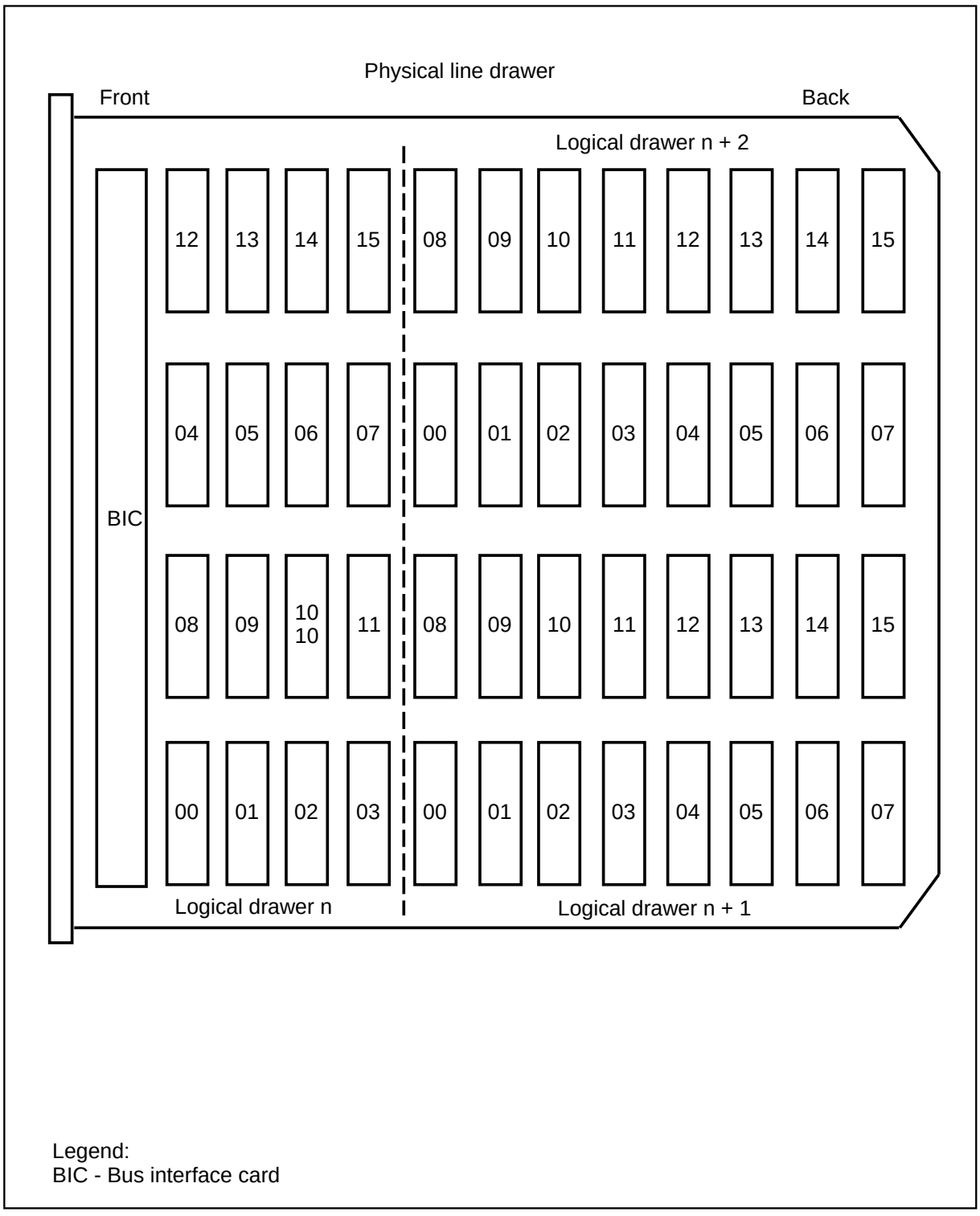
ISDN and non-ISDN line types can be mixed in the same physical drawer, but not in the same logical drawer. ISDN U-line cards and S/T-line cards can be mixed in the same logical drawer, and non-ISDN line cards (POTS, Datapath and EBS) can be mixed in the same logical drawer.

In each logical line drawer, each ISDN line card or Datapath line card occupies two single-slot positions (for example, slots 0 and 8 or slots 4 and 12, as shown in Figure 15-21). Each POTS or EBS line card occupies a single slot.

An LCMI that is fully configured with a single type of line card supports 192 ISDN S/T-lines, or 160 ISDN U-lines, or 192 Datapath lines, or 384 EBS lines, or 384 POTS lines. Table 15-14 summarizes the capacity of the LCMI. Where the LCMI supports a mixture of line types, the total number of lines that are supported varies, depending on the mixture of lines that are installed.

If a POTS line is datafilled in the LCMI, the ringing generator option must be entered in table LCMINV for the LCMI. In addition, only POTS line cards of type 6X17 (Table 15-13) can be datafilled in drawer 0, line 0 of the LCMI, to permit analog ringing tests. If POTS cards are present in the LCMI, no other type of line card can be datafilled in this position.

Figure 15-21
NTBX32AA LCMI line drawer physical versus logical layout



ISDN line cards

The ISDN U-line card performs two primary functions:

- It terminates and exchanges data between the L-bus that connects the line card to the BIC, and the U-loop that connects the line card and the NT1.
- It provides registers, loop-around points and metallic test access points for maintenance activities.

The ISDN S/T-line terminates and exchanges data between the L-bus that connects the line card to the BIC, and the line card and the S/T bus.

The S/T-line card supports the same maintenance activities as the U-line card.

Bus interface card (BIC)

As illustrated in Figure 15-21, each line drawer has a BIC. The C-side of the ISDN line cards is linked to the BIC by means of an L-bus.

The BIC performs the following functions:

- It provides connections between the line cards and the three digroups. (Figure 15-22)
- It provides a connection between the processor and the line cards.
- It scans line cards in order to detect a change in supervision bits.
- It receives control messages from the DCCs, and passes on control messages from the DCCs to the line cards.
- It splits the C-channel off each ISDN line and terminates it.

(ISDN line card and network termination maintenance functions are performed through C-channel messages. These messages are sent by the processor, and from the network termination, acting under the control of DMS-100 maintenance system software.)

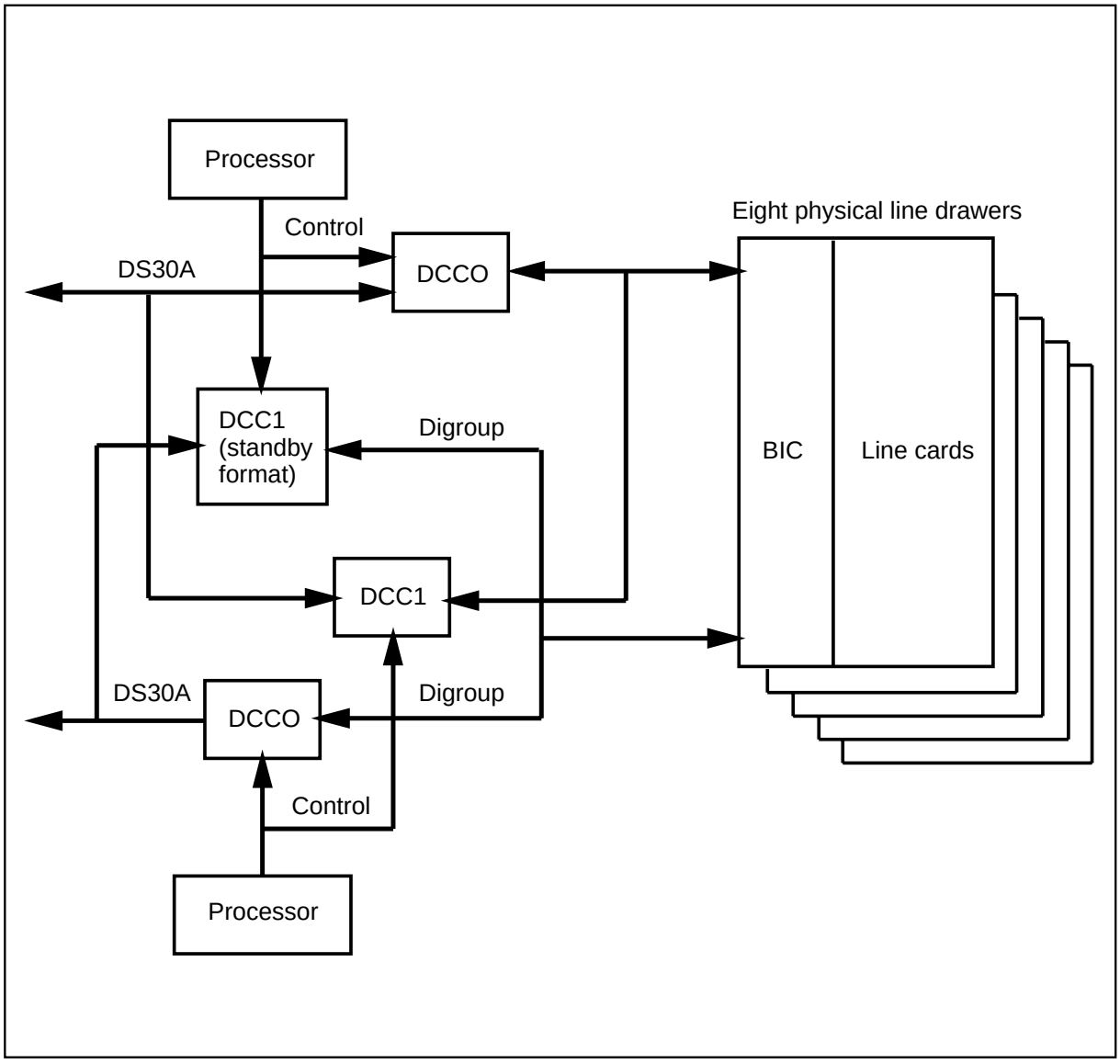
- It transfers the two B-channels and the D-channel to the DCCs.
- It transfers pulse code modulated (PCM) data to and from the POTS line cards.
- It switches ringing signals to the line cards.

A BIC contains three scan chips, one for each logical drawer. There are twelve scan chips in an LCAI, and twenty-four in an LCMI. All twenty-four scan chips in the eight line drawers interface to either LCAI through the two DCCs in each LCAI (Figure 15-22). This configuration eliminates the potential for service blocking if a control takeover becomes necessary.

The scan chips make one-to-one connections between the channels on the digroup links, and the B- and D-channels that the ISDN line cards serve. In

addition, the scan chips pass maintenance and control messages between the LCMI controller and the ISDN line card.

Figure 15-22
LCMI internal configuration



Digroup controller cards (DCCs)

The DCCs allow the LCMI to connect its line drawers to the DS-30A links, which connect to an ISDN peripheral such as the LGC or LTC.

The DCCs separate B- and D-channel data, and timeswitch it between up to 18 DS-30A ports (to the LGC or LTC) and 12 P-side digroups. Three digroups terminate to one physical line drawer. (A digroup is a 32-channel,

pulse code modulated path that allows the line drawers to communicate with the DCC.)

The DCC multiplexes the 16 kbps D-channels in the line card-to-switch direction, at a 4:1 ratio, into 64 kbps channels and routes them through the DS-30A links to the LGC or LTC. The DCC demultiplexes the D-channels in the switch-to-line card direction.

From the DCC, the B- and D-channels then pass through connections in the timeswitch of the LCMI towards the LGC or LTC.

D-channels have permanent connections datafilled in the switch. However, B-channel connections for the LCMI are dynamic, and are assigned and taken down for each call.

In addition to the timeswitching function, the DCC inserts PCM codes into the PCM stream. Using these codes, the DCC instructs a POTS line card to operate or release its ringing relay.

The DCC performs these additional functions:

- It provides a clear connection between the processor card, and the DS-30A channel that is used as the control channel between the LCMI and the LGC or LTC.
- It applies looparound tests to the digroup links between the DCC and the BIC.
- It supports the set up of looparounds between DS-30A channels, to allow the LGC or LTC to test the DS-30A channels between the LGC or LTC and the LCMI.

Load sharing and takeover

In normal operation, both units (LCAIs) of the LCMI are in service and active, with each unit controlling all the lines in half of the LCMI's drawers. When the LCMI operates in takeover mode, only one unit is active. The active unit controls all of the lines in all eight drawers, without a loss in channel bandwidth.

Each unit is equipped with two DCCs. DCC0 is responsible for all connections for the line drawers to which it normally has access. DCC1 is responsible for all connections for line drawers to which the mate normally has access (Figure 15-22).

Each physical drawer has three logical drawers; each of which is assigned one digroup that is always active. Either LCAI 1 (unit 1) or LCAI 0 (unit 0) can control the digroup. If an LCAI is active, it controls the digroups that are connected to its drawers. If a unit is inactive, the mate unit controls the digroups.

In normal operation (that is, with both units active), when a call is being set up, the essential data necessary to make a call is sent both to the active DCC (normally DCC0) and to the standby DCC (normally DCC1) in the mate unit. When one unit relinquishes activity for any reason (for example, a hardware or software fault), the standby DCC takes over the function of the mate's DCC.

When a controlled takeover occurs, the standby DCC already has the physical connections in place for both the digroups and the C-side DS-30A channels. Therefore, calls that were stable before the takeover are not lost. In a controlled takeover, D-channel connectivity is not lost and there is no loss of service to an ISDN subscriber loop. There is no service blocking because the three C-side DS-30A ports (connecting the LCMI with the LGC or LTC) are also taken over by the standby DCC.

Only during a controlled takeover is there no loss of stable calls, no loss of connectivity, and no service blocking (Table 15-16).

When an inactive LCAI is returned to service, it takes back control of its lines.

Table 15-16
Types of control transfer in LCMI

Type of Transfer	Explanation
Solicited	Initiated by the CCC in response to error logs or a MAP request. It can be either controlled or uncontrolled.
Unsolicited	Fault recovery action due to a hardware- or software-detected fault. It is only uncontrolled if one processor is not in service, or if the inter-unit communication link is not functioning.
Controlled	Involves the mate LCAI unit's full co-operation. All essential connection data is transferred; stable calls are not lost.
Uncontrolled	No coordination between the two mates. Calls may be lost.
Conditional	No control transfer initiated unless the inter-unit communication link between the units is operational.
Unconditional	Either a controlled or uncontrolled control transfer depending on whether the inter-unit communication link is operational.

Processor card

The processor card contains all the programs that control the operation of the LCMI and carry out all of the processing functions performed by the LCMI.

The processor card generates control messages to the CCC, and acts on control messages received from the CCC. The processor supervises the transfer of messages between the LGC or LTC, and the LCMI.

There is a direct connection between the processor and the BIC, consisting of the TCON (transmit) bus and the RCON (receive) bus. This connection is used to exchange line card and C-channel control, maintenance and test messages.

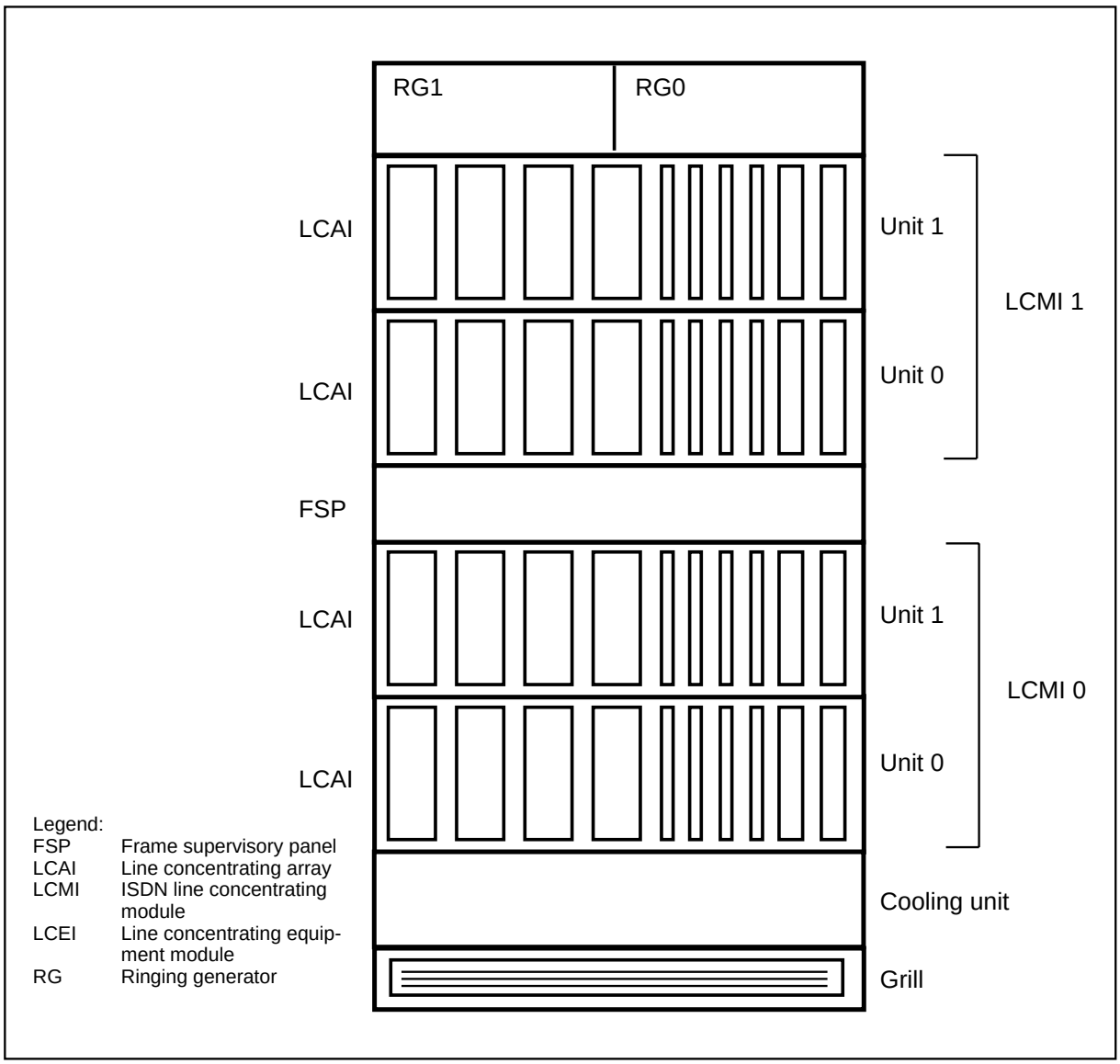
Power converters

Each LCAI is equipped with two power converters, a 6X53BA and a 6X53EA card. Both of these converters provide regulated 5 volt and 15 volt dc outputs from the nominal -48 volt office battery input. The 6X53BA power converter provides +5 volt and +15 volt common-ground outputs. The 6X53EA power converter provides +5 volt and -15 volt common-ground outputs. If the first LCAI power converter fails, the second power converter can provide power for all LCAI cards on the shelf.

LCMI frame

The ISDN line concentrating equipment frame (LCEI) is an evolution of the standard LCE frame. It contains two LCMIs, each consisting of two LCAIs (Figure 15-23).

Figure 15-23
ISDN line concentrating equipment frame



LCMI maintenance

The LCMI firmware performs periodic audits of its hardware and software. If the integrity of one of its units is lost or a service routine detects an error, an error log is generated and is sent to the CCC. The CCC may then initiate a control takeover.

Hardware failures of an LCAI's processor card result in an unsolicited uncontrolled takeover. Failure of a primary digroup control card causes the mate unit in the LCMI to execute an unsolicited controlled takeover. In both of the preceding cases (faulty processor card and faulty DCC), the faulty

unit (processor or DCC) is taken out of service. The ISDN line concentrating array (LCAI) that is without faults assumes full control of the LCMI, and a fault diagnosis is run on the faulty unit.

The LCMI checks for frame synchronization on the ISDN line. In addition, the LCMI provides a message transport mechanism (using the C-channel) to enable the CCC to initiate maintenance procedures on the ISDN line. ISDN line maintenance procedures are described in detail in *DMS-100F ISDN Line Maintenance REference Manual,* 297-2401-516.

LCMI call routing

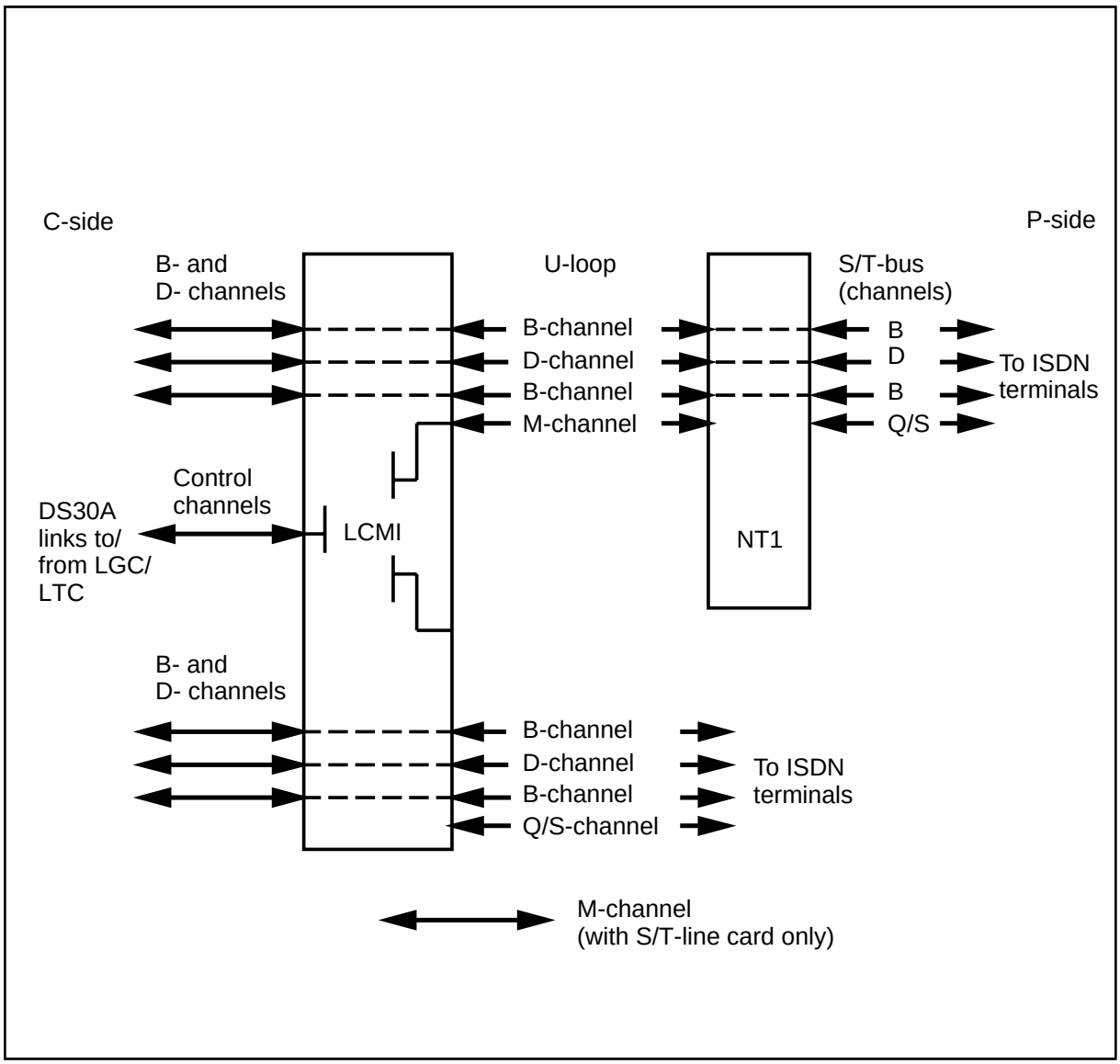
The LCMI routes B-, D-, and C-channel data, according to its type, as illustrated in Figure 15-24.

The LCMI connects the B-channel on each customer line to a channel on the DS-30A link to the ISDN LGC or LTC. Connections for circuit-switched voice and data on the B-channel are set up and taken down dynamically for each call. Connections for high-speed B-packet data are dedicated connections, which are datafilled at subscription time.

The LCMI maintains dedicated connections between the D-channel on each customer line, and a channel on the DS-30A link to the LGC or LTC. The connection also carries low-speed D-packet data.

The C-channel carries maintenance and diagnostic data that allows the LCMI to check the status of the customer line, and the NT1 if it is present. A control message, intended for the network termination, prompts the LCMI to send a C-channel message to the network termination. If the NT1 is not present (when the S/T-line card is used), this C-channel message is carried entirely inside the line card (Figure 15-24).

Figure 15-24
LCMI data paths



Enhanced ISDN line concentrating module (LCME)

Description

The enhanced ISDN line concentrating module (LCME) is a dual unit peripheral module that terminates ISDN 2B1Q U-type lines and ISDN S/T-type lines, and provides access to the ISDN B-, D-, and M-channels. The LCME has the capacity for 480 U-type (single-slot) line cards, or 240 S/T-type (double-slot) line cards.

The LCME supports, with no drawer level B-channel blocking, a maximum of 320 (40 per physical drawer) ISDN-only lines (U-type), or a mixture of ISDN U-type and S/T-type lines.

DS-30A links connect the C-side of the LCME to a controller PM. This controller PM is either an ISDN line group controller (LGC), or an ISDN line trunk controller (LTC). The maximum of 18 DS-30A links provide non-limiting channel bandwidth for up to 239 ISDN lines, even during takeover configurations.

On instruction from the LGC or LTC, the LCME associates a DS-30A channel with a subscriber line to allow circuit-switched voice and data calls to be placed or received. (The ISDN D-channel and B-channel packet-switched services use dedicated connections.)

This chapter provides the specification for, and the configuration of, the LCME. The tasks that are performed by each component of the LCME are discussed in the configuration section. LCME maintenance tasks are described separately, as is LCME call routing.

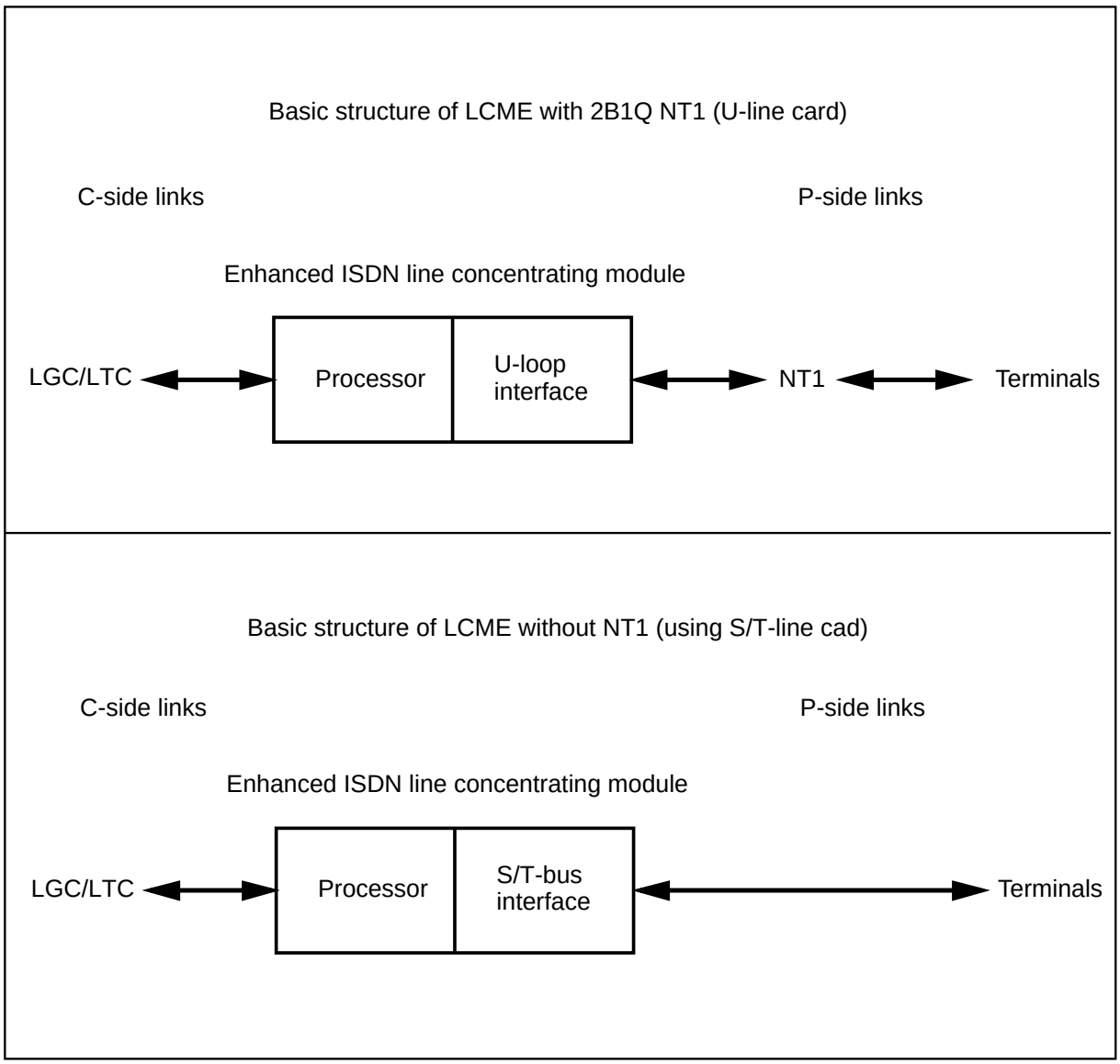
LCME specification

The link characteristics and structure of the LCME are summarized in Table 15-17 and Figure 15-25.

Table 15-17
LCME characteristics

Minimum	Maximum	Link type	Channels	Remarks
C-side links				
2	18	DS30-A	32	Access to LGC/LTC. Links time switched by DCCs to 12 P-side digroups of 32 channels each.
P-side links				
0	480	U-loop	2 B,D,M	Single cable pair connecting LCME to 2B1Q NT1. Link exists when U-line card is used.
0	240	S/T-bus	2 B,D,Q/S	8-wire interface between (up to) eight ISDN terminals and LCME. Link exists when S/T line card is used.

Figure 15-25
LCME structure



LCME configuration

As shown in Figure 15-26, a typical DMS frame houses two LCMEs. Space for two ringing voltage generators, to supply ringing voltages to POTS line cards, is provided for future additions to LCME capabilities.

Each LCME consists of two units or line concentrating arrays (LCAIs). Each LCAI occupies a separate shelf and consists of the following components:

- four physical line drawers, each providing space for up to 60 line cards (equipped depending on the line types installed)

- four ISDN bus interface cards (BICs), one in each line drawer
- four point-of-use power supplies (PUPS), one in each line drawer
- two ISDN digroup controller cards (DCCs)
- one LCME processor card
- two power converters
- one to nine DS-30A links for connection to the LGC/LTC

Table 15-18 lists the product engineering codes (PECs) for each card. Figure 15-26 illustrates the arrangement of the cards in the LCME shelves.

Table 15-18xxx
LCME cards and PEC identifiers

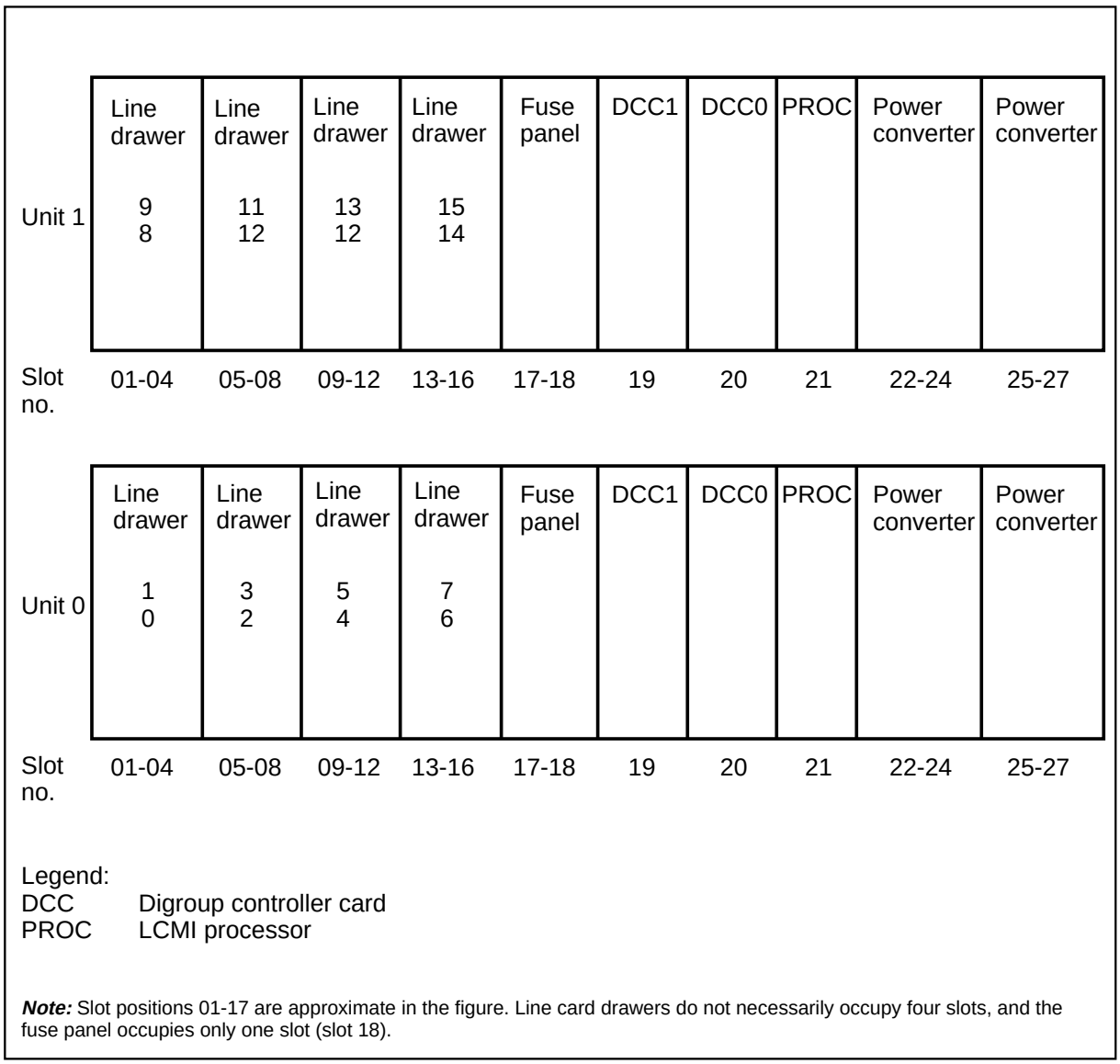
Card name	PEC
ISDN 2B1Q U-line card	NTBX27AA
ISDN S/T-line card	NTBX26AA
PUPS card	NTBX71AA
Bus interface cards (BICs)	NTBX36BA
Digroup controller cards (DCCs)	NTBX35AA
LCME processor card	NTBX34BA
Power converter 0	NTBX72AA
Power converter 1	NT6X53CA
Filler plate for unequipped line drawers	NT6XO5AX

LCME line drawer

Each ISDN subscriber line terminates on a line card in the line drawer of the LCME. The line cards transmit and receive messages and data between the ISDN line and the bus interface card.

The LCME has eight physical line card drawers (four for each LCAI), each with space for up to 60 single-slot line cards. Each physical line drawer is divided into two logical line drawers. These are the numbers shown for the line drawers in Figure 15-26. Each even-numbered logical line drawer has 32 single line card slots, and each odd-numbered logical line drawer has 28 single line card slots, as shown in Figure 15-21. The point-of-use power supply (PUPS) occupies the space of four single line card slots in the odd-numbered logical line drawers.

Figure 15-26
LCME shelf card locations



Both logical drawers connect to an S14 scan chip, and are maintained in pairs. Failure of, or operations on, one logical drawer affects the operations of the other logical drawer in the pair.

ISDN U-line cards and S/T-line cards can be mixed in the same logical drawer.

In each logical line drawer, each S/T-type ISDN line card occupies two single-slot positions (for example, slots 0 and 1 or slots 4 and 5, as shown in Figure 15-27).

An LCME that is fully configured with a single type of line card supports 240 ISDN S/T-lines, or 480 ISDN U-lines. Table 15-19 summarizes the capacity of the LCME. Where the LCME supports a mixture of line types, the total number of lines that are supported varies, depending on the mixture of lines that are installed.

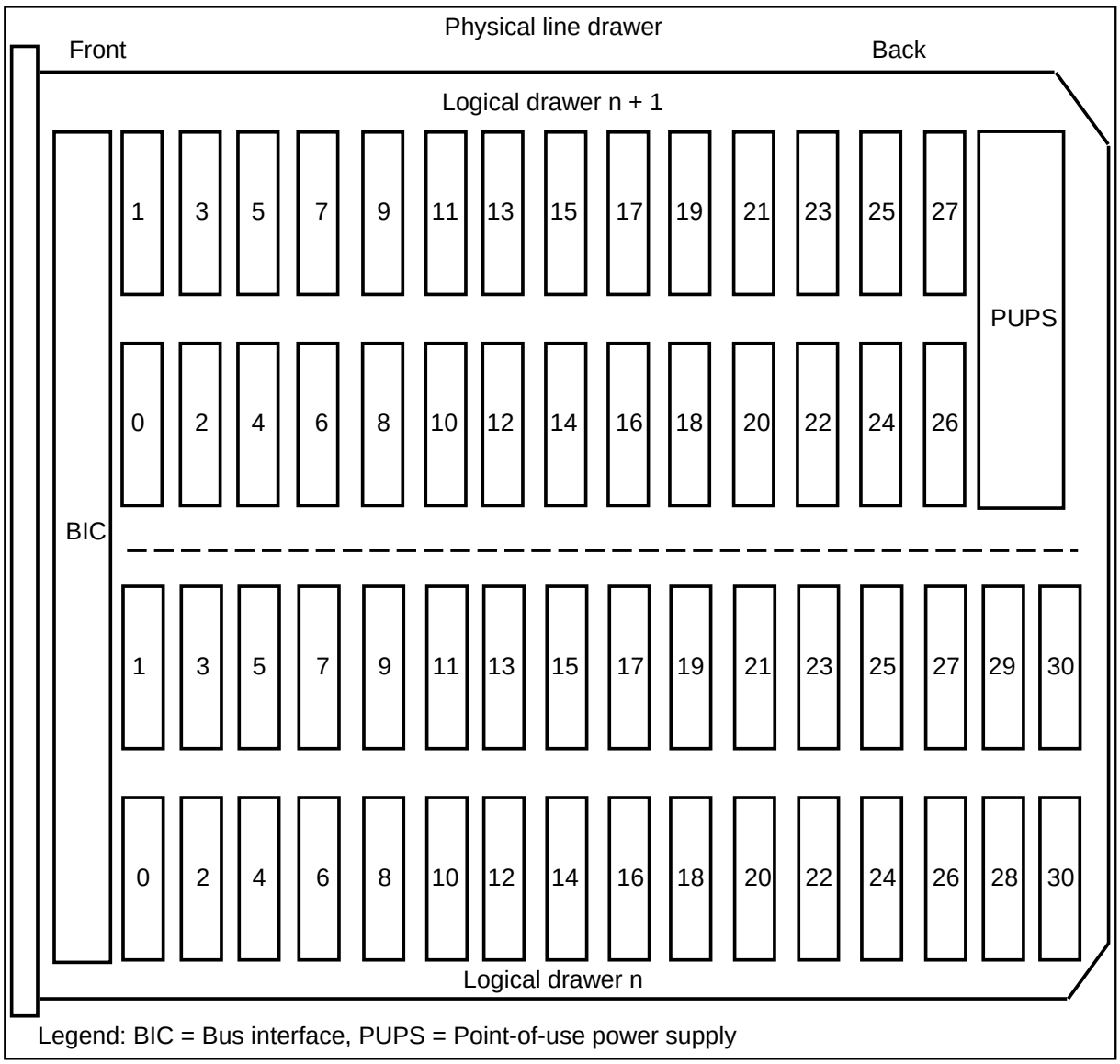
Table 15-19xxx
LCME line card provisioning

Card name	Type	Cards/logical drawer	Cards/physical drawer	Cards/LCME
ISDN 2B1Q U-line card	single-slot	(notes)	60	480
ISDN S/T-line card	double-slot	(notes)	30	240

Notes:

1. Thirty-two U-line cards can be placed in even-numbered logical line drawers while only twenty-eight can be placed in odd-numbered drawers.
2. For S/T-line cards, the quantities are sixteen and fourteen in the even- and odd-numbered logical line drawers respectively.
3. For further information on ISDN line cards, refer to *DMS-100F ISDN Line Maintenance Reference Manual,* 297-2401-516.

Figure 15-27
NTBX32BA LCME line drawer physical versus logical layout



ISDN line cards

The ISDN 2BIQ U-line card performs two primary functions:

- It terminates and exchanges data between the L-bus that connects the line card to the BIC, and the U-loop that connects the line card and the 2B1Q NT1.
- It provides registers, loop-around points and metallic test access points for maintenance activities.

The 2B1Q line card has additional maintenance capabilities, provided by an on-board maintenance processor (MP) and its firmware. The MP provides both maintenance and control functions which include:

- message transaction processing
  - non-autonomous maintenance and control messages sent by the LCME over the L-bus are decoded and a response message returned over the SCP interface and L-bus to the LCME
  - autonomous indicating the status of the M-channel overhead bits controlled by the 2B1Q NT1, these messages are debounced by the MP to prevent false alarm messages, the MP then indicating the presence of an alarm message to the LCME
- serial control port (SCP) interface control
  - The MP generates the SCP interface master clock, selects the appropriate subsystem, L-bus or U subsystem, for communication, and receives and transmits SCP messages.
- U-subsystem maintenance
  - The MP provides U-loop transmission performance monitoring, M-channel communication control, and line card loopback point control.
- U-loop transmission performance monitoring
  - continuous transmission quality assessment, including daily and hourly figures for the following parameters in each direction of transmission:
  - block error (BE)
  - erred seconds (ES)
  - severely-erred seconds (SES)

Performance monitoring capabilities include items such as:

- recent history values and current values are stored in the line card MP
- near-end (NE) parameters, which are in the NT1-to-line card direction, are based on a comparison of a received cyclic redundancy check (CRC) to a calculated CRC every superframe. Disparities result in near end block errors (NEBE)
- far-end (FE) parameters, which are in the line card-to-NT1 direction, are based on a similar comparison made by the 2B1Q NT1, and are reported in the far end block error (FEBE) bit received in every superframe
  - fault detection and isolation
  - storage of performance data
  - LCME access to current and stored performance data
  - LCME controllable thresholds
  - M-channel communication control

- line card loopback point control

The M-channel uses overhead bits M1 to M6 in each U-loop interface frame, in both directions, for passing maintenance information between the line card and the NT1. The information includes embedded operations channel lower level functions, data transparency status, NT1 power supply status, NT1 test mode status, warm-start capabilities, results of cyclic redundancy check, and NT1 detection of FEBE in its received frame.

The MP controls full-frame or individual channel loopback points to allow the LCME to test B1, B2, and D-channels. The loopback points are activated towards the LCME or the NT1 and in the transparent or non-transparent mode.

The MP also provides U-loop control and sealing current control functions for the U subsystem. U-loop control includes:

- control of U-loop CO relay
- control of TA-IN relay
- control of TA-OUT relay

Sealing current control includes selection of the mode of operation and timing control for the sealing current driver. The modes are:

- normal mode - 20ma sealing current is generated as a periodic pulse with a 1/60 duty cycle
- diagnostic mode - 20ma sealing current is generated continuously or it is turned off
- line card self-diagnostics

On power-up, an automatic self-diagnostic is performed by the MP. The diagnostic takes the line card out of service and includes:

- microcontroller self-testing
- L-bus subsystem testing
- U subsystem testing

The result is available to the LCME through a non-autonomous message.

The LCME can activate each part of the diagnostic in any order, and the line card stays in service during the procedure.

The ISDN S/T-line terminates and exchanges data between the L-bus that connects the line card to the BIC, and the line card and the S/T bus.

The S/T-line card supports the same maintenance activities as the U-line card.

Bus interface card (BIC)

As illustrated in Figure 15-27, each line drawer has a BIC. The C-side of the ISDN line cards is linked to the BIC by means of an L-bus.

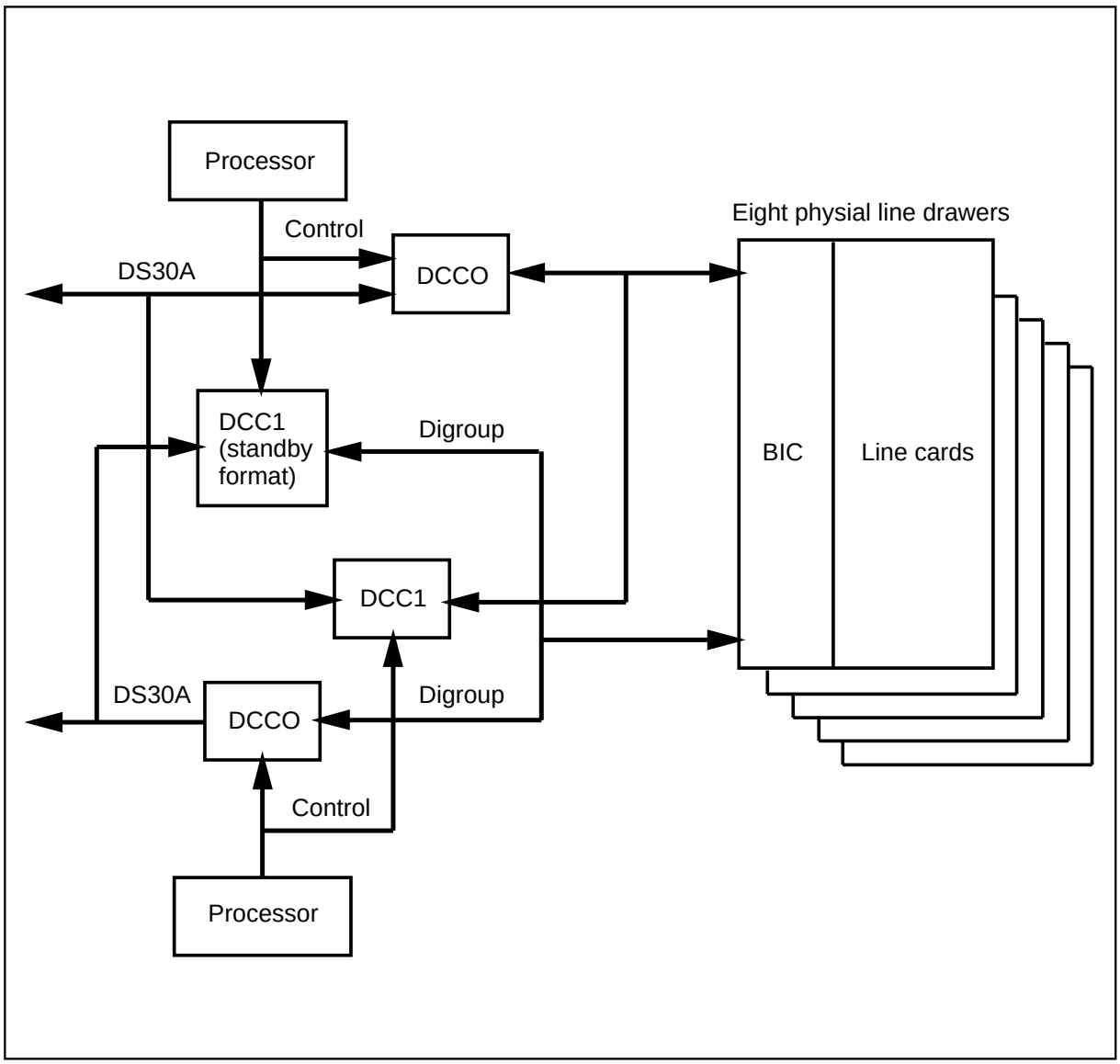
The BIC performs the following functions:

- Provides connections between the line cards and the three digroups (Figure 15-28).
- Serves as a message transceiver between the LCME processor and the line cards, executing commands sent by the LCME processor via the serial communications link. The commands include connection requests and loopback requests.
- Scans line cards in order to detect a change in supervision bits.
- Receives control messages from the DCCs, and passes on control messages from the DCCs to the line cards.
- Splits the M-channel off each ISDN line and terminates it.
  - ISDN line card and network termination maintenance functions are performed through M-channel messages. These messages are sent by the processor, and from the network termination, acting under the control of DMS-100 maintenance system software.
- Time-switches the two B-channels and the D-channel between the DCCs and the line card.
- Multiplexes four ISDN line card 16 kbps D-channel data streams, from the line card to the LCME processor, onto one 64 kbps digroup channel. In the opposite direction, it demultiplexes the digroup channel into four D-channel data streams.
- Monitors the status of the point-of-use power supply (PUPS), reporting to the LCME whenever the status of the PUPS changes.

A BIC contains one scan chip which supports both logical drawers. There are four scan chips in an LCAI, and eight in an LCME. All eight scan chips in the eight line drawers interface with either LCAI through the two DCCs in each LCAI (Figure 15-28). This configuration eliminates the potential for service blocking if a control takeover becomes necessary.

The scan chips pass maintenance and control messages between the LCME controller and the ISDN line card.

Figure 15-28
LCME internal configuration



Digroup controller cards (DCCs)

The DCCs allow the LCME to connect its line drawers to the DS-30A links, which connect to an ISDN peripheral such as the LGC or LTC.

The DCCs provide the B- and D-channel connections between up to 18 DS-30A ports (to the LGC or LTC) and 12 P-side digroups. Three digroups terminate to one physical line drawer. A digroup is a 32-channel, pulse code modulated path that allows the line drawers to communicate with the DCC.

From the DCC, the B- and D-channels then pass through connections in the timeswitch of the LCME towards the LGC or LTC.

D-channels have permanent connections datafilled in the switch. However, B-channel connections for the LCME are dynamic, and are assigned and taken down for each call.

The DCC performs these additional functions:

- It provides a clear connection between the processor card, and the DS-30A channel that is used as the control channel between the LCME and the LGC or LTC.
- It applies looparound tests to the digroup links between the DCC and the BIC.
- It supports the set up of looparounds between DS-30A channels, to allow the LGC or LTC to test the DS-30A channels between the LGC or LTC and the LCME.

Load sharing and takeover

In normal operation, both units (LCAIs) of the LCME are in service and active, with each unit controlling all the lines in half of the LCME's drawers. When the LCME operates in takeover mode, only one unit is active. The active unit controls all of the lines in all eight drawers, without a loss in channel bandwidth.

Each unit is equipped with two DCCs. DCC0 is responsible for all connections for the line drawers to which it normally has access. DCC1 is responsible for all connections for line drawers to which the mate normally has access. (Refer to Figure 15-28.)

Each physical drawer has two logical drawers, each of which is assigned one digroup that is always active. Either LCAI 1 (unit 1) or LCAI 0 (unit 0) can control the digroup. If an LCAI is active, it controls the digroups that are connected to its drawers. If a unit is inactive, the mate unit controls the digroups.

In normal operation (that is, with both units active), when a call is being set up, the essential data necessary to make a call is sent both to the active DCC (normally DCC0) and to the standby DCC (normally DCC1) in the mate unit. When one unit relinquishes activity for any reason (for example, a hardware or software fault), the standby DCC takes over the function of the mate's DCC.

When a controlled takeover occurs, the standby DCC already has the physical connections in place for both the digroups and the C-side DS-30A channels. Therefore, calls that were stable before the takeover are not lost. In a controlled takeover, D-channel connectivity is not lost and there is no loss of service to an ISDN subscriber loop. There is no service blocking because

the three C-side DS-30A ports (connecting the LCME with the LGC or LTC) are also taken over by the standby DCC.

Only during a controlled takeover is there no loss of stable calls, no loss of connectivity, and no service blocking (Table 15-20).

When an inactive LCAI is returned to service, it takes back control of its lines.

Table 15-20xxx
Types of control transfer in LCME

Type of Transfer	Explanation
Solicited	Initiated by the CCC in response to error logs or a MAP request. It can be either controlled or uncontrolled.
Unsolicited	Fault recovery action due to a hardware- or software-detected fault. It is only uncontrolled if one processor is not in service, or if the inter-unit communication link is not functioning.
Controlled	Involves the mate LCAI unit's full co-operation. All essential connection data is transferred; stable calls are not lost.
Uncontrolled	No coordination between the two mates. Calls may be lost.
Conditional	No control transfer initiated unless the inter-unit communication link between the units is operational.
Unconditional	Either a controlled or uncontrolled control transfer depending on whether the inter-unit communication link is operational.

Processor card

The processor card contains all the programs that control the operation of the LCME and carry out all of the processing functions performed by the LCME.

The processor card generates control messages to the CCC, and acts on control messages received from the CCC. The processor supervises the transfer of messages between the LGC or LTC, and the LCME.

There is a direct connection between the processor and the BIC, consisting of the TCON (transmit) bus and the RCON (receive) bus. This connection is used to exchange line card and M-channel control, maintenance and test messages.

Drawer control task

The drawer control task (drawer task) of the LCME handles eight physical line drawers and up to sixty lines in each drawer. To service the 2B1Q line card, the drawer task provides the following functions:

- unsolicited 2B1Q line card message collection:
  - The 2B1Q line card has an indicator to signal the LCME processor that the line card has an unsolicited message pending
- 2B1Q line card message transceiver:
  - EBS, Datapath, and ISDN S/T line cards use messages with the same length. Messages used by the 2B1Q line card have a different length. The drawer task is capable of handling different message lengths for different line types.
- broadcast message:
  - The S14 chip has the capability of broadcasting messages to a group of selected line cards. The drawer task handles this sending of the same message to all selected line cards.

Power converters

Each LCAI is equipped with two power converters, an NT6X53CA and an NTBX72AA card, with a point-of-use power supply (PUPS), NTBX71AA, located in each line drawer.

The NT6X53CA power converter provides +5 volt and +15 volt outputs, the +5 volts for the shelf common control circuit cards, and the +15 volts for the line drawers.

The NTBX72AA power converter provides -48 volt and -48 volt return outputs for the line card drawers.

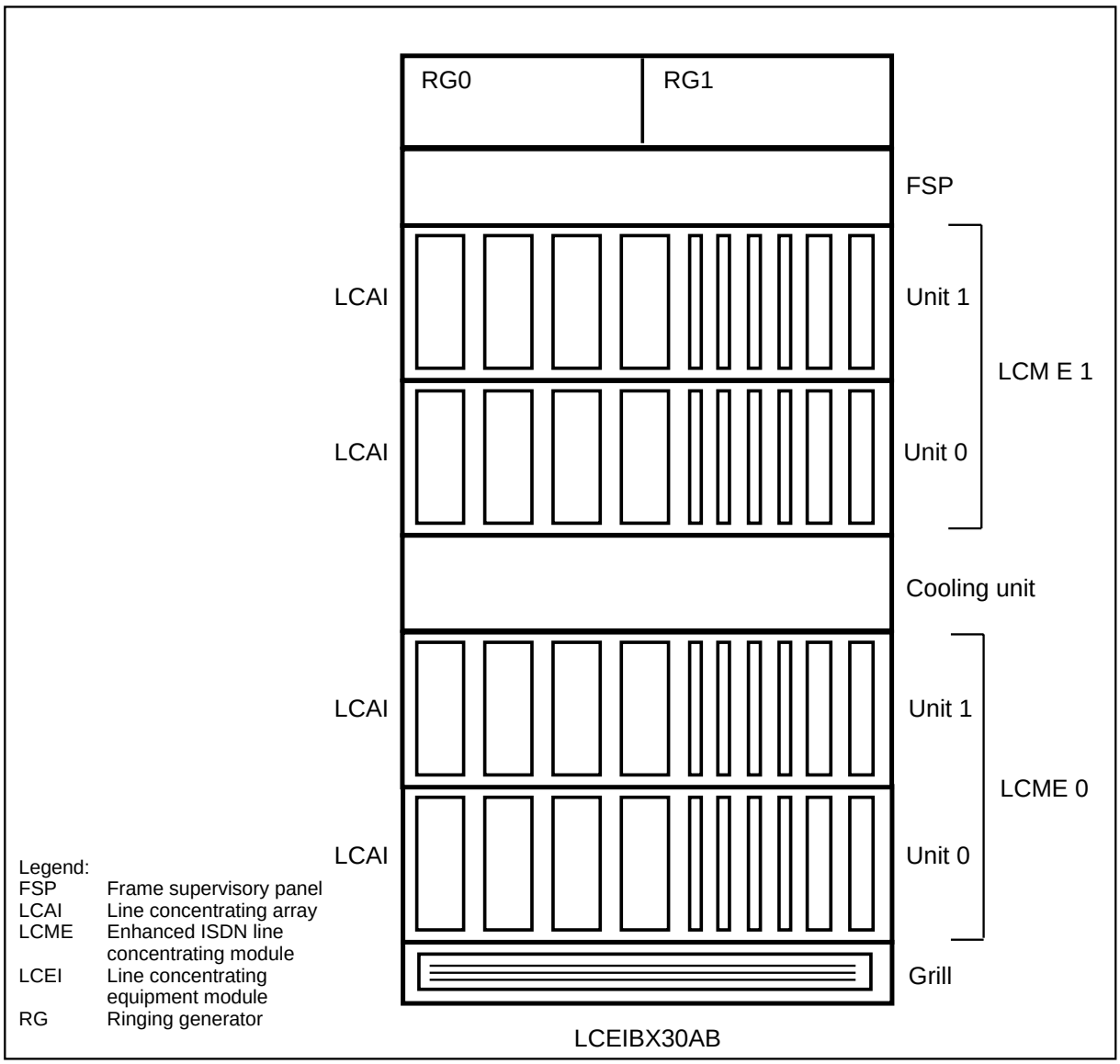
Both shelf power converters can supply power for the mate LCAI in case of power takeover.

The PUPS power supply, NTBX71AA, one located in each of the physical line drawers, converts the -48 volt input and provides its +5 volt output to the line card slots.

LCME frame

The enhanced ISDN line concentrating equipment frame (LCEI) is an evolution of the standard LCE frame. It contains two LCMEs, each consisting of two LCAIs (Figure 15-29).

Figure 15-29
Enhanced ISDN line concentrating equipment frame



LCME maintenance

The LCME firmware performs periodic audits of its hardware and software. If the integrity of one of its units is lost or a service routine detects an error, an error log is generated and is sent to the CCC. The CCC may then initiate a control takeover.

Hardware failures of an LCAI's processor card result in an unsolicited uncontrolled takeover. Failure of a primary digroup control card causes the mate unit in the LCME to execute an unsolicited controlled takeover. In both of the preceding cases (faulty processor card and faulty DCC), the faulty

unit (processor or DCC) is taken out of service. The ISDN line concentrating array (LCAI) that is without faults assumes full control of the LCME, and a fault diagnosis is run on the faulty unit.

The LCME checks for frame synchronization on the ISDN line. In addition, the LCME provides a message transport mechanism (using the C-channel) to enable the CCC to initiate maintenance procedures on the ISDN line. ISDN line maintenance procedures are described in detail in *DMS-100F ISDN Line Maintenance Reference Manual*, 297-2401-516.

LCME call routing

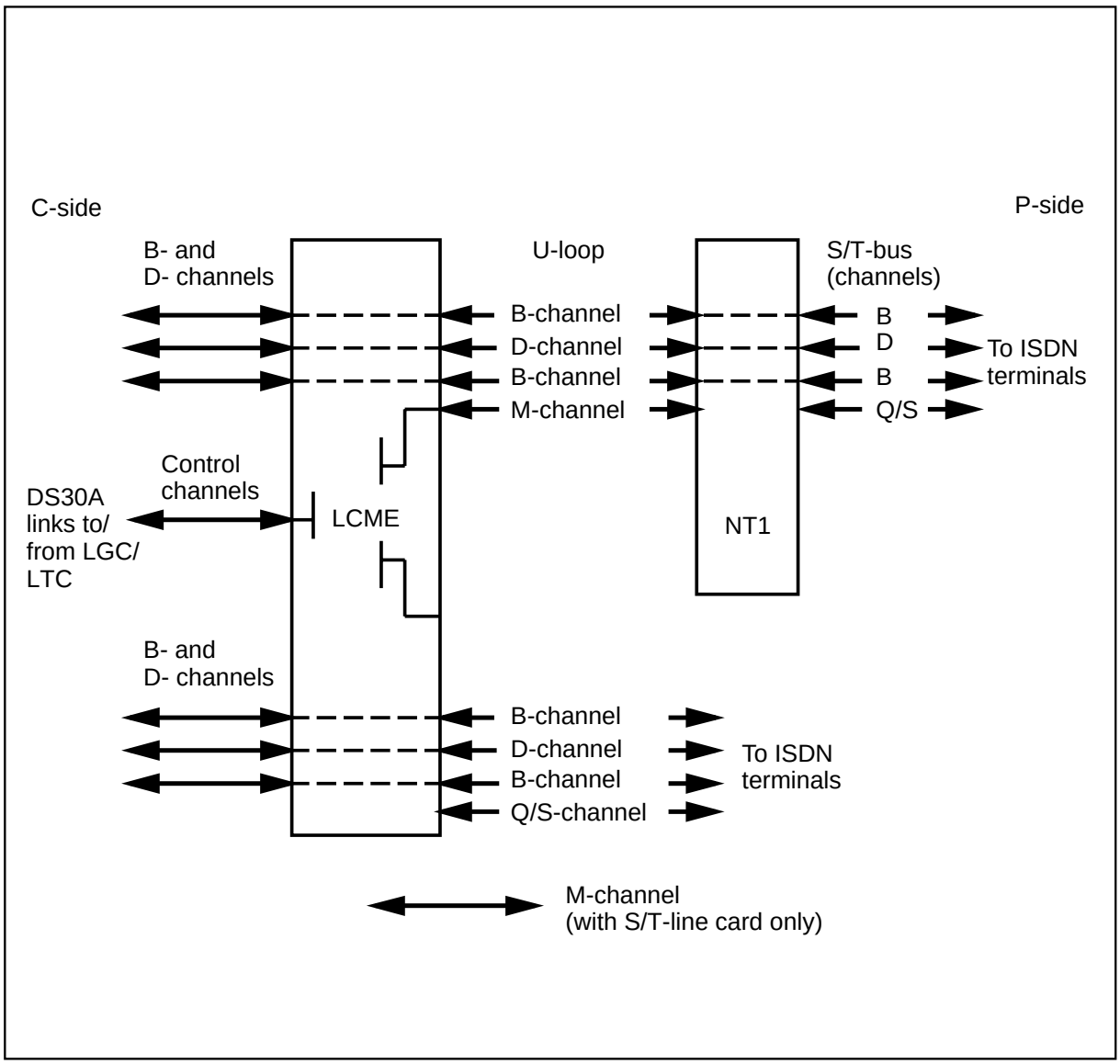
The LCME routes B-, D-, and M-channel data, according to its type, as illustrated in Figure 15-30.

The LCME connects the B-channel on each customer line to a channel on the DS-30A link to the ISDN LGC or LTC. Connections for circuit-switched voice and data on the B-channel are set up and taken down dynamically for each call. Connections for high-speed B-packet data are dedicated connections, which are datafilled at subscription time.

The LCME maintains dedicated connections between the D-channel on each customer line, and a channel on the DS-30A link to the LGC or LTC. The connection also carries low-speed D-packet data.

The M-channel carries maintenance and diagnostic data that allows the LCME to check the status of the customer line, and the NT1 if it is present. A control message, intended for the network termination, prompts the LCME to send an M-channel message to the network termination. If the NT1 is not present (when the S/T-line card is used), this M-channel message is carried entirely inside the line card (Figure 15-30).

Figure 15-30
LCME data paths



ISDN line group controller (LGCI) capacity

Description

Throughout this document, the term LGC refers to the LGC equipped for ISDN unless specifically identified as a non-ISDN LGC. The ISDN LGC was formerly identified as the LGCI. While hardware with the LGCI designation is supported, datafill and displays for this peripheral module now refer to it as an LGC.

The ISDN line group controller (LGC) is an XMS-based, dual-unit peripheral module. The LGC equipped for ISDN provides:

- D-channel handling and processing
- call processing for all the different types of lines (ISDN, EBS, POTS and Datapath), including Q.931 call processing
- maintenance and diagnostic capabilities

The LGC provides access to the circuit-switched network through one or more non-ISDN line trunk controllers (LTCs). The LGC provides access to the public packet-switched network (PPSN) through one or more packet handlers.

The P-side interface of the ISDN LGC consists of DS-30A links to the LCMI and LCME, and DS-1 links to the packet handler.

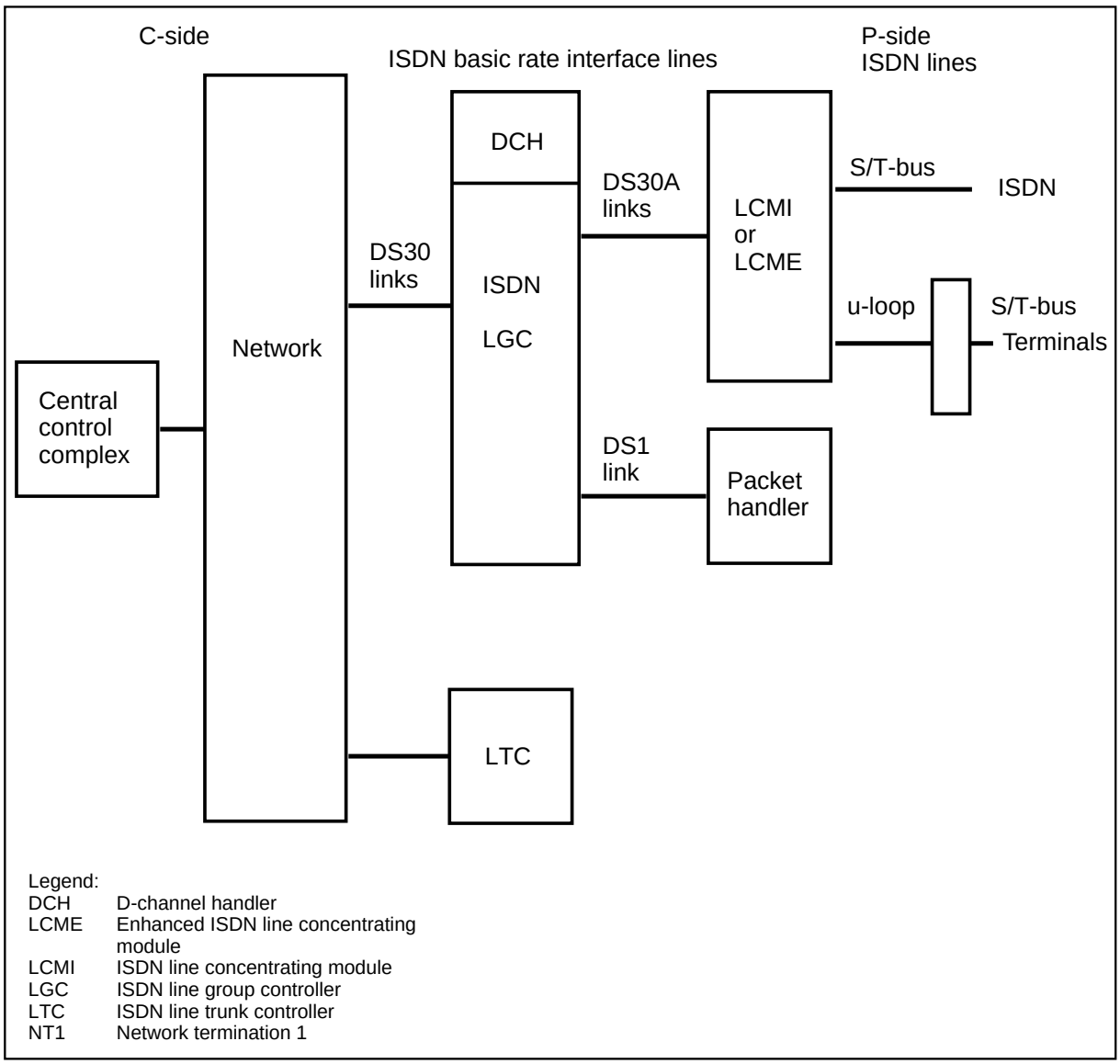
The LGC provides a DS-30 interface on its C-side for links that carry information through both planes of the network modules to the CCC, and to other local peripheral modules such as the LTC.

The ISDN LGC supports both LCMs, LCMIs, and LCMEs. For ISDN basic rate interface, the LGC is configured with the LCMI or the LCME. If the LCMIs are fully configured for ISDN-only lines, one LGC can support up to three LCMIs (480 BRA loops).

A switch that is configured for ISDN, running only ISDN traffic, can support 5000 ISDN lines (10 ISDN LGCs) or more. The actual number of lines that are supported varies from office to office, depending on such factors as line characteristics and the real time capacity of the switch.

This section provides the specification for, and the configuration of, the LGC. The tasks performed by the individual cards are discussed in the following paragraphs.

Figure 15-31
ISDN LGC basic rate interface configuration



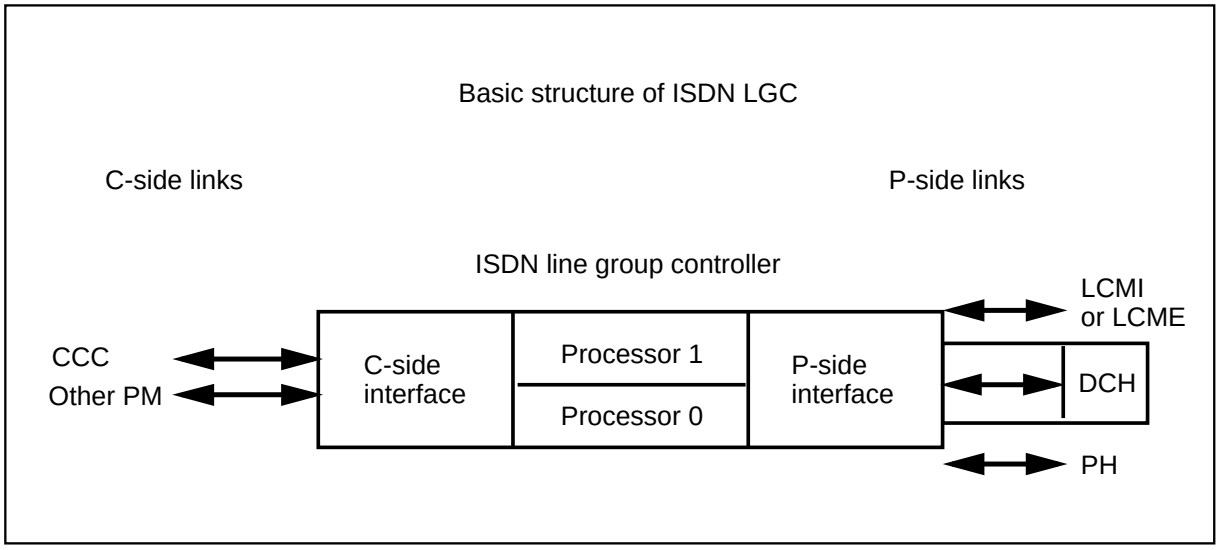
ISDN LGCI specification

The link characteristics and structure of the LGC are shown in Table 15-21 and Figure 15-32.

Table 15-21
LGC characteristics

Minimum	Maximum	Link type	Channels	Remarks
C-side links				
3	16	DS30	32	Two sets of links, one to each plane of the network
P-side links				
2	18	DS30-A	32	Two links to each LCMI OR LCME. An LGC can support a maximum of 480 D-channels for ISDN lines
1	16	DS1	24	Links to packet handler

Figure 15-32
ISDN LGC structure for basic rate interface



ISDN LGC configuration

The ISDN LGC is a dual-unit node that performs similar functions to a non-ISDN LGC, but it has additional components to perform D-channel handling.

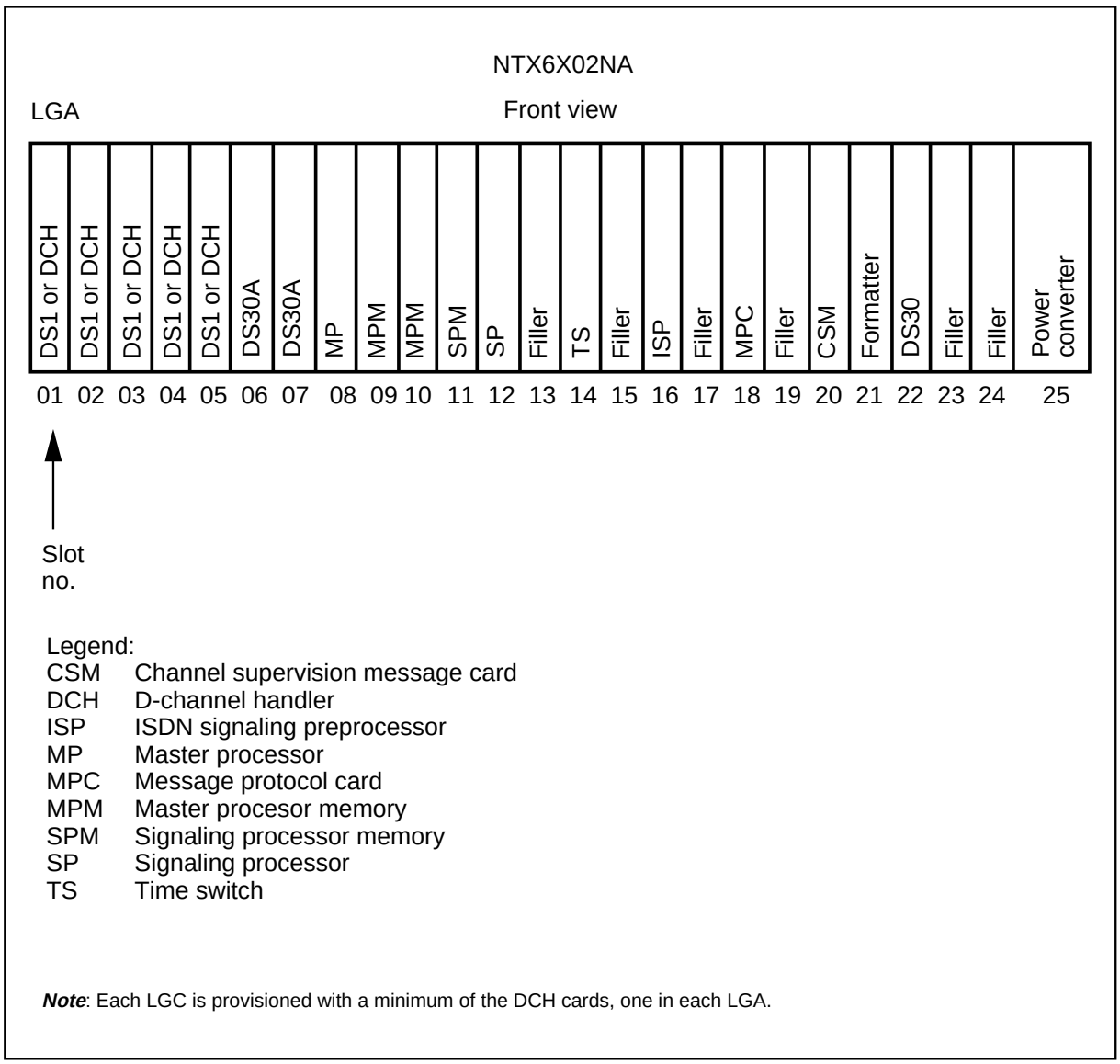
As shown in Figure 15-36, an ISDN LGC frame holds two LGCs, a cooling unit, and an FSP. Each LGC has two shelves called ISDN line group arrays (LGAs). Each LGA has the following sets of cards:

- one set of cards that provides the P-side, C-side and internal interfaces, including:
  - up to two DS-30A interface cards

  - DS-30 interface card
  - a combination of DS-1 and D-channel handler (DCH) cards, not to exceed five cards
- one set of cards that provides the control complex, including:
  - ISDN signaling preprocessor (ISP) card
  - timeswitch card
  - master processor (MP) and two MP memory cards
  - signaling processor (SP) and SP memory card
  - message protocol (MPC) card
  - formatter card
  - channel supervision message (CSM) card

Figure 15-33 illustrates the arrangement of the cards in the LGC shelves. Table 15-22 lists the product engineering codes (PECs) for each card. Figure 15-34 illustrates the logical architecture of the cards in one LGA.

Figure 15-33
ISDN LGA shelf card locations



Like the non-ISDN LGC, the ISDN LGC provides duplicate control complexes and interfaces (one in each LGA).

During normal operation, one control complex is active. The other control complex is held in standby mode, ready to take over if the first control complex fails. All interfaces are connected to both control complexes (Figure 15-35). If an interface fails, all the communications can be switched to the reserve interface.

Each DS-30 interface to the network module works in dual-plane mode. The receiver at the other end of the network connection (for example, the CCC) can choose between two separate data streams and can switch data streams if a problem occurs.

Table 15-22
ISDN LGC cards and PECs

Card name	PEC
DS1 interface	NT6X50AB
D-channel handler	NTBX02AA
DS30A interface	NT6X48AA
Master processor	NT6X45BA
Master processor memory	NT6X47AB
Signaling processor memory	NT6X46BA
Signaling processor	NT6X45BA
Time switch	NT6X44AA
ISDN Signaling preprocessor	NTBX01AA
Message protocol card	NT6X69AA
CSM Interface	NT6X42AA
Formatter	NT6X41AA
DS30 Interface	NT6X40AC
Power converter	NT2X70AD
Filler	NT0X50AA

Figure 15-34
ISDN LGC internal configuration simplified diagram

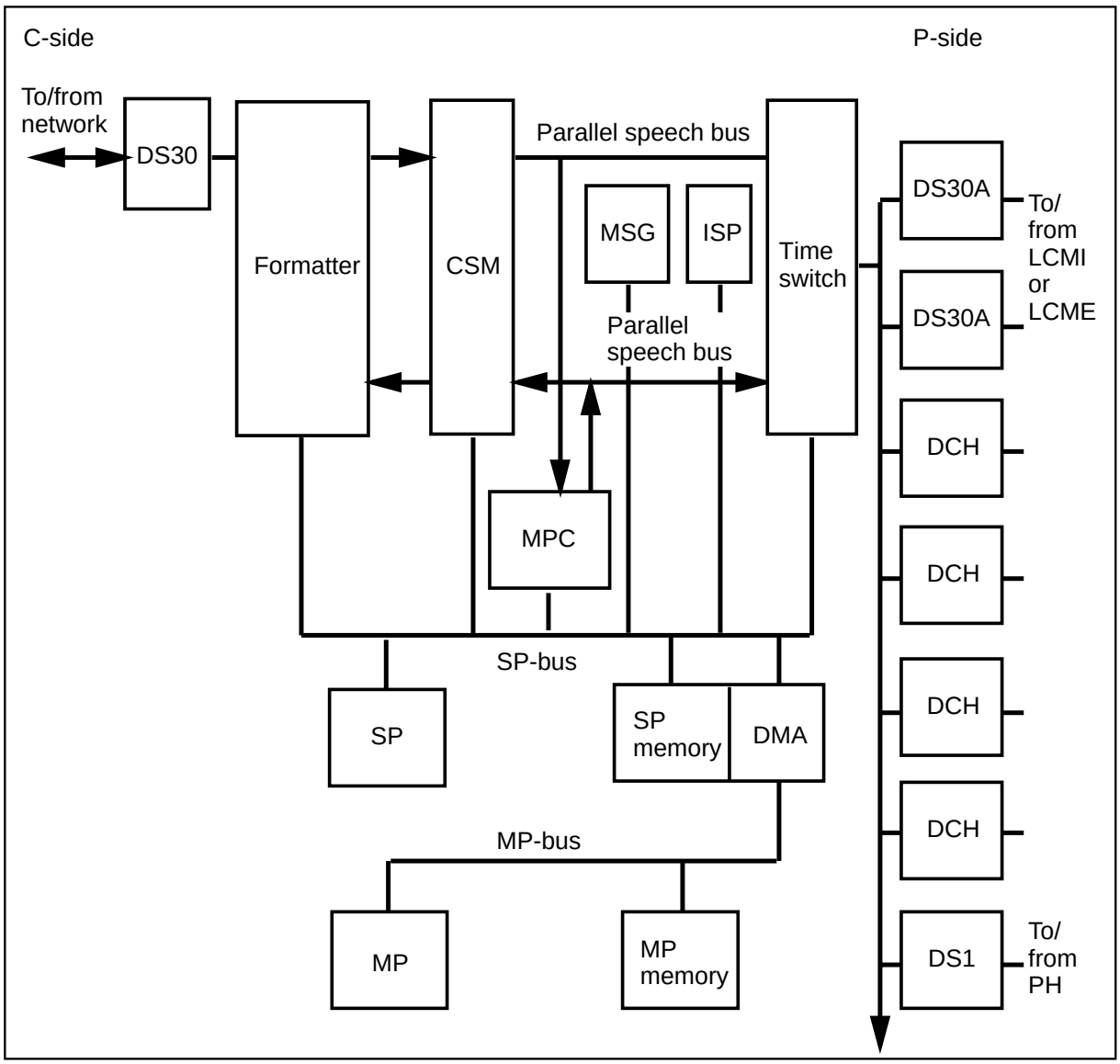
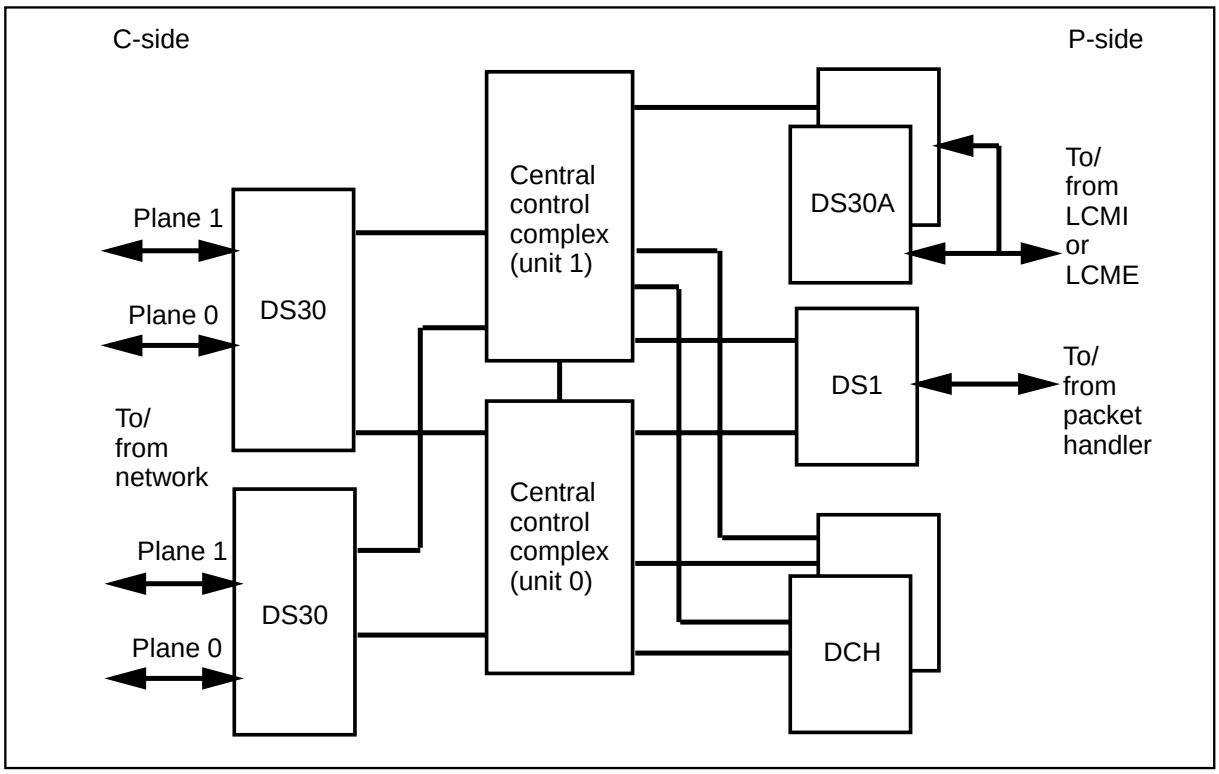


Figure 15-35
Interface and control complex duplex configuration



ISDN LGC cards and their functions

The function of each LGC card is discussed in the following paragraphs. The ISDN-specific cards (DCH, ISP) are discussed in detail. However, where the functions of a card are similar to that of a card in the non-ISDN LGC or another XMS-based peripheral, its functions are presented in outline form only, with emphasis on any ISDN-related tasks.

DS-30A cards

The DS-30A interface cards carry the B- and D-channels from the LCMI or LCME to the LGC.

The DS30A interface cards convert between the signal type that is used for internal LGC communication, and the bipolar signal that is used on a DS-30A link. Each DS30A interface card supports ten DS-30A ports. Each port can terminate one DS-30A link (32 channels).

A minimum of two DS-30A cards are required for each LGC, to provide redundant signaling links to the LCMI or LCME. D- and B- channels, which carry circuit-switched or packet-switched data, can be shared across the DS-30A links.

The DS-30A cards are duplicated within an LGC module.

DS-1 cards

The DS-1 cards carry B- and D-channel packet data to the packet handler.

The DS1 interface card converts between the unipolar signal type that is used for internal LGC communication and the bipolar encoded signal that is used on a DS-1 link. The DS1 interface card in the LGC supports both bipolar line codes ZCS and B8ZS. The ZCS line code uses bit insertion, and supports DS-0 channel data rates of 56 kbps. The B8ZS line code is a zero substitution scheme that supports DS-0 channel data rates of 64 kbps unrestricted.

Each DS-1 interface card supports two DS-1 ports. Each port terminates one DS-1 link (24 channels). The DS-1 cards are not duplicated within an LGC module.

DCH cards

The DCH card is the primary interface to all D-channels. Of the thirty-two 64 kbps channels that are connected to each DCH, one is used for call control messaging (communications with ISP) and four are used for packet data (Bd links), leaving 27 channels for D-channel signaling. When the D-channels are multiplexed (ratio of 4:1), a DCH can handle 108 D-channels.

The DCH transmits and receives data using the LAPD procedures that are specified by the International Telegraph and Telephone Consultative Committee (CCITT) in Recommendation Q.921.

Tasks performed by the DCH include:

- setting up communication with an ISDN terminal on request from the terminal or the LGC master processor (MP)
- maintaining a logical link with any ISDN terminal that is sending or receiving data
- setting up communication with the packet handler on request from the packet handler or the LGC MP
- maintaining the connection with the packet handler so long as data flows over the channel
- verifying and routing D-channel frames according to their type (D-call control or D-packet)

Each DCH occupies one DS-1 slot and communicates with the LGC through the DS-60 links. One DCH card uses one odd-numbered port of the twenty peripheral ports available, but it makes two DS-1 ports physically unavailable.

An LGC supports up to ten active DCHs. Each LGC is provisioned with a minimum of two DCH cards, with at least one spare.

Takeover in the DCH

The spare DCH contains the necessary data for all ISDN service groups (ISGs). Having this data allows it to take over for any ISG. (An ISG defines the services that a DCH provides and their allocation to the channels within the DCH.)

All static data and dynamic updates that are sent to each ISG are also sent to the spares.

Takeover occurs for the following reasons:

- a takeover command from the MAP
- detection of a fault in a DCH
- system action other than fault detection

Currently only SAPI 16 calls survive a DCH takeover.

ISDN signaling preprocessor (ISP)

The ISP provides call control messaging functions and DCH maintenance functions.

The ISP provides an interface between the DCH cards and the other processors in the ISDN LGC: the signaling processor (SP) and the master processor (MP). The ISP receives information from the DCHs by way of the speech bus. The information is then processed, and transferred to either the MP memory or the SP memory as appropriate, through the SP A-bus. Information flows from the processors to the DCH in a similar manner.

There is one ISP for each LGC unit. The LGC units operate in a mate configuration, with an active and an inactive unit. Only the active LGC communicates with the DCH cards.

When an active DCH is replaced by a spare DCH, dynamic data updates and call processing cannot be routed correctly and are disabled. If takeover is successful, the DCH mapping tables are updated with the new information, and data is rerouted to the correct ISG.

Only one takeover can occur on an LGC at one time.

Timeswitch

The timeswitch converts between the serial stream that is received from (or transmitted to) the DS30A interface card or the DS1 interface card, and the parallel stream that is used on the internal speech bus.

Under the control of the signaling processor, the timeswitch also associates any of the DS-30A or DS-1 channels with any of the time slots on the parallel speech bus, and transfers data between the associated channel and time slot.

Master processor

The master processor (MP) runs the programs that control the operation and maintenance of a peripheral module.

Master processor memory

The MP memory provides RAM for use by the master processor. There are two master processor memory cards.

Signaling processor

The signaling processor (SP) controls the formatter, the channel supervision message card, and the timeswitch. The SP collects all the incoming control messages from the MPC and passes all outgoing control messages to the MPC for transmission. The SP recognizes CCC-to-LCMI/LCME and LCMI/LCME-to-CCC control messages, and routes them back to the MPC to be transmitted onward.

Signaling processor memory

The signaling processor memory provides:

- RAM for use by the signaling processor
- a direct memory access area (the link between the MP and the SP) that can:
  - be accessed by the signaling processor
  - receive a copy of information from the master processor memory
  - be copied into the master processor memory

Message protocol card

The message protocol card (MPC) supervises the receipt of all incoming control messages as well as the transmission of all outgoing control messages between the LGC and the LCMI or LCME, and between the LGC and the CCC.

The MPC supports the transfer of messages, using:

- DS30 protocol (on the control channel between the LGC and the CCC)
- DMSX protocol (on the control channel between the LGC and the LCMI or LCME)

Formatter card

The formatter card converts the serial bit stream that is used on the internal speech bus to a DS-30 bit stream, and the DS-30 bit stream to a serial bit stream.

Under the control of the signaling processor, the formatter provides the path for the DCH to exchange call control information and packet data with the LCMI or LCME and the packet handler.

DS-30 interface card

The DS30 interface card converts between the signal type that is used for internal LGC communication and the bipolar encoded signal that is used on a DS-30 link. Each DS30 interface card supports eight DS-30 links. One DS-30 link (32 channels) can be serviced through each port.

The duplicated transmissions that are received by the DS30 interface card are passed on to the formatter card.

Channel supervision message interface card

The channel supervision message card (CSM) manages the speech link between the LGC and other PMs. Error conditions are reported to the SP.

ISDN LGC frame

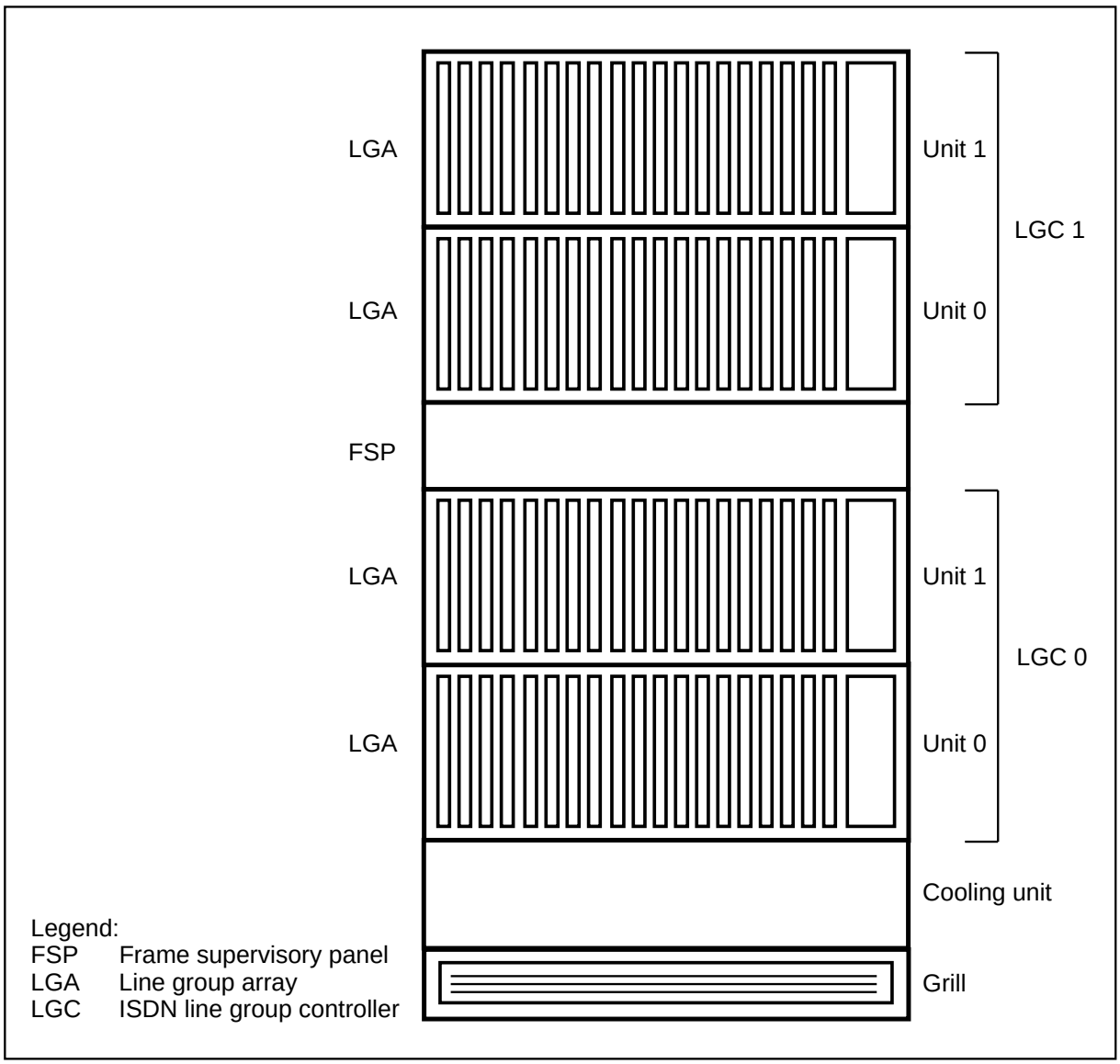
The ISDN LGC uses the ISDN line group controller equipment frame (LGE), which is illustrated in Figure 15-36. Each LGE contains two LGCs, which in turn are composed of two shelves (LGAs). Each LGA contains:

- a set of cards forming the control complex
- a set of interface cards
- a frame supervisory panel (FSP)
- a cooling unit

The control complex in LGA 1, on the upper shelf (Figure 15-36), is called unit 1. The control complex in LGA 0, on the lower shelf, is called unit 0.

The card complement and the layout of an LGA are shown in Figure 15-36.

Figure 15-36
ISDN LGE frame



ISDN LGC tasks for basic rate interface

For basic rate interface, the LGC:

- routes circuit-switched, packet-switched, and call control messages to and from points inside and outside the ISDN
- establishes and maintains both physical and logical links to allow call routing and associated maintenance
- exchanges Q.931 call control messages with the ISDN terminals, and tracks and manages call control messages

- routes D-packet messages to and from the packet handler
- routes internal control messages to and from components of the ISDN switch
- converts control messages from one internal protocol to another
- performs maintenance functions on its links and cards

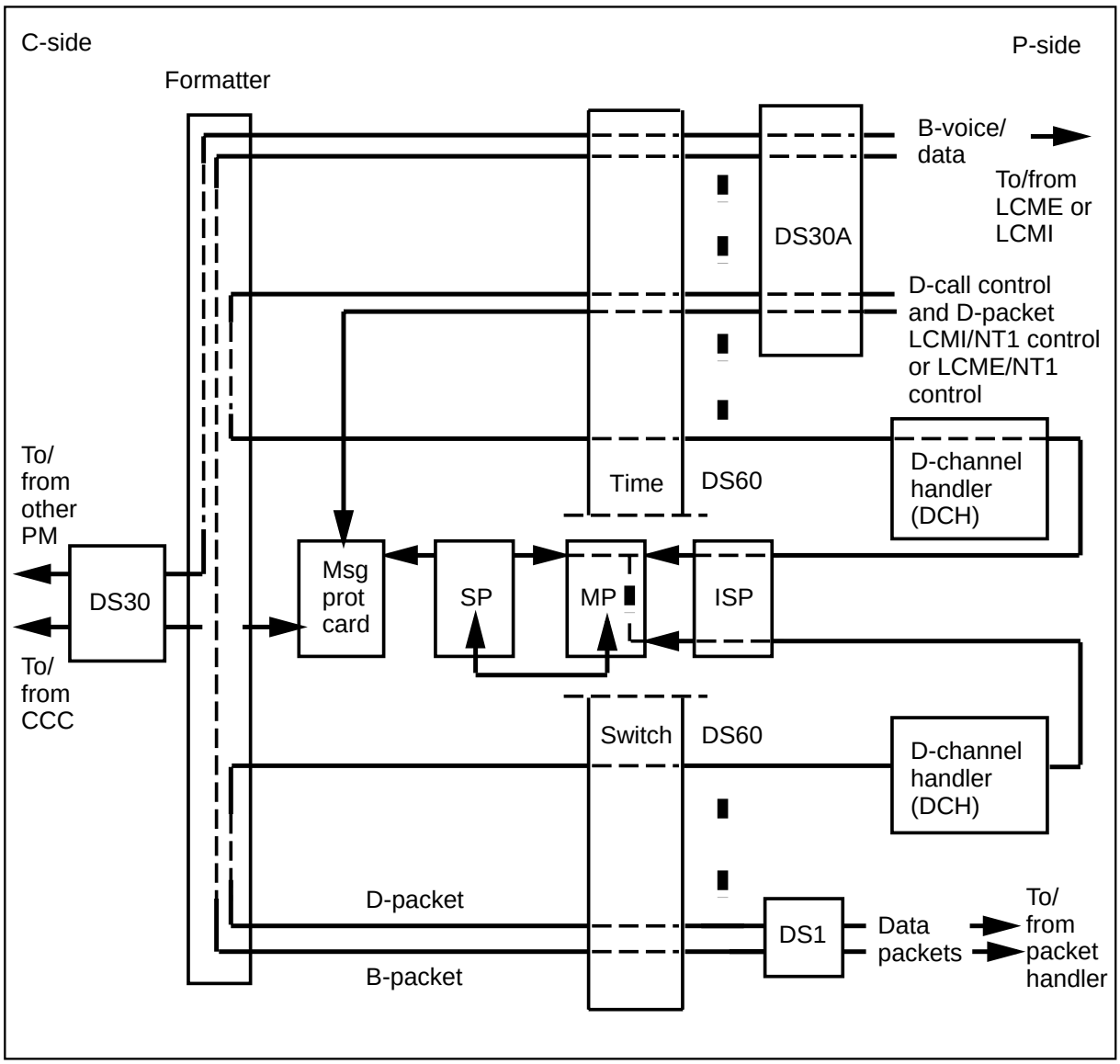
BRI call routing through the ISDN LGC

The LGC provides data paths for:

- B-channel circuit-switched voice and data
- dedicated B-channel packet data
- D-channel call control messages
- D-channel packet data
- LCMI/LCME to NT1 control messages

These paths are illustrated in Figure 15-37.

Figure 15-37
ISDN LGC basic rate interface data flow



Call routing for the messages and data occurs as follows:

- D-channels from ISDN 2B+D loops are time division multiplexed 4:1 (4 x 16 kbps = 64 kbps) through the LCMI or LCME onto the DS-30A links. These links terminate on the DS-30A interface cards in the LGC, and are carried to the timeswitch through the DS-60 links. The D-channels are then looped back at the formatter card, back to the timeswitch, onto other DS-60 links, and onto the DCHs that occupy DS-1 card slots on the LGC.

- The DCH provides Q.921 (LAPD) datalink level processing. The DCH sorts out the frame types according to their SAPI values.

For SAPI 0 (call control) and SAPI 63 (TEI management), the DCH acts as the termination point for the logical links.

SAPI 16 frames are statistically multiplexed (64:1 maximum) and routed to the packet handler through a dedicated DS-1 card.

SAPI 17 (user-to-user signaling) frames are handled within the DCH itself, which sends the frames back to the originating ISDN loop.

B-channel circuit-switched voice and data is carried on DS-30A links from the LCMI or LCME. The links terminate on the DS-30A interface cards in the LGC.

The voice and data is then carried on DS-30 channels to the network module, which connects to the far-end subscriber.

B-channel packet data is carried on dedicated channels and permanent connections through the LCMI/LCME and LGC. B-channels that are destined for the packet handler are carried on a dedicated DS-30A channel from the LCMI/LCME. They are then transported through the timeswitch, which loops back through DS-60 links to the DS-1 interface to the packet handler.

LCMI/LCME to NT1 maintenance and control messages are sent by the CCC to the LGC on DS-30 links, and through connections in the LGC to the LCMI/LCME (on DS-30A links).

Establishing physical and logical links

The ISDN LGC establishes and maintains physical and logical links to allow call routing, and maintenance routines that support call routing.

Physical links

As Figure 15-37 illustrates, the LGC provides connections between a BRI DS-30A P-side channel and a DS-30 C-side channel, and between a DS-30A P-side channel and a DS-1 P-side channel. The P-side interfaces are required to send data to, and receive data from:

- an LCMI/LCME (DS-30A links)
- a packet handler (DS-1 links)
- DCHs (DS-30A links)

The C-side interface is required to send and receive data over DS-30 links to and from the network modules.

The LGC software performs connection management under the supervision of the CCC, including internal channel allocation and deallocation, call connection timing and connection integrity supervision.

Logical links

Transmitting D-call control, D-packet and B-packet data requires the creation of logical data links. These logical data links are set up between service access points within the ISDN using service access point identifiers (SAPIs), and logical terminals using terminal endpoint identifiers (TEIs).

The DCH checks the frame sequencing, and the check digits that are built into each call control frame, and requests the ISDN terminal to resend missing or invalid frames. The DCH builds frames for the D-call control messages it transmits to an ISDN terminal, and responds to any requests to resend invalid frames. The DCH action for D-packet frames is limited to validity checking; if a frame fails the validity check, the frame is discarded.

Exchanging and managing Q.931 call control messages

The LGC call control software communicates with functional signaling terminals on the D-channel by means of call control messages. The structure of Q.931 call control messages is defined in CCITT Recommendation Q.931. The D-channel call control messages, which are exchanged between the ISDN LGC and the ISDN terminals (through the LCMI or LCME), conform to the CCITT standard.

The LGC MP converts Q.931 call control messages into the format used by the CCC and forwards them to the CCC. The MP performs the same functions for messages coming from the CCC to the terminals. In addition, LGC software constructs the frames in which call control messages are sent to the functional signaling terminals, tracks call states and communicates them to the terminals, controls the sequence for transmitting messages, and determines when to resend messages.

Routing D-packet messages

The LGC MP routes data packets from the packet handler to the ISDN terminal, using an address based on:

- the terminal endpoint identifier (TEI) that is associated with each logical terminal
- the DCH number

The LGC MP routes data packets from the ISDN terminal to the packet handler, using an address based on:

- the TEI
- the logical DS-1 to packet handler link that is associated with the terminal

The tables containing this address information are downloaded from the CCC. The LGC uses them to generate an address for onward routing.

Routing internal control messages

In addition to routing call control messages to and from the CCC, the LGC:

- sends and receives hardware control and diagnostic messages to and from the CCC
- forwards CCC messages that are destined for the LCMI/LCME, and LCMI/LCME messages that are destined for the CCC
- receives software loads for the LGC and its associated DCHs
- receives and routes software loads for the LCMI/LCME

The LGC accomplishes these functions using a dedicated control channel through the network modules to the CCC.

Maintenance functions

The LGC carries out maintenance functions on its links and cards.

Link maintenance

The LGC carries out periodic loop-around tests on the DS-30A links to the LCMI or LCME. The TDM D-channels from the LCMI are preassigned to specific channels on a DS-30A link. Therefore, if the LGC detects a link failure, all the relevant lines are flagged as out of service.

The ISDN LGC also monitors and carries out maintenance tests on the DS-1 links to the packet handler. In addition, each DCH monitors the integrity of the channel over which it sends data to, and receives data from, the packet handler.

ISDN LGC card maintenance

The LGC maintains the D-channel handlers, and the individual cards in the LGC processing complex.

The LGC and DCH maintenance procedures are described in *DMS-100F ISDN Peripheral Modules Maintenance Reference Manual*, 297-2401-515.

ISDN line trunk controller (LTCI)

Description

Throughout this document, the term LTC refers to the LTC equipped for ISDN unless specifically identified as a non-ISDN LTC. The ISDN LTC was formerly identified as the LTCI. While hardware with the LTCI designation is supported, datafill and displays for this peripheral module now refer to it as an LTC.

Like the ISDN line group controller (LGC), the ISDN line trunk controller (LTC) is an XMS-based, dual-unit peripheral module. The LTC equipped for ISDN performs similar functions to the ISDN LGC, including:

- D-channel handling and processing
- call processing for all the different types of lines (ISDN, EBS, POTS and Datapath)
- maintenance and diagnostics

In addition, the LTC can function identically to the DTCI, providing PRI call processing.

The cards in each shelf of the ISDN LTC are identical to the cards on an LGC except that slot 17, between the ISP and the MPC card, contains a universal tone receiver (UTR) card.

As Figure 15-38 illustrates, the P-side interface of the LTC consists of DS-30A links to the LCMI/LCME, and DS-1 links to the circuit-switched network and to the packet handler. The LTC supports DS-1 based digital trunks that use A/B-bit signaling and are supported by the non-ISDN LTC, including:

- POTS
- EAS
- MDC
- Intertoll
- CAMA
- FX lines

Currently, the ISDN LTC does not support common channel signaling trunks.

The LTC provides a DS-30 interface on its C-side, for links that carry information through both planes of the network modules to the CCC and to other local peripheral modules.

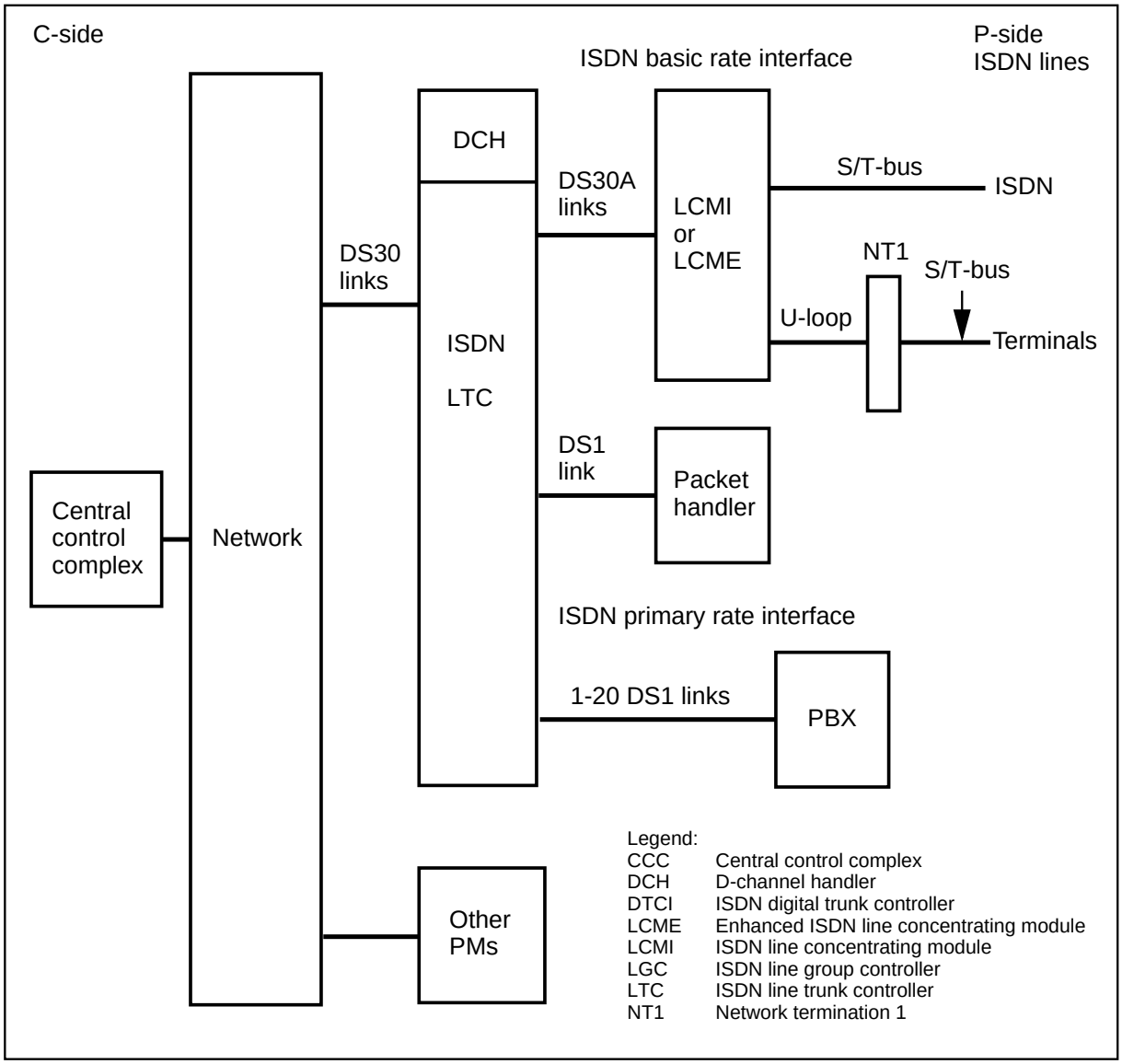
The LTC supports LCMs, LCMIs, and LCMEs. For ISDN basic rate interface, the ISDN LTC is configured with the LCMI or LCME. If the LCMIs are fully configured for ISDN-only lines, one LTC can support up to three LCMIs (480 BRI loops), one LCME (also 480 BRI loops) if only 2B1Q U-type line cards are equipped, or two LCMEs if only S/T-type line cards are equipped.

A switch that is configured for ISDN, running only ISDN traffic, can support 5000 ISDN lines (10 ISDN LTCs) or more. The actual number of

lines that are supported varies from office to office, depending on such factors as line characteristics and the real time capacity of the switch.

When used for both ISDN primary rate interface and basic rate interface, the ISDN LTC is equipped with more or less of the provisionable DCH cards required only for BRI. The ratio of DCH cards to DS-1 cards is flexible and is dependent on the requirements for each type of service in each office.

Figure 15-38
ISDN LTC basic and primary rate interface configurations



ISDN digital trunk controller (DTCI)

Description

The digital trunk controller (DTCI) provides the access for ISDN primary rate interface to a digital private branch exchange (PBX) such as the Meridian SL-1 or Meridian SL-100. The DTCI provides call control for PRI functional signaling. (PRI does not support stimulus signaling.)

Like the ISDN LGC and LTC, the ISDN DTCI is an XMS-based, dual-unit peripheral module. While the DTCI is based on the DTC, internally it performs similar functions to the ISDN LGC, including:

- D-channel handling and processing
- maintenance and diagnostics

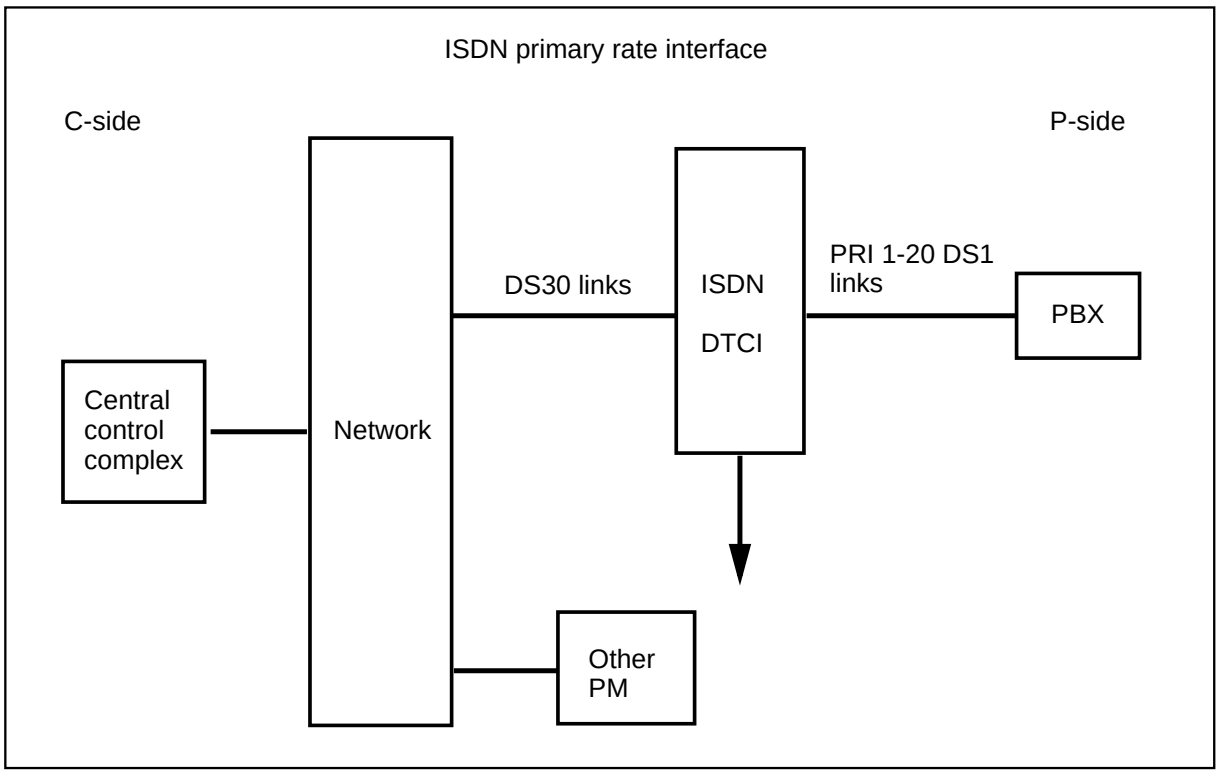
While the ISDN LGC performs the call processing function for ISDN BRI lines, the DTCI performs the call processing function for PRI trunks. The ISDN LTC can be equipped to perform the call processing functions for both BRI lines and for PRI trunks.

The DTCI contains many of the same cards located in the ISDN LGC or LTC except that there are no DS-30A cards in slots 6 and 7, and no DCH cards are required to handle the D-channels. D-channels and D-channel handling for all PRI interfaces terminating on the DTCI are provided by the ISDN signaling preprocessor (ISP).

A universal tone receiver (UTR) card may be placed in slot 15. The DTCI does not support the special tone receiver (STR) card.

As Figure 15-39 illustrates, the P-side interface of the DTCI consists of DS-1 links to the digital PBX. In addition to PRI trunks, the DTCI supports DS-1 based digital trunks that use A/B-bit signaling. The DTCI does not support CCS7 ISUP trunks.

Figure 15-39
DTCI primary rate interface configuration



For primary rate interface, the DTCI provides P-side DS-1 interfaces for links to digital PBXs or other switching offices. The DTCI also provides a DS-30 interface on its C-side for links carrying information through both planes of the network modules to the CCC and to other peripheral modules.

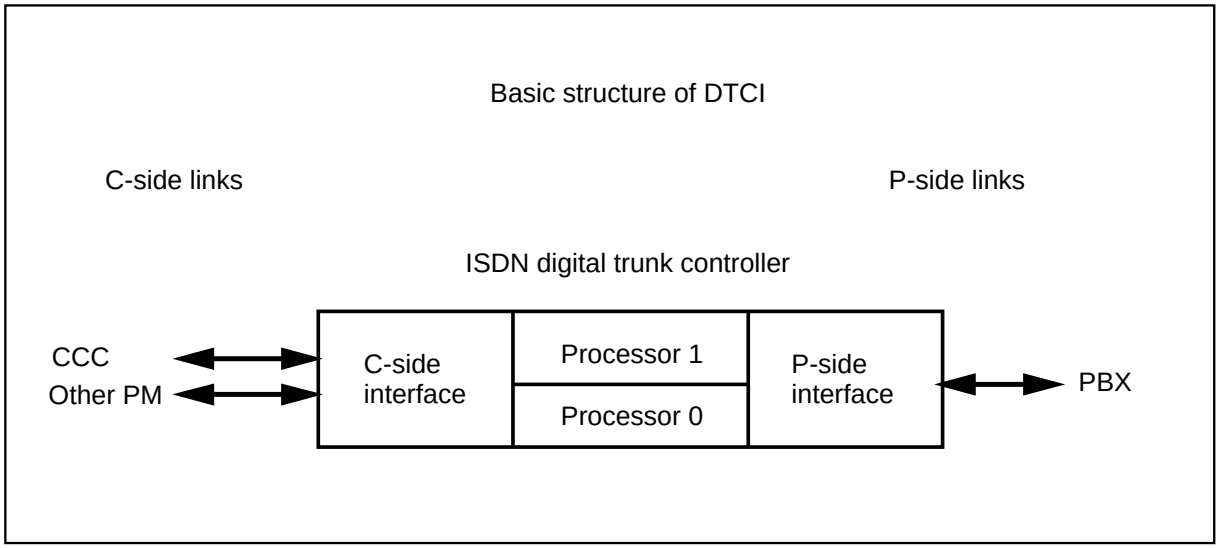
DTCI specification

The link characteristics and structure of the DTCI are shown in Table 15-23 and Figure 15-40.

Table 15-23
DTCI characteristics

Minimum	Maximum	Link type	Channels	Remarks
C-side links				
3	16	DS30	32	Two sets of links, one to each plane of the network
P-side links				
1	20	DS-1	24	Links to digital PBX. One D-channel can supply signaling for 479 B-channels on the same DTCI

Figure 15-40
DTCI structure for primary rate interface



DTCI configuration

The DTCI is a dual-unit node that performs similar functions to a DTC. As in the ISDN LGC, it has an additional capability to perform D-channel handling. This function requires use of the ISDN signaling preprocessor (ISP) card.

The frame and the shelves, and their PECs, used for the DTCI are the same as those for the LGC. Like the LGE frame shown in Figure 15-36 , a DTCI frame holds two DTCIs, a cooling unit, and an FSP. Each DTCI has two shelves (unit 0 and unit 1) and each shelf has the following sets of cards:

- one set of cards that provides the P-side and C-side interfaces, including:
  - DS-30 interface card

  - DS-1 cards, not to exceed five cards
- one set of cards that provides the control complex, including:
  - ISDN signaling preprocessor (ISP) card
  - timeswitch card
  - master processor (MP) and two MP memory cards
  - signaling processor (SP) and SP memory card
  - message protocol (MPC) card
  - formatter card
  - channel supervision message (CSM) card

Table 15-24 lists the product engineering codes (PECs) for each card. Figure 15-41 illustrates the arrangement of the cards in the DTCI shelves. Figure 15-42 illustrates the logical architecture of the cards in one DTCI shelf.

Like the DTC and the ISDN LGC, the DTCI provides duplicate control complexes and interfaces, one in each shelf.

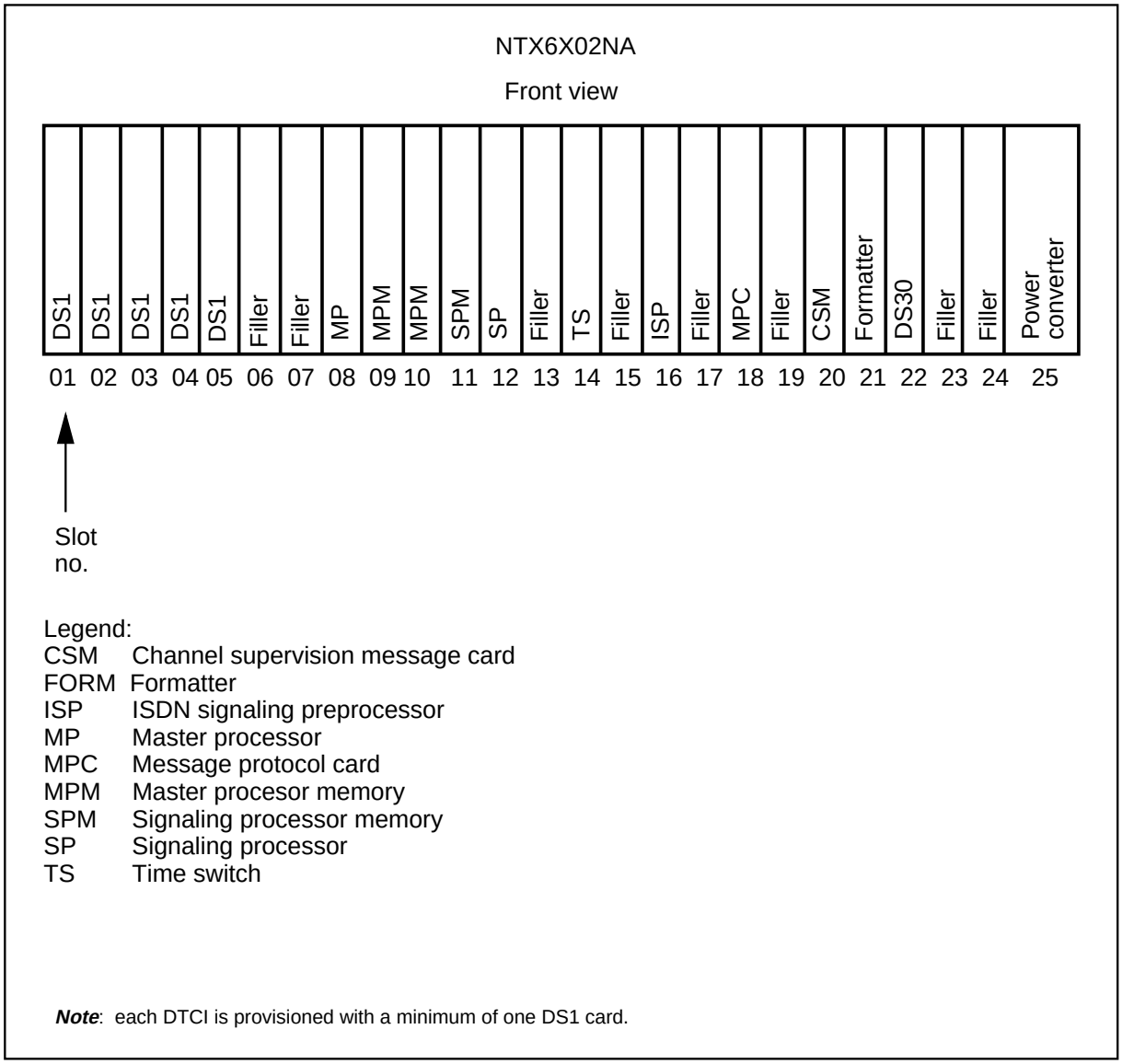
During normal operation, one control complex is active. The other control complex is held in standby mode, ready to take over if the first control complex fails. All interfaces are connected to both control complexes (Figure 15-43). If an interface fails, all the communications can be switched to the reserve interface.

Each DS-30 interface to the network module works in dual-plane mode. The receiver at the other end of the network connection (for example, the CCC) can choose between two separate data streams and can switch data streams if a problem occurs.

Table 15-24
DTCI cards and PECs

Card name	PEC
DS1 interface	NT6X50AB
Master processor	NT6X45BA
Master processor memory	NT6X47AB
Signaling processor memory	NT6X46BA
Signaling processor	NT6X45BA
Time switch	NT6X44AA
ISDN Signaling preprocessor	NTBX01AA
Message protocol card	NT6X69AA
CSM Interface	NT6X42AA
Formatter	NT6X41AA
DS30 Interface	NT6X40AC
Power converter	NT2X70AD
Filler	NT0X50AA

Figure 15-41
DTCI shelf card locations



Note: each DTCI is provisioned with a minimum of one DS1 card.

Figure 15-42
DTCI internal configuration simplified diagram

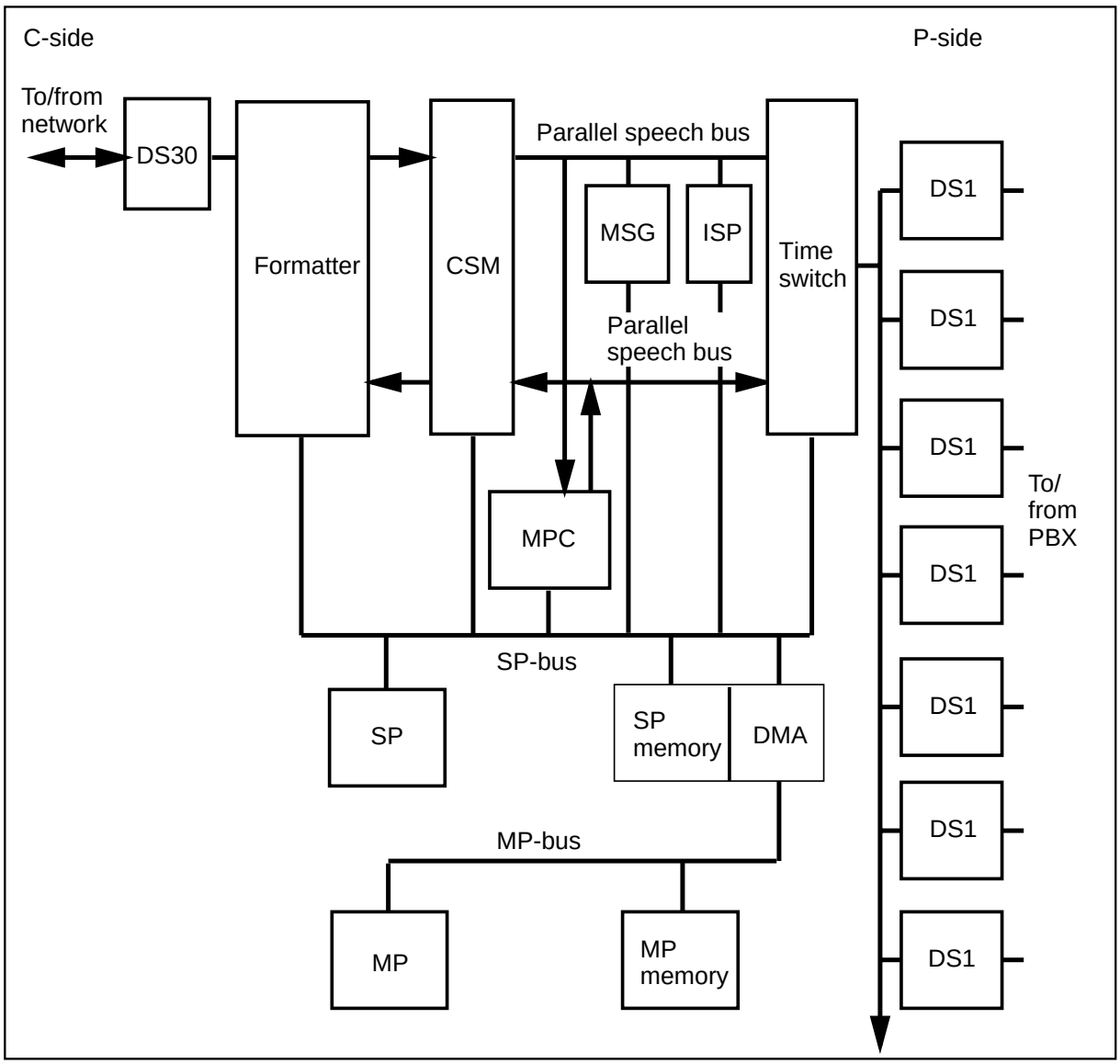
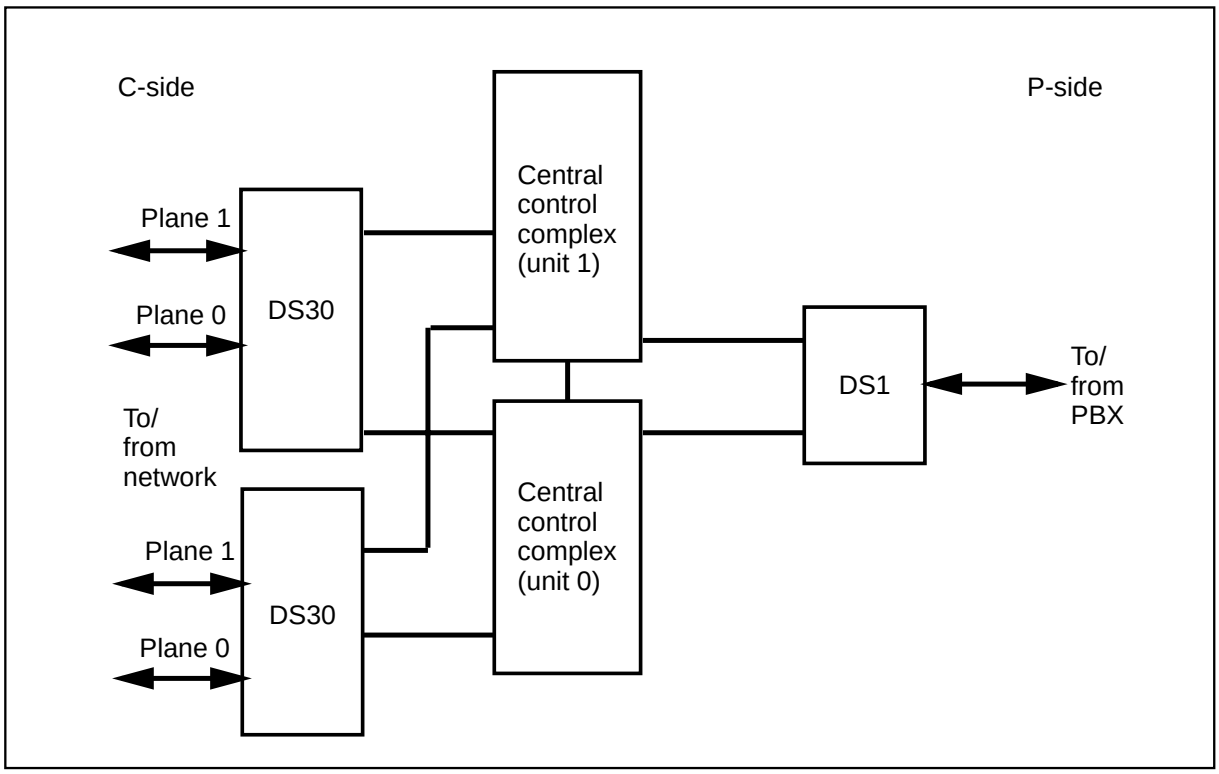


Figure 15-43
Interface and control complex duplex configuration



ISDN signaling preprocessor (ISP)

Like the ISP located in the LGC, the DTCI ISP provides:

- call control messaging functions and D-channel maintenance functions
- an interface between the D-channels and the other processors in the DTCI: the signaling processor (SP) and the master processor (MP). The ISP receives information from the D-channels by way of the speech bus. The information is then processed, and transferred to either the MP memory or the SP memory as appropriate, through the SP A-bus. Information flows from the processors to the D-channel in a similar manner.

In addition, the ISP in the DTCI, with the master processor (MP), provides the D-channels. This includes:

- the Layer 1 termination point for D-channels
- Layer 1 and Layer 2 protocol handling
- Layer 3 message packaging into Layer 2 frames for the PBX
- support for 32 D-channels

The D-channels, created by the ISP card, transmit and receive data using the LAPD procedures that are specified by the International Telegraph and Telephone Consultative Committee (CCITT) in Recommendation Q.921.

Tasks performed by the D-channel include:

- setting up communication with a PBX on request from the PBX or the DTCI master processor (MP)
- maintaining a logical link with any PBX that is sending or receiving data
- verifying and routing D-channel frames

DTCI frame

The DTCI uses the same ISDN line group controller equipment frame (LGE), which is illustrated in Figure 15-36, but it is designated the ISDN digital trunk controller equipment frame (DTEI).

DTCI tasks

The DTCI performs the following tasks:

- routes circuit-switched and call control messages to and from points inside and outside the ISDN
- establishes and maintains both physical and logical links to allow call routing and associated maintenance
- exchanges Q.931 call control messages with the PBXs, and tracks and manages call control messages
- routes internal control messages to and from components of the ISDN switch, and converts control messages from one internal protocol to another
- performs maintenance functions on its links and cards

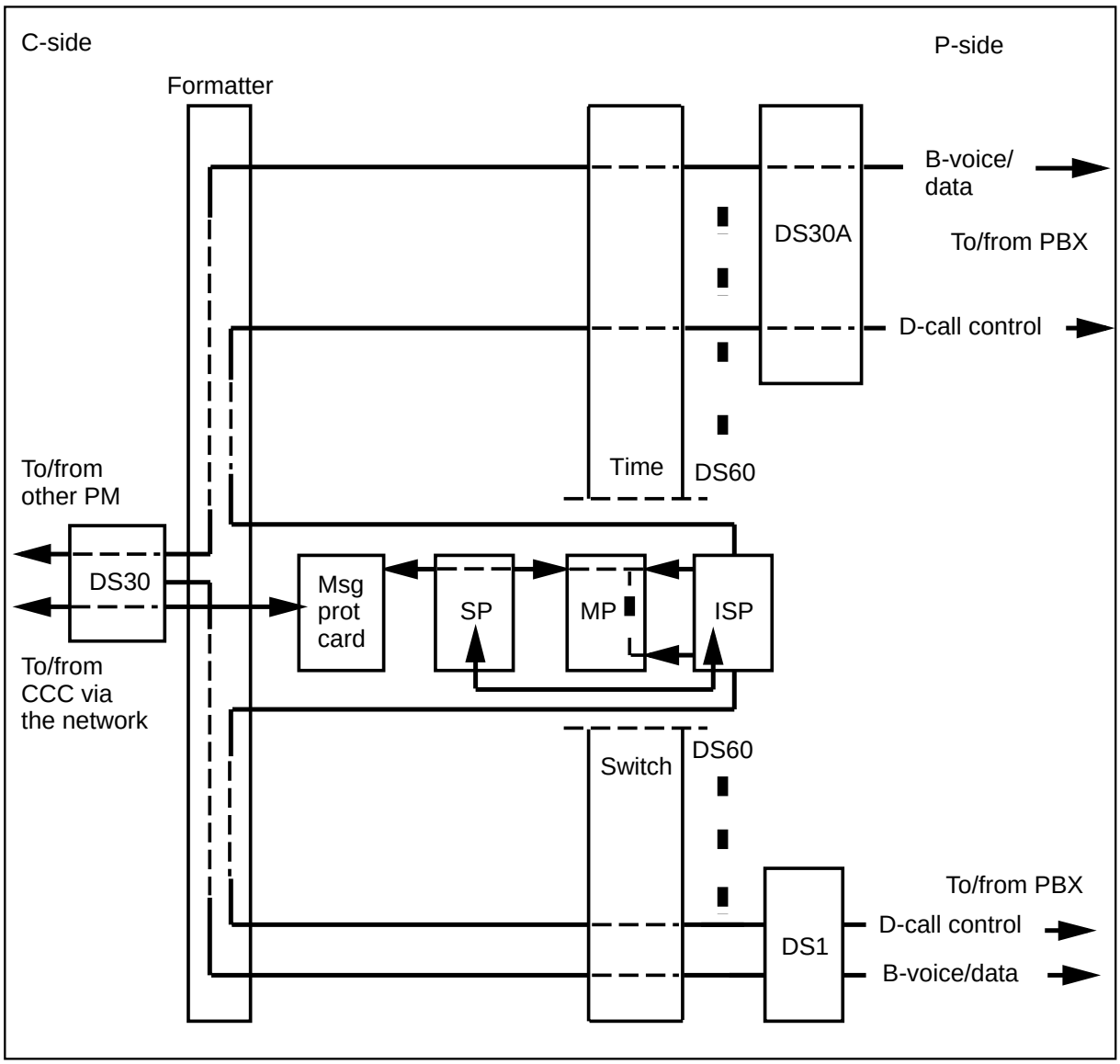
PRI call routing through the DTCI

The DTCI provides data paths for:

- B-channel circuit-switched voice and data
- D-channel call control messages

These paths are illustrated in Figure 15-44.

Figure 15-44
DTCI primary rate interface data flow



Call routing for the messages and data occurs as follows:

- D-channels on DS-1 links from the PBX are carried to the timeswitch through the DS-60 links. The D-channels are then looped back at the formatter card and routed to a channel on the speech bus.
- The ISP receives Layer 3 data which it processes and routes to either the SP or MP, as required. The ISP communicates with the MP through shared memory.
- The ISP provides Q.921 (LAPD) datalink level processing.

- Only SAPI 0 (call control) messages are sent over PRI D-channels. SAPI 0 frames are routed to the MP by way of the ISP for Q.931 processing.
- B-channel circuit-switched voice and data is carried on DS-1 links from the PBX.

The voice and data is then carried on DS-30 channels to the network module, which connects to the far-end subscriber.

Establishing physical and logical links

The DTCI establishes and maintains physical and logical links to allow call routing, and maintenance routines that support call routing.

Physical links

As Figure 15-44 illustrates, the DTCI provides connections between a DS-30 C-side channel and DS-1 P-side channel. The P-side interfaces are required to send data to, and receive data from a digital PBX. The C-side interface is required to send and receive data over DS-30 links to and from the network modules.

The DTCI software performs connection management under the supervision of the CCC, including internal channel allocation and deallocation, call connection timing and connection integrity supervision.

Logical links

Transmitting D-call control data requires the creation of logical data links. These logical data links are set up between service access points within the ISDN using service access point identifiers (SAPIs).

The D-channel checks the frame sequencing, and the check digits that are built into each call control frame, and requests the PBX to resend missing or invalid frames. The D-channel builds frames for the D-call control messages it transmits to an PBX, and responds to any requests to resend invalid frames.

Exchanging and managing Q.931 call control messages

The DTCI call control software communicates with PBXs on the D-channel by means of call control messages. The structure of Q.931 call control messages is defined in CCITT Recommendation Q.931. The D-channel call control messages, which are exchanged between the DTCI and the PBX, conform to the CCITT standard.

The DTCI MP converts Q.931 call control messages into the format used by the CCC and forwards them to the CCC. The MP performs the same functions for messages coming from the CCC to the PBXs. In addition, DTCI software constructs the frames in which call control messages are sent to the PBXs, tracks call states and communicates them to the PBXs, controls

the sequence for transmitting messages, and determines when to resend messages.

Routing internal control messages

In addition to routing call control messages to and from the CCC, the DTCI:

- sends and receives hardware control and diagnostic messages to and from the CCC
- receives software loads for the DTCI and its associated ISPs and D-channels

The DTCI accomplishes these functions using a dedicated control channel through the network modules to the CCC.

Maintenance functions

The DTCI carries out maintenance functions on its links and cards.

Link maintenance

The DTCI also monitors and carries out maintenance tests on the DS-1 links to the PBX. In addition, the ISP monitors the integrity of the channels over which it sends data to, and receives data from, the PBX.

DTCI card maintenance

The DTCI maintains the D-channels and the individual cards in the DTCI processing complex.

The DTCI and D-channel maintenance procedures are described in *DMS-100F ISDN Peripheral Modules Maintenance Reference Manual,* 297-2401-515.

Flow and overload control for PRI

A flow and overload control system is provided for ISDN primary rate interface (PRI) facilities on the following peripheral modules (PM):

- DTCI
- line trunk controller (LTC), equipped for ISDN

The PRI flow and overload control system described here applies only to Q.931 messages from the PRI D-channel incoming to the peripheral, and not to overloads caused either by CC generated messages or by internal operations of the ISDN signaling preprocessor (ISP) card.

When a peripheral module becomes overloaded, its overload control system ensures the impact on service from incoming Q.931 messages is regulated and predictable.

The PRI overload control system is intended to provide:

- 99.9% completion rate at the rated capacity

- reduction in the impact of overload on the peripheral module

Overload occurs when the PM has exhausted the resources required for call processing and is no longer able to handle the work it is being given. The main causes of overload in the PM are:

- the PM is flooded with call processing messages from the CC
- the call rate has exceeded capacity
- the PM is flooded with call originations or messages from the far end
- failure recovery, such as losing one of the network planes

When an overload condition persists, the PM is likely run out of one of the following resources:

- processor real time
- call processing data structures
- messaging buffers
- communication links on the P-side or C-side

The overload control system prevents this shortage of resources and the subsequent arbitrary or universal degradation in service. If the overload is extreme or sustained, the peripheral may become unstable and drop activity. Not all stable calls can be maintained over the SwAct since there might have been limited real time for data transfer to the inactive unit. The longer the peripheral is in the overload state, the more calls that drop after a warm SwAct.

Overload control system description

The PRI overload control system in the PM consists of:

- overload protection
- overload indicators

Overload protection

The key to overload protection is controlling the flow of messages to peripheral call processing. Flow control prioritizes the work being given to call processing for maximum system throughput.

The PRI overload control system delays incoming Q.931 messages on PRI trunks and presents them to call processing in regulated quantities when real time availability allows. In this way, call processing is isolated and protected from high peaks in incoming traffic.

The call priorities for the PRI PM, in descending order of importance, are:

- calls in progress and trunk terminations
- line terminations
- ELN terminals

- trunk and line originations

Occasionally, in the event of overload, it is necessary to shed incoming messages to protect the stability of the PM and maintain traffic throughput. Incoming messages are shed if the data structure for PRI flow control has reached the maximum capacity.

Overload indicators

Three existing mechanisms indicate overload for the PRI peripheral module.

The three mechanisms are:

- Peripheral state change
- When the peripheral enters overload, this information is passed to the CC and the peripheral state changes from INSV to ISTB. When the peripheral exits overload and has informed the CC, its state returns to INSV.
- Logs
- A PM128 log is generated when the peripheral enters overload. A PM106 log is generated when the peripheral exits from overload.
- OMs
- Register PRFLSHED in OM group PRADCHL2 pegs all PRI Q.931 SAPI 0 messages which PRI flow control sheds or discards due to an overload condition. Pegging is done on a per D-channel (interface) basis.

The PM clears its overload state indicator every three minutes. If the PM is still in the overload state, then the indicator is set again.

In the event of messages being shed in the PM by the overload control system, the DMS and the far end of the PRI link recover cleanly and the overall system maintains integrity. No calls are left in a hung state.

Overload controls in the PM cause a small increase in the real time used per PRI call. This increase is due to the extra processing of incoming PRI messages in the flow control system.

BRI stimulus and functional calls are not supported by overload controls implemented for the LTC. BRI facilities are not supported by the DTCI.

Measurement methods

The following section describes methods for measuring the capacity in a DMS-100 Family switch. These methods are based on the measurements that have been designed and are currently available in the data collection system.

Resident performance indicators

Performance indicators are measurements or records of events that occur during a given period of time or in a time sequence. For the DMS-100 Family switch, performance indicators take the form of operational measurements (OMs) and log reports. In addition, a method to measure and control the balance of traffic load offered to like components of the product or system is usually employed. This measurement method is usually developed by the operating company and uses the standard operational measurements provided by the DMS-100 Family switch.

Operational measurements

The measurement of capacities in the DMS-100 switch makes use of the switch's data collection system. This system collects groups of data designated as operational measurements (OMs). Operational measurements are derived by monitoring certain events in the switch and entering the results into registers in the data store. Each register has a unique name. The registers are scored individually each time an event occurs, or when the state of an item is scanned (sampled) at regular intervals regardless of the time of the occurrence of an event. Scan rates are either 100 seconds or 10 seconds.

The output from the OMs may be sent to a local printer or collected on a mechanized system, for example, the engineering and administrative data acquisition system (EADAS).

Refer to *Capacity Administration Guide*, 297-1001-304 for a more detailed discussion of operational measurements. All other DMS-100 Family OMs are contained in *Operational Measurements*, 297-1001-814.

Log reports

A log report is a message from the DMS whenever a significant event has occurred in the switch or one of its peripherals. Log reports include status and activity reports, as well as reports on hardware or software faults, test

results, and other events or conditions likely to affect the performance of the switch. A log report may be generated in response to a system or manual action. Complete descriptions of all log reports are contained in the *Log Report Manual*, 297-1001-510.

Subscriber trouble reports

Subscriber trouble reports are another source for monitoring the capacity of switch components. These reports can often point to off-busy hour capacity problems that otherwise may go undetected.

Peripheral module activity (PMAct) tool

The XPM real time and performance tool, software package NTX827AA, was introduced in BCS21. The PMAct tool allows a user to gather information detailing performance, usage, and real time activity on individual peripheral controllers. Users of BCS21 and BCS22 should refer to SEB 87-02-004, Issue #2.

The information is available from a MAP CI command within the MTC/PM level called PERFORM. This command has two sublevels, PM ACTIVITY (PMAct) and DELAYS, defined as follows.

- PMAct: This sublevel contains information indicating the activity within the peripheral posted. This will include the occupancy in both the master processor (MP) and signal processor (SP). Occupancy is divided into the following two categories.
  - CP: call processing
  - LP: low priority
- In addition, the PMAct sublevel provides the following information:
  - originating peg count
  - terminating peg count
  - universal tone recorder (UTR) peg count
  - P-side channel peg count
  - total UTR circuits available
  - total P-side channels available
  - highest number of UTRs used
  - highest number of P-side channels used
- DELAYS*:* This sublevel provides information on the following call processing delays:
  - dial-tone delay
  - dial-tone removal delay
  - post-dialing delay
  - cut-through to answer

  - cut-through to speechpath
- data for each call processing delay is divided into 3 sections:
  - average delay during the last minute
  - 50 percent of all delays less than this value in the last minute
  - 95 percent of all delays less than this value in the last minute

Two log reports are also available; PRFM200 for the PMAct sublevel and PRFM201 for the DELAY sublevel. The PRFM200 log displays results on a minute-by-minute basis for the posted peripheral over a 15 minute interval, and a summary of the data. The PRFM201 log displays the measured delays as an average over the 15 minute posted period. The XPM load name is printed with the logs.

Automated tools

There are several automated tools that are available to the administrator that will aid in the monitoring of capacity. Northern Telecom developed these tools to assist in the initial provisioning of an office and for use in the ongoing surveillance of a working switch.

REAL::TIME

REAL::TIME is a PC program designed to provide an estimate of the DMS-100 Family CPU real time requirements. The DMS-100 switch provides distributed processing over many switching entities. The call attempt capacity of each of these switching entities must be predicted to establish operating guidelines. These guidelines are used to determine the loading levels for specific applications, including residential services. The real time can be predicted by using the anticipated call mix and timing per call.

Using traffic criteria along with detailed office provisioning data, REAL::TIME generates an estimated occupancy for the central processor. REAL::TIME can be used in the following office configurations:

- DMS-100 POTS, MDC (including MADN) or both, in an equal access end office (EAEO).
- DMS-200 in an access tandem operation
- DMS-100/200 in a combination of the above
- TOPS applications
- SS7 trunking applications
- Enhanced 800 Service
- ISDN applications.

REAL::QUICK

REAL::QUICK is a condensed form of REAL::TIME and PRTCALC. A standard set of engineering assumptions and considerations are applicable to each processor. If there is a significant variance from these assumptions and considerations, a more detailed study should be performed using PRTCALC or REAL::TIME.

PRTCALC

PRTCALC is a PC program designed to provide an estimate of DMS-100 Family peripheral real time requirements. PRTCALC can be used to calculate the real time call attempt capacity for peripheral modules. PRTCALC is composed of three sections:

- an input section used to organize the controller call data and feature requirements
- a work sheet section that contains the PRTCALC call mix calculations. The call types derived from the input data are combined with the per call timings to determine the real time requirements
- an output section that is a summary of the input and the work sheet calculations.

Input for PRTCALC comes either from projected (forecast) data based on current operational measurement trends, or from inputs to the NT-ACCESS tool.

Peripheral real time concepts

Real time engineering of DMS-100 Series II peripherals is based on the following formula.

$$\frac{\text{Total real time required to process calls}}{\text{Total real time available for call processing}} \times 100 = \text{Percent call processing area utilization}$$

The standard measurement of real time in any processor is in milliseconds, and can therefore be shown as follows.

$$\frac{\text{Total milliseconds required to process calls}}{\text{Total milliseconds available for call processing}} \times 100 = \text{Percent call processing area utilization}$$

The milliseconds required to process calls are determined by calculating real time of the peripheral either manually or by using the mechanized program PRTCALC, ”Peripheral Real Time Calculation Tool.” The total milliseconds available for call processing in a peripheral can be expressed by the following formula.

$$3{,}600{,}000 \text{ msec/hr} - \text{msec/hr required for non-call processing function} = \text{msec available for call processing}$$

The milliseconds required by the peripheral for non-call processing functions are called the overhead. The overhead associated with a peripheral processor provides the following:

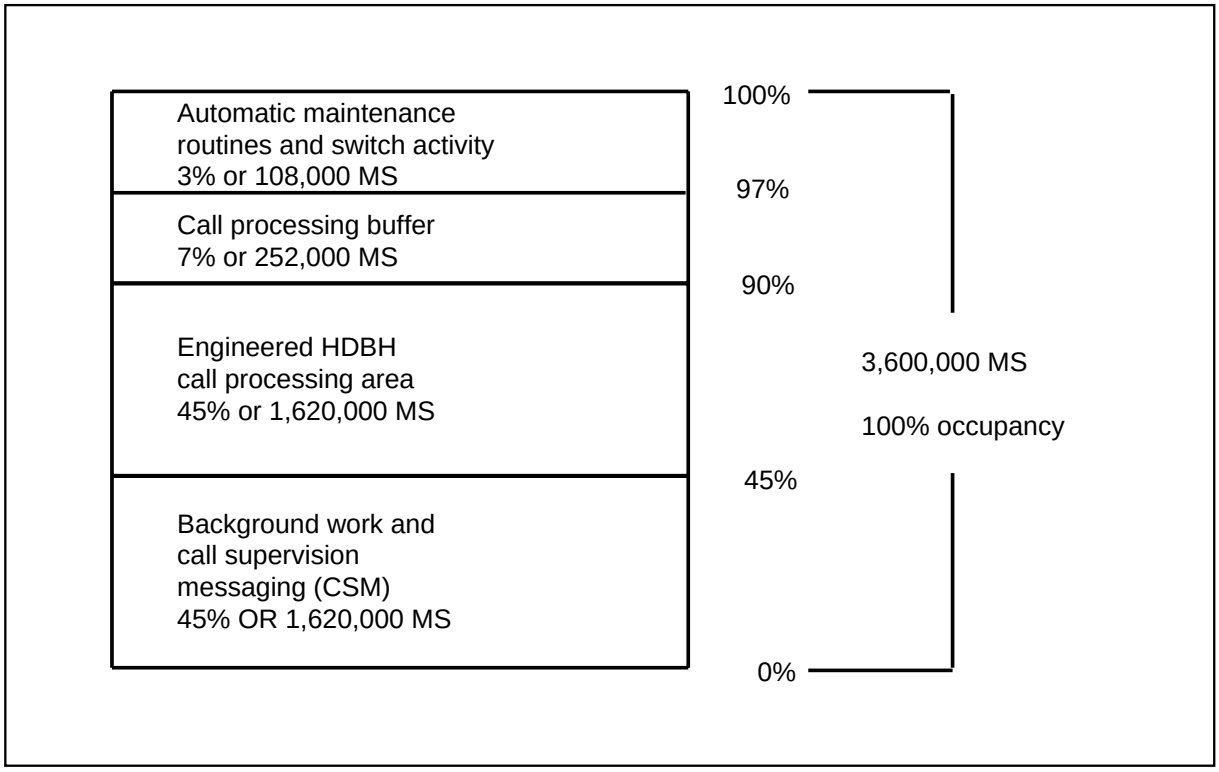
- background work and call supervision messaging (CSM)
  - This area provides the ongoing integrity and message functions of the processor.
- automatic maintenance routines and switch activities (SwAct)
  - This area is designed to run maintenance activities and to preserve stable calls in the event of a warm SwAct.
- call processing buffer
  - This area is not a true overhead but is designated as such to provide a buffer to accommodate peaks beyond high day busy hour (HDBH) engineered traffic.

The time in milliseconds not required by the peripheral processor for overheads is designated as the call processing area. This area is the recommended design limit for HDBH call processing real time engineering.

The formula provided below shows how allocated areas of the peripheral processor are developed. Figure 16-1 illustrates how overhead and call processing area allocations are modeled for the LGC signal processor (SP).

$$\frac{\text{Allocated area in milliseconds}}{\text{3,600,000 msec (total real time)}} \times 100 = \text{percent occupancy}$$

Figure 16-1
LGC signal processor real time model

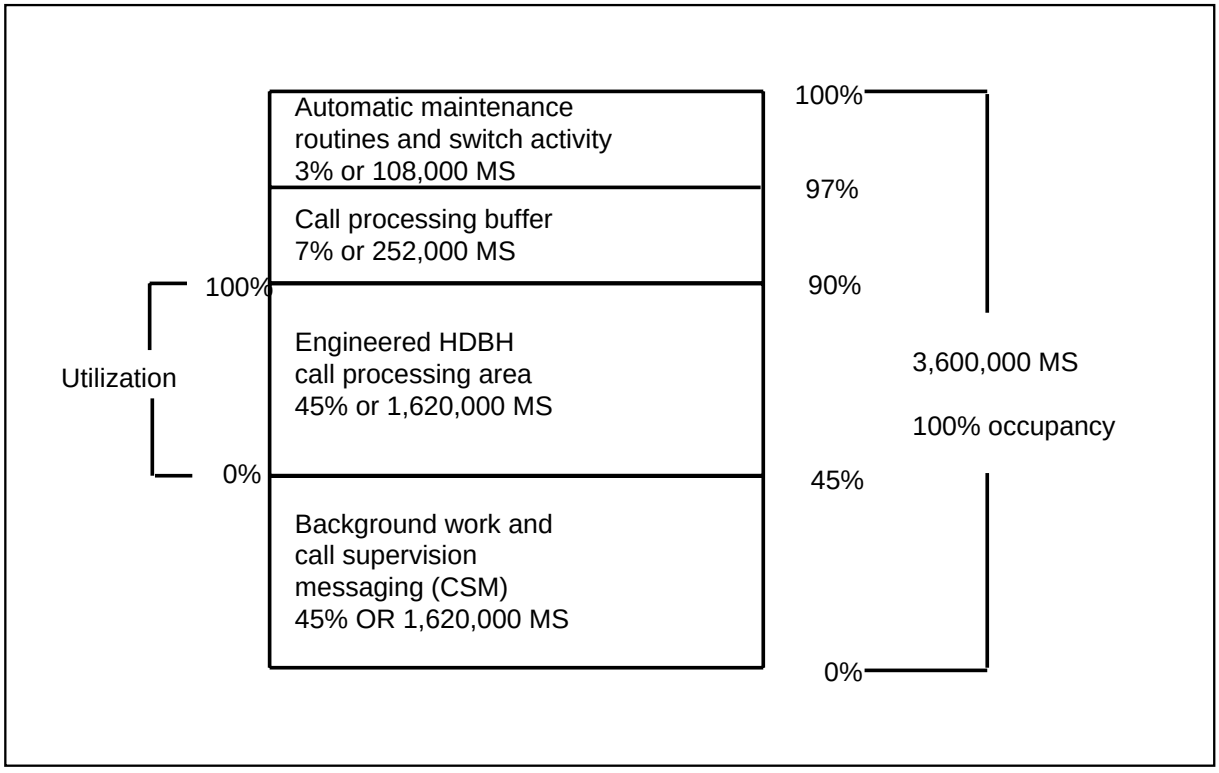


The HDBH real time engineering of a new peripheral concerns itself with the call processing area of the real time model. The end result of the calculation is expressed as utilization of the call processing area. Again, using Figure 16-1 as an example, utilization can be expressed by the following formula.

$$\frac{\text{Total milliseconds required to process calls}}{3{,}600{,}000 \text{ msec} \times 45\%} \times 100 = \text{Percent call processing area}$$

Since calculated HDBH engineering results are expressed in terms of utilization of call processing area while actual measured results output by the XPM ACTIVITY tool are expressed as percent processor occupancy, it is important to differentiate between the terms “occupancy” and “utilization” (Figure 16-2).

Figure 16-2
LGC signal processor real time utilization versus occupancy



Although the models represent each allocated area as residing within a distinct set of parameters, this is not always the case. The processor allocates real time on a prioritized as needed basis. For example, if the new peripheral controller is in a state of required maintenance, the overhead associated with background work takes time away from the area allocated for call processing, while the call processing area would take time away from the

call processing buffer, and so forth. In order to maintain processor sanity while still providing call processing function to the controller, a priority system is employed with real time allocation in a new peripheral processor prioritized as follows.

Call processing (CP)

This includes the areas reserved for the majority of the time spent for call processing, and background work and call supervision messaging (CSM).

Low priority (LP)

This includes the areas reserved for the call processing buffer, automatic maintenance routines, and SwAct coverage.

Call processing (CP) and low priority (LP) are the major defined components utilized by the BCS32 XPM ACTIVITY tool to measure the real time requirements placed on an inservice new peripheral controller.

Prerequisites

The prerequisites for running the XPM performance tool are as follows:

- BCS32 load
- BCS32 XPM load
- software package NTX827AA (XPM real time and performance tools)
- expanded memory in the peripherals
- new messaging in the peripheral to be posted (optional)

Limitations

The following restrictions are imposed on the XPM peripheral performance tool:

- no more than ten users can access the tool at the same time
- only one user can use the tool on a particular peripheral at a given time
- only the active unit of the posted peripheral can be queried
- the tool is only supported in the RCC, LGC, LTC and DTC type XPMs
- a peripheral that does not have expanded memory can be posted; however, the data output for the posted period is not valid
- a posted interval can be specified in 1-minute increments starting at 15 minutes (default) up to 24 hours
- the PRFM 200 and PRFM 201 logs can be turned on during the posted interval; however, they will be generated at 15 minute increments regardless of the posted interval length
- measurements are not transferred over a cold or warm SwAct

- for peripherals hosting trunks, terminating trunk attempts are not pegged in the posted peripheral: however, the real time utilized by the terminations is captured

Overheads associated with running the tool

There is approximately a 1.5 percent overhead in the CPU associated with running the XPM peripheral performance tool. Running the XPM tool will not preclude running the enhanced real time indicator, ACTIVITY, in the CPU.

Using the tool at the MAP level

The option PERFORM, whose execution will result in a new MAP sublevel for the posted peripheral, has been added to the peripheral menu. The options PMAct, DELAYS and PFQUERY are provided at this sublevel. PFQUERY lists the peripherals which have the PERFORM option running, up to a maximum of ten peripherals. PMAct or DELAYS result in another sublevel which provides the following options (Figures 16-3 and 16-4).

- QUIT: Stops displaying of any data on the screen and returns to the previous menu.
- STOP: Terminates START in process and displays the final data for PMAct or DELAYS.
- START: Provides the PMAct or DELAYS data for the posted peripheral in the format shown in Figures 16-3 and 16-4.
- STRTLOG: Is used with START to obtain a hard copy of the data displayed in log format.
- STOPLOG: Terminates STRTLOG in progress.

Figure 16-3
Sample PMAct MAP display

```
   CC    CMC   IOD  Net  PM  CCS  Lns  Trks  Ext
   .       .       .     .      .     .      .      .

    PMAct          |              Sysb Manb   OffL   Cbsy    ISTb    INSv
 0 Quit            |  PM            0    0      0      0       0       5
 2 Strt            |  LGC           0    0      0      0       0       1
 3 Strtlog         |
 4 Stoplog         |  LGC    1 InSv Links_OOS: CSide  0  PSide 0
 5 Stop            |  Unit 0:  Act  InSv
 6                 |  Unit 1:  Inact InSv
 7                 |  Load name:   NLG24BL
 8                 |  Status:RUNNING Reason:COMMAND  Logs:OFF Time:
 9                 |           MP   MPAVG  SP    SPAVG
 10                |  Call Processing --   --   --    --
 11                |  Low Prio Bgnd  --   --   --    --
 12                |           Orig  OrigAvg Term   TermAvg
 13                |           --   --   --    --
 14                |           Avail Inuse  High
 16                |  Ps_chnl      --   --   --
 17                |  Utr        --   --  --
 18                |

 TIME  09:34 >_
```

Figure 16-4
Sample DELAYS MAP display

```
   CC    CMC   IOD  Net  PM  CCS  Lns  Trks  Ext
   .       .      .    .     .    .     .     .

    Delays          |            Sysb  Manb   OffL   Cbsy   ISTb   INSv
0 Quit              |  PM          0     0      0      0      0      5
2 Strt              |  LGC         0     0      0      0      0      1
3 Strtlog           |
4 Stoplog           |  LGC    1 InSv Links_OOS: CSide  0  PSide 0
5 Stop              |  Unit 0:  Act  InSv
6                   |  Unit 1:  Inact InSv
7                   |  Load name:    NLG24BL
8                   |  Status:RUNNING  Reason:COMMAND   Logs:OFF Time:
9                   |      Dialtone  Dialtone  Post     PCM
10                  |           Removal  Dialing    Cutthrough
11                  |      DP  DT  DP  DT  DP DT   Answer Speech_P
12                  |  Avg   --  --  --  --  -- --    --     --
13                  |  50%   --  --  --  --  -- --    --     --   95%   --  --
14                  |  --  --  -- --    --     --
16                  |
17                  |
18                  |

 TIME  09:34 >_
```

Interpretation of PRFM 200 log (PMAct)

The following paragraphs deal with the interpretation of the PMAct sublevel as it is output via the PRFM 200 log.

The PRFM 200 log is output every 15 minutes and is requested via STRTLOG regardless of the time increment specified for peripheral posting (Figure 16-5). The PRFM 200 log contains information indicating the activity within the posted peripheral. This information is presented for each minute of the 15 minute period and a summary which is the average for the 15 minutes.

Figure 16-5
Sample PRFM 200 log (PMAct) display

```
FAST_II     PRFM200  JUL 18  16:47:55  2958  INFO  PMAct_DATA
      LGC 0  Unit 0 : Act
          MPCP   MPLP   SPCP   SPLP  ORIG   TERM  UTR  CHNL
    11:     34%   1 7%   57%    8%   40     59    0    32
    12:     33%   10%   59%    7%   36     66    0    31
    13:     34%   19%   57%    6%   37     67    0    31
    14:     34%   11%   59%    8%   39     62    0    31
    15:     33%   19%   57%    8%   39     61    0    33
    16:     35%   16%   57%    7%   35     69    0    32
    17:     34%   11%   59%    9%   39     63    0    32
    18:     34%   18%   57%    6%   39     64    0    30
    19:     34%   11%   59%    8%   34     59    0    34
    10:     34%   19%   58%    6%   39     69    0    32
    11:     34%   15%   56%    7%   39     60    0    32
    12:     34%   11%   59%    9%   39     66    0    33
    13:     33%   19%   57%    8%   34     61    0    34
    14:     34%   10%   58%    8%   40     64    0    35
    15:     33%   10%   58%    7%   38     65    0    31

   SUMMARY   33%    1 9%   57%    7%   37     63    0    32
   SUMMARY   UTRAVAIL  0   UTRHIGH  0   PSIDEAVAIL 360   PSIDEHIGH  48
```

The log provides data on real time being used for both the master processor (MP) and signal processor (SP) of the posted peripheral. The real time is divided into two categories for each processor.

- call processing (MPCP, SPCP)
- low priority (MPLP, SPLP)

In addition to real time data, the PRFM 200 log provides the following:

- originating peg count (ORIG)
- terminating peg count (TERM)
- number of UTR used (UTR)
- number of P-side channels used (CHNL)

Additional information is provided in the summary section of the PRFM 200 log as follows.

- UTRAVAIL: the number of UTR circuits available in the posted peripheral.
- UTRHIGH: the peak number of UTR used during the 15 minute period.
- PSIDEAVAIL: the number of P-side channels available to the posted peripheral.

- PSIDEHIGH: the peak number of P-side channels used during the 15 minute period.

Interpretation of PRFM 201 log (DELAYS)

This part deals with the interpretation of the DELAYS sublevel as output via the PRFM201 log.

The PRFM 201 log is output every 15 minutes if requested through STRTLOG regardless of the time increment specified for peripheral posting (Figure 16-6).

Figure 16-6
Sample PRFM 201 log (DELAYS)

```
FAST_II     PRFM201  JUL 18  16:47:55  3059  INFO  DELAYS_DATA
     LGC 0  Unit 0 : Act
                        DIALTONE       POST
          DIALTONE      REMOVAL     DIALING        CUTTHROUGH
            DP      DT     DP     DT     DP     DT     ANSWER   SPEECHPATH
     AVG   203ms    405ms   32ms    81ms   335ms   328ms    33ms     80ms
     50%<  160ms    352ms   32ms    96ms   352ms   288ms    32ms     96ms
     95%<  416ms    608ms   32ms    96ms   416ms   416ms    32ms     96ms
```

The measured delay categories are as follows.

Dial-tone delay

This delay is the interval between the recognition of off-hook by the peripheral and the application of dial-tone; the off-hook filter time in the LCM is excluded.

Dial-tone removal delay

This interval is from recognition of the first digit until idle tone is applied and dial-tone is removed. This time includes filtering in channel supervision messaging (CSM) for digits.

Post-dialing delay

This delay is from when the last digit was dialed until the application of audible ringing.

Cut-through to answer

This is the time between recognition of answer by the peripheral and transmission of off-hook to the originating end.

Cut-through to speechpath

The time from when the off-hook is recognized by the originating party to the application of PCM (speech path) between the two parties.

Each of the delay categories are divided into the two subcategories, DP and DT. The DP subcategory is used for dial pulse (DP) lines or electronic business set lines. The DT subcategory is used for Digitone DT0 lines using dual-tone multifrequency or universal tone receivers.

The DP and DT subcategories are measured at three reference points:

- average
  - The average delay for the 15 minute period.
- 50% <
  - Fifty percent of all delays measured over the last 15 minute period are less than this value.
- 95% <
  - Ninety-five percent of all delays measured over the last 15 minute period are less than this value.

Analysis of PRFM 200 log (PMAct) output

Although the PRFM 200 log output lists real time used in the peripheral controller processors on a minute-by-minute basis, it is recommended that several summary sections of the log be used for analyzing real time requirements placed on the posted peripheral.

Since real time engineering of new peripheral controllers is based on high day busy hour (HDBH) traffic, PMAct and DELAYS should be performed at the HDBH.

These allocations are calculated utilizing the data provided by running PMAct on IDLE inservice controllers and analyzing PRFM 200 log output.

Table 16-1 illustrates that an idle in-service peripheral controller has an associated overhead applied prior to any call processing requirement placed on the controller. This overhead is defined as preallocated overhead and is expressed as preallocated overhead = idle MPCP (master processor) = idle SPCP (signal processor).

Table 16-1
PMAct idle controller preallocated BCS32 overhead occupancies

Controller	Master processor preallocated overhead occupancies		Signal processor preallocated overhead occupancies	
	MPCP	MPLP	SPCP	SPLP
LGC	15%	10%	52%	7%
DTC with PTS	15%	10%	73%	7%
LTC without PTS	15%	10%	57%	7%
RCC	15%	10%	48%	7%

Note:

Adjustments:
Master Processor (MP)
None
Signal Processor (SP)
Use +3% (SPCP) for DS1 MTCE (applies to the LGC only)
Use +2% (SPCP) for UTR (applies to the LGC, DTC, and LTC)
There are no adjustments to the RCC

Using the values in Table 16-1 and the above definition, the preallocated overheads for BCS32 XPM prior to adjustments are as follows.

	Master processor (MP)	Signal processor (SP)
LGC	15 percent	52 percent
DTC	15 percent	73 percent
LTC	15 percent	57 percent
RCC	15 percent	48 percent

In addition to preallocated overhead, a portion of processor real time is reserved for low priority tasks which include the following:

- call processing buffer
- automatic maintenance routines
- SwAct coverage

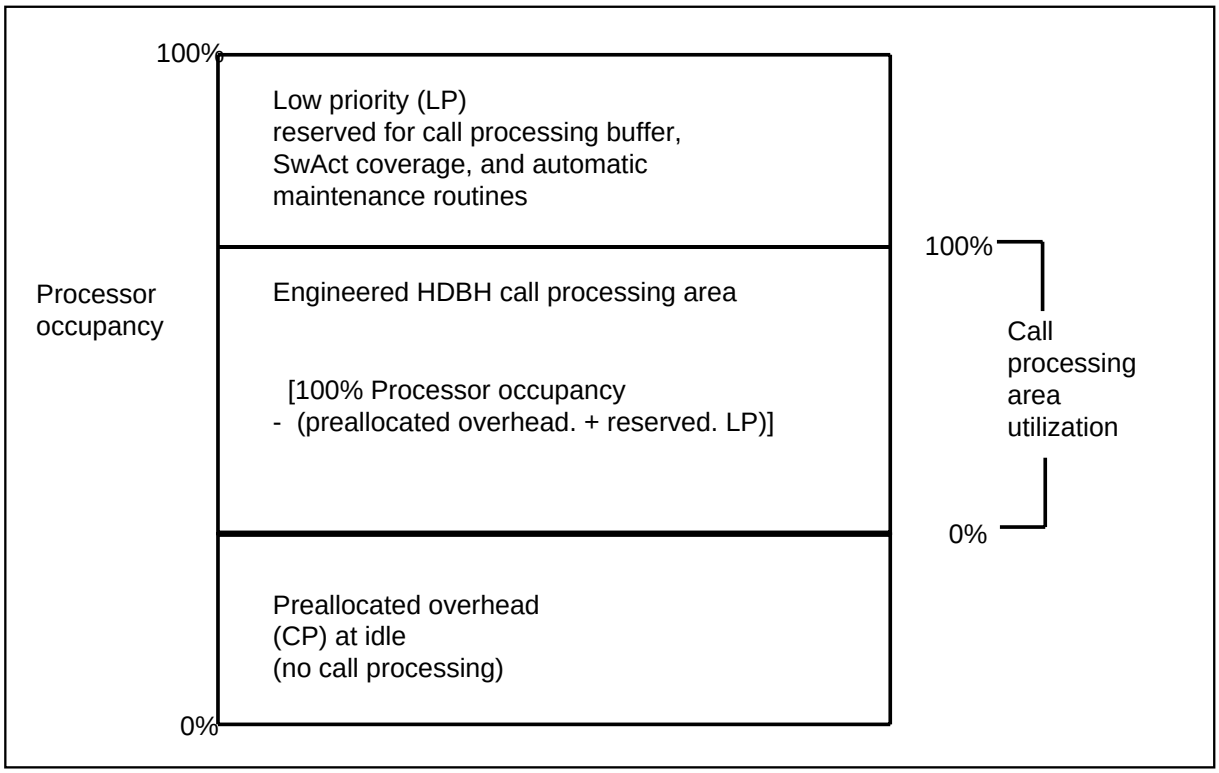
The allocations for low priority occupancy for BCS32 XPM are as follows.

- Master processors (MPLP) 20 percent
- Signal processors (SPLP) 10 percent

The real time occupancy allocated for the engineered HDBH call processing area (Figure 16-7) is expressed in the following formula.

Engineered HDBH call processing area = 100% processor occupancy + Preallocated overhead − Reserved LP

Figure 16-7
XPM activity tool real time model



Refer to Table 16-2 for the BCS32 XPM occupancy allocations for engineered HDBH call processing area in the LGC, DTC, LTC and RCC.

Table 16-2
BCS32 XPM engineered HDBH call processing area occupation allocation

Controller	Master processor engineered HDBH call processing area occupancy allocation	Signal processor engineered HDBH call processing area occupancy allocation
LGC	65%	40%
DTC with PTS	65%	17%
LTC without PTS	65%	38%
RCC	65%	42%
RCC with P-side trunk	37%	26%

Note:

Adjustments:
Master Processor (MP)
None
Signal Processor (SP)
Remotes: Use -3% for DS1 maintenance (applies to LGC only). Example: For an LGC with remotes (45% - 3% = 42%)
UTR: Use -2% for the LGC, DTC, and LTC. Example: For an LGC with UTR (45% - 2% = 43%)

The call attempt real time requirement on a peripheral processor is categorized into three different load levels.

Normal load

This is the call rate for which the peripheral has been real time HDBH call attempt engineered. The real time available in the call processing area allocation is greater than the real time required to process the offered call rate.

High load

The real time required to process the offered call rate is greater than the real time available in the call processing area allocation. The real time allocated for the call processing buffer is now being utilized to perform the call processing function. Once the buffer area allocation is fully utilized, the real time reserved for SwAct coverage and automatic maintenance routines is utilized to perform the call processing function. A peripheral processor in high load has reduced real time available for SwAct coverage and automatic maintenance routines.

Overload

All available real time in the peripheral has been utilized, and overload controls have been have been invoked.

Normal load real time requirement in a peripheral processor using PRFM 200 Log summary output is defined by the following formula.

CP <	Preallocated overhead occupancy	+	Engineered HDBH call processing area allocation occupancy

High load real time requirement in a peripheral processor using PRFM 200 Log summary output is defined by the following formula.

CP > NORMAL LOAD, but < 100%

The peripheral processor is in overload if CP = 100%.

Using the above formulas, peripheral processor load evaluation parameters are as follows.

Master processor

Normal load:

The MPCP is less than or equal to 80 percent.

High load:

The MPCP is greater than 80 percent but less than 100 percent.

High load can be further defined as follows:

- If the MPCP is greater than 80 percent but less than 95 percent, the call processing buffer is being utilized.
- If MPCP is greater than 95 percent but less than 100 percent, the call processing buffer is being utilized and real time available for SwAct coverage and automatic maintenance routines is reduced.

Overload:

The MPCP is equal to 100 percent.

Signal processor

Normal load:

The SPCP is less than or equal to 90 percent.

High load:

The SPCP is greater than 90 percent but less than 100 percent.

High load can be further defined as follows:

- If the SPCP is greater than 90 percent but less than 97 percent, the call processing buffer is being utilized.

- If the SPCP is greater than 97 percent but less than 100 percent, the call processing buffer is being utilized and real time available for SwAct coverage and automatic maintenance routines is reduced.

Overload:
The SPCP is equal to 100 percent.

Comparing PRFM 200 log output occupancies with predicted (calculated) call processing area utilization

The output of the PRFM 200 log real time used by the posted peripheral is expressed as occupancy; while the results of the predicted (calculated) real time engineering of the peripheral are expressed as utilization of the call processing area.

The formulas for converting call processing area utilization (predicted) to occupancy results, (MPCP and SPCP) in the PRFM 200 log summary, are as follows.

Master processor

$$\text{Call processing area utilization} \times \frac{\text{Call processing area allocation}}{100} = \text{Preallocated overhead MPCP}$$

Signal processor

$$\text{Call processing area utilization} \times \frac{\text{Call processing area allocation}}{100} = \text{Preallocated overhead SPCP}$$

The formulas for converting occupancy results, (MPCP) and (SPCP) in the PRFM 200 log summary, to call processing area utilization (predicted) results are as follows.

Master processor

$$\text{MPCP} - \text{Preallocated overhead} \times \frac{100}{\text{Call processing area allocation}} = \text{Call processing area utilization}$$

Signal processor

$$\text{SPCP} - \text{Preallocated overhead} \times \frac{100}{\text{Call processing area allocation}} = \text{Call processing area utilization}$$

Call processing area utilization is a calculated value derived by using the manual calculation method, or by using the mechanized Tool PRTCALC1.

The preallocated overhead associated with a specific peripheral processor type with BCS32 XPM is illustrated in Table 16-1, MPCP for master processors and SPCP for signal processors. Preallocated overheads for BCS32 XPM can also be found in SEB 88-11-003.

Engineered call processing area allocation for a specific peripheral processor type with BCS32 XPM is illustrated in Table 16-2 of this section.

Limiting components

Processor

The processor, either NT40 or DMS-SuperNode, has 100 percent of real time available to execute tasks. These tasks are divided into overhead and call processing areas, with allocations for each area dependent on the processor type (NT40 or DMS-SuperNode) and the requirements of a specific office. A properly engineered and provisioned office should not experience limitations from the system processor.

Network

The network is a fully duplicated (Plane 0 and Plane 1) digital network which functions as a four-stage time switch under the control of the central control complex (NT-40 CCC), or the DMS-Core (DMS-SuperNode)

Peripheral

Traffic sensitive components

Certain components of the DMS-100 are sensitive to the traffic load that is offered to the switch. Therefore, the offered load must be evenly distributed over these components to enable the switch to operate most efficiently.

The components that are traffic sensitive include the following:

- line module (LM)
- line concentrating module (LCM)
- remote line concentrating module (RLCM)
- outside plant module (OPM)
- remote switching center (RSC)
- line group controller (LGC)
- service circuits
- digital recorded announcement machine (DRAM)
- trunks

Balancing considerations

There are balancing guidelines to follow when attempting to balance the load on the peripherals (LM, LCM, RLCM, OPM, RLM, and RSC) that

connect lines to the switch. Lines should be distributed evenly across these modules by class of service. With this procedure, it is assumed that lines of like class of service generate approximately the same usage.

Lines that deviate from average usage can be identified through line studies and moved to other modules as appropriate; or the module may be administered with this deviation from normal taken into consideration. In a mechanized line assignment environment, the usage from these lines is automatically taken into consideration as lines are made available for assignment from the lowest loaded modules.

Overload controls

Introduction

It is the intent of this section to provide an understanding of processor overload philosophy as well as the rationale utilized for the application of overload controls in the DMS-100 switch.

An explanation is provided for the operation of overload controls, the causes of overload and their affect on the line module (LM), line concentrating module (LCM), line group controller (LGC), digital trunk controller (DTC) and the central processor unit (CPU).

Processor capacity models are provided where applicable which depict the capacity allocation in the CPU, LGC, DTC and LCM to give a clear understanding of when overload occurs.

The indicators associated with overload detection are identified, as well as some of the characteristics of the devices while at high load and active overload.

A definition is included of some analysis techniques which use the LOG messages, operational measurements (OM) and internal tools (ACTIVITY and ANALYSIS) for validation of the traffic and service conditions associated with the overload.

Finally, techniques or strategies are outlined which could minimize the traffic and/or condition(s) causing an overload.

Processor overload philosophy

Overload conditions affect call processing resources. Normal fluctuations to traffic load result in brief periods of peaked traffic causing congestion and delays to the intended operation of engineered equipment. This happens even when the average load on the system is below the peak system call processing capacity.

When demands for resources during these short peak traffic periods threaten to reduce call processing capacity, internal overload controls are invoked automatically. This automatic initiation of overload controls is to smooth the traffic peaks. Some calls will be delayed, but all calls will be served. New

originations are limited by scheduling a maximum number of call attempts for a specified amount of time.

Sustained overload conditions vary in origin and severity. The objective of an overload control strategy is to achieve prompt recovery to normal service, consistent with maximum throughput and providing continuous service. Processors will maintain stability while maximizing call handling throughput.

Processor overload occurs when offered traffic produces excessive demands on any available resource (hardware, software, real time, etc.) to the extent that service deterioration occurs.

Overload conditions are detected by measuring some key indicators such as:

- matching loss
- dial tone speed
- engineered circuit overflow
- receiver attachment delay
- queue overflow
- processor occupancy

Overload control strategies are a design function of the switching system architecture. The principles of overload strive to maintain a maximized throughput of successful calls regardless of the extent of overload.

General overload management considerations

Overload is a condition that happens in many different ways. Overload may be due to expected traffic load conditions; for example, holidays, or unexpected traffic; for example, snowstorms; or operational troubles. This section identifies the key considerations for overloads in general and in the DMS-100.

Overload is typically a point in which the grade-of-service objectives for call handling have been exceeded. The impact of an overload can be assessed through the monitoring of dial tone delay, receiver attachment delay, incoming start dial delay, matching loss, and the completion rate of the traffic accepted by the system. Overload management requires analysis of the office as a whole to determine the source of an overload condition and the appropriate action to respond to the overload.

First, it must be determined if traffic load is the cause of the overload. The traffic level can be determined through traffic or processor measurements established within the system. Traffic considerations must then pin-point any constraining engineered item.

These items consist of the following:

- processor occupancy
- peripheral channels
- network channels
- receivers
- software parameters

Exceeding any one of these items can lead to delays or blockages of call attempts. Overload controls limit the adverse affect due to lack of provisionable items. Even with overload controls in place, proper engineering of resources must exist to limit the customer impacts in ongoing day to day operations. Traffic measurements exist for all engineered items and in turn allow the operating company administrator to determine the level of operation appropriate for the traffic engineered for the system.

If traffic is not the overload source, then any operational issues must be examined. Operational issues may show up in heavy traffic conditions; however, many operational issues can be spotted and eliminated prior to an overload. As an ongoing maintenance activity, operational issues require LOG and OM analysis to identify trends in switch performance.

The maintenance goal for an operational switch is to achieve the assessment test criteria for office health and call completions. This level of operational health handles heavy loads in the most efficient manner. Without this level of maintenance, the trouble conditions can lead to ineffective call handling due to equipment out of service or mishandling of the call attempts.

Once the source of the overload is identified, measures are taken to reduce the impact of the overload. The internal overload controls will automatically limit new originations by delaying them and work on calls in progress to insure their proper completion. These controls will maximize the throughput of the traffic accepted by the switch.

Cases may arise which require the implementation of network management controls to preserve the overall grade-of-service for the network, including the switch in overload. After the switch has been allowed to control the traffic, the network controls may be implemented. Network controls should only be implemented once it has been determined that the overall throughput of the network can be improved.

The key to managing any overload condition is to determine its impact on performance, its source, and a suitable response, if any, to minimize the impact.

Overload controls

The DMS-100 Family office is designed and configured to handle a defined amount of traffic with defined characteristics. If the designed load is exceeded, some of the traffic must be delayed or blocked. The exact effect depends on the nature of the overload. The design intent is that any part of the equipment that is offered more than its rated load should continue to operate at or near its rated capacity. The excess load should be delayed or blocked in an orderly manner. The presence of excess load should not cause throughput degradation or outage.

Overload may be manifested in four main areas:

- shortage of hardware and software engineered resources
- shortage of speech paths
- shortage of processing capacity in one or more peripherals
- limits on global system capacity

The central control (CC), as the focus of all switching activity in the DMS-100, effectively determines the ultimate system capacity and hence requires overload protection in order that the system does not experience throughput degradation or outage in the presence of excess load.

The algorithms used in the DMS-100 to achieve processor overload protection are described in the following paragraphs.

Message throttling

Message throttling is a technique employed to limit the number of messages that a processor will accept in a unit of time. Basically, message throttling is realized by weighing messages according to category (call processing, non-call processing) and ensuring that, during any clock tick, the weighted sum of messages does not exceed a predefined threshold. Once the threshold is reached, interrupts are disabled until the start of the next clock tick, at which time the process is repeated.

Progress message favoring

Progress message favoring ensures that calls in progress are given preferential treatment over new originations. This is realized by splitting call processing into two queues, origination and progress, and always serving the progress queue first. Progress messaging favoring delays the number of originations accepted by the processor and limits the possibility of destructive processor overload.

A side effect of this technique is that it practically guarantees that accepted calls will be successfully completed.

Resource reservation

A variety of resources are required in order to process call events. These resources are office engineered and hence, under overload, a number of these resources will exhaust. In the DMS-100, by design, resources exhaust on originations and not progress events and, by impacting only originations, the shortage effectively serves as an overload control.

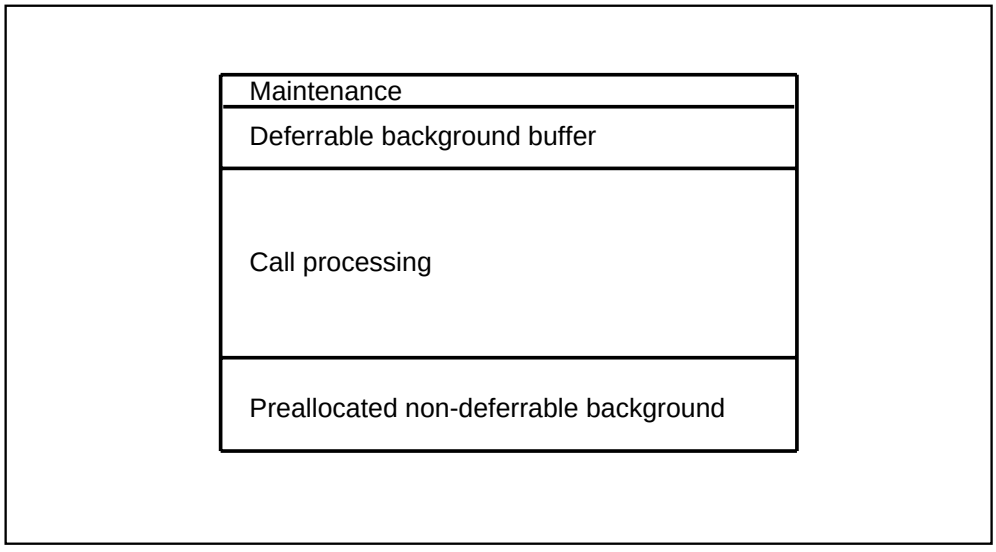
Ineffective attempt limitation

The primary goal of a processor under overload is the successful termination of the maximum number of calls. As overload conditions persist, delays tend to develop in processing new call originations and this leads to an increase in predial abandons. Handling abandoned calls lowers the overall capacity of the processor. Load shedding techniques have been introduced in the processors to control regeneration of messages.

A basic processor theory which can be applied to any type of processor unit incorporates capacity allocations for the following areas as shown in Figure 18-1:

- preallocated background which is non-deferrable
- call processing
- deferrable background buffer

Figure 18-1xxx
Typical processor allocation model



All processors in the DMS-100F switch remain stable in overload. There are specific operations which are affected by the overload to allow for stability and maximum call processing:

- dial tone speed

- terminal response
- OM transfer
- incoming start dial delay
- matching loss

Indications of the active overload condition include operational issues associated with service deterioration along with specific LOG messages, operational measurements and alarms. Periodic notification of the overload condition is provided as a reminder.

Static operational issues which take place in the DMS-100 switch along with maintenance activities during overload tend to magnify the traffic and/or condition associated with the overload. Methods can be introduced to minimize these activities in order to maximize capacity utilization during high traffic periods. A properly performing switch will provide the most efficient capacity utilization.

Network management controls

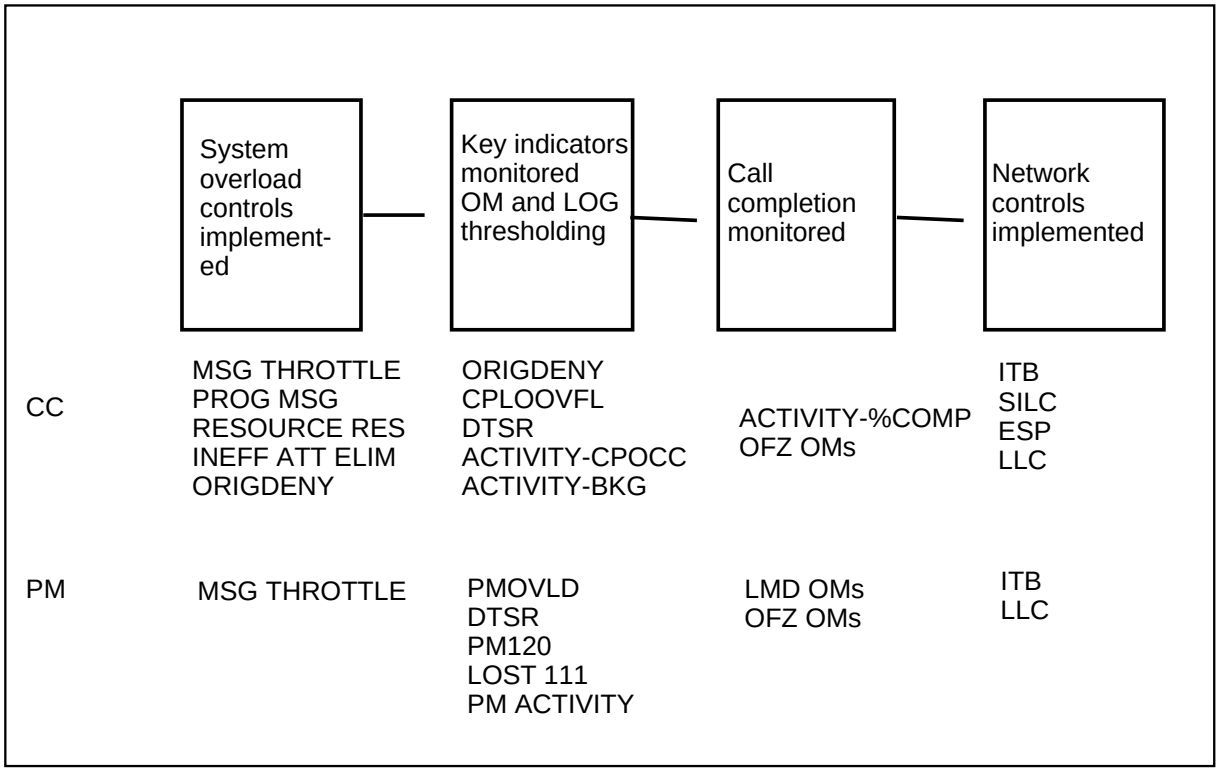
Network management controls are typically used to limit or alter traffic for purposes of insuring maximum traffic throughput under adverse or overload conditions. Network controls are pre-planned for typical high network traffic days such as Mother's Day or Christmas. Other days may unexpectedly produce traffic overloads. Network management controls are not expected to replace internal overload controls. They are used as a supplementary tool to enhance the throughput of the switch and the network completion of traffic.

The internal overload controls must be first allowed to throttle traffic for unexpected traffic conditions. If the overload is so extreme that grade-of-service and throughput are significantly diminished, then the network controls may be implemented. grade-of-service or call completion characteristics of the traffic should be used as a basis for the decision to use network management controls in any situation.

As with planned high network traffic days, unexpected load conditions can have pre-planned network management strategies. These paragraphs will discuss the traffic considerations for the implementation of network management controls. The considerations are diagrammed in Figure 18-2. Northern Telecom network management controls are described in *DMS-100F Network Management System Reference Manual,* 297-1001-453.

Network management trunk group controls are used to remove traffic load from the switch. Where possible, block the offered traffic in the offices sub-tending off of the one in overload. Internal dynamic overload controls can be built to limit traffic from offices for which there is no remote capability.

Figure 18-2
System and network overload control strategy



For a switch in overload, three network controls provide traffic relief and one control provides a grade-of-service enhancement for key users. The controls are incoming trunks busy (ITB), selective incoming load control (SILC), line load control (LLC), and essential service protection (ESP). These controls should be applied only when the source of the overload, the effect of the overload and the benefit of the control have been determined.

Incoming trunks busy (ITB) restricts incoming traffic by removing incoming trunks from service. By manually applying this control to specific trunk groups, a percentage of the trunks are made busy. This control should be applied to the trunk groups that are using the call processing resources and in turn affecting the grade-of-service of the PM or CC.

When this control is activated, the usage and attempt limited call processing resources in the PM and the CC are preserved by denying access to incoming traffic. The call processing resources do not see this traffic. This control is very effective since it is removing a portion of the traffic offered to the switch. In the sub-tending office, the traffic is either directed to other trunk groups or sent to tone or announcement.

Selective incoming load control (SILC) restricts incoming traffic by routing calls either within a preset gap, or a percentage of the calls, to 120 impulses per minute (IPM) tone. For selected trunk groups, this control can be activated automatically or manually to route set levels of incoming traffic to 120 IPM tone. The control allows a percent of the traffic to be completed or establishes a timing gap between the calls that will be completed. In the switch, this control preserves usage and attempt limited resources by denying terminations to lines or trunks and routing these attempts to tone.

The initial seizure is recognized by the switch, and thereby requires some call processing resources to be used in satisfying the requirements of this control. This control should be used only if the incoming traffic is the source of the overload and the grade-of-service can be enhanced by this control. The control can lead to regenerated traffic if the end user re-dials the call after receiving the 120 IPM. When this control is active, the OM OFZ_INTONE and TONES_T120_TONEATTS will be pegged for the calls routed to 120 IPM.

Line load control (LLC) restricts line traffic by routing lines (other than essential service classed lines) to lockout. This control can only be implemented manually. For this control, the initial request for service is recognized by the call processing resources and the central control determines if the line is an essential line. If the call is from an essential line (ELN option is assigned to the line), the call is provided dial tone and completed in a normal manner. If the call is not from an essential line, the call is put in a lockout state and is forced to re-originate.

Line load control provides a savings for call processing resources by forcing line originations out of the system. However, from the non-essential subscriber point of view, this control would look like a no dial tone condition and may cause the subscribers to produce multiple originations with no effective completion. This control should only be used in very extreme circumstances in which the only way to provide relief is to force out line originations. OM OFZ_ORIGLKT is pegged when calls are forced out through this control.

Essential service protection (ESP) provides no traffic relief, but it does provide key users with a preferential grade-of-service. The preferential users are identified by an ELN option established against their line. This control can only be activated manually. When the control is activated, the essential lines are placed at the head of the origination queue, thereby providing dial tone to these users before any others. Using this control will eventually provide dial tone to all users who remain off-hook, which in turn maximizes the throughput. When in overload, this control is preferred over LLC to limit the impact on line originations.

The key considerations for implementation of network management controls for an unexpected traffic overload are:

- where is the source of the overload
- what is its impact on the throughput and the grade-of-service
- what network control should be used
- what is the benefit to the service when the control is implemented

Determining the factors noted above initiates the groundwork for individual office strategies to deal with traffic overloads.

Traffic overload considerations

In the DMS-100 Family of switches, various modules interface lines and trunks. These interfaces are combined with the network to provide switching paths for calls. The interaction and connection of these modules can be sources of delay or blocking. Traffic overloads can cause the delay and blocking criteria to be exceeded for these system components and thus affect the end user grade-of-service.

Dial tone delay and incoming start dial delay measurements indicate the level of service offered to originating traffic. Dial tone delays and incoming start dial delays may occur when the CPU is busy, if the peripheral has no channels available, or if the peripheral processor is busy, or if a receiver cannot be attached. The cause of these delays can be established through operational measurements.

The key operational measurements to monitor for dial tone delays are DTSR, SITE, SITE 2, LMD, PMOVLD, UTR, RCVR, LM, PMTYPE, PM, and PM2. DTSR provides the level of dial tone delays encountered in the system and designates the type of PM and signaling system which encounters the delay (LM or LCM and DP or DT). With BCS24, dial tone delays will be available as an OM on an individual PM module basis. A relative indication of dial tone delays due to the central control can be obtained from the ACTIVITY measurement of OAVGDEL.

A dial tone delay caused by a shortage of receivers or a PM type can be determined from the OMs. LMD and PMOVLD measures the individual PM which may cause dial tone delay due to traffic usage or attempt overloads. Dial tone delay measurements on an individual PM basis will also identify individual PMs which may be overloaded. RCVR and UTR indicate the level of receiver traffic and is used to determine if a lack of receivers are causing dial tone delays. LM, PMTYPE, PM and PM2 measure the equipment performance which may in turn produce dial tone delays because of operational issues.

For incoming start dial delays, the key operational measurements are TRK, RCVR, UTR, DCM, TM, PMTYPE, PM and PM2. The measurement for

incoming start dial delays is currently targeted for BCS24 and will provide the level of delays on a per PM basis. A relative indication of incoming start dial delays due to the central control can be obtained from the ACTIVITY measurement of OAVGDEL. TRK identifies the traffic for individual trunk groups which may focus a load on a system. RCVR and UTR would indicate whether or not a lack of receivers would cause the delay. Operational performance must also be considered for incoming start dial delay. The DCM, TM, PMTYPE, PM, and PM2 measurements identify equipment issues which may produce these delays.

Blocking of calls are measured by matching loss measurements. A certain level of blocking is engineered into office applications. Chapter 14, Load versus Service, specifies the matching loss criteria.

Prior to establishing a network path, dial tone delay or incoming start dial delay criteria apply to the call attempt. Once the call attempt seizure has been satisfied and called number information has been processed, the switch will attempt to establish a network path to the terminating line or trunk if it is idle.

Once dial tone or start dial requirements are satisfied, the DMS-100 central control treats line and trunk originations equally. Therefore, a line attempt to establish a network path to a line is equivalent in nature to a trunk attempt to provide a network path to a line. Conversely, a line attempt to provide a network path to a trunk is functionally equivalent to a trunk attempt to establish a network path to a trunk. Since lines have concentration associated with them, their terminations have a higher probability to block than terminations to a trunk.

In the DMS-100 Family, terminating matching loss criteria is identical to incoming and intra-office matching loss and is defined as the failure to set-up a network connection from a line or trunk to an idle line. Likewise, outgoing matching loss criteria is identical to tandem matching loss and is redefined as the failure to set-up a network connection from a line or trunk to an idle trunk.

If the blockage occurs in the network, TRMT1_NBLH (TRMTRS_TRSNBLH) is pegged. The OM group TS is then used to determine which network is at or over its capacity. If the blockage occurs in the peripheral, TRMT1_NBLN (TRMTRS_TRSNBLN) is pegged. The OM LMD_TERMBLK is then used to determine which line peripheral contributes to the blockage. Trunk peripherals have no concentration, and therefore will not contribute to blockage.

Engineered parameters is another area in which a lack of resources results in unsatisfactory completion of call attempts. Ideally, the engineered software parameters should not be exceeded. For example, a lack of CPLETTERS or CCBS results in no dial tone for the end user. The lack of these resources is

measured in the CP group by the OMs CPLOOVFL and CCBOVFL. If some of the engineered parameters are exceeded, activation of a feature may be prevented. As an example, the lack of call waiting extension blocks causes the failure to attach a call against a busy line that has the call waiting feature. In general, if an OFCSTD or OFCENG parameter is exceeded and is affecting the call completion or feature activation, the overflow OMs in the groups EXT and CP are pegged.

The last provisionable item to consider for overload is the receiver. A lack of receivers will cause calls to be delayed and queued. These receivers are typically engineered for a specified level of delay. Some operating operating company administrations will engineer this component for no delay. In either case, a delay due to receiver availability would be measured by the DTSR, SITE, SITE 2 OM.

The number of calls sent to queue due to a lack of receivers is measured by UTR_UTROVFL or RCVR_RCVOVFL. If the queue is full, the call will peg the UTR_UTRQOVFL or RCVR_RCVQOVFL OM and the call will be re-originated by the PM. Receiver usage is measured by the UTR_UTRTRU or RCVR_RCVRTRU OMs. These OM are used to determine the engineered load level for the receivers. Standard practice should be to engineer the receiver such that it contributes a minimal amount of dial tone delay or incoming start dial delay.

Line concentrating module overload controls

Line concentrating module (LCM) internal overload controls provide a staged response to traffic peaks. At times of peak traffic an LCM faces more demand than it can process or queue. Overload controls allow the LCM to finish work in progress by slowing down or rejecting incoming work until the peak has passed.

The processors of the LCM have two resources: real time and data store. Each processor can perform only one operation at a time. Thus it is possible for more work to arrive than the LCM can handle in a short period of time. The LCM queues work to be done in data store to spread the work over a longer period.

Additionally, each processor must communicate with the C-side device, line cards and its mate. Any one of these communication links cannot accept data as fast as the processor can write it. Therefore, the LCM queues completed work in data store.

If the LCM cannot keep up with the arrival of new work or if it cannot communicate work it has finished while new work arrives, it runs out of data store. Therefore, an LCM which has run out of data store is in overload.

The LCM overload detection and control monitors the amount of data store available to queue work. Rather than waiting for data store to run out

completely, overload is introduced in two stages. At each stage, a particular type of new work is either accepted at a slower rate or rejected until more data store is available.

The overload stages include functions associated with controlling inter-unit communication (IUC) and line scanning are described below:

- Inter-unit communication will be eliminated when overload progresses to the second stage. Update messages to the mate processor will not be created.
- Line scanning functions will be terminated in the third and final phase of overload controls in the LCM. At this point the scanning of the bus interface card (BIC) for new work will stop.

The staged introduction of overload controls is accomplished using a threshold utility associated with memory block management. When the free memory blocks reduce to the set thresholds, the overload stage is activated.

Enhancement to the LCM has been limited by two major deficiencies; limited random access memory (RAM) and LCM's ignorance of call processing state. The limited RAM space prevents adding sophisticated overload controls to the present code. Furthermore, since the LCM cannot determine call processing state, it handles originations, terminations, and calls in progress indiscriminately.

To supplement the existing LCM overload controls, it was necessary to utilize existing line group controller (LGC) overload controls. LCM overload controls in the LGC consist of the following:

- a means of signaling load state to the LGC
- a throttle for originations from overloaded LCMs
- an audit of LCM overload state
- a means of reporting control activity to the CC

Signaling the load state of the LCM is accomplished by adding data store reserve information to messages bound for the LGC flow controls. If one or both units of the LCM has a low reserve of data store, the LGC decides that the LCM is overloaded and applies origination controls to messages for that LCM. The LGC continues to apply these controls until both units of the LCM have sufficient free data store to resume normal processing.

Origination control is incorporated after the LGC reads the load state from the LCM message. The LGC decides whether to queue the message. If the terminal is idle or there are already messages queued for that terminal, the LGC puts the new message on the last-in-first-out (LIFO) queue.

After at least 20 ms, the LGC flow control takes a message from the queue. If the LCM happens to be overloaded, flow control puts the message on the

guaranteed dial tone (GDT) queue. Eventually the GDT audit will dequeue a message from its queue. If the message is from an overloaded LCM, the audit places the message back on the queue.

If the LCM is not overloaded, the GDT audit checks how long the message has resided in queue. If the message is less than 3 seconds old, flow control sends it to the master processor (MP). Those messages which are older require that the LGC query the LCM for present terminal state.

Thus LCM origination control acts as a throttle on the rate that the MP and the CC process originations for overloaded LCM.

Every three seconds an audit checks the load state of each processor unit. If there are no terminations queued for a unit and there have been no overload messages from that unit for 3 seconds, the audit changes the unit to “out of overload”.

Reporting overloaded LCMs to the central control is accomplished whenever the LGC flow control puts a message on the GDT queue. The origination deny operational measurement (OM) is incremented for the affected LCM.

Locating these LCM controls in the LGC takes advantage of the following LGC flow controls:

- origination flow control
- guaranteed dial tone
- per terminal queuing
- LIFO queuing of originations
- these flow controls are beyond the capabilities of the LCM

Indicators associated with the overload controls of the LCM come in various forms. Service indicators as well as LOG messages, operational measurement and alarms are provided to alert personnel of the overload condition. Interactions caused by overload in the LCM depend upon which stages are in effect.

Inter-unit communication, stage one, will cause cut off conditions if there happens to be an uncontrolled takeover by the mate processor.

Line scanning, stage two, will cause the BIC output buffer to fill. The BIC will not accept new work. Symptoms of this stage include partial dials and ignored keys on the electronic business sets.

LOG messages associated with overload control in the LCM include PM 128, PM 180, and LOST 111.

The PM 128 indicates that the node (LCM) has changed service state. This LOG is provided when the LCM goes in-service trouble (ISTB) from in-service (INSV) and also when the LCM returns back to in-service (INSV) from in-service trouble (ISTB).

The PM 180 is an exception report which identifies why the node (LCM) has changed service state. The first PM 180 message, which follows the PM 128, indicates that the LCM is overloaded. Identified in this message is the number of messages for each stage of overload which have been lost due to overload. A second PM 180 is produced when the LCM has been in an overloaded state for approximately five (5) minutes. This PM message is produced by an internal audit. The time between logs of this nature in a sustained overload situation depends on the traffic load.

The number of messages lost for each stage of overload control are identified in the PM 180 report. The amount of messages lost cannot be directly compared to calls in the OM on a one for one basis. A call attempt will require two or more messages before it can be classified a call.

A LOST III is produced for each message that is lost due to an overloaded LCM. These lost messages may lead to a PM state change that would result in PM 128 and PM 180 logs.

Figure 18-3 provides an example of a LCM overload report.

Figure 18-3
LCM overload report format

```
*  PM 128   FEB 28      09:13:53    5574  TBL   ISTB  LCM   HOST 01 1
FROM :      INSV, UNIT 0 :     ISTB FROM  INSV*
   PM 180   FEB 28      09:13:53    5575  TBL   PM  EXCEPTION REPORT
HOST 01 1   LCM 3  UNIT 0
LCM ENTERS OVERLOAD :  DMSX : 1     IUC : 0           SEQ : 1
*  PM 180   FEB 28      09:15:42    5688  TBL   PM    EXCEPTION REPORT
HOST 01 1   LCM 3  UNIT 0
LCM OVERLOADED :  DMSX : 154        IUC : 19    SEQ : 2
*  PM 180   FEB 28      09:23:57    5743  TBL   PM    EXCEPTION REPORT
HOST 01 1   LCM 3  UNIT 0
LCM OVERLOADED :  DMSX : 22         IUC : 1     SEQ : 2
*  PM 128   FEB 28      09:30:08    5808  TBL   ISTB  LCM   HOST 01 1
FROM :      ISTB, UNIT 0 :    INSV   FROM ISTB
*  PM 180   FEB 28      09:30:08    5809  TBL   PM    EXCEPTION REPORT
HOST 01 1   LCM 03  UNIT 0
LCM OUT OF OVERLOAD
```

Operational measurements, which aid in the identification of overload in the LCM, include PM2FLT in the PMZ OM group and PORGDENY in the PMOVLD OM group.

- PM2FLT is a maintenance operational measurement which provides information on the number of times that the LCM goes ISTB.
- PORGDENY is provided on a per LCM basis to indicate the number of originations which were denied in that node. This OM is under control of the LGC as part of the enhanced LCM overload controls.

The dial tone speed indicator for each node was committed for availability in the BCS24 time frame. This measurement will provide a good indicator of LCM operational state.

Verification of the traffic conditions which were associated with any overload condition can be accomplished by using operational measurements, logs and service indicators.

When the log is printed out showing the state change from INSV to INTB, all activity on the LCM by craftspersons, or hardware failures on the switch should be recorded. Attempts should be made to determine if the LCM has been under-provisioned or the result of other maintenance problems.

Analysis of the PM180 logs will provide the number of messages which have been lost for each communication path. Through the evaluation of the numbers presented in the printout, one can evaluate the extent of the overload condition.

Operational measurement group PMOVLD, registers PORGDENY and PTRMDENY associated with the overloaded LCM will provide the number of calls which were denied due to the overload condition.

The LMD operational measurement field will provide the number of attempts which tried to originate on or terminate to the LCM at the time of overload as known by the CC. This information, along with call timing and capacity allocation information, will allow manual calculation of the call attempt capacity on the LCM. The PC-based tool PRTCALC provides a mechanized calculation of the LCM capacities.

Customer reports can be used to isolate or help identify overload conditions. No dial tone or slow dial tone are good indicators as are cutoffs and incompleted calls, to indicate that the LCM is under a higher than normal load.

Some actions which may be taken to minimize the overload condition include the restriction of originations from the line by incorporating manual line load control techniques. This is a drastic measure, but the effect on the processing is instantaneous.

Some measures which may be taken by the operating operating company to prevent the overload condition from recurring are defined in the following techniques. These are just examples of actions which could prevent overload:

- balance line and load
- increase the links to the LGC
- correct any operational issues
- deload the LCM

The resources of the LCM processors are real time and data store. Since data store depletes before real time can be completely used, the overload controls are keyed on the free data store available for call processing. However, since the amount of data store required for each message or call is not a typical or standard value, an alternative method of determining capacity utilization for engineering had to be developed.

A test plan was developed and run which produced a high rate of call attempts on the LCM to the extent that the LCM went into overload. At the same time, the amount of real time capacity utilized by this test plan was monitored to evaluate the real time level of overload.

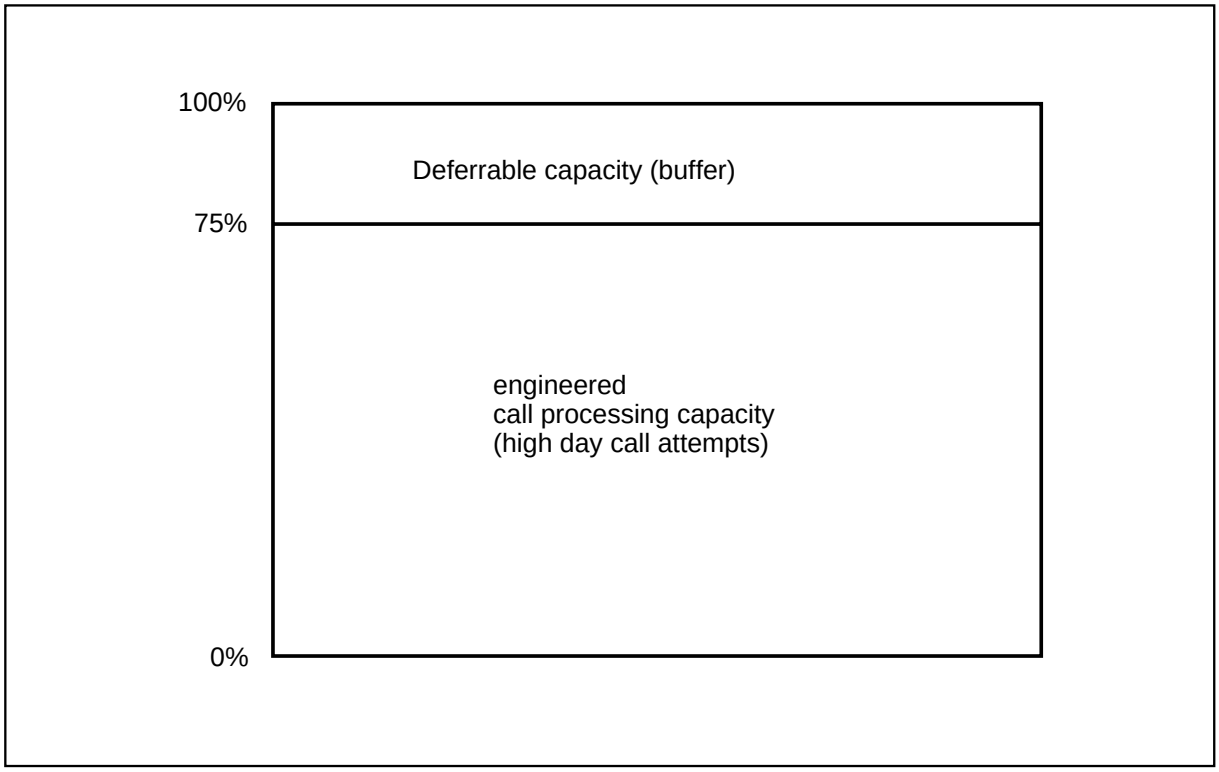
Once the real time level of overload had been determined, it was decided to provide a capacity area for fluctuations in normal traffic patterns. This area is deferrable and gives way to all processing.

After allowing for the buffer area, the remainder of the real time capacity is used for call processing. Knowing the allocation for call processing and the call configuration used, the call attempt value in milliseconds was determined.

The process just mentioned was the one used to develop the call timings and capacity allocations for the LCM which are for engineering projections. Engineering projections are based on the operating company requirements for the high day busy hour (HDBH) call attempt rate.

The HDBH engineered call processing area has 2,700,000 milliseconds available for call processing. The typical call attempt in the LCM will require between 535 and 585 milliseconds. The area set aside for buffer is 900,000 milliseconds and is not used for engineered load (Figure 18-4).

Figure 18-4xxx
DMS-100 LCM processor model



Peripheral overload controls

A peripheral XPM in overload is defined as when a resource needed for processing is exhausted and the XPM can no longer handle the work it is given. That resource may be processor time (real time), call processing blocks, message buffers for communication of P/C side links. The lack of that resource causes problems within the peripheral. Not dealing with the overload condition results in these problems degrading service given to the customer. When a situation arises that results in the peripheral about to go into overload, actions are taken to ensure the impact on service to the customer is minimized.

The new peripheral overload control goals provide the following characteristics:

- Of the calls presented and accepted, 99.99 percent of the calls will be completed, assuring maximum throughput.
- Of the accepted calls during overload, the grade-of-service will not be reduced below published specifications.
- All transitions of peripherals into active overload will be noticeable with visual and audible indicators and operational measurements showing calls denied.
- Occurrences of extreme overload should be reduced.

The overload controls in the peripheral can be divided into three sections:

- flow control
- overload protection
- overload indicators

All three sections are needed to provide a controlled and stable overload transition if associated with internal overload strategy.

Flow control is the mechanism which minimizes the impact of a peripheral going into overload. Placing these controls in the peripheral does minimize the transitions into overload, and their impact on the customer is controlled. No new work will begin on new calls (both terminating and originating) when there is not enough resource to service calls already in progress. This does not mean that the flow control sheds the originations or terminations. Call processing messages and control are prioritized before being routed to the signal processor for handling. This in turn reduces the load being sent to the master processor.

The flow control system has been designed to provide control in the master processor (MP) and the signal processor (SP). The SP flow task will not give work to the MP until the SP has some time available and the MP has been doing work from its idle queue. The SP will not be given new work until the MP has processed its idle queue.

The SP flow controls are based on the aforementioned principle that no new work will be started until the SP has time to do the work which is already on its queues. To accomplish this, the SP must monitor real time. When the real time drops below a predetermined level, it will not allow new work to begin. New work is defined as messages to terminate or originate.

The main objective of the flow controls is to reduce the load in an orderly manner. The algorithms built into the flow tasking functions accomplish this by giving call processing functions in progress priority over terminations and terminations over originations.

Termination message flow control will only deny terminations when the incoming queue reaches its maximum and there are no originations that can be denied first. The LGC will not deny terminations unless under very severe conditions.

Some enhancements introduced to the overload flow controls include per terminal queuing, guaranteed dial tone or dial tone at all costs (DAAC) and trunk flow and overload controls.

Individual terminal queuing

Individual terminal queuing is used by the flow control to increase the effectiveness of termination flow and overload controls. It performs the following functions:

- Individual terminal queuing is implemented with the overload and flow controls to reduce initial messaging when a call originates or terminates. The master processor code receiving the messages is streamlined for better handling of multiple messages for any particular terminal. Individual terminal queuing allows the sending of a single message per terminal to the master processor even when there are several messages sent from the CC. This is accomplished by linking additional messages to the first. The master processor has the ability to unlink these messages and place them into the queuing system for master processor call processing.
- Individual terminal queuing reduces the impact of babbling on the peripheral. It also eliminates the possibility that supervision could be processed out of sequence by linking the messages in order until they are sent to the CC. No supervision will be sent to call processing if supervision for that terminal is still on the flow control queues.
- Individual terminal queuing is the linking of messages against one terminal in one queue in the order of receipt. This is used for both termination flow control and origination flow control.

- Individual terminal queuing reduces message overhead and decreases the number of message transfers within or between processors. This is achieved by transmitting messages relative to the same terminal together rather than handling the messages in the order that they arrived on the queue.

Guaranteed dial tone

Guaranteed dial tone (GDT) or dial tone at all cost (DAAC) provides dial tone eventually to all phones that remain off-hook even if the message has been lost due to overload or message faults. This does not mean that the phone receives dial tone quickly but that dial tone is applied eventually. This feature ensures that users receive dial tone without having to reoriginate. Messages lost on the way to the LGC from the LCM will not get GDT treatment.

The guaranteed dial tone feature gives protection under CC overload conditions or warm restart. The LGC/RCC will not retransmit originations to the CC at a random rate. If the LGC receives no reply from the CC from an origination it will not retransmit any origination until one second later. Under CC overload or restart the CC will not be flooded with originations.

The DAAC feature is supported in the line environment only. Trunk originations are not provided the DAAC feature simply due to the fact that the control of the trunk origination is external of the switch which has DAAC controls. The chance of the originator abandoning the request is highly probable, thereby eliminating the need for the reattempt.

Trunk flow control

Trunk flow and overload control uses the same system as the line flow and overload control. Trunk types which use winks after receiving off-hooks from the other end (for example, MF wink, DP wink, MF delay dial, ground start) are supported. Trunk types like dial pulse (DP) immediate and revertive pulsing (RP) immediate cannot have the off-hook delayed since digits are sent soon after seizure. Therefore, these trunk types do not have overload protection.

The trunk flow and overload control reduce trunk originations to a lower priority than call processing. Trunk originations utilize LIFO queuing. Since the system will delay originations until new work can be started, any trunk that sends unsolicited information is not handled.

Trunk flow and overload control can be summarized by stating that only under severe conditions will a single origination be thrown away by the control system. In effect, the flow control system is the overload system.

Once the flow controls have been initiated, messages will get delayed on the queue in the SP and MP. If these queues become too large, there is a risk of degradation of services to the calls in progress.

There is an algorithm which monitors the available real time and the communication buffers. At a defined level (30), the load is shed by denying originations and throttling terminations.

Messages delayed due to the prioritizing of call processing are handled systematically so that stale calls are not set up just to be taken down.

The best way to find out whether the P-side of the LGC or the LTC is overloaded is not by guessing what kind of work it has done previously, but by using a straightforward indication to the controller.

If the LCM is overloaded, it sends a message to the LGC/LTC so that the controller can slow down the origination rate from the LCM. Once the LCM has gone out of overload, it informs the host controller to revert its action back to normal condition.

When the new peripheral goes into active overload, there are indicators which notify personnel and machine of the event. Operational measurements, LOG messages, PM Activity tool, and service indications provide accurate information of the overload.

Operational measurements

All originations and terminations which are denied in either the CC or the peripheral during active overload are reported on a new peripheral basis.

The CC is notified of the counts of the originations and terminations which are denied in OM tables for each LCM, LGC, LTC, or DTC (PMOVLD). Registers PORGDENY and PTRMDENY are provided in PMOVLD as operational measurement indicators.

The PORGDENY register is incremented when the peripheral runs out of real time and begins to deny originations. The originations are denied so that in progress calls are completed with good grade-of-service.

The PTRMDENY register is incremented when new termination attempts are made after the peripheral runs out of real time and its flow control queue grows above a defined level.

When a trunk origination is denied, a peg against the peripheral (LTC, DTC, RCC) will be incremented in PMOVLD under the column for origination deny (PORGDENY). Remember, trunk originations are denied only if the queue becomes full and terminations will be denied only when the length of the queue grows above the defined level.

If the peripheral should drop activity during overload, OMs will be retained in the peripheral and transmitted to the CC when it returns to service.

LOG/OM cross reference

When the peripheral goes into overload a PM 128 log is registered. This log will not be printed for each origination or termination that is denied. When the peripheral goes out of overload a PM 106 message is printed.

Babbling lines

A babbling line is a line which sends messages at a high rate (operating in a loop) toward the controller. To avoid overloading the controller, it is necessary to detect such babblers rapidly and stop further messages until cause of the fault can be determined.

The detection and disabling of messages is best done in the LCM with overall control by the CC. The LCM detection code performs measurements on one line at a time. Slightly different checks are performed for plain ordinary telephone service (POTS) and intelligent (business sets or data unit) lines due to the difference in the characteristics of the messages.

When a babbling line is identified, a report is sent to the CC through the controller. The CC will output the associated log message and remove the line from service. In BCS22, the incoming message overload line handler feature provides the means to return temporary babblers to service.

Excessive key hits on the electronic business set can cause the LCM to recognize the set as being a babbler. The LCM will inform the CC to operate the cutoff relay on the business set and thus put it out of service.

Trunk call attempts which have very short off-hooks are not reported to call processing. This is the extent of the overload controls for babbling trunks.

Maintenance indicators - logs

The peripheral maintenance information indicates the change of state of the peripheral from inservice (INSV) to inservice trouble (ISTB). This change of state provides an awareness of the overloaded condition by three means:

- PM 128 logs are printed to report when the peripheral state changes. The reason for the change is included in the log text. The peripheral changing state from INSV to ISTB with the reason PM OVERLOADED means that calls have been denied.
- The peripheral state is changed creating a peripheral in trouble condition. The reason will be available with the Query PM FLT command.
- A minor alarm is activated.

The peripheral remains stable when in active overload. The overload condition due to traffic should never take the controller completely out of service. System busy conditions are typically due to other than capacity utilization related faults.

When the peripheral comes out of overload the central control is notified so that the state can be updated as well as the minor alarm being shut off. When the peripheral state changes back to INSV from ISTB, the peripheral load will have been reduced to a level that call attempts are not denied. A PM 106 log message is printed indicating that the peripheral changed state from ISTB to INSV.

When a directory number (DN) and line equipment number (LEN) have been identified as a babbler, the CC will output a LINE 204 log message and then place the line in the shower queue for diagnostics. This same application applies to lines which are equipped with electronic business sets and an excessive amount of key hits are received.

A log message, LINE 205, will be generated if the electronic business set user depresses an invalid sequence of keys.

Customer service indicators

There are some specific service conditions which could be experienced by the customer that are related to overload. However, these indications are not restricted to overload. Therefore, the system must be clear of maintenance related faults to allow for a more efficient real time utilization of call processing. No dial tone, slow dial tone, incomplete calls and cutoff or dropped calls are a few of these indicators.

Actions to be taken

When a log is printed showing the state change from INSV to ISTB, all activity on the peripheral by the craftsperson, or hardware failures on the switch should be recorded. The OMs for the period when the overload occurred should be recorded with the information obtained about other activity on the peripheral and its P-side nodes.

Attempts should be made to determine if the state change is due to underprovisioning or a result of maintenance related problems.

Causes of overload in the PM controller

The following is a list of causes of overload in the PM controller:

- Hardware failure on P-side of peripherals.
- The LCM or several LCMs send a large number of originations and on-hooks to the XPM in a very short period of time. Most of these messages will be handled, creating work until the processor either runs out of real time or the interprocessor communication buffers are expended.
- During some type of failures, work can be created within the XPM that would cause it to go into overload. This could be the loss of a network plane producing integrity failures and plane switching (hardware failure on C-side node).

- Datafill changes resulting in extensive messaging to the peripheral.
- Peak traffic on the peripheral above the high day busy hour. The traffic rate has reached a high enough peak that there is not enough real time capacity to handle all calls presented. This work load will eventually cause a shortage of communication buffers and call processing blocks.
- The central control has flooded the XPM with supervision. The work generated by these messages may send either processor into a real time limited condition.

These are only possibilities. The reasons for an overload peripheral is unique to the individual configuration and operational application. When the peripheral goes into overload the peripheral should be investigated in detail.

In typical applications under normal operating conditions, overload controls are not an issue. Even though the overload controls are enabled at all times, the shedding of messages does not occur until active overload.

Since the peripheral controllers have deferrable capacity above the call processing capacity for high day busy hour engineered load, fluctuations (peaks) in traffic are efficiently handled. The deferrable background allows the handling of higher than expected loads with minimum degradation to grade-of-service.

The area of the processor allocated for call processing is capable of handling the expected high day busy hour engineered call attempts. The area allocated as deferrable is not to be used for engineered loads.

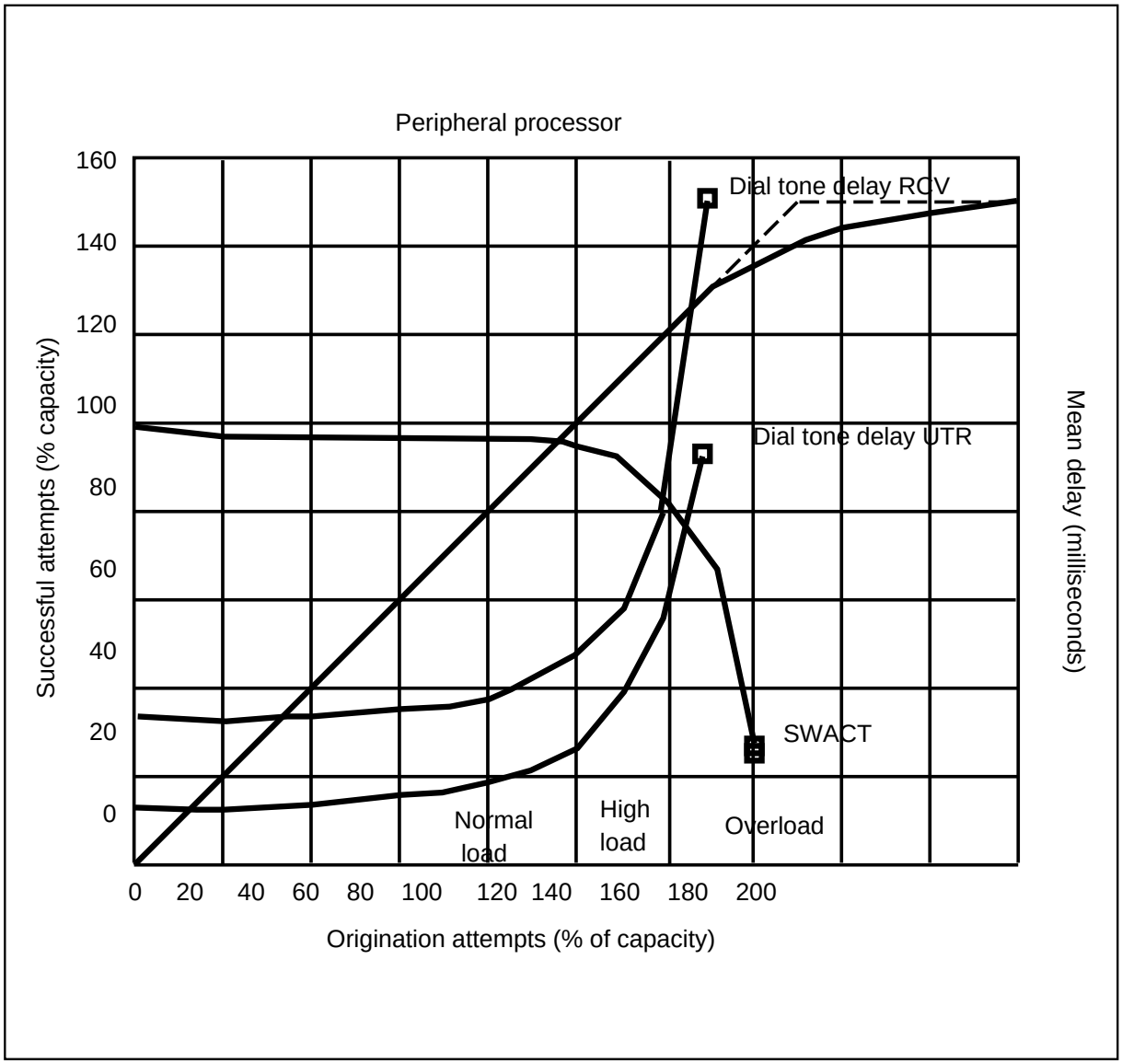
Normal call attempt load is classified as that call rate which is generated in the daily busy hour, average busy season busy hours, and the high day busy hour. Since the high day busy hour is the greatest load within the normal operating range, the call processing area will be able to accommodate the other busy hours within the engineered allocation.

When loads higher than those engineered (for example, snow storms, mass call-ins, holidays) demand higher utilization of the processor capacity, the capacity in the deferrable area will be penetrated. Handling high loads in the deferrable area will introduce dial tone delay (DTD) of varying degrees dependent on the size of the load. DTD greater than 3 seconds between 1.5 percent and 20 percent will be seen. This operational state is within the LSSGR guidelines. Normal operations will also produce DTD; however, the percentage greater than 3 seconds is less than 1.5 percent.

DTD greater than 3 seconds for more than 20 percent of the call attempts will be seen at extreme high loads just prior to going into overload. This point equates to 125 percent of the high day busy hour real time engineering load level. Even at this point the processors are stable and complete 99.99 percent of the accepted load.

Figure 18-5 provides a visual explanation of the load service relationship. The areas identified are normal load, high load, and overload.

Figure 18-5
Load/service relationships



The peripheral module activity and performance tool, PMAct, provides a means of monitoring the load on the peripheral controllers. Normal load, high load and overload can be determined by either monitoring the activity screen at the MAP or obtaining a PRFM 200 log. The information included in the report, either MAP or log, will provide the call processing, overhead and buffer information for quick reference.

Non-ISDN peripheral controllers have two processors which handle functions associated with call attempt message handling. These processors have capacity allocations which are the same as the theory defined in Figure 1. However, since the functions associated with these controllers (LGC, LTC, DTC, RCC) are different, the capacity allocations for each must reflect this difference.

Validation of the information associated with conditions of high load or overload requires operational measurements, maintenance logs, PM activity log and customer service trouble reports. Since the high load point is above the high day engineered configuration, investigations should be completed to determine if this was an abnormal occurrence or an ongoing happening which needs to be addressed. Overload conditions also fall within this criteria.

Operational measurements which are helpful in determining high load and overload are as indicated below:

- PMOVLD - the registers in this OM field are PORGDENY and PTRMDENY. Numbers in these fields indicate that calls are being denied due to overload. Each peripheral in the switch which is denying calls will be noted (LCM, LGC, LTC, DTC, RCC).
- LMD - provides the calls originating and terminating to the LCMs associated with the controllers. The information obtained from this report is useful in calculating the real time utilization.
- There is an OM for call attempts on the DTC. The PMAct tool shows incoming attempts for PTS, while the tool counts all attempts for SS7.
- Overflows are a good indicator that there is a higher than normal load being handled by the processors. Operational measurements associated with the overflows should be investigated. If there are no overflows the chances are extremely good that the traffic load is not the issue.
- Dial tone speed recorder (DTSR) will provide information which can be used to calculate percent dial tone delay. If the calculations fall within the LATA switching system general requirements (LSSGR) guidelines, there is a possibility that there was a high load; however, there was not an overload. With BCS24 this information became available on an individual PM basis.

Maintenance logs provide an indication that the processor has experienced an overload condition. PM128 indicates the change of service state from INSV to ISTB. At this point, the activities associated with the node ISTB should be closely monitored and fully investigated.

The PM activity and performance tool can be used to monitor the operational state of the peripheral processors. The capacity power utilized by the processes in operation are clearly defined. The two processors have their own maximum call processing point. The master processor occupancy

engineered maximum for call processing is 80 percent, while the signal processor maximum is 90 percent.

If the call processing is between 0 percent and the maximum for the processor, the operating conditions are within the normal engineered range. If the indications are between the maximum and 99 percent, the processors are handling higher than normal call attempt or maintenance activity load. When the processor is utilizing the total 100 percent for call processing the processor is in an overloaded state.

An important fact to remember is that some maintenance activities have priority over call processing. If the processor is engaged in evaluating its health, call processing will suffer. Therefore, it is important to assure that all processors are in good health at all times.

Service trouble reports may be used to identify high load or overload conditions. Numerous reports from a single node would indicate a focused problem. Steps should be initiated to evaluate the situation. Indications of slow dial tone, no dial tone, incomplete calls and cutoffs are a few reports which may be associated with overload conditions.

Line peripheral processor (LPP)

Flow controls for ISDN user part (ISUP) trunks

In a distributed process system, it is possible for more work to be presented to the system than it can handle. Time and resources are spent doing work that will not be finished, thus degrading the overall performance of the system. Overload controls provide a means of avoiding this wasted effort and for the system to maintain its sanity and throughput when it is excessively loaded.

The solution is to have controls in the system which monitor the current state of the bottleneck processor. When a processor cannot handle any more work, these controls withhold work from the processor until it is able to recover from an overloaded state. These flow controls allow the system to finish its current work without wasting further effort on new work that will not be completed.

The ISDN user part (ISUP) does not have any overload controls. However, the digital trunk controller No. 7 (DTC7) has two levels of overload protection for non-ISUP messages.

First, flow tasking in the extended peripheral module (XPM) provides incoming message protection to serve in-process work before originating new work. This flow tasking resides in the signal processor (SP) of the XPM, and passes work to the master processor (MP) when the required real time is available.

The second layer of overload control, system overload control (SOC), resides in the MP. SOC controls outgoing origination messages by monitoring the state of the central controller (CC) and holding back work presented to the CC when it is too busy.

Prior to BCS 31, ISUP did not use these controls since the messages for ISUP do not pass through flow tasking or SOC. Basically, ISUP runs parallel to the flow tasking process, only intersecting in the messaging utilities. The data information came through the MSB7 to the DTC7, where the work to set up a call is actually done. This data may contain the ISUP initial address message (IAM), and represents new work presented to the system. Since it is new work presented to the system which will be withheld, it is the IAM that will be delayed or rejected by the overload controls.

All data signaling for ISUP enters the system through one or two LPPs. The LPP receives all of the data for an ISUP call and distributes it to the appropriate DTC7. This makes the LPP the entry point for all ISUP calls for the switch. The capacity of the LPP far exceeds the capacity of the MSB7 and hence it can be assumed that the ISUP load on a DTC7, and the number of DTC7s increasing, created a need for overload controls.

Two features implement overload/flow controls for ISUP trunks. The first flow control feature provides a method of controlling the rate of ISUP generations presented to the ISUP call processing task in the individual XPM (DTC7). The second widens the coverage of DMS system overload controls (SOC) to include ISUP trunks. This activity also enhances trunk flow controls in the XMS based peripherals (XPMs) to include trunks that use both the A and B bits for inband signaling. Individual ISUP trunk flow controls and ISUP SOC work independently toward the goal of ensuring that ISUP performance is maintained at as high a throughput as possible while protecting both the entire DMS and the individual DTC7.

The ISUP trunk flow control feature may toss origination messages for ISUP. These are tossed in the DTC7 by a flowtasking mechanism. When an IAM is tossed, an operational measurement (OM) is pegged (PORGDENY register in OM group PMOVLD) to record this action. This OM should be observed on a regular basis to ensure that the ISUP trunks are functioning properly under extreme overload conditions.

Flowtasking serves ISUP origination messages on a last-in, first-out queue. This improves ISUP service during extreme overload. There is no provision made by this feature to react to lower, less severe overload conditions.

The interceptors for ISUP messages are enhanced to route origination messages to the flowtasking software. ISUP progress and termination messages are sent directly to the ISUP task software in the MP. If there are messages already waiting for service, progress messages will go to the flowtasking software and be added to the appropriate queue for the trunk in

question. Flowtasking for ISUP originations is sent to the ISUP queue and other trunk origination queues are served in round-robin fashion.

The flowtasking software relies totally on the scheduler in the SP to enforce throttling of work passed to the MP from the SP for trunks. This is effective due to the priority of the flowtasking software which runs at a lower priority than call processing work in the SP. Work is only passed to the MP when there is no call processing work to do in the SP. This is effective since the MP sends the SP call processing work.

The first level of overload defense appears when a DTC7 is in the first stages of overload. This occurs when the flowtasking code does not run due to call processing load on both the MP and SP. In this stage, flowtasking begins to delay messages directed to the MP.

Initial address messages (IAMs) are only delayed when the DTC7 becomes overloaded to the point where there is insufficient real time to service all the presented work. The flowtasking code acts as a buffer protecting the MP from large amounts of work by smoothing out peaks in offered traffic.

There is a minor capacity reduction, (approximately + 5 ms), in the DTC7 caused by implementation of these flow controls. This only affects the originating IAM's time spent in the SP, while MP performance is improved during overload. However, despite the fact that the amount of time required to service an ISUP message is increased, the call capacity of the DTC7 is actually increased.

This increase is due to the philosophy behind flowtasking, in that if a small amount of time is spent initially deciding what should be serviced, there is an overall increase in throughput because of the more effective selection of work.

System overload control (SOC) implementation real time effects are also extremely minor. When the ISUP SOC exit routine is called, there is approximately + 0.1ms (minimum) to + 0.5ms (maximum) impact to the MP. The minimum corresponds to exits from SOC where no messages are queued, and the maximum relates to exits when there is at least one message queued against the trunk.

Load service curves

Defining load service curves

Load service curves, as presented here, are graphic representations of the relationship of central processing unit (CPU) percentage of real time used for call processing (CPOCC), to the percentage of dial tone delay (dial tone not provided in three seconds from the time the request is received) that can be expected. Three dial tone delay (DTD) service objective points are identified on each curve; 1.5 percent, 8.0 percent, and 20.0 percent.

Deriving load service curves

The curves illustrated in this document were derived under controlled conditions in the RTPFAST (Research Triangle Park First Application System Test) office. The FAST switch is loaded with calls, using various call mix models, that simulate an actual working office. These curves reflect the call mix and BCS load that was selected for these examples. Results for actual offices conditions may vary resulting in similar, but slightly different curves.

In this document, load service curves and supporting data are presented for the NT40 processor and SuperNode (SR) processors SR10 (BCS28), SR20 (BCS31), SR30 (BCS29), and SR40 (BCS30). In addition, curves are provided for the origination queue average delay (OAVGDEL) and progress queue average delay (PAVGDEL) relationship to CPU occupancy, and offered traffic compared to accepted traffic as the load is increased.

Series 10 SuperNode

Described in this section are the results of the Series 10 SuperNode (SR10) BCS28 load service curve verification.The results are presented with comparisons to the NT40 CPU equipped with a 36Mhz clock.

Test objectives

Testing was conducted to investigate the following areas:

- grade-of-service and processor class allocations
- SR10 gain factor
- overload control performance

- restart timings

RTPFAST switch environment

The switch was tested in the following environment:

- DMS 100/200/TOPS call mix
- no peripherals operating above their engineered limit
- series I and II peripherals
- AMAB logs turned on in Table AMAOPTS
- AMA routed to disk
- BCS28 RTM superset software load

Detailed test results

The load service results of this test are shown graphically in Figure 19-1 which indicates the maximum performance load service curve for the SR10. The 1.5 percent, 8.0 percent, and 20.0 percent grade-of-service points are labeled with the corresponding call processing occupancy (CPOCC). With the engineering factors that are applicable to the RTPFAST call mix, the expected CPOCC at the grade-of-service points is 72.5 percent, 77.1 percent, and 77.1 percent respectively. In the RTPFAST test environment, the actual measured SR10 CPOCC at the three grade-of-service points is 77.2 percent, 79.5 percent, and 81.2 percent. All of the measured call processing occupancy points are higher than predicted. The processor allocation of classes at the 20 percent grade-of-service is shown in Table 19-1.

Origination and progress queues average delay

The measured load service curves for the origination queue average delay (OAVGDEL) and progress queue average delay (PAVGDEL) are shown in Figure 19-2.

Figure 19-1
DTD and CPOCC load service curve

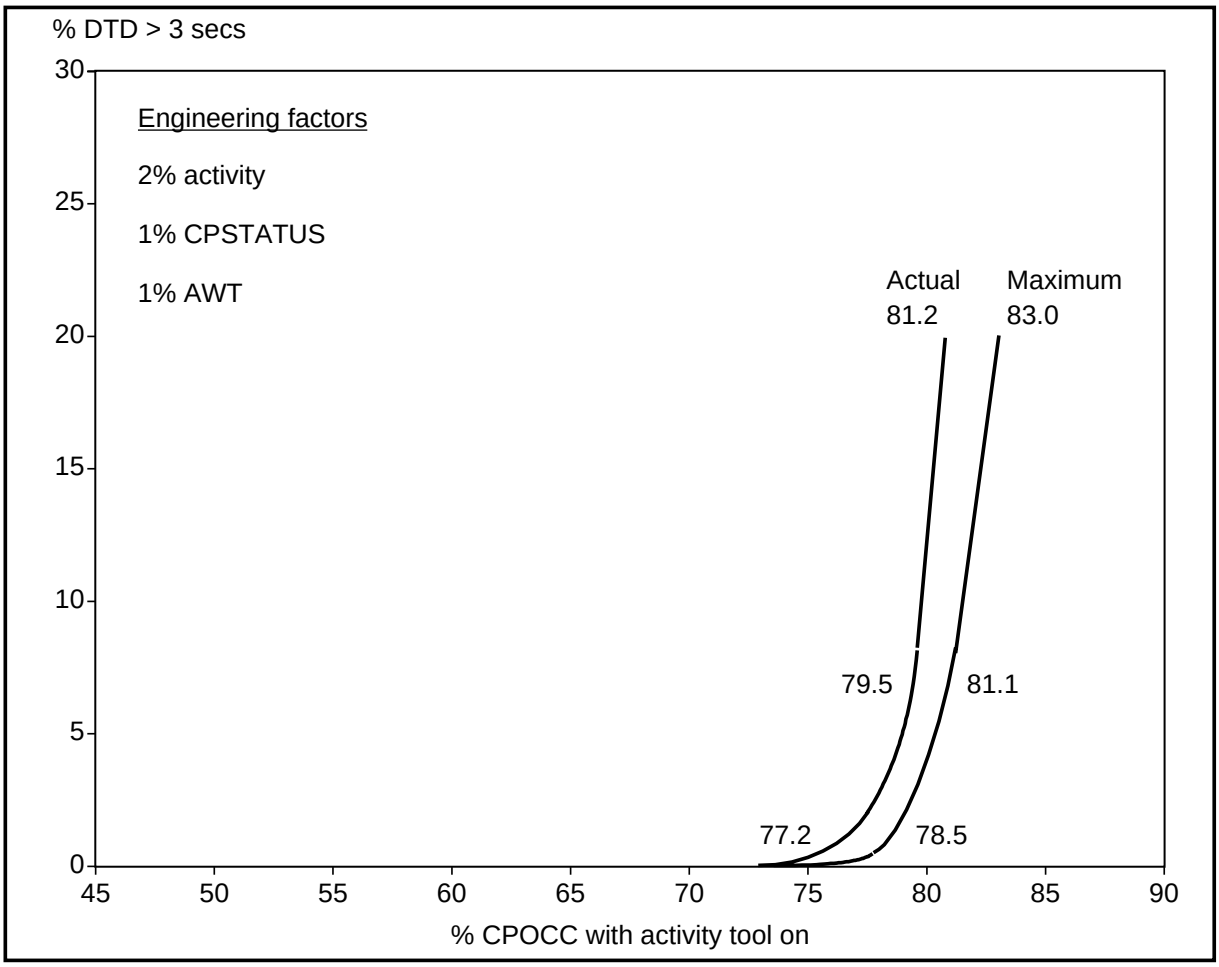
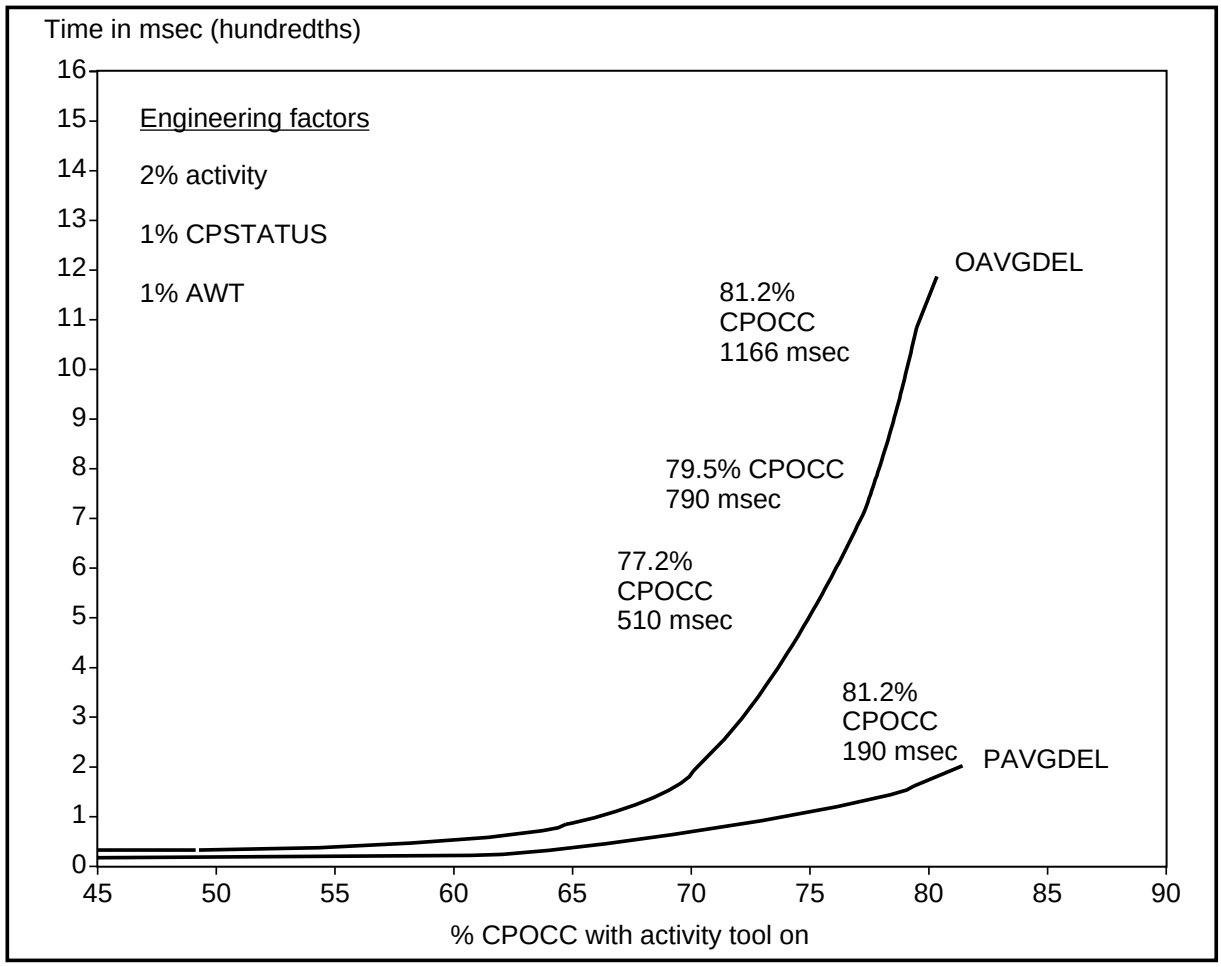


Table 19-1xxx
Allocation of classes at 20% dial tone delay > 3 seconds

Class name	POTS NT40 model (%)	SR10 actual BCS28 (%)
Scheduler	6.0	5.3
System 7	0.5	0.6
System 6	0.5	1.0
Maintenance	2.0	3.1
Background	3.0	5.1
Guaranteed background	2.0	1.5
OM and non-guaranteed OM	3.0	2.2

Figure 19-2
OAVGDEL and PAVGDEL load service curve



SR10 gain factor

There are six office models that consist of specific call types that are measured with each BCS load. The six models are as follows:

- POTS equal access end office urban
- POTS equal access end office suburban
- access tandem without 800 service
- TOPS host operator centralization stand-alone
- TOPS remote operator centralization/ access tandem (non-TICS)
- Meridian Digital Centrex

Tables 19-2 through 19-7 contain the call mix data, call mix percentages, milliseconds per call, and the resulting weighted call times. In addition, the

maximum calls per hour and corresponding percentage of delay, and call processing time occupancy (CPOCC) are shown.

Call timing is measured in the following switch configuration:

- computing module/central processing unit in sync
- DTSR unbound
- Bellcore AMA format
- AMA tape
- no UTRs

The maximum call processing occupancy for the NT40 and SR10 is 83 percent of the total real time available. The gain factor is the measurement that indicates the improvement in the call processing rate when one processor is compared to another. The gain factor is calculated by dividing the maximum SR10 calls per hour by the maximum calls per hour of the NT40. In this test the average gain of the SR10 is 1.38 times the NT40 call rate. Table 19-8 shows the individual call mix results.

Table 19-2xxx
TOPS host OC/stand-alone model

Call type	Call description	Call mix percentage	NT40 MS per call	NT40 weighted call time	SR10 MS per call	SR10 weighted call time
340	HOC MCCS	15.0	4.8	0.7174	3.8	0.5700
327	S/A MCCS2	21.0	64.9	13.6272	47.7	10.0170
326	ACTS coin	14.0	70.7	9.8913	54.9	7.6860
487	HOC non-coin 0+	4.5	44.6	2.0054	29.6	1.3320
334	HOC non-coin 0-	6.0	45.0	2.7000	30.0	1.8000
614	HOC coin 0+	2.3	45.4	1.0450	30.5	0.7015
613	HOC coin 0-	2.3	46.1	1.0600	30.5	0.7015
330	S/A non-coin 0+	6.3	74.7	4.7045	55.9	3.5217
315	S/A non-coin 0-	8.4	72.3	6.0717	54.0	4.5360
814	S/A coin 0+	3.1	94.5	2.9282	70.3	2.1793
813	S/A coin 0-	3.1	95.3	2.9551	70.8	2.1948
048	MF INCAMA trunk-trunk	14.0	19.2	2.6935	14.5	2.0300
Totals		100.0		50.399		37.270
Maximum calls per hour at 20% DTD and 80% CPOCC				57144		78240

Table 19-3xxx
POTS EAEO suburban model

Call type	Call description	Mix percentage	NT40 MS per call	NT40 weighted call time	SR10 MS per call	SR10 weighted call time
994	DTMF 1FR line-line	5.0	18.9	0.9457	14.0	0.7000
995	DTMF 1FR line-EAS trunk	3.0	16.1	0.4826	11.9	0.3570
950	DTMF 1MR line-line	15.0	28.0	4.2065	19.5	2.9250
016	DTMF 1MR line-EAS trunk	7.0	26.4	1.8489	18.7	1.3090
011	DTMF 1FR line-LAMA trunk	10.0	25.3	2.5326	18.7	1.8700
360	FGC 1 + 10D-IC trunk	5.0	31.4	1.5707	22.6	1.1300
401	FGD 1 + 7D-IC	5.0	35.4	1.7717	26.4	1.3200
993	DTMF 1FR line-abandon	4.0	8.7	0.3478	6.6	0.2640
308	DTMF 1MR line-busy	6.0	16.6	0.9978	12.2	0.7320
996	MF trunk-line	30.0	13.5	4.0435	10.2	3.0600
453	IC trunk-line	10.0	25.9	2.5870	18.2	1.8200
Totals		100.0		21.335		15.487
Maximum calls per hour at 20% DTD and 82% CPOCC				138366		190611

Table 19-4xxx
POTS EAEO urban model

Call type	Call description	Mix percentage	NT40 MS per call	NT40 weighted call time	SR10 MS per call	SR10 weighted call time
974	DTMF 1MR-AT-to-FGD IC	5.0	35.9	1.7935	26.4	1.3200
950	DTMF 1MR line-to-line	18.0	28.0	5.0478	19.5	3.5100
016	DTMF 1MR line-to-EAS trunk	7.0	26.4	1.8489	18.7	1.3090
308	DTMF 1MR line-to-busy	3.0	16.6	0.4989	12.2	0.3660
018	DTMF coin line-to-busy	1.0	19.7	0.1967	15.1	0.1510
996	MF trunk-to-line	7.0	13.5	0.9435	10.2	0.7140
990	C trunk-to-line	14.0	26.0	3.6370	17.9	2.5060
019	DTMF coin-to-line	2.0	30.7	0.6130	23.2	0.4640

-continued-

Table 19-4xxx
POTS EAEO urban model (continued)

Call type	Call description	Mix percentage	NT40 MS per call	NT40 weighted call time	SR10 MS per call	SR10 weighted call time
954	DTMF coin line-to-IC/FGD	1.0	41.3	0.4130	30.7	0.3070
054	PBX DOD trunk-to-line	11.0	17.9	1.9728	14.3	1.5730
958	MF PX DOD trunk-to-IC trunk	3.0	33.5	1.0043	25.9	0.7770
961	MF PX DOD trunk-to-EAS trunk	4.0	16.4	0.6565	13.4	0.5360
888	DTMF MDC line-to-MDC line	10.0	17.8	1.7826	13.5	1.3500
889	DTMF MDC line-to-EAS trunk	4.0	18.7	0.7478	14.3	0.5720
858	DTMF MDC line-to-abandon	2.0	15.5	0.3109	11.9	0.2380
854	MF POTS trunk-to-MDC line	5.0	13.5	0.6739	10.2	0.5100
883	FGD DTMF MDC line-to-AT	3.0	37.8	1.1348	27.3	0.8190
Totals		100.0		21.335		17.02
Maximum calls per hour at 20% DTD and 82% CPOCC				126,825		173,423

End

Table 19-5xxx
Access tandem without 800 service model

Call type	Call description	Mix percentage	NT40 MS per call	NT40 weighted call time	SR10 MS per call	SR10 weighted call time
998	MF IT trunk-to-IT trunk	27.5	12.6	3.4674	9.6	2.640
048	MF INCAMA trunk-to-trunk	5.5	19.2	1.0582	14.5	0.798
455	IT trunk-to-IC carrier trunk	22.0	12.5	2.7500	9.5	2.090
456	IC carrier trunk-to-trunk	33.0	20.8	6.8511	14.7	4.851
997	Tandem INCAMA-to-tandem	12.0	9.5	1.1348	7.5	0.900
Totals		100.0		15.26		11.28
Maximum calls per hour at 20% DTD and 83% CPOCC				195,788		264,929

Table 19-6xxx
TOPS remote OC/AT model (non-TICS)

Call type	Call description	Mix percentage	NT40 MS per call	NT40 weighted call time	SR10 MS per call	SR10 weighted call time
998	MF IT trunk-to-IT trunk	12.5	12.6	1.5761	9.6	1.2000
048	MF INCAMA trunk-to-trunk	12.5	19.2	2.4049	14.5	1.8125
455	IT trunk-to-IC carrier trunk	10.0	12.5	1.2500	9.5	0.9500
456	IC carrier trunk-to-trunk	15.0	20.8	3.1141	14.7	2.2050
997	Tandem INCAMA-to-tandem	5.0	9.5	0.4728	7.5	0.3750
924	E800 AT-to-IC trunk D/B QBY	5.0	48.7	2.4348	33.4	1.6700
497	ROC MCCS	15.0	69.0	10.3533	50.8	7.6200
503	ROC ACTS	10.0	70.7	7.0652	54.9	5.4900
506	ROC non-coin 0+	4.5	85.7	3.8543	61.1	2.7495
491	ROC non-coin 0-	6.0	82.8	4.9696	58.9	3.5340
714	ROC coin+	2.3	103.7	2.3850	73.2	1.6836
713	ROC coin-	2.2	103.3	2.2717	75.6	1.6632
Totals		100.0		45.152		30.953
Maximum calls per hour at 20% DTD and 83% CPOCC				68,324		94,208

Table 19-7xxx
MDC model

Call type	Call description	Mix percentage	NT40 MS per call	NT40 weighted call time	SR10 MS per call	SR10 weighted call time
888	DTMF MDC line-to-MDC line	8.0	17.8	1.4261	13.5	1.0800
889	DTMF MDC line-to-EAS trunk	3.0	18.7	0.5609	14.3	0.4290
858	DTMF MDC line-to-abandon	5.0	15.5	0.7772	11.9	0.5950
884	MDC intraLATA-to-toll trunk	7.0	28.5	1.9935	22.6	1.5820
883	FGD DTMF MDC line-to-AT	9.0	37.8	3.4043	27.3	2.4570
873	DTMF MDC line-EBS with display	5.0	20.5	1.0272	14.6	0.7300
891	EBS with display-to-EBS with display	5.0	28.6	1.4293	17.4	0.8700
890	EBS with display-to-abandon	3.0	18.2	0.5446	12.0	0.3600
892	EBS with display-to-EAS trunk	3.0	23.4	0.7011	14.2	0.4260
885	EBS with display FGD-to-AT MF	8.0	42.7	3.4174	27.7	2.2160
893	EBS with display-to-LAMA trunk	5.0	32.6	1.6304	21.1	1.0550
862	EBS without display-to-MDC line	4.0	21.1	0.8435	13.3	0.5320
854	MF POTS trunk-to-MDC line	19.0	13.5	2.5609	10.2	1.9380
879	MF POTS trunk-to-EBS without display	16.0	15.4	2.4696	10.9	1.7440
Totals		100.0		22.786		16.014
Maximum calls per hour at 20% DTD and 82% CPOCC				129,554		184,339

Table 19-8xxx
Capacity test analysis

Call mix model	NT40/36Mhz BCS28 RTM Max call attempts	SR10 BCS28 RTM Max call attempts	NT40 to SR10 gain factor
POTS urban	126825	173423	1.37
POTS suburban	138366	190611	1.38
Access tandem	195788	264929	1.35
TOPS SA/HOC	57144	78240	1.37
TOPS ROC/AT	68324	94208	1.38
MDC	129554	184339	1.42
		Overall average gain	1.38

Comparison of offered to accepted calls

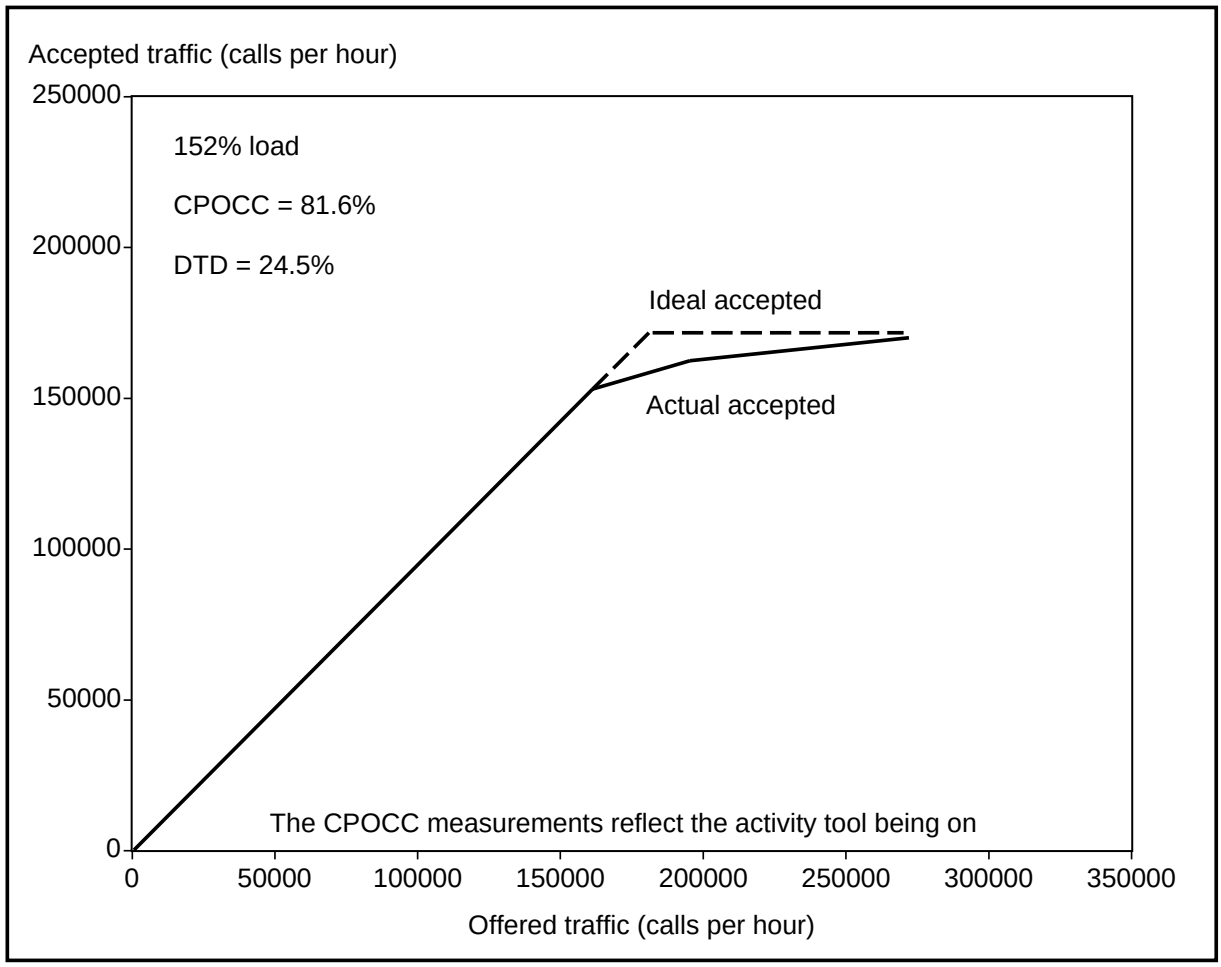
The processor was tested to 152 percent load with a total of 272,930 offered attempts (Figure 19-3). The dial tone delay at that point was 24.5 percent. Percent load is determined by dividing the number of accepted calls by the number of offered calls (multiplied by 100). Offered calls consist of accepted calls, and calls encountering the following conditions: originating denied (ORIGDENY), ineffective denied (INEFDENY), and CP letters overflow (CPOVFL).

Operational measurement definitions

The following further describes the operational measurements that record the call dispositions included as offered calls:

- ORIGDENY , also known as one message toss, is pegged when an origination has been queued for longer than three seconds and is discarded
- INEFDENY, also known as two message toss, is pegged when both of the following occur:
  - more than one message has arrived for a particular terminal while it is waiting in the origination queue
  - the first message arrived more than one-half second ago
- CPOVFL is pegged when the available number of CP letters for originations is exceeded

Figure 19-3
Accepted and offered traffic load service curve



Reload and restart timings

As part of the test plan, restart timings are measured on the SR10. The timings are measured for a warm, cold, and reload restart along with the time required to reload an image from the SLM disk, SLM tape, and 8 inch disk drive unit. The time results are shown in Table 19-9.

Table 19-9xxx
Reload and restart timings

Image reload			**Time (min: sec)**
	SLM	Disk	02:55
		Tape	12:58
	IOC	DDU (8 inch)	14:30
Restart timings	Warm	A1	02:53
		First dial tone	02.57
		100% dial tone	02:57
	Cold	A1	03:15
		First dial tone	03:19
		100% dial tone	03:21
	Reload	A1	
		First dial tone	06:00
		100% dial tone	06:03
			12:03

Conclusions

The following conclusions were made from the results of the SR10 processor, BCS28 testing:

- the system engineering models show that the SR10 gain factor is 1.38 times the NT40 processor
- when using the established NT40 engineering factors for the SR10, there is a buffer of call processing time available at each grade-of-service level

Series 20 SuperNode

Testing was conducted at the RTPFAST facility to verify the real time performance of the Series 20 (SR20) SuperNode processor using the BCS31 RTM software. This section contains the results of that testing.

Test objectives

Testing was conducted to investigate the following areas:

- load service curves
- processor class allocations
- overload performance
- terminal response
- REAL:TIME tool accuracy

RTPFAST switch environment

The switch was tested in the following environment:

- SR20 SuperNode processor
- DMS 100/200/TOPS call mix
- Series I and II peripherals
- AMAB logs turned on in Table AMAOPTS
- AMA routed to disk
- BCS31 RTM software load

Engineering factors

Engineering factors must be considered when determining processor loading, because these factors affect the switch's overall call processing capacity. The factors affect the percentage of real time allocated between overhead and call processing. The factors included here are the tool ACTIVITY, average work time (AWT), and the processor measurement CPUSTAT. Some tools such as ACTIVITY are optional, but when activated will add to the minimum overhead requirements. Factors such as average work time and traffic peaking are traffic characteristics that can also increase the overhead requirements. As a result, theses factors can decrease the maximum percentage of real time allocated to call processing. Table 19-10 shows the engineering factors that apply to the RTPFAST call mix and the expected percentage of real time occupied with call processing (CPOCC) at three grade-of-service points.

Table 19-10xxx
Grade-of-service, overheads and call processing

Overheads	Grade-of-service		
	20%	**8%**	**1.5%**
Basic	14.0%	15.0%	18.0%
ACTIVITY tool	01.0%	01.0%	01.0%
CPUSTAT	00.5%	00.5%	00.5%
Average work time	01.0%	01.0%	03.0%
Total	16.5%	17.5%	22.5%
Expected CPOCC	83.5%	82.5%	77.5%

Scheduler class real time allocations

Actual real time allocations compared to the predicted real time allocations for the scheduler classes are shown in Table 19-11 at the 20 percent grade-of-service point. The predicted values are based on a maximum call processing allocation of 86.0 percent, minimum overhead allotments 14 percent, and adjustments for engineering factors ACTIVITY, CPUSTAT, and average work time. The predicted results were calculated by using the loading recommendations for the DMS-100 Family of central processors.

Table 19-11xxx
Allocation of classes at 20% dial tone delay > 3 seconds

Class name	Predicted (%)	Actual (%)
Scheduler	4.0%	3.0%
System and system tool	2.5%	1.2%
Maintenance	1.0%	2.1%
Background and audit	5.0%	6.0%
Guaranteed OM and non-guaranteed OM	2.0%	1.5%
Idle	0.0%	0.0%
Guaranteed terminal	2.0%	1.8%
Call processing	83.5%	84.4%
Total real time	100.0%	100.0%

The allocations in Table 19-11 show that the call processing percentage exceeds the expected level, while the total overhead is lower than expected. Since the total overhead classes used less than their guaranteed percent, more time was allotted to call processing.

Load service curves

There are three load service curves presented here. They are as follows:

- dial tone delay and processor occupancy
- origination and progress queues average delay
- accepted traffic and offered traffic

Dial tone delay and processor occupancy

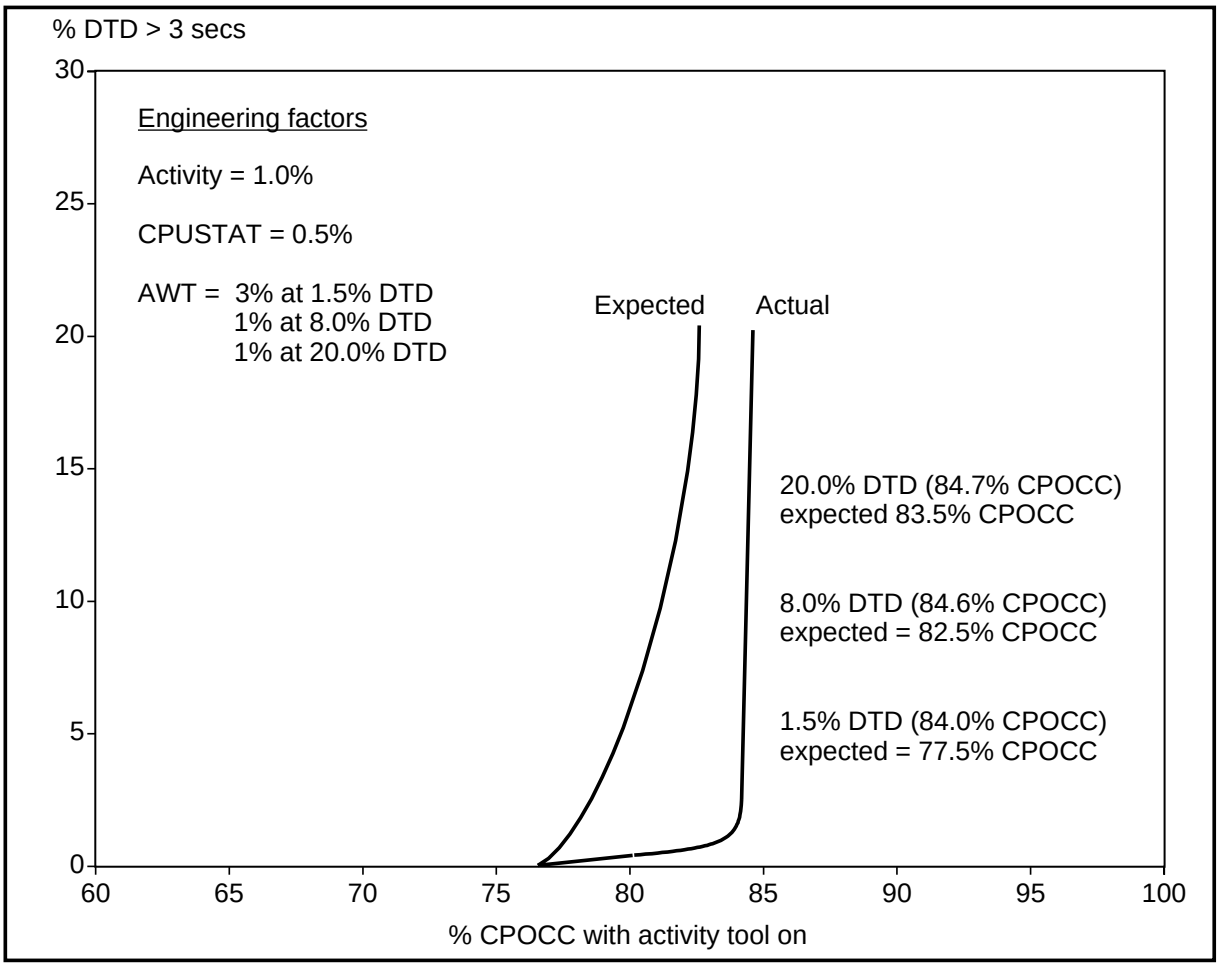
As call processing nears its real time capacity, dial tone delay, origination denial, terminal response, and other key service measurements are effected. Therefore, information is provided at three dial tone delay (delay greater than 3 seconds) grade-of-service levels: 1.5, 8.0, and 20 percent dial tone delay (DTD). The dial tone delay load service curve is plotted from the test results shown in Table 19-12.

Table 19-12xxx
Percent real time used for call processing at three service levels

Grade-of-service (% DTD)	Expected %	Actual %
1.5%	84.0%	77.5%
8.0%	84.6%	82.5%
20.0%	84.7%	83.5%

The comparison in Table 19-12 shows that the SuperNode equipped with the SR20 processor performed better than expected at all three service levels. This favorable difference between actual and expected values has also been documented by previous SR20 processor test results. Figure 19-4 shows these results graphically.

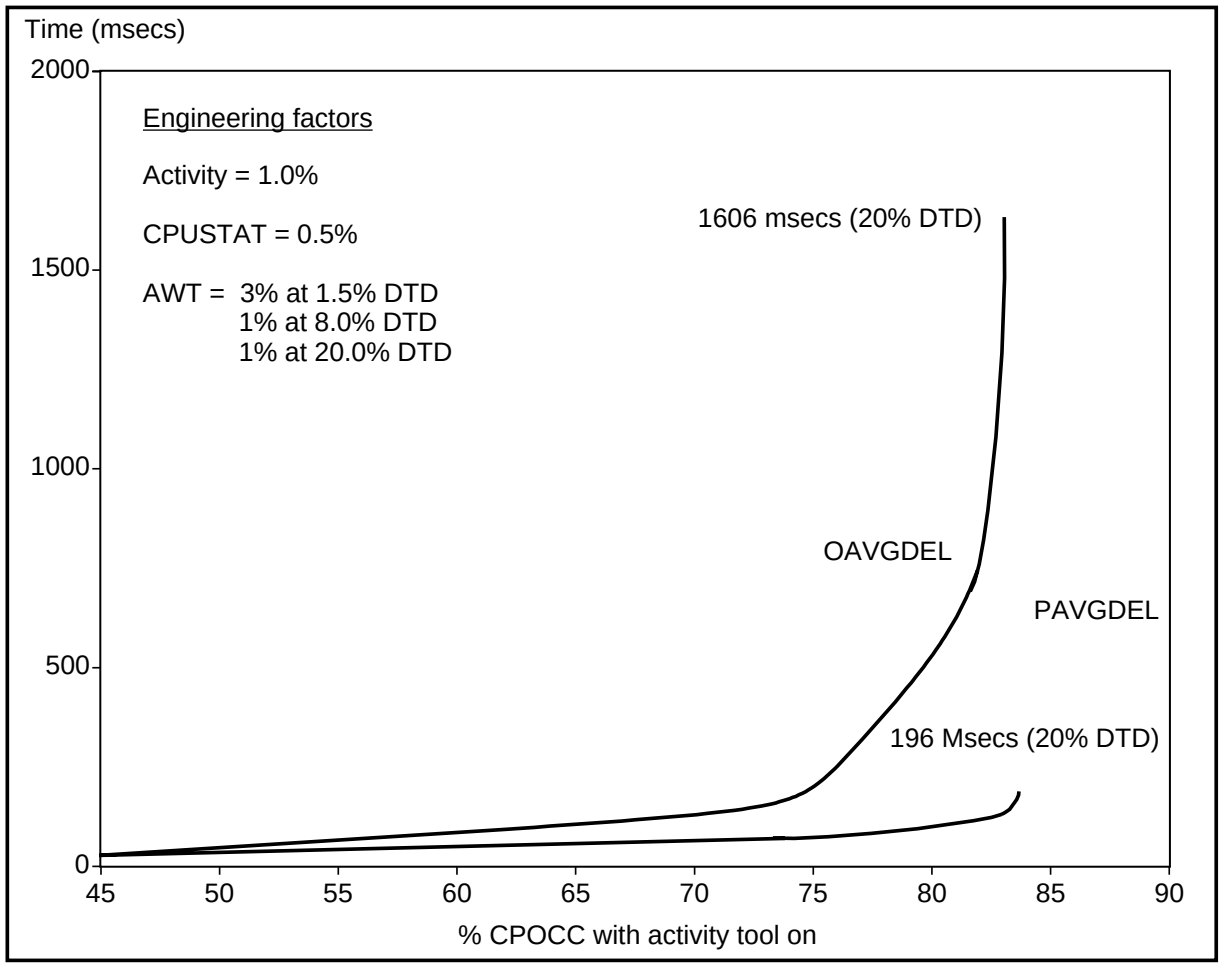
Figure 19-4
DTD and CPOCC load service curve



Origination and progress queues average delay

The origination queue average delay (OAVGDEL) and progress queue average delay (PAVGDEL) are presented in Figure 19-5. The curves demonstrate the the DMS gives priority to calls which are accepted before new originations are served. This is accomplished by overload controls guaranteeing resources to calls in progress, rather than for new originations. Work for processing new originations will only be performed if the time available is not required for calls in progress.

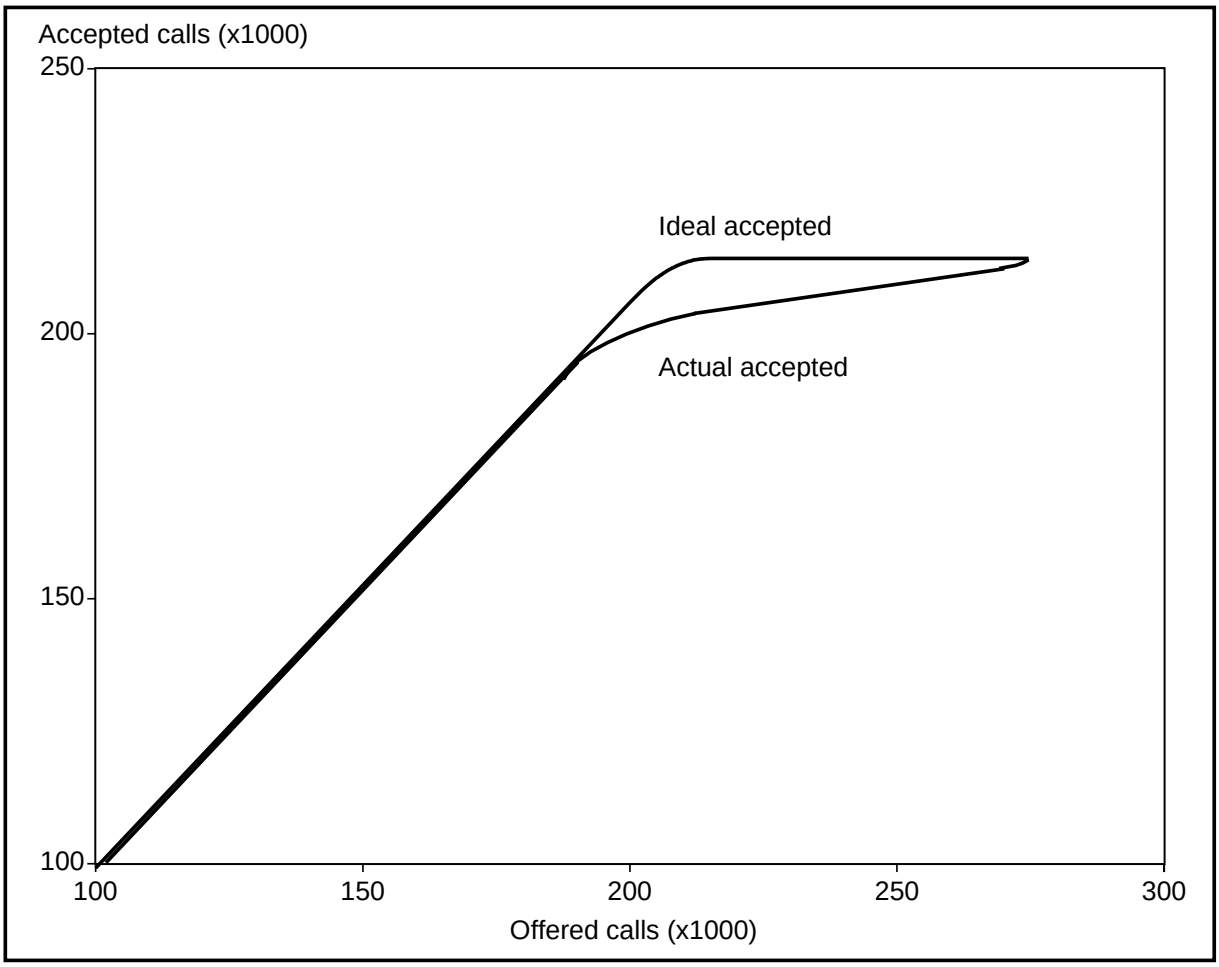
Figure 19-5
OAVGDEL and PAVGDEL load service curve



Accepted traffic and offered traffic

Theoretically, the accepted traffic should equal the offered traffic up until the point at which the system cannot handle any additional traffic. At this point and beyond, the quantity of calls should remain constant. In reality, the level of accepted calls will decrease slightly as the level of offered calls increases because the processor takes some of the real time available to reject offered calls that can not be processed. Real time is used to shed calls to maintain the system stability. Figure 19-6 shows the accepted to offered load curve. Satisfactory and stable performance was achieved during overload. The traffic did not reach the point where accepted calls decreased due to the processor rejecting offered calls.

Figure 19-6
Accepted and offered traffic load service curve



Terminal response

Terminal response measurements were performed using the commands listed in Table 19-13.

Table 19-13xxx
Commands used for terminal response testing

Request	Command
Trunks	**>MAPCI;MTC;TRKS;TTP;POST; G OTRAF1FREAS;QUIT ALL**
Lines	**>MAPCI;MTC;LNS;LTP;POST D 3258308;QUIT ALL**

-continued-

Table 19-13xxx
Commands used for terminal response testing (continued)

Request	Command
Query directory number	**>QDN 3258308**
Query LEN	**>QLEN 12 1 00 01**
SERVORD	**>SERVORD; OUT $ 3258308 12 1 00 01 BLDN;NEW $**
End	

Terminal response times

Tables 19-14 through 19-16 show the measured terminal response results for one priority, one non-priority, and two priority terminals. The commands were first performed on a priority terminal and one non-priority terminal and then the commands were performed on two different priority devices.

Table 19-14xxx
Terminal response measurements - priority device (BCS31)

Request	Idle (secs)	30% (secs)	60% (secs)	70% (secs)	75% (secs)	86% (secs)
Trunks	6.9	7.7	22.6	34.6	36.7	75.4
Lines	5.9	6.3	20.9	32.0	41.6	132.9
QDN	2.7	3.3	12.1	18.9	24.2	38.4
Qlen	3.0	3.4	12.2	17.4	21.8	45.1
SERVORD	11.9	13.3	35.2	54.1	65.8	108.4

Table 19-15xxx
Terminal response measurements - non-priority device (BCS31)

Request	Idle (secs)	30% (secs)	60% (secs)	70% (secs)	75% (secs)
Trunks	4.7	5.4	23.4	59.6	94.9
Lines	5.3	6.8	202	57.9	88.0
QDN	2.0	2.1	12.0	29.4	52.5
QLEN	2.0	2.2	9.3	26.6	40.7
SERVORD	9.6	10.7	32.2	62.6	147.3

Table 19-16xxx
Terminal response measurements - two priority devices (BCS31)

Request	30%	60%	70%	75%
Trunks	10.3	41.1	61.7	87.6
Lines	9.4	40.8	60.8	80.2
QDN	5.4	22.3	32.4	42.7
QLEN	5.1	21.3	33.0	38.9
SERVORD	16.4	58.6	90.0	114.8

REAL::TIME tool comparison

The operational measurement data that showed the percentage of real time (CPOCC) being used at a 76.4% level was entered in the REAL::TIME tool. Table 19-17 shows a comparison of REAL::TIME tool predictions and actual system measurements. The tool predicted a CPOCC of 73.6 percent which is a 3.8 percent difference between the measured value and the REAL::TIME tool value.

Table 19-17xxx
Comparison of REAL::TIME tool values and actual values

Measurement	REAL::TIME	Actual
% CPOCC	73.6%	76.4%
% overheads	26.4%	24.6%

Conclusions

The following conclusions were made from the results of the SR20 processor, BCS31 testing:

Load service curve

The load service curve shows that the Series 20 processor performed better than expected at the three given grade-of-service points. Calculating the difference between the actual and expected values shows that the actual values provide a 1.2 to 6.5 percent favorable difference.

Scheduler allocations

The total real time overhead allocations for the classes at the 20 percent grade-of-service point are below the expected values, even though some of the individual overhead allocations exceeded their minimum allocation.

OAVGDEL and PAVGDEL curve

The originating queue average delay (OAVGDEL) and progress queue average delay (PAVGDEL) curve demonstrate that priority is given to calls that have been accepted before new originations are served.

REAL::TIME tool predictions

This test indicates that the REAL::TIME tool predicted CPOCC value is within the stated 10 percent accuracy of the tool.

Terminal response times

The terminal response times of both priority and non-priority terminals at call processing occupancies of less than 60 percent are approximately the same. Above 60 percent CPOCC, response times for priority terminals are considerably less than the non-priority terminals.

Series 30 SuperNode

Testing was conducted at the RTPFAST facility to verify the real time performance of the Series 30 (SR30) SuperNode processor using the BCS29 RTM software. This section contains the results of that testing.

Test objectives

Testing was conducted to investigate the following areas:

- processor allocations at 20 percent dial tone delay
- SR30 gain factor
- terminal response times
- operational measurement output
- restart timings

RTPFAST switch environment

The switch was tested in the following environment:

- DMS 100/200 /TOPS call mix
- no peripherals operating above their engineered limit
- combination of old and new peripherals
- AMAB logs turned on in Table AMAOPTS
- AMA routed to disk
- BCS29 superset software load

Detailed test results

The results of the SR30 processor testing are presented in this section. The engineering factors for optional features are identical to those of the SR20 processor. The test results demonstrate that by applying the SR20 engineering factors to the SR30, the measured amount of real time used by the SR30 for call processing is higher at any grade-of-service level than predicted.

Dial tone delay and processor occupancy

The maximum performance load service curve for the SR30 is shown in Figure 19-7. The grade-of-service points (1.5 percent, 8.0 percent, and 20 percent) are labeled with the corresponding percentage of real time occupancy used by call processing labeled as CPOCC. Figure 19-8 shows the measured results of the test. Using the engineering factors that are applicable to the RTPFAST call mix, the expected amounts of real time used for call processing at the three grade-of-service points are 77.5 percent, 82.5 percent, and 83.5 percent. In the RTPFAST environment the actual measured all call processing points are higher than predicted. The processor allocations at the 20 percent point are shown in Table 19-18.

Figure 19-7
Dial tone delay and maximum call processing occupancy

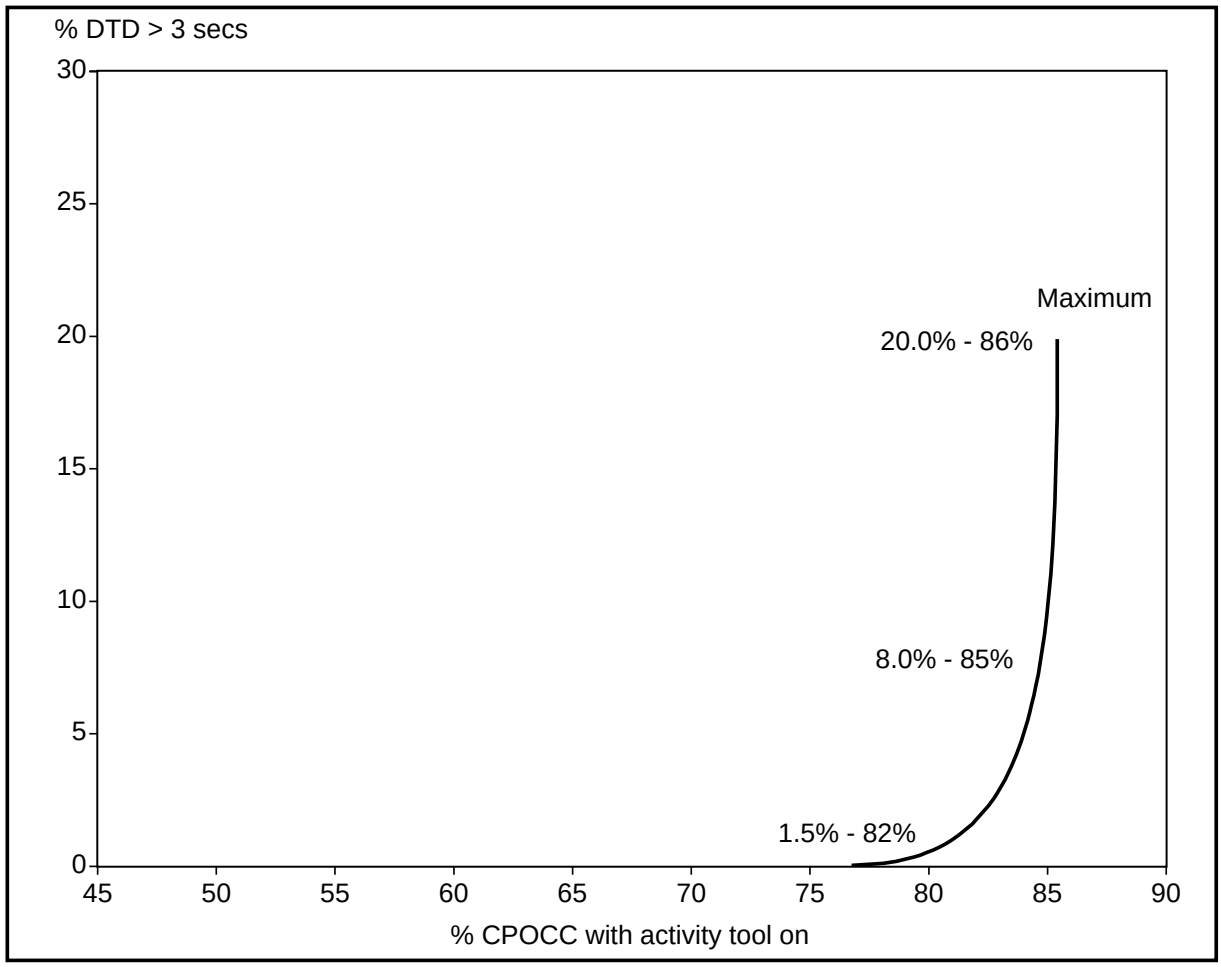


Figure 19-8
Dial tone delay and processor occupancy test results

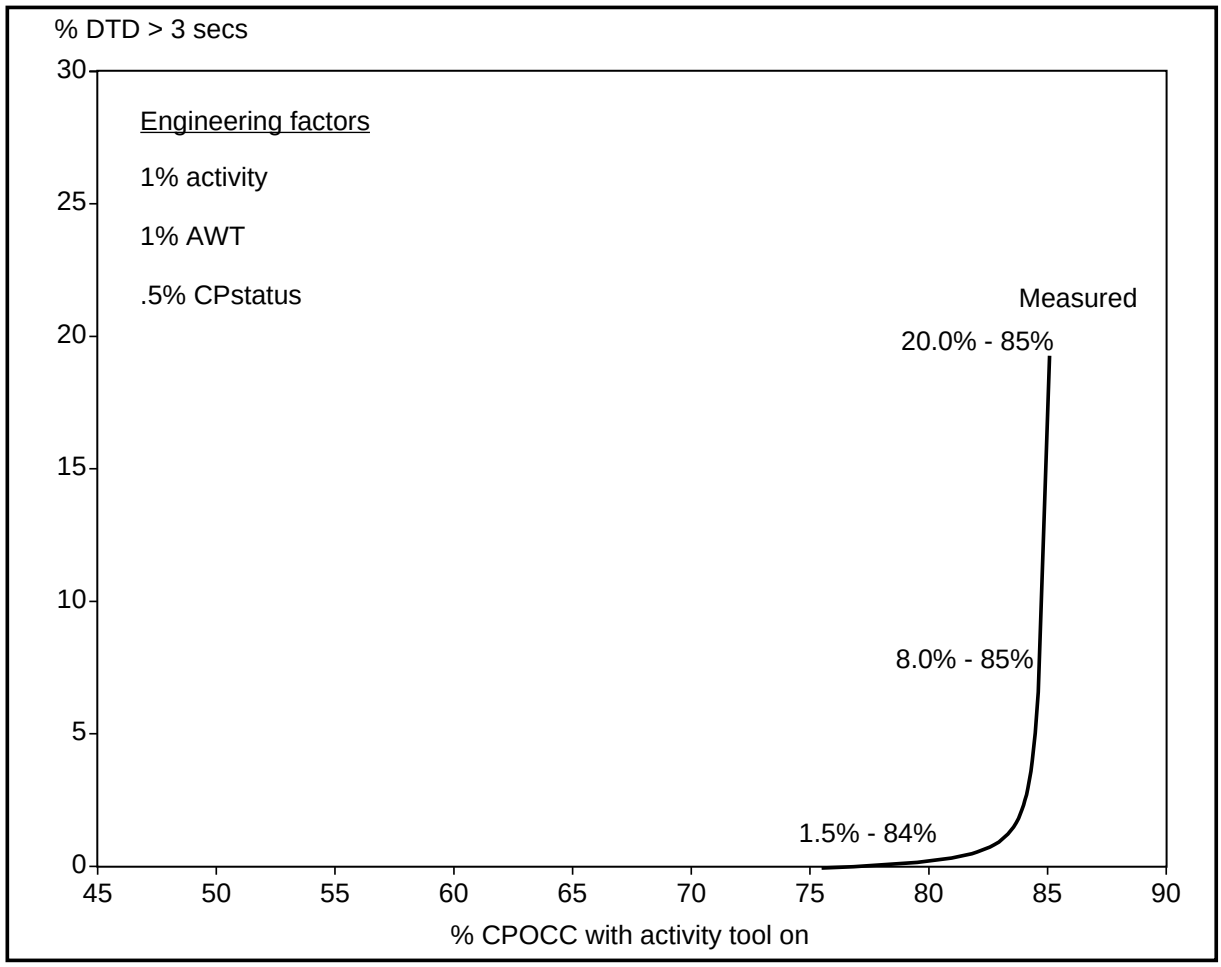


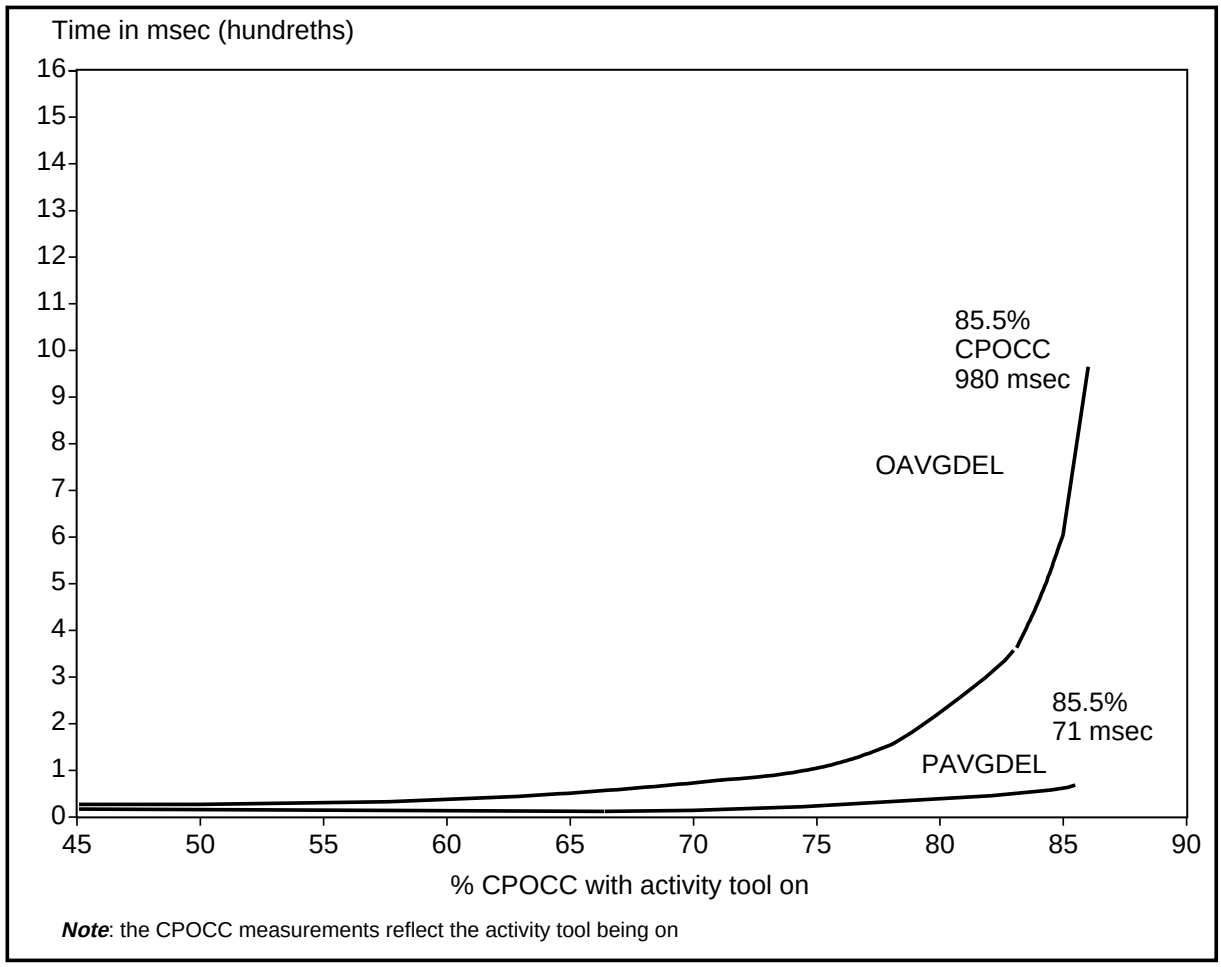
Table 19-18xxx
Allocation of classes at 20% dial tone delay > 3 seconds

Class name	Expected (%)	Actual (%)
Scheduler	4.0%	3.5%
System 7	0.5%	0.5%
System 6	0.5%	0.5%
Maintenance	1.0%	1.0%
Background	4.0%	5.8%
Guaranteed background	2.0%	2.0%
Guaranteed OM and non-guaranteed OM	2.0%	2.0%
Call processing and input/output (CPOCC)	86.0%	85.5%

Origination and progress queues average delay

The origination queue average delay (OAVGDEL) and progress queue average delay (PAVGDEL) are presented in Figure 19-9. The curves demonstrate the the DMS gives priority to calls which are accepted before new originations are served. This is accomplished by overload controls guaranteeing resources to calls in progress, rather than for new originations. Work for processing new originations will only be performed if the time available is not required for calls in progress.

Figure 19-9
Origination and progress queues average delay curve



SR30 gain factor

This section contains a series of office models that consist of specific call types that are measured with each BCS load. The six models are as follows:

- POTS equal access end office urban
- POTS equal access end office suburban
- access tandem without 800 service
- TOPS host operator centralization stand-alone
- TOPS remote operator centralization/ access tandem (non-TICS)
- Meridian digital centrex

Tables 19-19 through 19-24 contain the call mix data, call mix percentages, milliseconds per call, and the resulting weighted call times. In addition, the maximum calls per hour, corresponding percentage of delay, and call pro-

cessing time occupancy (CPOCC) are shown.

> ***Note:*** The NT40 milliseconds per call values used to compare the SuperNode series may change slightly from one BCS to another.

Call timing is measured in the following switch configuration:

- computing module/central processing unit in sync
- DTSR unbound
- Bellcore AMA format
- AMA tape
- no UTRs

The maximum percentage of the total real time available to be used in call processing for the NT40 is 83 percent and 86 percent for the SR30. The gain factor is the measurement that indicates the improvement in the call processing rate when one processor is compared to another. The gain factor is calculated by dividing the maximum SR30 calls per hour by the maximum calls per hour of the NT40. In this test the average gain of the SR30 is 3.21 times the NT40 call rate.

Table 19-19xxx
TOPS host OC/stand-alone model (BCS29)

Call type	Call description	Call mix percentage	NT40 MS per call	NT40 weighted call time	SR30 MS per call	SR30 weighted call time
340	HOC MCCS	15.0	4.8	0.7174	1.5	0.2250
327	S/A MCCS2	21.0	63.1	13.2437	21.4	4.4940
326	ACTS CN	14.0	69.4	9.7117	24.9	3.4860
487	HOC non-coin 0+	4.5	45.1	2.0299	11.9	0.5355
334	HOC non-coin 0-	6.0	45.9	2.7522	12.1	0.7260
614	HOC coin 0+	2.3	50.3	1.1575	13.3	0.3059
613	HOC coin 0-	2.3	51.0	1.1725	13.3	0.3059
330	S/A non-coin 0+	6.3	76.4	4.8133	24.7	1.5561
315	S/A non-coin 0-	8.4	73.4	6.1621	23.2	1.9488
814	S/A coin 0+	3.1	98.5	3.0525	31.6	0.9796
813	S/A coin 0-	3.1	97.2	3.0121	32.4	1.0044
048	MF INCAMA trunk-trunk	14.0	19.6	2.7391	6.5	0.9100
Totals		100.0		50.564		16.477
Maximum calls per hour at 20% DTD and 80.0% CPOCC NT40, 84.5% CPOCC SR30				56,957		184,619

Table 19-20xxx
POTS EAEO suburban model (BCS29)

Call type	Call description	Mix percentage	NT40 MS per call	NT40 weighted call time	SR30 MS per call	SR30 weighted call time
994	DTMF 1FR line-to-line	5.0	19.1	0.9565	6.6	0.3300
995	DTMF 1FR line-to-EAS trunk	3.0	16.2	0.4859	5.7	0.1710
950	DTMF 1MR line-to-line	15.0	28.2	4.2228	8.8	1.3200
016	DTMF 1MR line-to-EAS trunk	7.0	26.5	1.8565	8.4	0.5880
011	DTMF 1FR line-to-LAMA trunk	10.0	25.3	2.5326	8.3	0.8300
360	FGC 1 + 10D-IC trunk	5.0	31.6	1.5815	10.1	0.5050
401	FGD 1 + 7D-IC	5.0	35.7	1.7826	11.5	0.5750
993	DTMF 1FR line-to-abandon	4.0	8.7	0.3478	3.1	0.1240
308	DTMF 1MR line-to-busy	6.0	16.5	0.9913	5.8	0.3480
996	MF trunk-to-line	30.0	13.7	4.1087	4.7	1.4100
453	IC trunk-to-line	10.0	26.4	2.6413	7.9	0.7900
Totals		100.0		21.508		6.991
Maximum calls per hour at 20% DTD and 82.0% CPOCC NT40, 86.0% CPOCC SN30				137,254		442,855

Table 19-21xxx
POTS EAEO urban model (BCS29)

Call type	Call description	Mix percentage	NT40 MS per call	NT40 weighted call time	SR30 MS per call	SR30 weighted call time
974	DTMF 1MR-AT to FGD IC	5.0	36.2	1.8098	12.0	0.6000
950	DTMF 1MR line-to-line	18.0	28.2	5.0674	8.8	1.5840
016	DTMF 1MR line-to-EAS trunk	7.0	26.5	1.8565	8.4	0.5880
308	DTMF 1MR line-to-busy	3.0	16.5	0.4957	5.8	0.1740
018	DTMF coin line-to-busy	1.0	19.3	0.1935	7.3	0.0730
996	MF trunk-to-line	7.0	13.7	0.9587	4.7	0.3290
990	C trunk-to-line	14.0	26.4	3.6978	7.9	1.1060
019	DTMF coin-to-line	2.0	30.3	0.6065	11.3	0.2260
954	DTMF coin line-to-IC/FGD	1.0	41.1	0.4109	14.0	0.1400
054	PBX DOD trunk-to-line	11.0	18.6	2.0446	6.9	0.7590
958	MF PX DOD trunk-to-IC trunk	3.0	35.3	1.0598	12.3	0.3690
961	MF PX DOD trunk-to-EAS trunk	4.0	17.2	0.6870	6.5	1.2600
888	DTMF MDC line-to-MDC line	10.0	18.3	1.8261	6.4	0.6400
889	DTMF MDC line-to-EAS trunk	4.0	19.1	0.7652	7.0	0.2800
858	DTMF MDC line-to-abandon	2.0	15.9	0.3174	5.8	0.1160
854	MF POTS trunk-to-MDC line	5.0	13.8	0.6902	4.7	0.2350
883	FGD DTMF MDC line-to-AT	3.0	38.6	1.1576	12.6	0.3780
Totals		100.0		23.65		7.86
Maximum calls per hour at 20% DTD and 82% CPOCC NT40, 86.0 % CPOCC SR30				124,849		394,044

Table 19-22xxx
Access tandem without 800 service model (BCS29)

Call type	Call description	Mix percentage	NT40 MS per call	NT40 weighted call time	SR30 MS per call	SR30 weighted call time
998	MF IT trunk-to-IT trunk	27.5	12.9	3.5570	4.4	2.640
048	MF INCAMA trunk-to-trunk	5.5	19.6	1.0760	6.5	0.798
455	IT trunk-to-IC carrier trunk	22.0	12.8	2.8220	4.4	2.090
456	IC carrier trunk-to-trunk	33.0	21.2	6.9950	6.5	4.851
997	Tandem INCAMA-to-tandem	12.0	9.6	1.1480	3.4	0.900
Totals		100.0		15.59		5.09
Maximum calls per hour at 20% DTD and 83% CPOCC NT40, 86% CPOCC SR30				191,572		608,431

Table 19-23xxx
TOPS remote OC/AT model (non-TICS, BCS29)

Call type	Call description	Mix percentage	NT40 MS per call	NT40 weighted call time	SR30 MS per call	SR30 weighted call time
998	MF IT trunk-to-IT trunk	12.5	12.9	1.6168	4.4	0.5500
048	MF INCAMA trunk-to-trunk	12.5	19.6	2.4457	6.5	0.8125
455	IT trunk-to-IC carrier trunk	10.0	12.8	1.2826	4.4	0.4400
456	IC carrier trunk-to-trunk	15.0	21.2	3.1973	6.5	0.9750
997	Tandem INCAMA-to-tandem	5.0	9.6	0.4783	3.4	0.1700
924	E800 AT-IC trunk D/B QBY	5.0	49.0	2.4511	15.3	0.7650
497	ROC MCCS	15.0	67.1	10.0630	22.8	3.4200
503	ROC ACTS	10.0	69.4	6.9370	24.9	2.4900
506	ROC non-coin 0+	4.5	86.9	3.9086	27.3	1.2285
491	ROC non-coin 0-	6.0	83.0	4.9820	26.1	1.5560
714	ROC coin+	2.3	108.1	2.4873	34.6	0.7958
713	ROC coin-	2.2	107.7	2.3695	34.6	0.7612
Totals		100.0		42.201		13.974

-continued-

Table 19-23xxx
TOPS remote OC/AT model (non-TICS, BCS29) (continued)

Call type	Call description	Mix percentage	NT40 MS per call	NT40 weighted call time	SR30 MS per call	SR30 weighted call time
Maximum calls per hour at 20% DTD and 83% CPOCC NT40, 84.5% CPOCC SR30				68,245		217,960

End

Table 19-24xxx
MDC model (BCS29)

Call type	Call description	Mix percentage	NT40 MS per call	NT40 weighted call time	SR30 MS per call	SR30 weighted call time
888	DTMF MDC line-to-MDC line	8.0	18.3	1.4609	6.4	0.5120
889	DTMF MDC line-to-EAS trunk	3.0	19.1	0.5739	7.0	0.2100
858	DTMF MDC line-to-abandon	5.0	15.9	0.7935	5.8	0.2900
884	MDC intraLATA-to-toll trunk	7.0	29.0	2.0315	9.8	0.6860
883	FGD DTMF MDC line-to-AT	9.0	38.6	3.4728	12.6	1.1340
873	DTMF MDC line-EBS with DISP	5.0	21.1	1.0543	7.1	0.3550
891	EBS with DISP-to-EBS with DISP	5.0	29.6	1.4783	8.4	0.4200
890	EBS with DISP-to-abandon	3.0	18.7	0.5609	5.9	0.1770
892	EBS with DISP-to-EAS trunk	3.0	23.8	0.7141	7.2	0.2160
885	EBS with DISP FGD-to-AT MF	8.0	43.3	3.4609	12.9	1.0320
893	EBS with DISP-to-LAMA trunk	5.0	33.0	1.6522	9.7	0.4850
862	EBS without DISP-to-MDC line	4.0	21.6	0.8652	6.5	0.2600
854	MF POTS trunk-to-MDC line	19.0	13.8	2.6228	4.7	0.8930
879	MF POTS trunk-to-EBS without DISP	16.0	15.9	2.5391	5.1	0.8160
Totals		100.0		23.280		7.486
Maximum calls per hour at 20% DTD and 82% CPOCC NT40, 85.0% CPOCC SN30				126,802		413,572

Terminal response time

Terminal response time testing was conducted at the following three levels (percentage of total real time) of processor occupancy: 63.0 percent, 73.0 percent, and 78.0 percent as measured by the ACTIVITY tool.

The command files used for the test are comprised of four different test groups, each containing a set of individual commands as shown in Table 19-25.

Table 19-25xxx
Commands used for terminal response testing

Request	Command
Trunks	**>MAPCI;MTC;TRKS;TTP;POST; G STTOUT;QUIT ALL**
Lines	**>MAPCI;MTC;LNS;LTP;POST D 6215601;QUIT ALL**
Query directory number	**>QDN 6215601**
Query LEN	**>QLEN 12 1 00 01**
SERVORD	**>SERVORD** **NEW $ 3221459 1FR NILLATA 0 0 0 0 11$YY** **OUT $ 3221459 0 0 0 0 11BLDN YY]** **LEAVE**

Tables 19-26 and 19-27 show the SR30 measured terminal response results for one priority terminal, and one non-priority terminal. At lower levels of call processing (up to approximately 73.0 percent), there is no significant difference in the response times between a priority and non-priority device. At the three levels of call processing, 63.0 percent, 73.0 percent, and 78 percent, the response for a non-priority device on the SR30 indicates an average improvement of 82.0 percent when compared to the NT40 results. The comparison for a priority device shows a 65 percent improvement over the NT40.

Table 19-26xxx
Terminal response measurements (BCS29) - priority device

Processor	CPU % occupancy	Lines (secs)	Trunks (secs)	SERVORD (secs)	QDN (secs)	Avg.% improvement
NT40	63	49	46	38	33	
SR30	63	17	27	26	10	52.0

-continued-

Table 19-26xxx
Terminal response measurements (BCS29) - priority device (continued)

Processor	CPU % occupancy	Lines (secs)	Trunks (secs)	SERVORD (secs)	QDN (secs)	Avg.% improvement
NT40	73	108	121	95	143	
SR30	73	24	35	33	16	71.0
NT40	78	131	115	119	480	
SR30	78	26	40	41	16	72.0

End

Table 19-27xxx
Terminal response measurements (BCS29) - non-priority device

Processor	CPU % occupancy	Lines (secs)	Trunks (secs)	SERVORD (secs)	QDN (secs)	Avg.% improvement
NT40	63	68	81	126	44	
SR30	63	16	31	26	10	74.0
NT40	73	276	252	206	190	
SR30	73	37	64	49	17	82.0
NT40	78	553	512	468	423	
SR30	78	38	82	60	24	90.0

Operational measurement output

The operational measurement (OM) output test is performed to determine the quantity of OM registers that can be accumulated at various levels of call processing. As part of the test, OM data was reported at a non-priority printer and a priority printer.

Table 19-28 shows the results for the number of registers reported at each device during a half-hour reporting period.

Table 19-28xxx
Operational measurement output test results

Device	Call processing % occupancy	OM registers reported
Non-priority	63.0	7005
Priority	63.0	13019
Non-priority	73.0	4015
Priority	73.0	9405
Non-priority	78.0	2733
Priority	78.0	5095

Reload and restart timings

As part of the test plan, restart timings are measured on the SR30. The timings are measured for a warm, cold, and reload restart along with the time required to reload an image from the SLM disk, SLM tape, and 8 inch disk drive unit. The time results are shown in Table 19-29.

Table 19-29xxx
Reload and restart timings

			Time (min: sec)
Image reload			
	SLM	Disk	02:47
		Tape	12:32
	IOC	DDU (8 inch)	14:37
Restart timings			
	Warm	A1	01:50
		First dial tone	01.52
		100% dial tone	01:54
	Cold	A1	02:02
		First dial tone	02:05
		100% dial tone	02:09
	Reload	A1	03:02
		First dial tone	03:07
		100% dial tone	07:00

Conclusions

The following conclusions were derived from the SR30 testing:

- The system engineering models show that the SR30 gain factor is 3.21 times the NT40 processor and exceeds the 2.9 to 3.0 objective.
- By using the established SR20 engineering factors for the SR30, there is a buffer of call processing time available at each grade-of-service level.

Series 40 SuperNode (BCS 30 RTM)

Testing was conducted on the RTPFAST switch to measure the real time performance of the Series 40 SuperNode (SR40) processor (6803-40Mhz) using the BCS30 RTM software. The test was performed by Northern Telecom System Engineering, RTPFAST personnel, and Bellcore.

Test objectives

Testing was conducted to investigate the following areas:

- load service curves
- processor class allocations
- overload control behavior
- restart timings
- image loading timings
- call timings

RTPFAST switch environment

The test was conducted with the following switch configuration:

- SR40 processor
- DMS100/200 TOPS call mix
- Series I and II peripherals
- AMAB logs turned on
- AMA routed to disk
- BCS30 RM software load

Engineering factors

The following engineering factors were applied to the switch:

- ACTIVITY turned off, adding 1.0 percent to the expected value of overhead
- CPUSTAT turned on, adding 0.5 percent to the expected value of overhead
- with an average work time (AWT) of 8.2 msec, the AWT factor equaled 3.0 percent at a 1.5 grade-of-service (GOS) level, 1.0 percent at 8.0 percent GOS, and 1.0 percent at 20.0 percent GOS
- AWT was calculated by multiplying the percent call processing occupancy (CPOCC) at 20.0 percent GOS by 3,600,000 msec and dividing the result by the number of calls per hour at 20 percent GOS

Detailed test results

Each of the test objective results and supporting data are described in detail here with the appropriate load service curves.

Load service curves

Four load service curves are presented here. They are as follows:

- dial tone delay and processor occupancy
- incoming start-to-dial delay and processor occupancy
- origination and progress queues average delay
- accepted traffic and offered traffic

Dial tone delay and processor occupancy

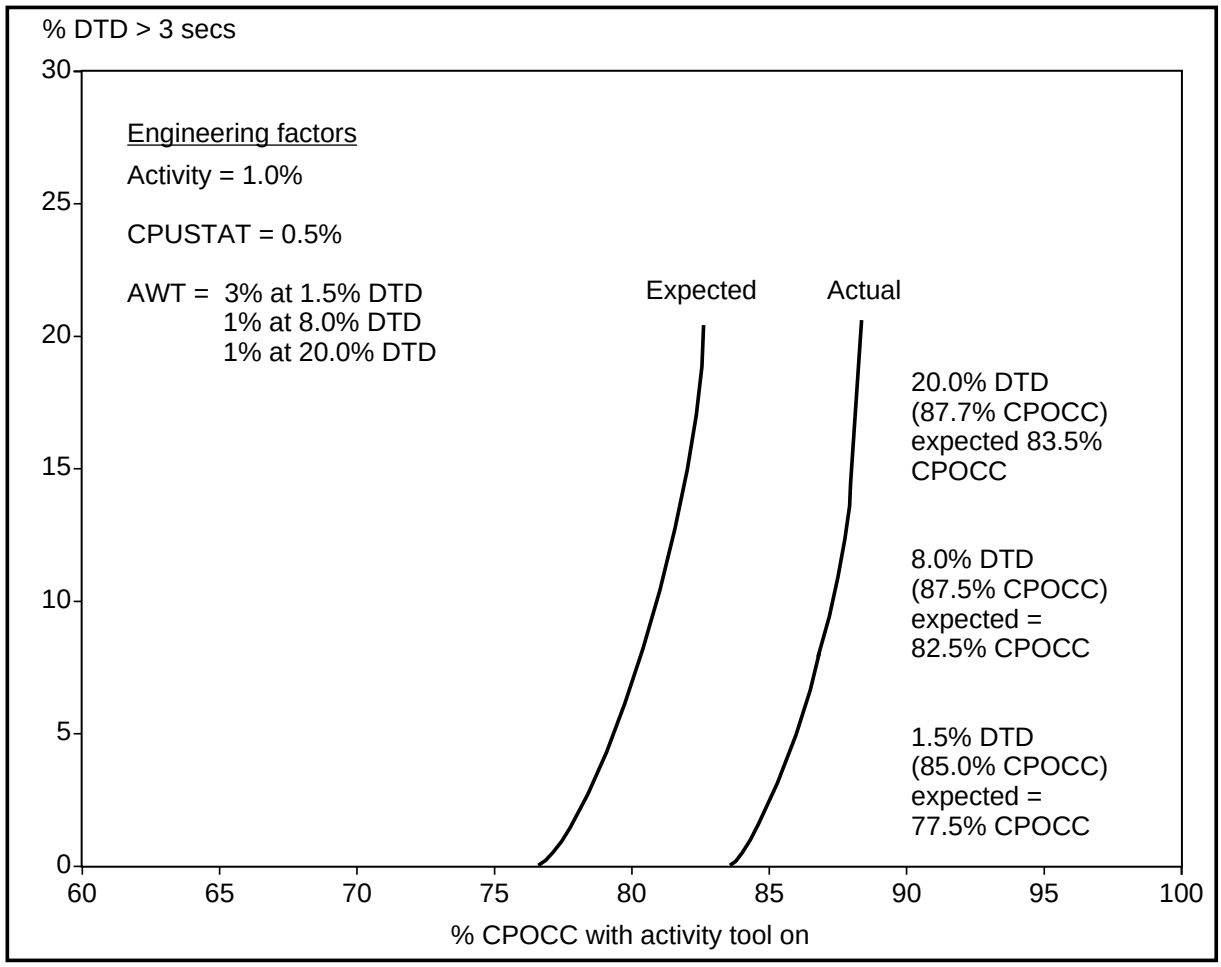
The percent dial tone delay (DTD) greater than three seconds load service curve (plotted from the RTPFAST results) is shown in Figure 19-10. Table 19-30 compares the test results with the expected values. The expected values were calculated by using the loading recommendations for the DMS-100 Family of central processors.

Table 19-30xxx
Percent real time used for call processing at three service levels

Grade-of -service (% DTD)	Expected %	Actual %
1.5	85.0	77.5
8.0	87.5	82.5
20.0	87.7	83.5

The comparison in Table 19-30 shows that the DMS SuperNode with the Series 4 processor performed better than expected at the three grade-of-service points. The RTPFAST switch performed above the predicted values by 7.5 percent at the 1.5 percent GOS, 5.0 percent at 8.0 percent GOS, and 4.2 percent at 20.0 percent GOS. This difference in expected and actual values has been documented by previous test results.

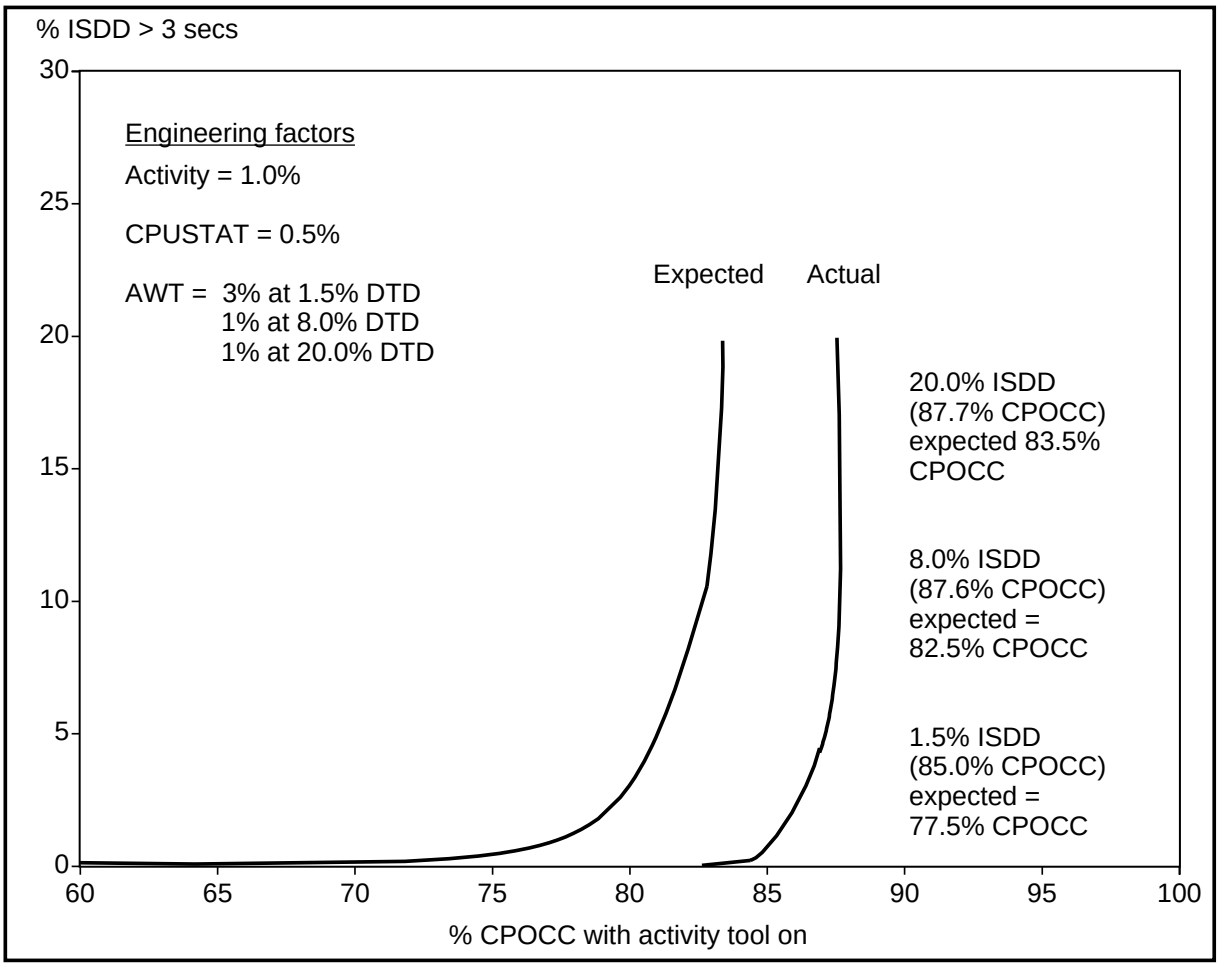
Figure 19-10
Dial tone delay > 3 seconds and processor occupancy



Percent incoming start-to-dial delay load service curve

The incoming start-to-dial delay (ISDD) load service curve plotted from the RTPFAST test results is shown in Figure 19-11. The data shows that the RTPFAST switch performed above the predicted values for the percent ISDD with the amount of difference approximating the percent dial tone delay results.

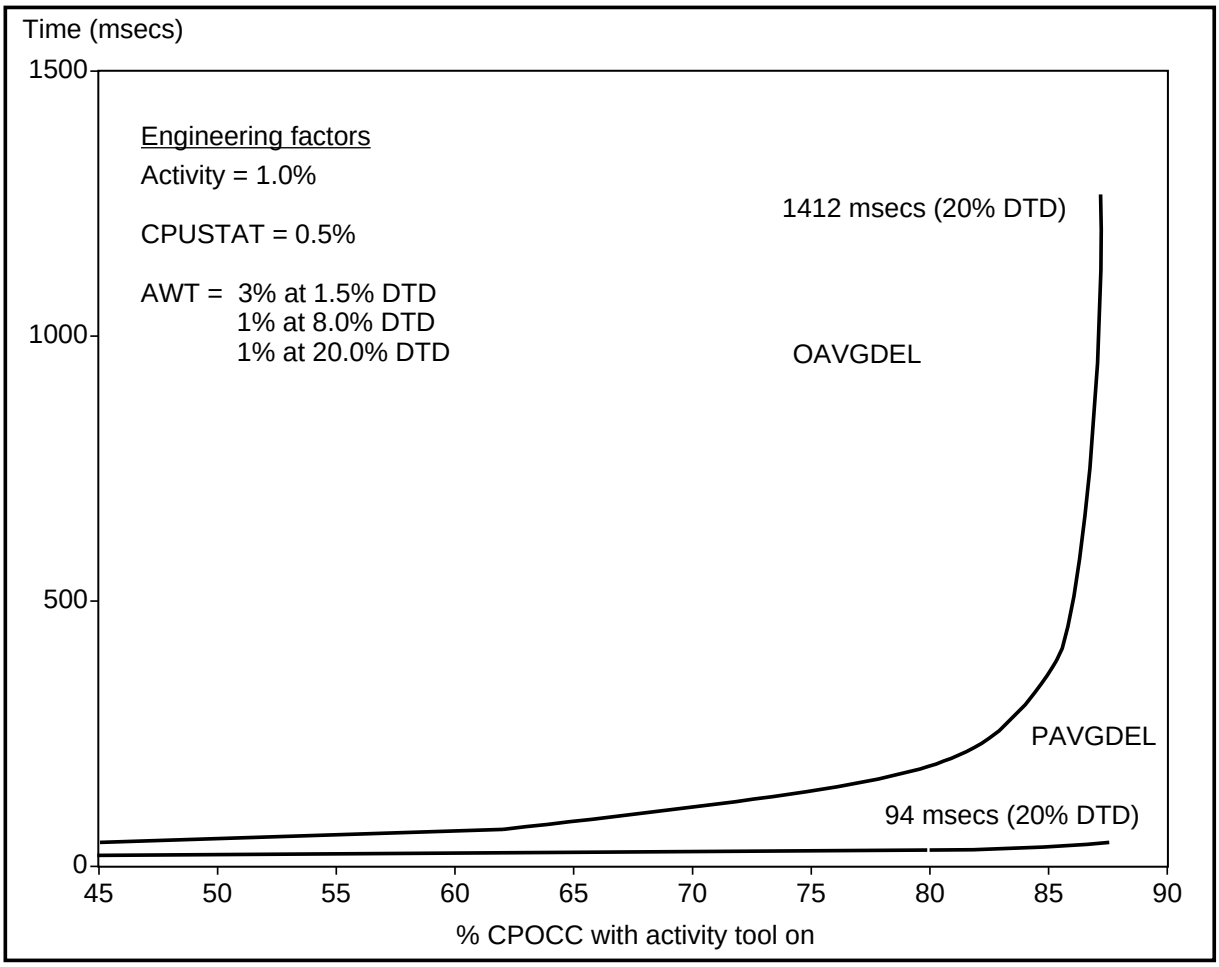
Figure 19-11
Percent incoming start-to-dial delay load service curve



Origination and progress queues average delay

The originating queue average delay (OAVGDEL) and progress queue average delay (PAVGDEL) measured at the RTPFAST are presented in Figure 19-12. The curve demonstrates that the DMS switch gives priority to calls that are accepted before new originations are served.

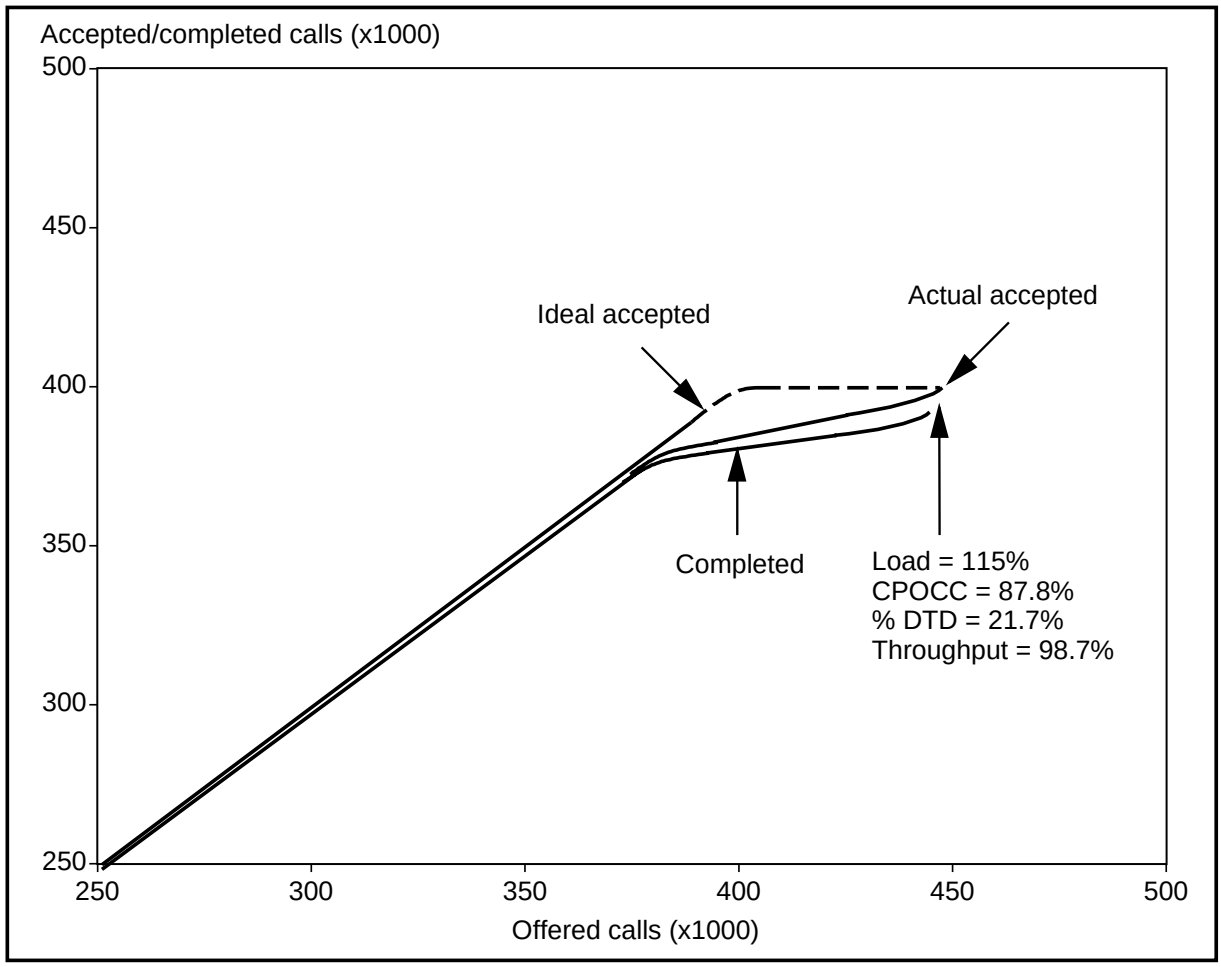
Figure 19-12
Origination and progress queues average delay



Accepted and offered calls

Shown in Figure 19-13 are the accepted and completed calls compared to the number of offered calls.

Figure 19-13
Comparison of accepted and completed calls to offered calls



Scheduler class real time allocations

Shown in Table 19-31 are the RTPFAST real time allocations compared to the predicted real time allocations for the scheduler classes at the 20 percent grade-of-service point. The engineering factors ACTIVITY, AWT, and CPUSTAT are included in the actual and predicted values.

Table 19-31xxx
Allocation of classes at 20% dial tone delay > 3 seconds

Class name	Predicted (%)	Actual (%)
Scheduler	4.0	3.10
System	1.0	0.28
System tool	1.5	0.40
Maintenance	1.0	1.30
Background	4.7	4.50
Guaranteed terminal	2.0	1.25
Idle	0.0	0.00
Guaranteed OM and non-guaranteed OM	2.0	1.14
Audit	0.3	0.33
NOSFT	0.0	0.00
Call processing	83.5	87.70
Total real time	100.0	100.0

Notes:
1. NOSFT = network operations system processes
2. Call processing includes: HPCP (high priority call processing), CP (call processing), DEFCP (deferrable call processing), I/O (input/output)

The allocations in Table 19-31 show that the call processing occupancy exceeded the expected level, while the overhead values were lower than expected. The system and system tool allocations, which are where the CPUSTAT and ACTIVITY processes run, were approximately 2.0 percentage points lower than expected.

One priority terminal was kept 100 percent busy during the test using the E800VER command. Even with this 100 percent duty cycle, the priority devices did not use their guaranteed 2.0 percent

The guaranteed operational measurement (GOM) and non-guaranteed operational measurement (NGOM) that contain OM reporting and sampling also used less than their guaranteed allocation. Because the overhead classes used less than their guaranteed percent, more time was allocated to the call processing processes; thereby, allowing the call processing allocation to exceed its maximum expected value.

> ***Note:*** The processor allocations that are used for the Series 20 SuperNode are also used for the Series 40 SuperNode; therefore, the increased efficiency of the Series 40 is not reflected in the expected values.

Restart timings

The restart timings (BCS30) were measured for warm restart, cold restart, reload restart along with the timing for image loading from a SLM disk, a

SLM tape, and a 8 inch disk drive unit. The results for the restarts are provided in Table 19-32 through Table 19-34, along with the restart timings from the previous Series 20 (using BCS30) testing and Series 30 (using BCS29) testing.

Table 19-32xxx
Warm restart timings (minutes and seconds)

Event	BCS28/SR20	BCS29/SR30	BCS30/SR40
SOS	0:35	0:35	0:35
Logs start	1:39	1:49	1:27
A1 flashing	2:01	1:50	1:42
1st LOGIN	2:04	2:10	1:51
1st host dial tone	2:04	1:52	1:42
100% host dial tone	2:05	1:54	1:43
1st DDU	1:44	1:32	1:25
AMA active	1:50	1:38	1:30

Table 19-33xxx
Cold restart timings (minutes and seconds)

Event	BCS28/SR20	BCS29/SR30	BCS30/SR40
SOS	0:35	0:35	0:35
Logs start	1:40	1:30	1:31
A1 flashing	2:14	2:02	1:53
1st LOGIN	2:18	2:15	2:01
1st host dial tone	2:17	2:05	1:56
100% host dial tone	2:17	2:09	1:58
1st DDU	1:47	1:40	1:33
AMA active	2:04	1:45	1:40

Table 19-34xxx
Reload restart timings (minutes and seconds)

Event	BCS28/SR20	BCS29/SR30	BCS30/SR40
SOS	1:01	1:07	1:04
Logs start	2:22	2:18	2:03
A1 flashing	3:17	3:02	2:57
1st LOGIN	3:25	3:24	3:29
1st host dial tone	3:23	3:07	3:03
100% host dial tone	9:51	7:00	7:23
1st DDU	2:29	2:36	2:26
AMA active	3:20	3:10	3:13

Image loading

The results of the image loading timing are presented in Table 19-35 with timings from previous Series 20 (using BCS28) testing and Series 30 (using BCS29) testing.

Table 19-35xxx
Image loading timings (minutes and seconds)

Event	BCS28/SR20	BCS29/SR30	BCS30/SR40
DDU (8 inch)	14:10	14:37	14:48
DDU (14 inch)	19:28	21:25	21:35
SLM disk	03:43	02:47	02:33
SLM tape	13:20	12:32	12:29

Call timings and call mix

Call timings or average work times (AWT) were measured on all the call types used during the test and the results are shown in Table 19-36 with the percent mix and weighted call timings for each call type.

Table 19-36xxx
Call timings and call mix used in the RTPFAST switch

Call description	Msecs/call	Call mix percentage	Weighted call time
DTMF 1MR line-to-1FR line	8.33	01.18	.0983
DTMF 1MR line-to-MF it trunk	4.69	02.36	.1107
MF IT trunk-to-1 MR line	5.08	02.30	.1168
DTMF 1 FR line-to-ATC trunk	8.36	01.41	.1178
MF ATC trunk-to-1FR	6.94	01.40	.0970
DTMF 1FR line-to-ATC trunk	8.24	01.40	.1195
MF ATC trunk-to-1FR line	6.91	01.42	.0981
DTMF 1MR line-to-MF T1 trunk	4.85	01.56	.0756
MF T1 trunk-t-1MR line	5.25	01.50	.0814
DTMF 1MR line-to-T1 MF trunk	4.89	02.90	.1452
MF T1 trunk-to-1MR line	4.28	02.85	.1220
DTMF 1MR line-to-1MR line	6.83	10.81	.7383
EBS line-to-EBS line	8.57	00.23	.0197
MDC line-to-MDC line	7.85	02.80	.2198
MDC line-to-MF IT trunk	10.98	00.27	.0296
MF IT trunk-to-MDC line	4.22	00.19	.0080
MDC line-to-SS7 trunk	7.60	01.39	.1056
SS7 trunk-to-MDC line	6.68	01.35	.0905
MDC line-to-EBS line	9.67	00.33	.0319
EBS line-to-MDC line	7.00	00.18	.0126
SS7 trunk-to-SS7 trunk	4.83	14.80	.7150
S/A TOPE non-coin 1+	11.48	01.12	.1286
S/A TOPS non-coin 0+	20.43	01.14	.2330
S/A TOPS coin 1+	61.48	01.14	.0699
S/A TOPS coin 0+	21.94	01.13	.2480
S/A TOPS coin 0-	23.02	01.13	.2601
S/A TOPS MCCS 0+	16.56	01.29	.2136
S/A TOPS non-coin 0-	19.26	01.14	.2195

-continued-

Table 19-36xxx
Call timings and call mix used in the RTPFAST switch (continued)

Call description	Msecs/call	Call mix percentage	Weighted call time
Hotel 1+	21.60	01.14	.2462
Hotel 0-	23.32	01.12	.2672
Hotel 0+	23.79	01.14	.2712
MF INCAMA trunk	6.25	03.40	.2125
Local	4.62	04.88	.2254
MF T1 trunk-to-trunk	3.09	04.30	.1328
IT trunk-to-trunk	.14	04.46	.1402
2W local MF trunk-to-trunk	2.47	05.09	.1260
Local MF-to-trunk	4.70	04.28	.2012
Local MF trunk-to-MDC line	6.45	03.92	.2528
MDC line-to-MDC line	5.41	04.22	.2286
Ineffective	*8.00	1.13	.0900
ACB	37.37	0.21	.0747
Totals		100.0	7.0000

Note: * estimated value

End

The call timings can only be measured with ACTIVITY turned off; therefore, the measured average work time of 7.0 msecs will be lower than the 8.2 msecs calculated under engineering factors with ACTIVITY turned on. In addition, each measured call timing is an average value based on a small sample size which can account for a portion of the difference.

The average work time calculated by the REAL::TIME tool, using the OM values from the test office, is equal to 8.8 msecs. The 7.0 percent difference between the measured (8.2 msecs) value and the REAL::TIME tool value is within the stated 10 percent accuracy of the REAL::TIME tool.

Conclusions

The following conclusions were based on the the results of the Series 40 processor testing:

- The load service curves show that the Series 40 processor performed above the expected service curves at the three grade-of-service points. Calculating the difference between actual values and the expected values shows that the expected values provide a 4.0 to 8.0 percent favorable difference. It should be noted that the expected values are derived from BNR computer simulated modeling of the SuperNode SR20 processor. The values for the SR20 were considered conservative at the time of the SR20 introduction, and with the introduction of the SR30/SR40 processors, the values become more conservative.
- The real time allocations (scheduler allocations) for the classes at the 20 percent grade-of-service are, in general, below the expected values which is reflected in the load service curves. These expected values are based on the SR20 processor and are considered conservative.
- The timings for warm restart, cold restart, and reload restart have been reduced slightly. The image loading timings showed a small increase using DDUs and a small decrease using SLMs.

Series 40 SuperNode (BCS 32 RTM)

Testing was conducted on the RTPFAST switch to measure the real time performance of the Series 40 SuperNode (SR40) processor (6803-40Mhz) using the BCS32 RTM software. The test was performed by Northern Telecom System Engineering, RTPFAST personnel, and Bellcore.

Test objectives

Testing was conducted to investigate the following areas:

- load service curves
- processor class allocations
- overload performance
- terminal response

RTPFAST switch environment

The test was conducted with the following switch configuration:

- SR40 processor
- DMS100/200 TOPS call mix
- Series I and II peripherals
- AMAB logs turned on
- AMA routed to disk
- BCS32 RTM software load

Engineering factors

Engineering factors must be considered when determining processor loading, because these factors affect the switch's overall call processing capability. These factors influence the percent of real time allocated between overhead and call processing. Some of the factors like ACTIVITY tool are optional, but when activated will add to the minimum overhead requirements. Factors such as average work time (AWT) and peaking are traffic characteristics that can also increase the overhead requirements. As a result, these factors can decrease the maximum amount of time for call processing.

Table 19-37 shows the engineering factors that apply to the RTPFAST call mix and the expected CPOCC at the grade-of-service points.

Table 19-37xxx
Grade-of-service, overheads, and call processing

Overheads	Grade-of-service		
	20 %	**8 %**	**1.5 %**
Basic	14.0 %	15.0 %	18.0 %
ACTIVITY tool	1.0 %	1.0 %	1.0 %
CPUSTAT	0.5 %	0.5 %	0.5 %
AWT	1.0 %	1.0 %	3.0 %
Total	16.5 %	17.5 %	22.5 %
Expected CPOCC	83.5 %	82.5 %	77.5 %

Detailed test results

Scheduler class real time allocations

The RTPFAST real time allocations versus expected real time allocations for the scheduler classes at the 20 percent grade-of-service points are shown in Table 19-38. The expected values are based on a maximum call processing allocation of 86 percent, minimum overhead allotments of 14 percent, and adjustments for engineering factors (ACTIVITY/AWT/CPUSTAT). The expected results were calculated using procedures located in *Loading Recommendations for the DMS-100 Family of central processors,* SEB 87-05-001, Issue 4.

Each of the test objective results and supporting data are described in detail here with the appropriate load service curves.

Table 19-38xxx
Series 40 DMS-SuperNode processor allocations at 20 percent DTD

Class name	Expected	Actual
Scheduler	4.0 %	3.8 %
System/system tool	2.5 %	1.6 %
Maintenance	1.0 %	4.0 %
Background/audit	5.0 %	4.0 %
NGOM/GOM	2.0 %	1.7 %
Idle	0.0 %	0.0%

-continued-

Table 19-38xxx
Series 40 DMS-SuperNode processor allocations at 20 percent DTD
(continued)

Class name	Expected	Actual
Guaranteed terminal	2.0 %	0.8 %
HPCP, CP, DEFCP, I/O	83.5 %	84.1 %
Total real time	100.0 %	100.0 %

End

The allocations in Table 19-38 show that the call processing occupancy exceeded the expected level even though the maintenance class used more than it's real time allocation. Since the total overhead classes used less than their guaranteed percent, more time was allocated to call processing.

Load service curves

Call processing occupancy has effects on grade-of-service when near maximum capacity. Dial tone delay, origination denial, terminal response, and other key service measurements are affected when call processing occupancy reaches capacity. For this reason, information is provided at three different grade-of-service levels (20 percent, 8 percent, 1.5 percent DTD > 3 seconds).

The dial tone delay (DTD) load service curve plotted from the test results is shown in Figure 19-14. The actual results compared against expected are shown in Table 19-39.

Figure 19-14
Dial tone delay > 3 seconds versus percent CPOCC

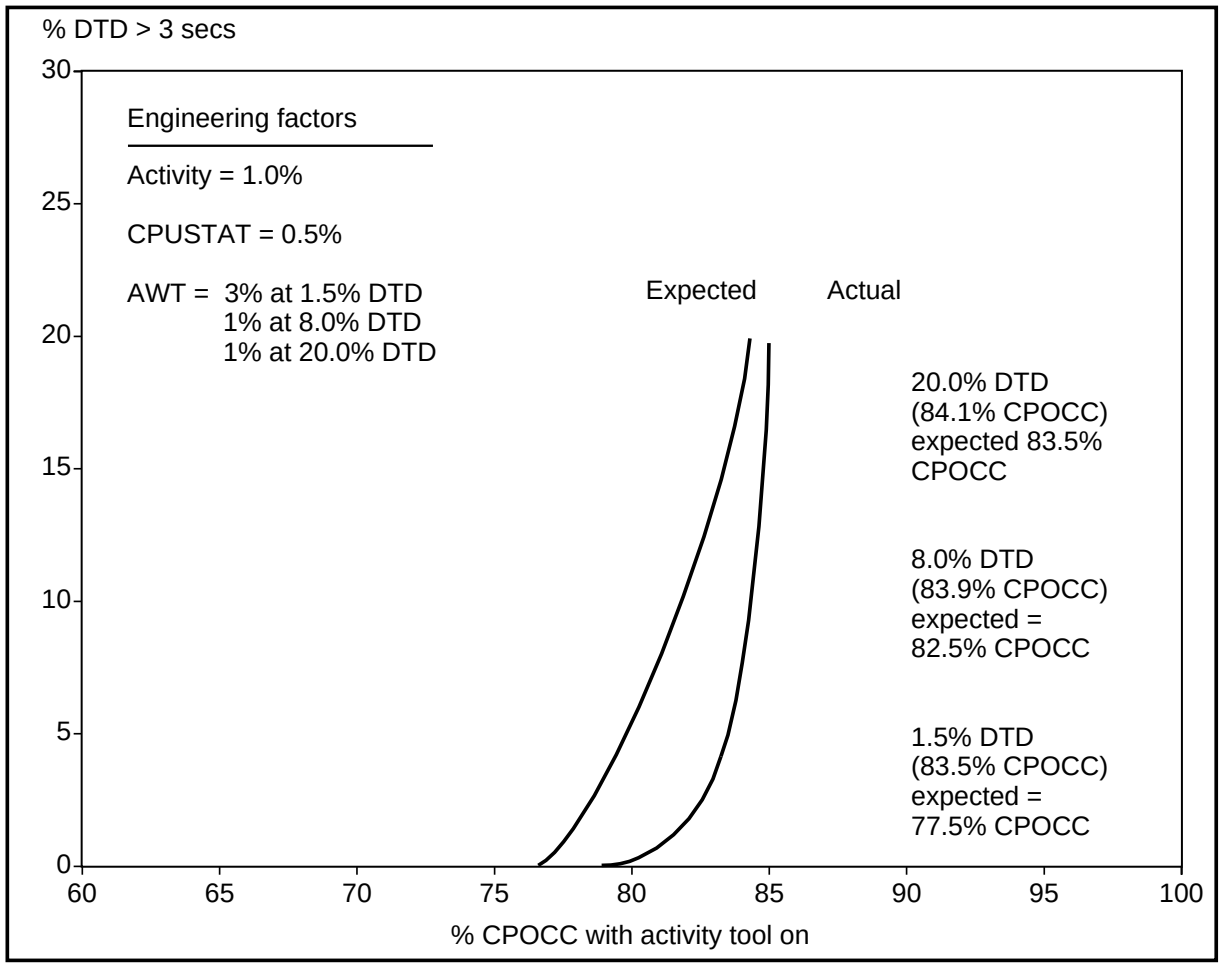


Table 19-39xxx
Percent real time DTD > 3 secs versus percent CPOCC

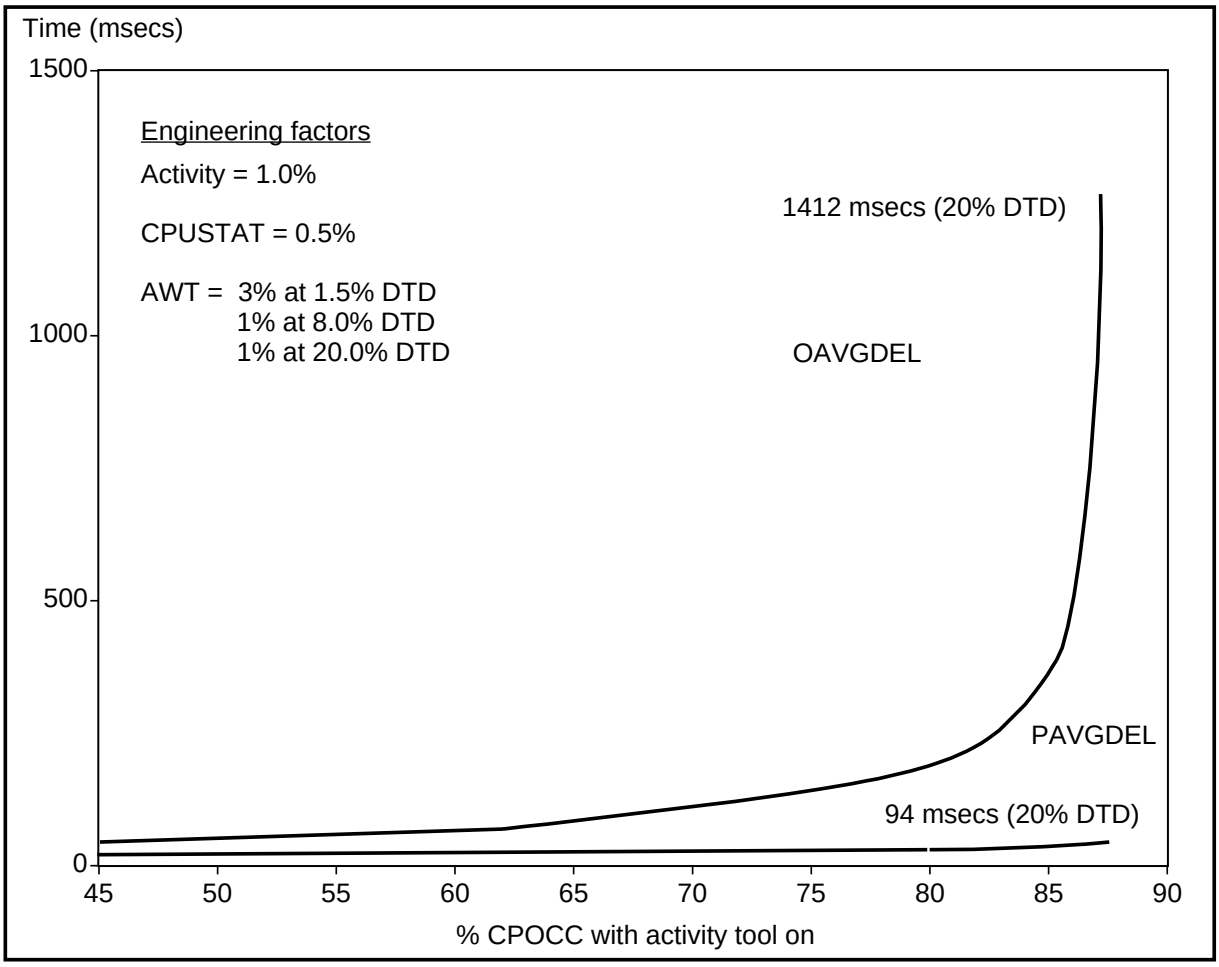
Grade-of -service (% DTD)	Actual %	Expected %
1.5 % DTD	83.5 %	77.5
8.0 % DTD	83.9 %	82.5
20.0 % DTD	84.1 %	83.5

The comparison shows that the DMS-SuperNode with the SR40 processor performed better than expected at the three grade-of-service points. This favorable difference between actual and expected values on the Series 40 processor has also been documented on previous Series 40 processor test results.

Origination and progress queues average delay

The originating queue average delay (OAVGDEL) and progress queue average delay (PAVGDEL) measured at the RTPFAST are presented in Figure 19-15. The curve demonstrates that the DMS switch gives priority to calls that are accepted before new originations are served. This is accomplished by overload controls guaranteeing resources to calls in progress, rather than for new originations. Work for processing new originations will only be performed if the time available is not required for calls in progress.

Figure 19-15
Origination and progress queues average delay

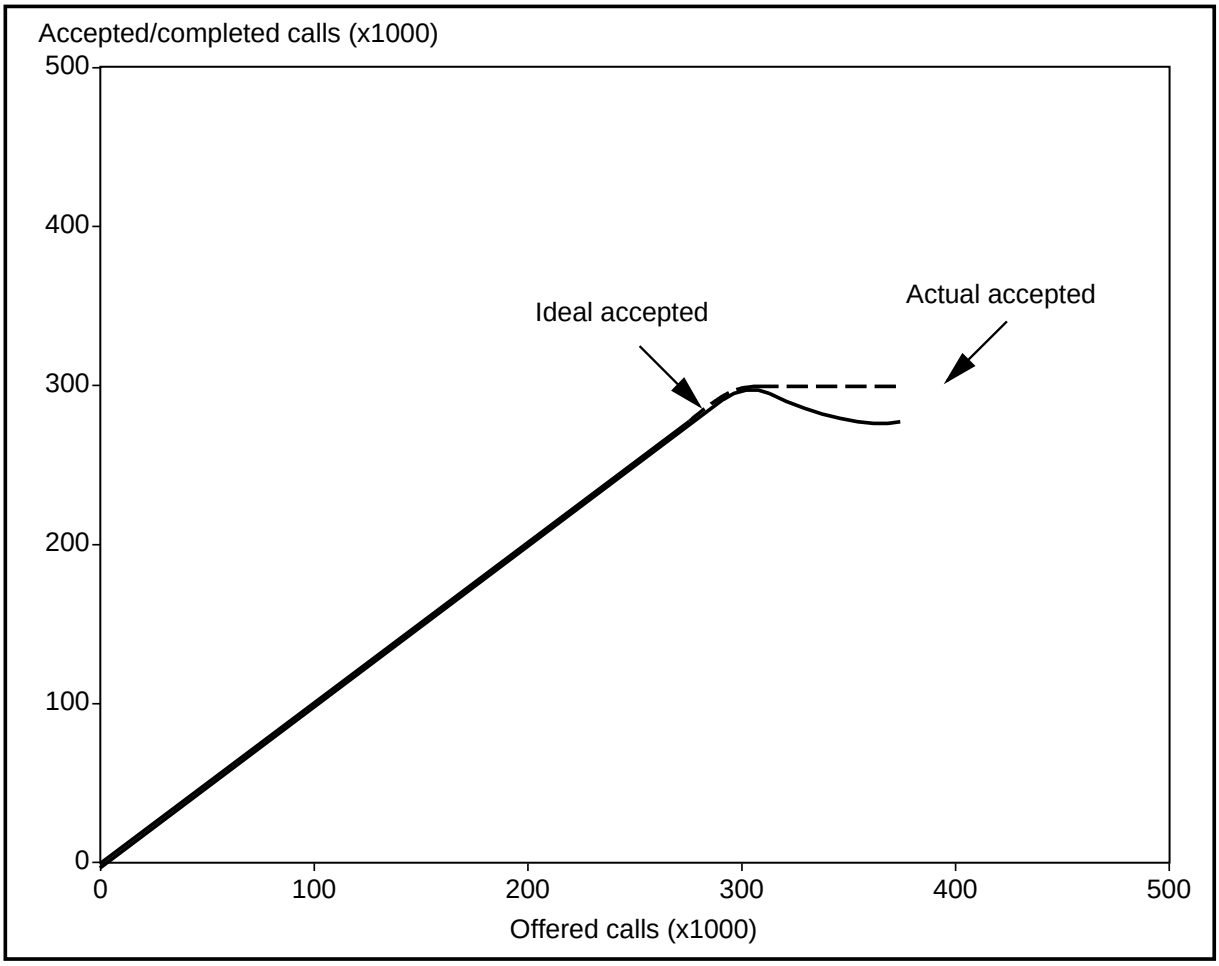


Theoretically, the accepted traffic should equal the offered traffic up until the point at which the system cannot handle the additional traffic. At this point and beyond, the quantity of calls accepted should remain constant. In reality, the level of accepted calls will decrease slightly as the level of

offered calls increases because the processor takes some of the real time available to reject offered calls which cannot be handled.

The accepted versus offered calls measured in RTPFAST are shown in Figure 19-16. Satisfactory and stable performance was achieved, and the accepted calls decreased slightly due to the processor rejecting offered calls.

Figure 19-16
Accepted versus offered calls



Terminal response

Terminal response measurements were performed using the commands listed in Table 19-40.

Table 19-40xxx
Terminal response testing commands

Terminal	Command
Trunks	**MAPCI;MTC;TRKS;TTP;POST G OTRAF1FREAS;QUIT ALL**
Lines	**MAPCI;MTC;LNS;LTP;POST D 3258308;QUIT ALL**
QDN	**QDN 3258309**
QLEN	**QLEN 12 1 00 01**
SERVORD	**SERVORD; OUT $ 3258308 12 1 00 01 BLDN;NEW$ 3258308 1FR NILLATA 0 12 1 00 01;QUIT**

The measured results for one priority terminal and one non-priority terminal are shown in Table 19-41.

Table 19-41xxx
Terminal response measurements

	Percent CPOCC					
Priority device						
	Idle	**30%**	**60%**	**70%**	**75%**	**86%**
Trunks	3.3	10.7	17.5	29.9	34.1	72.3
Lines	3.7	8.8	15.1	26.9	36.7	70.4
QDN	1.1	4.5	7.3	11.7	14.8	30.5
QLEN	1.8	4.6	7.6	39.8	50.1	31.1
SERVORD	8.8	17.0	26.6	39.8	50.1	112.1
Non-priority device						
	Idle	**30%**	**60%**	**70%**	**75%**	
Trunks	4.1	7.2	23.8	51.3	101.3	
Lines	3.1	6.4	21.0	61.5	81.2	
QDN	0.9	2.3	7.1	20.1	22.4	
QLEN	1.5	2.6	7.2	27.1	23.0	
SERVORD	7.2	12.3	28.7	63.2	101.7	

Conclusions

The following conclusions are made from the results of the SR40 processor BCS 32 testing.

Load service curve

The load service curve shows that the Series 40 processor performed better than expected at the three given grade-of-service points.

Scheduler allocations

The total real time overhead allocations for the classes at the 20 percent grade-of-service are below the expected values, even though maintenance class exceeded it's minimum allocation.

OAVGDEL and PAVGDEL curves

The origination queue average delay (OAVGDEL) and progress queue average delay (PAVGDEL) curves demonstrate that the DMS gives priority to calls which have been accepted before new originations are served.

Response times

The response times of both priority and non-priority terminals at call processing occupancies of less than 60 percent are approximately the same/ Above a CPOCC of 60 percent, response times for priority terminals are considerably less than the non-priority terminals.

NT-40 to DMS-SuperNode conversion

Introduction

This chapter provides a discussion of system architecture and memory considerations for NT-40 and DMS-SuperNode central control complexes in the DMS-100 Family switch. Guidelines are also given for evaluating memory capacity in an NT-40 controlled switch, and up-grading to a DMS-SuperNode. These guidelines are to be used for all new switches and additions to existing switches.

Growth of lines, features, usage, and equal access requirements have expanded table sizes within the DMS-100 Family switch. This growth has increased the data store memory requirement in an NT-40 to the point where it can become a limiting item. Program store within an NT-40 is not limiting at this time. Program store and data store are physically separate in an NT-40.

Expanded memory requirements in a DMS-SuperNode micro-processor are such that a DMS-100 utilizing 6Mbyte memory cards will also need to be administered to orderly migrate to the higher density 24 Mbyte memory card.

The unit of measurement for memory in an NT-40 is in K-words of memory. The unit of measurement in a DMS-SuperNode is in Mbytes. To convert K-words to Mbytes; divide K-words by 1024 to get M-words and multiply M-words by 2 to get Mbytes.

Architecture

There are two basic configurations in which a DMS-SuperNode may be ordered; a DMS-SuperNode complex only (upgrade), or a total switch (extension or initial) including the DMS-SuperNode complex. The initial NTI strategy focuses on the DMS-SuperNode complex only.

This strategy addresses DMS-SuperNode provisionable items and any existing switch provisionable items that are directly related to the changeover from an NT40 to a DMS-SuperNode complex (Figures 20-1, 20-2). It assumes that all other existing switch engineered components, such

as lines, trunks, networks, I/O devices, etc., are within existing design intervals and are not re-engineered at this time. The total switch engineering considerations with a DMS-SuperNode complex will be addressed at a later date.

Provisioning/Hardware

DMS-SuperNode major system engineered components consist of:

- computing module
- message switch
- memory
- office image (disk/tape)
- system load module (SLM)
- reset terminals

The basic configuration of a DMS-SuperNode complex consists of a single-cabinet containing two planes of the computing module on one shelf, two planes of the message switch on two shelves, and two system load modules on one shelf. The single-cabinet configuration is adequate for all DMS-100 applications where the addition of enhanced network is not planned.

Figure 20-1
Engineering considerations flowchart for DMS-SuperNode complex (1 of 2)

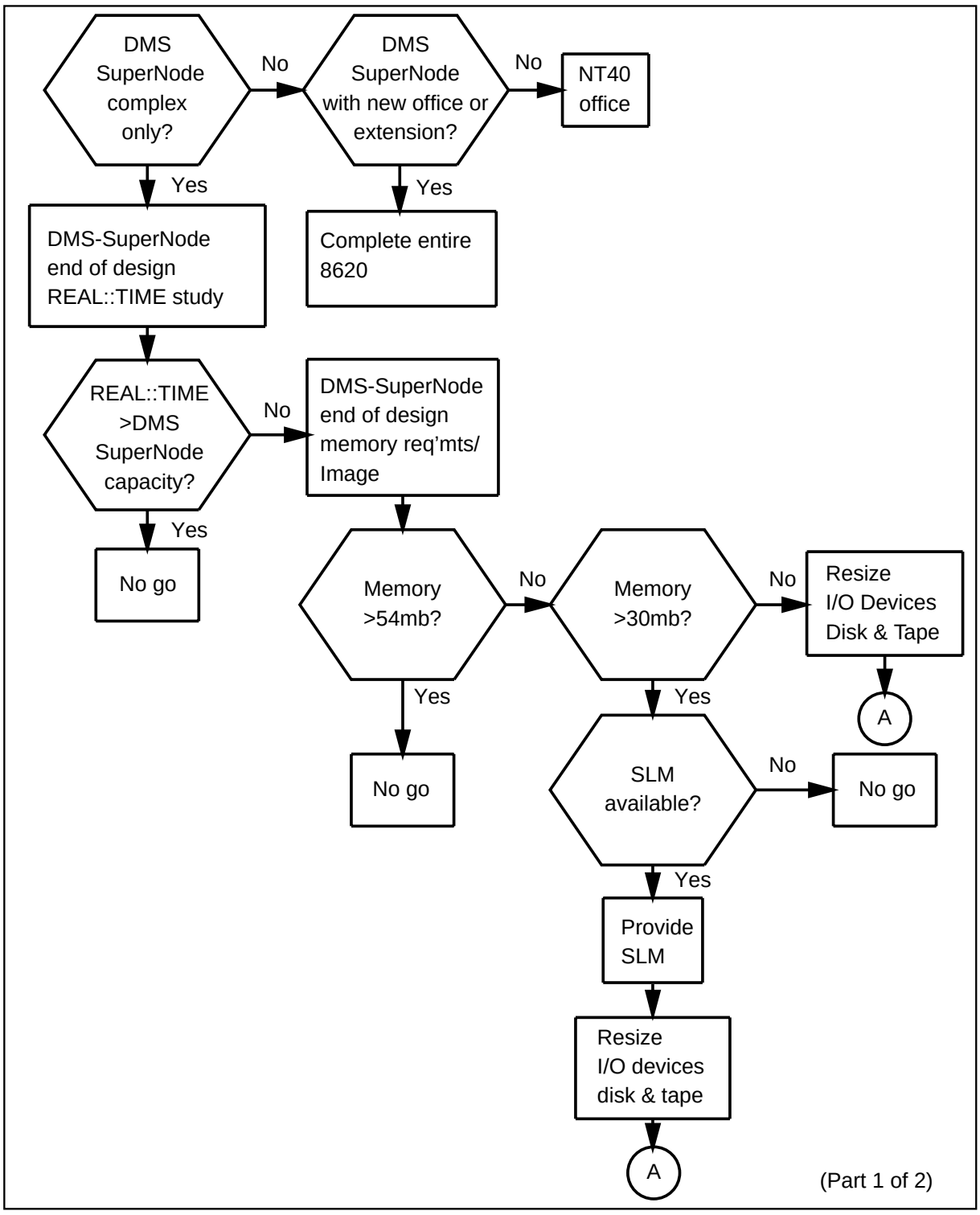
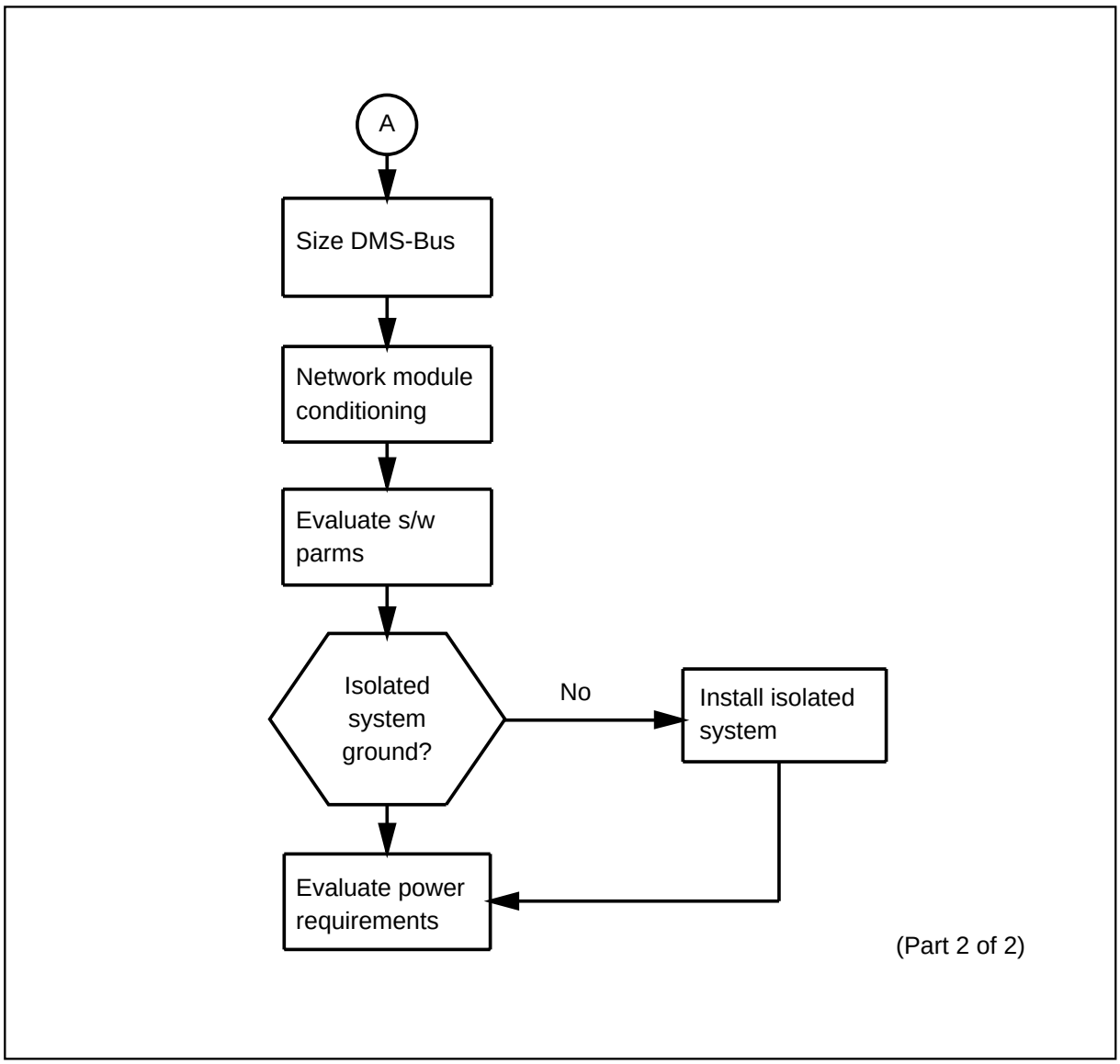


Figure 20-2
Engineering considerations flowchart for DMS-SuperNode complex (2 of 2)



DMS-Bus

The total size of the DMS-Bus is based upon the number of ports required. This is dependent upon existing peripherals (for example, network modules and IOCs).

Clock system

The system clock reference is provided within DMS-Bus. The clock reference can be provided internally or can be slaved off of another switch using an interface within DMS-Bus. (The DMS-Bus reference clock replaces

the current CMC-based system clock.) Therefore, the network module clock subsystem must be conditioned for DMS-SuperNode. This requires pack changeover in the various network module types. See API 085, Issue 5, for details.

Reset terminal interface

DMS-SuperNode requires Reset terminals connected directly to DMS-Core. These terminals provide the man-machine interface to rest or display the status of individual processors of DMS-Core and DMS-Bus. These terminals provide the same function as the face plate switches and indicators on the existing NT40 CCC.

These terminals can be provided by NTI or the customer and must be from the NTI approved list found in the NT8620 Questionnaire, Section 4, page 26. A minimum of two terminals is required, with an option of adding two more. Reset terminals can be remoted to a switching control center. Terminal provisioning is based upon operating company administration and management requirements. See API 085, Issue 5, for details.

Capacity planning

Although the DMS-SuperNode complex will provide increased real time efficiency over NT40, a new REAL::TIME study must be done to ensure customer expectations are satisfied based on the DMS-SuperNode traffic data for the end of design (EOD) period. In order to do this, it is essential to complete Section 13 of the NT8620 Questionnaire. The answers to Section 13 are then used as input to the REAL::TIME, Issue 3E, program to calculate the capacity requirements.

The call attempt results of the REAL::TIME calculations will reflect the BCS25 general availability efficiency of 2 x NT40.

DMS-SuperNode loading will conform to the guidelines for CPU loading shown in Table 20-1.

Table 20-1
CPU engineering rules (High Day EOD)

	Range	POTS	MDC	TOPS
Rated capacity (FAST II)		83%	83%	83%
Engineering factors				
Maintenance	1 - 3% (0-2)	2%	2%	2%
1 priority terminal	0%	0%	0%	0%
Operating capacity	81%	81%	81%	81%
Grade-of-service				
AWT	0-3%	0% (0-15)	1% (16-25)	3% (41-65)
Peaking	2-6%	2%	2%	2%
Grade-of-service level		79%	78%	76%
Optional features				
EDAS (DC/NM)	2%	2%	2%	2%
2 Priority terminal (SCCS)	0-14%	4%	4%	4%
2 NOS (DNC)	3%/link	---	6%	---
Typical operating company				
Operating capacity	---	72.5%	65.5%	68.5%
Activity	4%	68.5%	61.5%	64.5%

Memory

Memory sizing requirements need evaluation for provision of DMS-SuperNode memory. This will also drive the office image sizing. In order to do this, Section 7 of the NT8620 Questionnaire must be completed using the new DMS-SuperNode end of design requirements for memory. The Section 7 and Section 13 requirements must cover the same end of design period.

MEMCALC will be used by the operating company and NTI to calculate the required memory. MEMCALC incorporates the BCS policy of calculating memory for three BCS periods beyond the present BCS. This policy still holds for DMS-SuperNode.

Unlike the NT40, there is no hard-partitioned separation of program store and data store memories with DMS-SuperNode. Memory is provided in a common pool for DMS-SuperNode. To estimate the initial DMS-SuperNode

requirements, the NT40 Program Store and Data Store memory is measured and factored into the following formula:

2.3 x existing NT40 program store (in MB) + 1.3 x existing NT40 data store (in MB).

By using the preceding calculations for initial memory, and the end of design MEMCALC for DMS-SuperNode, memory requirements are determined. The operating company can grow from an initial level into the end of design requirements as economics dictate. This can be done in 6MB increments. A total of 10 6MB cards can be provided with one of the 10 being utilized as a “hot” standby.

Note: Any DMS-SuperNode application that exceeds 54MB of total memory will not be accepted by NTI. During the second half of 1988, the standard of 6MB memory cards will be replaced with 24MB cards as the system standard.

Office image

The next step is to determine office image memory size requirements. This is necessary to determine the adequacy of disk and tape I/O devices or provision of a system load module (SLM). If the office image memory size is greater than 32MB, the SLM must be provided. If the office image memory size is less than 32MB, existing I/O disk and tape requirements can be evaluated through Section 4 of the NT8620 Questionnaire.

Office image memory size may be estimated by the following formula:

2.3 x existing NT40 program store (in MB) + .61 x existing NT40 data store (in MB).

The SLM is an option that may be considered if dump and load speed efficiency is a factor for the operating company. NTI engineering strongly recommends the SLM for all applications.

Translations

The existing DMS-100 software is being designed to run on the DMS-SuperNode. Initial office datafill for DMS-Super Node will be accomplished in the same manner as for the NT40.

There are new office parameters and data tables associated with the computing module and message switch subsystems that are specific to the new hardware. The new parameters are OFCOPT and OFCVAR. The OFCVAR parameter establishes the DMS-SuperNode format for the distributed log system. Parameter OFCOPT enables remote log in.

New data tables for DMS-SuperNode are CMSHELF, MSINV, MSCDINV, and SYNCLK. The CMSHELF table replaces the CCC table that is associated with NT40. It provides location information for the DMS-Core shelves. The MSINV and MSCDINV tables are inventory tables for DMS-Bus. The synchronous clock system can be configured by datafilling the SYNCLK table. This table is datafilled after the MSCDINV table has been datafilled.

In addition, two fields in the existing NETWORK and IOC tables must be changed to reflect that the office is a DMS-SuperNode office. Datafill of the tables noted above will be detailed in the data schema associated with DMS-Core and DMS-Bus.

Basic considerations (NT-40 to DMS-SuperNode)

The following DMS-SuperNode engineering strategy outlines the specific considerations that must be addressed when planning and engineering a transition from NT40 to DMS-SuperNode. This document supplements ECM 331 and the current NT8620 Questionnaire, and it also describes the minimum engineering considerations for a DMS-SuperNode upgrade.

The flowcharts in Figures 20-3, 20-4 diagram the steps to follow when engineering an DMS-SuperNode complex, and should be used in conjunction with the considerations documented below.

Two basic configurations in which a DMS-SuperNode may be ordered are:

- DMS-SuperNode complex only
- total switch (extension or new) including the DMS-SuperNode complex

The initial strategy will focus on the DMS-SuperNode complex only. This strategy will address DMS-SuperNode provisionable items and any existing switch provisionable items that are directly related to the change out from an NT40 to a DMS-SuperNode complex. It will assume that all other switch engineered components, such as lines, trunks, networks, I/O devices, and so forth, are within existing design intervals and are not re-engineered at this time.

Figure 20-3
DMS-SuperNode engineering flowchart (1 of 2)

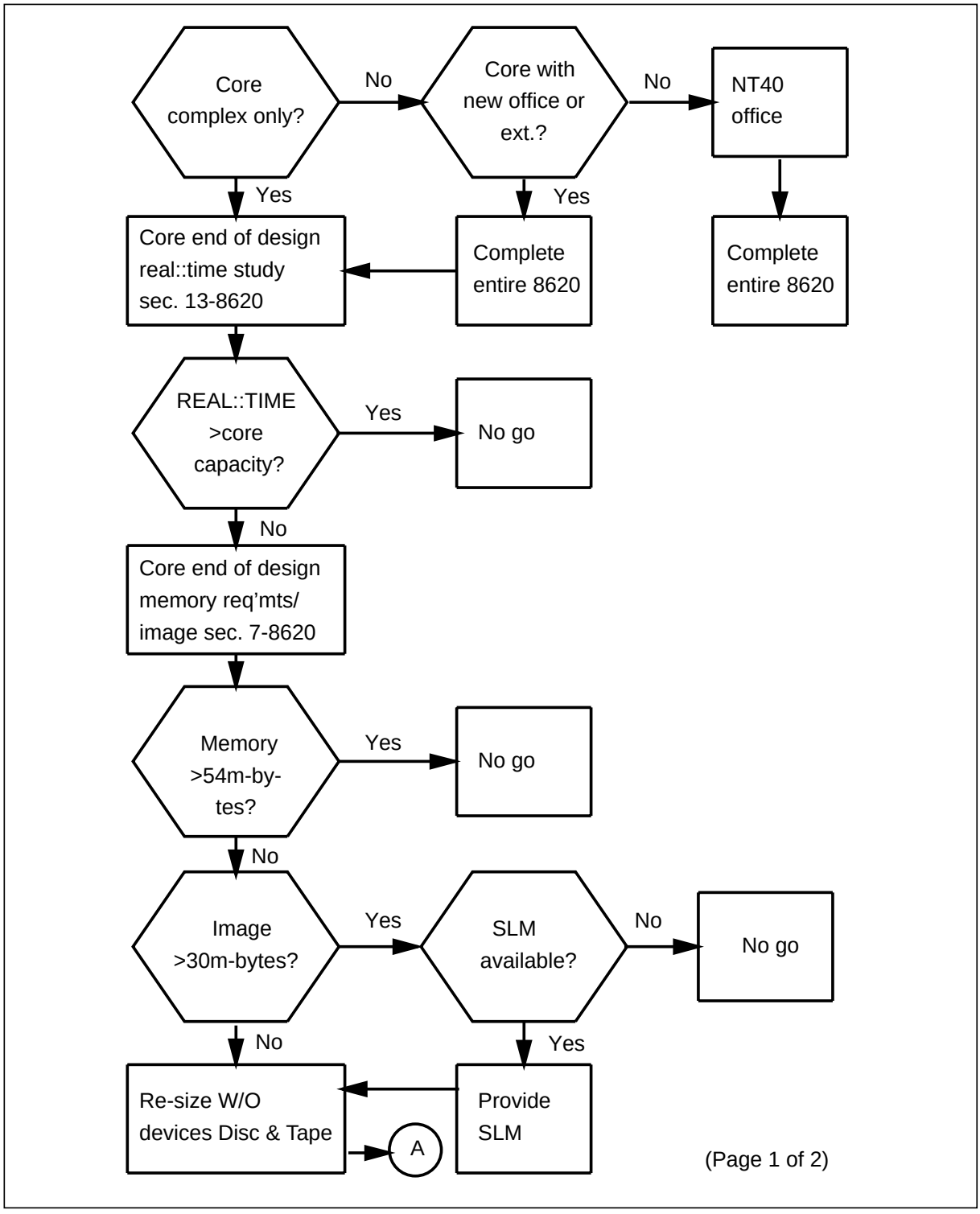
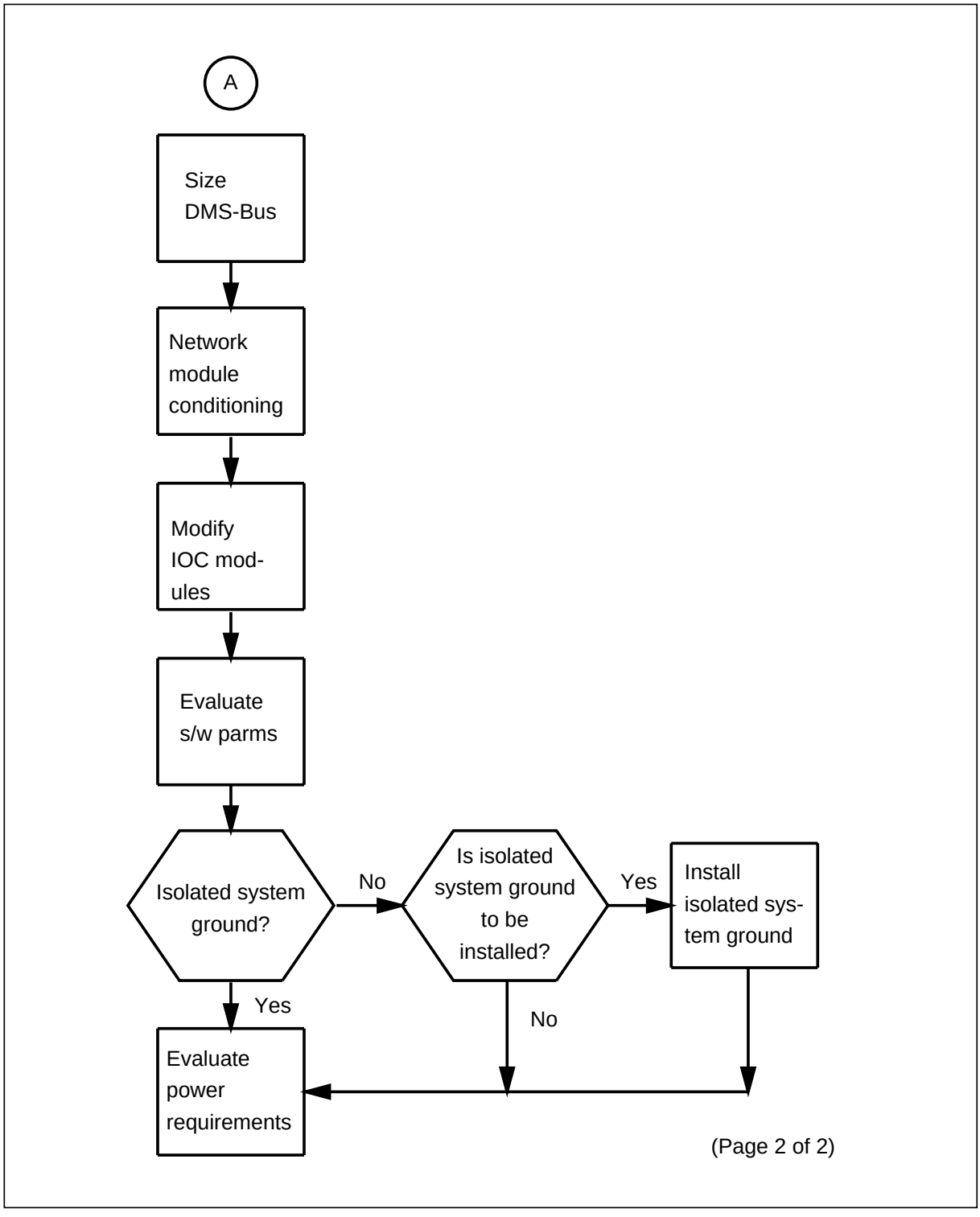


Figure 20-4
DMS-SuperNode engineering flowchart (2 of 2)



DMS-SuperNode major system engineered components consist of:

- DMS-Core
- DMS-Bus
- memory
- office image (Disk/Tape)
- system load module (SLM)
- reset terminals

Office engineering items that need evaluating for DMS-SuperNode impact are:

- DMS-Core real time capacity
- office memory sizing
- office image size on disk and tape
- DMS-Bus ports
- terminal requirements
- network module conditioning
- input output controllers
- power/grounding requirements
- cabling
- software parameters
- new DMS-SuperNode software packages

REAL::TIME

The DMS-SuperNode complex will provide increased real time efficiency over the NT40. However, it is still a requirement that a new REAL::TIME study be done to ensure customer expectations are satisfied based on the DMS-SuperNode traffic data for the end of design period. In order to do this, Section 13 of the 8620 Questionnaire must be completed. The answers to Section 13 are used as input to the REAL::TIME, Issue 3E, program to calculate the capacity requirements. DMS-SuperNode efficiency is rated at twice the NT40 capacity for the delivered BCS. The call attempt results of the REAL::TIME calculations will reflect the BCS25 general availability.

DMS-SuperNode loading will conform to the guidelines for central processor unit (CPU) engineering outlined in Table 20-2.

Table 20-2
CPU engineering rules (High Day EOD)

	Range	POTS	MDC	TOPS
Standard features				
Rated Capacity (FAST II)		83%	83%	83%
Maintenance	(0-3)	2%	2%	2%
1 priority terminal	0%	0%	0%	0%
Operating capacity		81%	81%	81%
Grade-of-service				
AWT	0-3%	0% (0-15)	1% (16-25)	3% (41-65)
Peaking	2-6%	2%	2%	2%
Grade-of-service level		79%	78%	76%
Optional features				
EDAS (DC/NM)	2%	2%	2%	2%
SES	0.5%	0.5%	0.5%	0.5%
Engineerable background 2 Priority terminals	0-14% 4%			
2 NOS (DNC)	3%/link	6%	6%	6%
Activity	4%	4%	4%	4%

Memory

Memory sizing requirements need evaluation for provision of DMS-SuperNode memory. This will also drive the office image sizing. In order to do this, Section 7 of the 8620 Questionnaire must be completed using the new DMS-SuperNode end of design requirements for memory. Requirements in Sections 7 and 13 must cover the same end of design period. MEMCALC will be used by the operating company and NTI to calculate the required memory. MEMCALC incorporates the BCS policy of calculating memory for three (3) BCS periods beyond the present BCS. This policy still holds for DMS-SuperNode.

Unlike the NT40, DMS-SuperNode does not physically separate program store and data store memories since memory is provided in a common pool for DMS-SuperNode. To estimate the initial DMS-SuperNode requirements, the NT40 program store and data store memory is measured and factored into the following formula:

- 2.3 x existing NT40 program store (in M-bytes) + 1.3 x existing NT40 data store (in M-bytes)

By using the above calculations for initial memory, and the end of design MEMCALC for DMS-SuperNode, memory requirements are determined. The operating company can grow from an initial level into the end of design requirements as economics dictate. This can be done in 6 M-bytes increments. A total of ten 6 M-byte cards can be provided with one of the ten being utilized as a "hot" standby. Any DMS-SuperNode application that exceeds 54 M-bytes of total memory will not be accepted by NTI. During the second half of 1988, the 6 M-byte memory cards will be replaced with 24 M-byte cards as the system standard.

Office image

The next step is to determine office image memory size requirements, which is a necessary step in determining the adequacy of disc and tape input/output (I/O) devices or provision of a system load module (SLM). If the office image memory size is greater than 30 M-bytes, the SLM must be provided. If the office image memory size is less than 30 M-bytes, existing I/O disc and tape requirements can be evaluated through Section 4 of the 8620 Questionnaire.

Office image memory size may be estimated by the following formula:

2.30 x existing NT40 program store (in M-bytes) + .71 x existing NT40 data store (in M-bytes)

SLM is an optional cost item that may be considered if dump and load speed efficiency is a factor for the operating company. NTI engineering strongly recommends the SLM for all applications.

DMS-Bus

The total size of the DMS-SuperNode DMS-Bus is based upon the number of ports required. This is dependent upon existing peripherals, such as network modules and IOC.

The single-cabinet DMS-Bus is adequate for all DMS applications where enhanced network (ENET) is not a factor. If ENET is planned in a future addition, the two-cabinet DMS-Bus is recommended. The three-cabinet DMS-Bus is not recommended at this time.

Terminals

DMS-SuperNode requires "RESET" terminals connected directly to the DMS-Core. These terminals provide the man-machine interface to reset or display the status of individual processors of the DMS-Core and the DMS-Bus. They provide the same function as the face plate switches and indicators on the existing NT40 central control complex (CCC). These

terminals can be provided by NTI or the customer and must be from the NTI approved list found on page 26, Section 4 of the 8620 Questionnaire. There is a minimum of two with an option for two additional terminals. “RESET” terminals can be remoted to a switching control center. The terminal provisioning is based upon operating company administration and management requirements.

Clock system

The system clock reference is provided within the DMS-Bus. The clock reference can be provided internally or can be slaved off of another switch via an interface within the DMS-Bus. (The DMS-Bus reference clock replaces the current central message controller (CMC) based system clock.) Therefore, the networks module clock subsystem must be conditioned for DMS-SuperNode. This requires pack changeover in the various network module types.

Input/output Controller

The input/output controller (IOC) modules must be modified to work with the DMS-SuperNode. This requires pack changeover in each IOC.

Isolated system grounding

DMS-SuperNode is designed utilizing isolated system grounding concepts. Northern Telecom policy is as follows:

- All initial offices involving DMS-SuperNode will be engineered, shipped, and installed to configure the offices to *Isolated System Grounding Practices*, BellCore TA-EOP-000295.
- If an existing NT40 based DMS-100F is being upgraded to a DMS-SuperNode, it is highly recommended that the total switching complex be upgraded to ISG grounding standards. Where economics preclude the implementation of ISG grounding, then the DMS-SuperNode based system can be configured for the existing non-isolated system grounding practices.

Grounding audits are highly recommended for all DMS-SuperNode upgrades. The audits can be conducted by either the operating company or NTI, in accordance with the grounding audit procedures section of *Power and Grounding Routine Maintenance*, 297-1001-158.

Parameter changes

Changes are needed on these existing office parameter tables; OFCENG, OFC OPOT and IOC. New tables for DMS-SuperNode are MSINV, CMSELF and MSCDINV. These changes and additions are found in their respective feature documents.

Memory configuration

NT-40 central control complex (CCC)

An NT-40 central processor and memory shelf has 8 card slots available for active program store, plus one card slot used as a memory controller. This controller card has 256 K-words of memory to be used to spare a detected memory fault in any one of the 8 memory cards.

This shelf has a maximum capacity of 8 M-words (MWs) of program store. Of this, 7.75 MWs are addressable. The remaining 0.25 MWs are reserved for system use such as write-protected registers.

An NT-40 data store shelf has 16 card slots available for active data store, plus one card slot used as a memory controller. This controller card has 256 K-words of memory to be used to spare a detected fault in any one of the memory cards.

This shelf has a maximum capacity of 15.75 MWs of addressable data store memory dependent on central control complex (CCC) vintage. The remaining 0.25 MWs of memory is reserved for system use such as write-protected registers.

There are two types of memory cards available for both program and data store:

- NT3X93 256 K-words
- NT4X80 1 M-words

Older vintage NT-40 systems may have NT3X40 cards which contain 64 K-words of memory. This card may exist in either program or data store shelves and can be mixed on the last addressable shelf with NT3X93 cards.

DMS-SuperNode

A DMS-SuperNode has 10 card slots available for memory on the DMS-Core shelf. Unlike the NT-40, there is no hard partitioned separation of program and data store. The memory is provisioned in a common pool. Also, there is no separate spare for fault detection built into a controller card.

There are two types of memory cards available for both program and data store:

- NT9X14BB 6 MByte
- NT9X14DB 24 MByte

Memory sparing

NT-40 and DMS-Core (DMS-SuperNode) sparing philosophies are different in their premise: NT-40 utilizes an always provided 256 K-word block of

memory (NT4X79AA memory controller card) for both data and program store. This reliability spare can take the place of any 256 K-word block of memory from a 256 K-word NT3X93AA or 1 M-word NT4X80AA card that encounters a single fault.

DMS-Core, however, must be provisioned for reliability spare. DMS-core memory is spread evenly over all cards in the memory shelf, so there is no physical spare as such. When a card fails, the store allocator automatically reconfigures memory over the remaining cards without service interruption. Because the two central control complexes have different sparing techniques, separate provisioning guidelines are required.

MEMCALC

MEMCALC is an engineering tool that requires as inputs, all software packages that will reside in the in-service BCS load, as well as data based on end-of-design quantities. MEMCALC calculated the memory required to satisfy the switch application and includes required memory allocator rounding rules in its output.

Administrative spare, which includes spare to account for MEMCALC accuracy, BCS dump and restore tools, and normal service order activity is also required. Prior to BCS28, both administrative and reliability spare were added in addition to MEMCALC output. With BCS28, administrative sparing was included in MEMCALC outputs; retroactively for all BCS periods in accordance with the memory provision policy outlined in the following paragraphs.

List of terms

ABH

average busy hour

ABS

average busy season

ABSBH

average busy season busy hour

ACB

automatic call back

ACCS

automatic calling card service

ACD

automatic call distribution

ACM

address complete message; acknowledgement message

ACTS

Automatic Coin Toll Service

AWT

average work time

average work time (AWT)

The time in seconds required by a TOPS operator to handle an average call and perform other related duties.

A/D

analog-to-digital

adaptive differential pulse code modulation (ADPCM)

Used to encode speech for storage in memory. ADPCM is memory-efficient, utilizing 4-bit speech samples taken at an 8 kHz rate, representing a saving of 50% over 64K byte pulse code modulation.

ADPCM

adaptive differential pulse code modulation

AIOD

Automatic Identified Outward Dialing

Alarm (ALM)

A visual and/or audible signal used to alert staff to a condition requiring attention.

ALIT

automatic line insulation test

All trunks busy (ATB)

Condition indicated when all the circuits in a group are occupied.

ALM

alarm

ALT

automatic line testing

alternate route

A second-choice or subsequent-choice path between two exchanges, usually consisting of two or more circuit groups in tandem. Synonymous with alternative route and second-choice route.

A-law

Pulse code modulation (PCM) translation algorithm defined in CCITT recommendation G711. It is used in converting audio analog signals to digital PCM data and vice-versa. A-law conversion is primarily used in Europe. *See* Mu-law.

AM

data packet network access module

AMA

automatic message accounting

AMAT

automatic message accounting transmitter

AMATPS

Automatic Message Accounting Teleprocessing System

American National Standards Institute (ANSI)

Organization supported by U.S. industry to establish uniformity of standards.

American Standard Code For Information Interchange (ASCII)

Coded character set used for the interchange of information among information-processing systems, communications systems, and associated equipment. ASCII defines one format in which data is exchanged between an input/output device and the device controllers of the DMS-100 Family of switches.

AML

actual measured loss

Analog

Pertains to representation by means of continuously variable physical quantities. Contrast with digital.

analog-to-digital (A/D)

A device or process for converting a continuously varying voice frequency signal to a stream of coded digital samples. *See* CODEC.

analog transmission

Transmission of a continuously variable signal, as opposed to a discretely variable signal.

ANI

automatic number identification

ANM

answer message

announcement machine

A recording machine that gives voice guidance to a subscriber if, for example, the call cannot be connected.

ANSI

American National Standards Institute

AOSS

Auxiliary Operator Services System

AP

applications processor

AQ

autoquote

AR

automatic recall

Area code

See numbering plan area

ARU

automatic recording unit

ASCII

American Standard Code For Information Interchange

ASIC

application specific integrated circuit

ASO

automatic service observing

ASP

application service part

ASU

acknowledgement signal unit

asynchronous operation

A sequence in which operations are executed out of time-coincidence with any event; an operation that occurs without a regular or predictable time relationship to a specified event. Synonymous with asynchronous working. Contrast with synchronous operation.

asynchronous transmission

Transmission in which each information character, word, or small block is individually synchronized, usually by the use of start and stop elements. The gap between each character or word is not necessarily of a fixed length. Also known as start-stop transmission. Contrast with synchronous transmission.

asynchronous working

See asynchronous operation.

AT

access tandem

ATB

all trunks busy

ATC

access to carrier

ATMS

automatic transmission measuring system

ATT

automatic trunk testing

attempt

The initiation of a telephone call. A repeat of the action is known as a retrial or subsequent attempt.

attendant key (AK)

A three-position illuminated switch at an attendant console which connects a communication module telephone circuit - as well as an optional handset, headset, automatic dialer, and/or hands free unit - to a conference bus or telephone bus. The third position is neutral.

audible ringing tone

Information tone sent back to the calling telephone subscriber as an indication that the called line is being rung. Formerly called ringback tone.

audit

Process of verifying the integrity of the system, and attempting to correct errors when detected.

Automatic Call Back (ACR)

The CLASS service that enables subscribers to dial a feature code to automatically set up a call to the last directory number that was dialed. If the destination line is busy, ACB monitors it until it becomes idle and can accept the call.

Automatic Call Distribution (ACD)

A set of Meridian Digital Centrex features that assigns answering machine priorities to incoming calls, and then queues and distributes them to a predetermined group of telephone sets designated as answering positions.

Automatic Call Distribution Management Information System (ACDMIS)

A management information system that allows a downstream processor to request and assemble ACD information.

Automatic Calling Card Service (ACCS)

A feature in which the subscriber dials a call and bills it to a calling card number provided by the operating company. In Canada ACCS is known as custom charge calling.

Automatic Coin Toll Service (ACTS)

A feature that enables the operating company to handle, without operator assistance, long-distance (1+) coin calls from a coin station.

Automatic Identified Outward Dialing (AIOD)

A feature that is used in PBX applications to identify the station from which a call is originating.

Automatic Message Accounting (AMA)

An automatic recording system that documents all the necessary billing data of subscriber-dialed long distance calls.

Automatic Message Accounting Transmitter (AMAT)

A subsystem of the automatic message accounting teleprocessing system that, on request, transmits automatic message accounting data to the collector in the central office.

automatic number identification (ANI)

The number identification of the calling station. This number is used for billing records generated by an inter LATA/international carrier. ANI is used in the United States only. Contrast with operator number identification.

Automatic recall (AR)

The CLASS service that enables subscribers to dial a feature code to automatically set up a call to the directory number from which the last incoming call was placed. If the destination line is busy, AR monitors it until it becomes idle and can accept the call.

Autoquote (AQ)

A service provided for hotels/motels whereby guest billing information is automatically transmitted over a dedicated facility to a receive-only teletypewriter located at the hotel. *See* HOBIC administrative teletypewriter, record teletypewriter, voice-quote.

Auxiliary operator services system (AOSS)

A service-related system in which operators provide subscribers with such services as directory assistance (local & long distance) and call-intercept.

available time

The time during which a unit can be used. Contrast with maintenance time.

average busy hour (ABH)

See busy hour.

average busy season (ABS)

The three months, not necessarily consecutive, having the highest average time-consistent busy hour hundred call seconds per main station for the component in question. *See* busy hour; busy season.

average busy season busy hour (ABSBH)

A time-consistent hour, though not necessarily a clock-hour, having the highest average business-day load throughout the busy season.

AWT

Average work time or actual work time.

BAC

bus access circuit

band

- In data communication, the frequency spectrum between two defined limits.
- A group of tracks on a magnetic drum or on one side of a magnetic disk.

bandwidth

- The difference in cycles-per-second between the high and low frequencies of a band.
- The range of frequencies present in any given signal.
- The range of frequencies that can be passed by a transmission medium or an electronic apparatus without undue distortion.

basic 800 Service

A one-way incoming long distance service providing called party billing on vocal/data type calls, originating from within specific calling areas. Each 800 line is associated with a standard unlisted telephone number. *See* also 800 Plus Service and Enhanced 800 Service.

basic rate access (BRA)

Access to ISDN service provided by a set of time-division multiplexed digital channels, including two B-channels, one D-channel and one or more maintenance channels. These are often described as 2B (channels) + D (channel). BRA is typically used on lines between customer premisses and a central office switch.

batch change supplement (BCS)

A DMS-100 Family software release.

baud

A unit of signaling speed equal to the number of discrete conditions or signaling events per second.

bay

A physical structure of the DMS-100 that houses equipment such as shelves, frame supervisory panel, and cooling units. *See* frame, shelf.

A 64 kbit/s digital, bi-directional channel used by Integrated Services Digital Network (ISDN) for carrying either circuit-switched voice or data, or packet-switched data. *See* Bb channel.

Bb channel

A 64 kbit/s channel carrying multiplexed B-channel packets to the network.

Bb link

DS0 carrying provisioned B-channel packet data

BCS

batch change supplement

Bd link

DS0 carrying statistically multiplexed D-channel packet data

BDW

block descriptor word

bearer capability (BC)

Associated with a DN to indicate the type of call (voice or data), and the rate of transmission that is allowed. Bearer capability is also an information element that is carried in the setup message for functional signaling to indicate the type of call and the rate of transmission required (for ISDN). *See* bearer services.

bearer services

Characteristic that is associated with a logical terminal (service profile) in functional signaling. It offers a pool of bearer capabilities to a logical terminal. Also called authorized call type.

Bell Communications Research (Bellcore)

A group responsible for co-ordinating Bell Operating Company projects and setting guidelines for a switching system.

Bellcore

Bell Communications Research

Bell-Northern Research (BNR)

Part of the tricorporate structure consisting of Bell Canada, Northern Telecom Ltd., and Bell Northern Research.

BERT

bit error rate test

BH

busy hour

BIC

bus interface card

billed number screening (BNS)

- A Common Channel Signaling No. 7 application process that performs a validation check on the number to which a call is billed. This check is initiated by the operator on operator-assisted and third-number billed calls.
- The procedure used to identify the aspect vector to the gate utility.

bit error rate test (BERT)

- A test that is used to measure the transmission quality of a loop. The BERT transmits a known bit pattern over a line and compares the reflected signal with that sent.
- A measurement of the density of data recorded on each track of a magnetic tape data recording.

blocking

- The forming of blocks for purposes of transmission, storage, checking, or other functions.
- In reference to call traffic flow, occurs when the immediate establishment of a new call is impossible owing to the inaccessibility of facilities in the system being considered. Synonymous with congestion.
- In connection with maintenance operations, the deliberate withdrawal from service of a circuit or other resource.

BNR

Bell-Northern Research

BNS

Billed number screening

BOT

beginning-of-tape

B-packet

Packet data that is transmitted over a B-channel.

BPI

bits per inch

BPVO

bipolar violation

BRA

- Basic rate access
- Setup that provides basic rate access to ISDN services for up to eight ISDN terminals. All terminals must be carried on one customer premises loop, and on one line between the customer premises and the ISDN switch.

BRISC

Bell-Northern Research, Ltd. reduced instruction set computing

buffer

A storage device used to compensate for a difference in rate of data flow or time of occurrence of an event when transmitting data from one device to another.

buffer storage

- A storage device that is used to compensate for differences in the rate of flow of data between components of an automatic data processing system or in the times of occurrence of events in the components.
- An isolating circuit used to prevent a driven circuit from influencing the driving circuit.
- An area of storage that is temporarily reserved for use in performing an input/output operation. Data may be read from or be written into the buffer storage area.

burst

- Interference with, or interruption of, a digital signal.
- Transmission of a packet of data.
- In data communications, a sequence of signals counted as a unit in accordance with a specific criterion or measure.

bus

A strap that connects two adjacent terminals.

business set

A control device with addressable points, for example, directory number keys, feature keys, display units). Business sets can support multiple simultaneous calls, and are capable of supporting premium voice features and low-speed data service.

bus interface card (BIC)

A card located in the drawer of the line concentrating module which interfaces two 32-channel digroups to a maximum of 64 line cards.

busy hour (BH)

- The uninterrupted period of 60 minutes - not necessarily a clock hour - for which the average intensity of traffic is at the maximum.
- The busiest hour of the busiest day of a normal week, excluding holidays, weekends, and special event days. *See* average busy season.

busy-out (BO)

To take action that causes the line on equipment to test busy to an incoming call.

busy season

The three months with the highest busy-hour traffic per office. *See* average busy season.

busy signal

- An audible and/or flashing signal, often 60 impulses per minute, that indicates that the called number is unavailable.
- A signal, transmitted at 120 impulses per minute, that indicates that all voice paths are temporarily unavailable.

B-voice

Pulse-code modulated (PCM) voice signal that is carried on a B-channel.

CA

Call attempt

call

In DMS, any demand to set up a connection through the switch. Also used as a unit of telephone traffic. Synonymous with cue.

call condense block (CCB)

A data block associated with a call from initiation through completion. The CCB contains enough information to describe a basic call, and can be extended for calls which require more data.

call condensing

- Condensing the data stored in the call data block (CDB) such that only the information necessary to handle further functions associated with the call is retained.
- Idling the process previously associated with the call and freeing the CDB.

call forwarding

A Meridian Digital Centrex feature that allows a subscriber to have incoming calls to a station's directory number forwarded to a predetermined directory number. There are five types of call forwarding:

- Call forwarding universal (CFU) - permits stations to forward calls to locations inside or outside the customer group.
- Call forwarding intragroup (CFI) - permits stations to forward calls only to customer-defined locations within the customer group.
- Call forwarding fixed (CFF) - permits stations to forward calls to locations determined by the operating company.
- Call forwarding don't answer (CFD) - permits an incoming call that is not answered within a specified length of time to be forwarded to another designated station.
- Call forwarding busy (CFB) - permits all calls to a busy station to be forwarded to a designated station within the customer group.

call pickup

A service-related telephony feature that permits a station to answer incoming calls to another station in the same pickup group.

call processing (CP)

The software system that handles the processes involved in setting up connections through the DMS-100 Family network between calling and called parties.

call processing agent

- An originator or receiver of a call in the system.
- A member of a call-processing agency uniquely identified by a CP-ID.

Call Transfer

A service-related telephony feature that permits the called subscriber to instruct the switching equipment or operator to transfer an incoming call to another station.

Call Waiting

A service-related telephony feature that allows a subscriber already in the talking state to be alerted - by means of an audible tone - that another call to his station is being attempted.

Calling Card Validation (CCV)

A Common Channel Signaling No. 7 feature that allows the traffic operator position system operators to validate card number in the network service database system by entering the special billing class charge and the calling card number.

calling line identification (CLI)

In data transmission, a facility provided by the network that enables a called terminal to be notified by the network of the address from which the call has originated.

Calling Number Delivery (CND)

The CLASS service that shows the ten-digit (NPA-NXX-XXXX) directory number of a calling party, and the date and time of the call.

Calling Number Delivery Blocking (CNDB)

The CLASS service that blocks the display of the calling party's directory number on a CND subscriber's set.

calling party category indicator

A CCITT Signaling System 6 (N6) and CCITT Signaling System 7(N7) signaling parameter which denotes the country of destination for an international call.

calling sequence

An arrangement of instructions, and in some cases of data as well, that is necessary to perform a call.

CAMA

Centralized automatic message accounting

card

A plug-in circuit pack containing components. In DMS, "card" is the preferred term for a printed circuit pack or printed circuit board.

CAROT

Centralized automatic reporting on trunks

carrier

- In DMS, the communication links between switching offices.
- The protocol by which these links communicate.

CC

Central control

CCB

call condense block

CCC

central control complex; custom charge calling

C-channel

An 8 kbit/s, digital, bi-directional channel that is used for transferring maintenance information between the network termination (NT1 or NT2) and the exchange termination.

CCIS6

common channel interoffice signaling Number 6

CCITT

Consultative Committee on International Telegraphy and Telephony

CCITT No.6 Signaling

Common Channel Signaling system, typically with a 2.4K bps transmission rate.

CCITT No.7 Signaling

Common Channel Signaling system, normally using a transmission rate of 64 kbit/s occupying one slot in a PCM system. The system is designed for digital networks.

CCITT Signaling System 5 (N5)

An analog inband signaling system used internationally between gateway (DMS-300) switches and nationally between toll switches.

CCITT Signaling System R1

A standardized inband signaling system suitable for terminal (inside the same world zone) working.

CCITT Signaling System R2

A standardized inband signaling system suitable for terminal (inside the same world zone) and transit (between world zones) working.

CCN

calling card number

CCODE

country code

CCS

hundred call seconds; common channel signaling

CCS7

Common Channel Signaling No. 7

CCS7 link interface unit 7 (LIU7)

A peripheral module that processes messages entering and leaving a link peripheral processor through an individual signaling data link. Each LIU7 consists of a set of cards and a paddle board that is provisioned in one of the link interface shelves of the link peripheral processor. *See* link peripheral processor.

CCSA

common control switching arrangement

CCT

carrier connect time

CDF

coin dial tone first

CDO

community dial office

CDPA

called party address

CDR

call detail recording

cell site

A strategically located transmit/receive facility that forms part of a cellular mobile radio network. Each cell site contains radio transmitting and receiving equipment, and a cell site controller.

cellular mobile radio

A mobile telephone service in which radio transmit/receive facilities, called *cells*, distributed over an extended area, can pass on or take over the call handling functions associated with a call in progress as the mobile station moves from the vicinity of one cell to that of another.

central control (CC)

Comprises the data processing functions of the DMS-100 Family, with associated data store and program store.

central control complex (CCC)

Comprises all the central control functions of the DMS-100 Family systems. It consists of the central message controller, central processing unit, program store, and data store.

central control CPU (NT40)

A 16-bit, stack-oriented, microprogrammable processor. It is equipped with two independent parallel bus memory ports. One port is connected to the external memory that contains variable-length program instructions (program store). The other port is connected to the external memory that contains data (data store), and two central message controllers that provide communication with other elements of the system.

central message controller (CMC)

A hardware entity, located in the central control complex frame, that provides an interface between the central processing unit, and network message controllers and input/output controllers.

central office (CO)

A switching office arranged for terminating subscriber lines and provided with switching equipment and trunks for establishing connections to and from other switching offices. Synonymous with class 5 office; end office; local office. *See* office classification.

central processing unit (CPU)

A hardware entity, located in the central control complex frame, that contains the central data processor for the DMS-100 Family system.

central processor and memory (CPM)

The shelf in the central control complex combining a central processing unit and program store.

central side (C-Side)

The side of a node facing the central control. Contrast with P-side.

Centralized Automatic Message Accounting (CAMA)

A system that produces itemized billing details for subscriber-dialed long distance calls. Details are recorded at a central facility serving a number of exchanges. In exchanges not equipped for Automatic Number Identification, calls are routed to a CAMA operator who obtains the calling number and keys it into the computer for billing. *See* local automatic message accounting.

Centralized Automatic Reporting On Trunks (CAROT)

A system for automatically reporting faults identified on toll trunk circuits.

centrex

Centralized PBX. A service that provides a Business telephone subscriber with direct inward dialing to extensions on the same system and direct outward dialing from all extensions. Centrex switching equipment is normally located at the central office, but may be located on the operating company client's premises.

CIC

circuit identification code

CFB

- call forward busy
- call forward don't answer

CFP

channel frame processor

CFU

call forward universal

CFW

call forwarding

CH

call hold

channel capacity

A measure of the maximum possible information rate through a channel, subject to specified constraints.

channel group

Twelve voice channels which have been frequency-division multiplexed into single frequency band. Also known as group.

CI

command interpreter

circuit pack (CP)

In DMS-SuperNode, consists of multi-layer PCB, through-hole electronic components, backpanel connector, faceplate, lock latches, and stiffeners.

circuit-switched network

A synonym for the telephone network.

CLASS

Custom Local Area Signaling Services

CLASS base

The base capability on which the DMS-100 implementation of CLASS services is built. CLASS base comprises: origin DN attribute identification that assembles calling DN details, CCS7 ISUP signaling that passes calling DN attributes to the destination as part of call setup, and incoming and outgoing call memory update that stores details of the last incoming and last outgoing call.

class of office

A rank assigned to switching offices in the telephone network. An office's rank is determined according to the office's switching functions, its relationship to other offices, and transmission requirements. *See* office classification.

class of service

The categorization of telephone subscribers according to the specific types of service extended. Telephone service distinctions include such items as rate differences between individual and party lines, flat rate and message rate, and restricted and extended area service.

Common language location identifier

clock (CLK)

- A repetitive precisely-timed signal used to control a synchronous process such as logic or transmission.
- A hardware device that provides accurate timing signals to synchronize DMS-100 Family system circuits.
- An ultra-stable square-wave oscillator capable of maintaining a precise output frequency for long periods of time.

clock interrupt

A type of interrupt which occurs at regular intervals and is used to initiate processes, such as polling, which must occur regularly.

CM

communication module; computing module; connection memory

CMC

central message controller

CMIC

computing module interface card; computing module inter-communications link

CMU

card maintenance unit

CN

coin

CNAMD

calling name delivery

CND

calling number delivery

CNDB

calling number delivery blocking

CO

central office; cutoff (relay)

CODEC

coder-decoder

coder-decoder (CODEC)

An assembly comprising an encoder and a decoder in the same equipment. It produces a digital output from an analog input and vice-versa.

cold restart

An initialization phase during which temporary storage is deallocated and cleared. All calls are dropped and the peripheral processors clear all channel assignments. *See* warm restart.

- A control signal.
- In man-machine language, the specification of an expected action or function by the system.

command interpreter (CI)

A support operating system component that functions as the main interface between machine and user. Its principal roles are:

- to read lines entered by a terminal user
- to break each line into recognizable units
- to analyze the units
- to recognize command item-numbers on the input lines
- to invoke these commands

Common Channel Interoffice Signaling Number 6 (CCIS6)

A Common Channel Signaling system using analog trunks for the North American market. CCIS6 uses fixed length signaling messages.

Common Channel Signaling (CCS)

A signaling system in which a multiplicity of labelled messages may be transmitted over a single channel using time-division digital techniques.

Common Channel Signaling No.7 (CCS7)

Digital, message-based, network signaling CCITT standard. It separates call signaling information from voice channels so that inter-office signaling is exchanged over a separate signaling link.

common control

An automatic switching arrangement in which the control equipment necessary for the establishment of connections is shared. The equipment is associated with a given call only during the period required to accomplish the control function.

common control switching arrangement (CCSA)

Switching facilities connected by the telephone company to corporate tie-line networks. Switching of the leased lines in the network is accomplished by common-control central office switching equipment.

common language location identifier (CLLI)

A standard identification method for trunk groups in the form:

- **aaaa bb xx yyyy**
- Where:
- aaaa=City code
- bb=Province/state code
- xx=Trunk group identity
- yyyy=Trunk number
- *See* short common language location identifier.

communication module (CM)

Connects to key telephone systems installed in DMS-100 Family offices. The CM is used for voice communication applications where control of KTS lines on a priority basis and a conference capability of up to five KTS lines are required.

community dial office (CDO)

A small, rural, automatic telephone office.

computing module (CM)

The processor/memory complex of DMS SuperNode.

One of the three cabinet models for DMS-SuperNode. The CMDC is dedicated to a computing module, and consists of a computing module shelf

and one provisionable system load module extension shelf to house the SLMs.

computing module interface card (CMIC)

In DMS-SuperNode, the card used by the message switch to interface with the computing module. The CMIC uses fiber optic transmission links.

concentrator

A device that connects a large number of inlets, which are not all used at once, to a small group of outlets for economical transmission. A telephone concentrator achieves the reduction by means of a circuit-switching mechanism. A data concentrator buffers incoming data and retransmits it over appropriate output lines.

conference call

A call established among three or more parties in such a manner that each of the stations is able to communicate with all of the others. Synonymous with conference connection.

Consultative Committee on International Telephony and Telegraphy

Committee that is responsible for creating a series of recommendations for telephony service.

contention

A condition arising when two or more data stations attempt to transmit at the same time using shared facilities.

conversation

In the context of the multi-protocol controller, a messaging activity on a system-designated channel through which data transmission occurs. It does not apply to voice transmission or to the establishment of a voice link for call processing.

core

In the DMS-100 Family system, consists of the central processing unit, memory, and central message controller. The DMS-100 packaged system core includes the input/output controller and network module as well. *See* dual network packaged core.

COT

customer originated trace; continuity test

country code (CCODE)

A code consisting of up to three digits identifying the called country.

CP

call processing; circuit pack

CPS

calls per second

CPE

customer premises equipment

CPU

central processing unit

CRA

circuit reservation acknowledgement

CRC

cyclic redundancy check

CRM

circuit reservation message

CSC

cell site controller

CS-data

circuit-switched data that is carried on a B-channel.

CSDDS

circuit switched digital data service

C-side

the central control side of the peripheral

CSM

channel supervision module

customer data schema

A complete and detailed description of the tables associated with the DMS-100 Family of systems. It lists the contents of tables and the range of the data controlling the operation of the office.

customer group

Consists of a number of Meridian Digital Centrex stations which share a set of MDC features.

Customer Originated Trace (COT)

The CLASS service that enables a subscriber to dial a feature code to generate a trace report for the last incoming call. The report, which is printed

in the central office, is intended to support a customer complaint about a malicious call.

Customer premise equipment (CPE)

Refers to equipment, such as ISDN terminals, that is located on the customer's premises.

Custom Local Area Signaling Services (CLASS)

A set of call services that is based on the ability to supply calling line identification to the call destination, to store information on the last incoming and last outgoing call, and to monitor the status of a destination line.

CWT

call waiting

data above voice (DAV)

A data facility, consisting of a subscriber access multiplexer and a line card, that allows simultaneous voice and data service, over a single pair of wires, between the central office and the subscriber's data terminal equipment. Data transmission may be at standard asynchronous rates between 110 and 9600 baud.

data circuit

A means of two-way data transmission between two points comprising associated transmit and receive channels.

data line card (DLC)

The line card that interfaces a data path loop to a data unit. It is part of a line subgroup in a line concentrating module.

data link

A full-duplex data set used to connect the message desk terminal devices to the DMS-100 switch. It is used to transmit messages between the message desk and the DMS-100 switch.

data network

- The assembly of units that establishes data circuits between data terminal equipment units.
- The interconnection of a number of locations, by means of communication facilities such as telegraph lines, telephone lines, or microwaves, for the purpose of transmitting or receiving data.

data networking system (DPN)

A packet switch that Northern Telecom manufactures.

data packet collector (DPC)

An input/output device used for data communications with the DMS-100.

data port (DP)

- The point of connection in the central processing unit (CPU) of the parallel data buses between the CPU and the central message controller or data store.
- The format of data for a particular data base table.

data set

In data communication, an electronic device that provides an interface between a data processing machine and a telephone or telegraph line. Synonymous with modem.

data store (DS)

The main data memory for the DMS-100 Family system. The DS is part of the central control complex and contains transient information on a per-call basis as well as customer data and office parameters.

Equipment that is used as a data interface, enabling data terminal equipment to access the DMS-100 switch network. A data unit can be configured as a desk top unit or as a rack-mounted component of the switch.

DATALINK

A Bell Canada digital data service. DATALINK is a trademark of Bell Canada.

Datapath

Northern Telecom's system for providing direct, circuit-switched digital data transmission through a DMS switch over existing telephone networks. Datapath also provides connectivity to public and private networks. Datapath functions with industry standard data terminal equipment and applications, using T-link rate adaption protocol for communication.

DAV

data above voice

dc

direct current

DCC

digroup control card

DCE

digital carrier equipment (frame); data communication equipment

DCH

D-channel handler

DCHI

D-channel interface

D-channel

For basic rate access, a 16 kbit/s bi-directional channel used for carrying call control messages between a terminal on an ISDN interface and the exchange termination. The D-channel also carries low speed packet data between a terminal on an ISDN interface and a terminal in the packet data network. For primary rate access, the D-channel is a 64 kbit/s bi-directional channel used for carrying call control messages between a terminal on an ISDN interface and the exchange termination. *See* Bd channel.

D-channel handler (DCH)

A card in an ISDN line group controller (LGCI) or line trunk controller (LTCI) that provides the primary interface to all D-channels and performs Q.921 LAPD layer 2 processing. The DCH is permanently connected to an Integrated Services Digital Network loop and receives or sends messages on the signaling/packet data channel.

DCM

digital carrier module

DCP

data communications processor

DDD

direct distance dialing

DDM

distributed data manager

DDO

direct dialing overseas

DDU

disk drive unit

decoder

A device that decodes data. It consists of a number of input lines of which any number may carry signals and a number of output lines of which not more than one at a time may carry a signal, there being a one-to-one correspondence between the outputs and the combinations of input signals. Contrast with encoder.

dedicated

Used exclusively for a single purpose or by a single subscriber.

dedicated access line (DAL)

A trunk interface that connects a PBX, a key system, or a single telephone to a DMS-250.

delay dial (DD)

A telephony function, applicable to specified incoming, outgoing, and two-way trunks, used to inform the calling office that the called office is prepared to receive address signals.

destination address

Directory number (DN) or code representing the party that is reach when a voice or circuit-switched data call is made through the circuit switched network. Compare with destination code.

destination code

The complete ten-digit number (three-digit NPA code + three-digit central office code + four-digit station number) that pinpoints the location of a telephone in North America. Also known as national number; telephone address; destination address.

destination point code (DPC)

A Common Channel Signaling No.7 term defining the termination of a signaling message. Contrast with origination point code.

Software that automatically directs data from the various administrative and maintenance facilities to the appropriate recording devices.

DF

distribution frame

DGT

Digitone

dial long lines circuit

Used to extend the range of subscriber loops by repeating supervision and dial pulses from the subscriber to the central office and by repeating ringing from the central office to the subscriber.

dial pulse (DP)

Method of transmitting signaling information from a telephone set or trunk circuit. Dial pulses are generated by alternately opening and closing a a contact in the telephone through which the DC current flows. Contrast with dual-tone multifrequency dialing.

dial tone speed recording (DTSR)

A measurement of the ability of the DMS-100 to return dial tone within a specified period of time after an off-hook signal is sent. The time period can be set by the operating company.

A feature that allows hotel billing data to be batched and transmitted to a receiving device over a switched network path. *See* autoquote.

DID

direct inward dialing

digital

Pertaining to digits or to the representation of data or physical quantities by digits. Contrast with analog.

digital carrier equipment (DCE) frame

An equipment frame that houses digital carrier modules.

digital carrier module (DCM)

A peripheral module, located in a digital carrier equipment frame, that provides speech and signaling interfaces between a DS30 network port and digital trunks. A DCM is provisioned with up to five line cards.

digital multiplex system (DMS)

A central office switching system in which all external signals are converted to digital data and stored in assigned time slots. Switching is performed by reassigning the original time slots.

digital recorded announcement (DRA)

A set of one or more phrases routed to a subscriber as a recorded announcement. The DRA is stored in the digital recorded announcement machine and is initiated by the system software.

A peripheral module, developed for DMS, in which voice messages are stored in digital form, providing access to up to thirty different service voice announcements.

digital signal

A discontinuous signal that changes from one state to another in discrete steps.

digital signal 0 (DS-0)

A protocol for data transmission that is used to represent one channel in a 24-channel DS-1 trunk. May also appear as DS0.

digital signal 1 (DS-1)

The 8-bit, 24-channel, 1.544 Mb/s digital signaling format as used in the DMS-100 Family. The DS-1 is the North American standard for digital trunks. A closely specified bipolar pulse stream with a bit rate of 1.544 Mb/s. It is the standard signal used to interconnect Northern Telecom digital systems. The DS-1 signal carries 24 information channels of 64 kbit/s each (DS-0s).

digital-to-analog (D/A)

A device or process for converting a stream of coded digital samples to the original analog voice-frequency signal. *See* CODEC.

digital trunk controller (DTC)

A peripheral module that interfaces DS30 links from the network with digital trunk circuits. *See* Austrian digital trunk controller.

digital trunk equipment (DTE) frame

Frame containing up to two dual-shelf digital trunk controllers.

digitize

To convert non-discrete data into a digital form.

Digitone (DGT)

A service-related telephony feature that provides for the generation of address information from a telephone set in the form of dual-tone multifrequency signals by the manual pressing of non-locking buttons. Also known as dual-tone multifrequency dialing. Contrast with dial pulse. Digitone is a trademark of Northern Telecom Ltd.

Digroup

A basic group of 24 PCM channels assembled by time-division multiplex.

Direct distance dialing (DDD)

A telephone exchange service that permits a subscriber to call a number outside his local area without operator assistance.

Direct inward dialing (DID)

An optional telephony feature that allows an incoming exchange network call (not FX or wide area telephone service) to reach a specific private branch exchange station line without attendant assistance. When DID is available, central offices are capable of providing specific station identification to the PBX.

direct route

A single trunk group direct from origination to destination switch.

directory number (DN)

The full complement of digits required to designate a subscriber's station within one NPA - usually a three digit central office code followed by a four-digit station number.

Directory Number Hunt (DNH)

A service-related telephony feature that permits calls to a busy line to be re-routed. Lines in the hunt group are searched in order of their directory numbers, beginning with the directory number dialed. Refer to line hunting.

DIRP

device independent recording package

disconnect signal

A signal transmitted from one end of a subscriber line or trunk to indicate at the other end that the established connection should be terminated.

disk drive unit (DDU)

- Consists of a disk drive and a power-converter card installed in an input/output equipment frame.
- A peripheral module that accepts data from the DMS-100, formats the data if necessary, and stores it on a disk. Upon request, the DPP retrieves and sends data to the host office collector.

distribution frame (DF)

- A hardware entity that, on one side, provides metallic terminations for cables carrying incoming and outgoing voice paths to the peripheral modules and, on the other side, provides terminations for outside cables.
- A structure with terminations for connecting permanent wiring in such a manner that interconnection may be readily achieved by means of cross-connecting wires.

DIU

digital interworking unit

DLC

data line card; dynamic load control (unit)

D-link

A signaling data link that connects a signaling transfer point (STP) of one STP pair to another to another STP pair in the network. *See* signaling data link and signaling transfer point.

DLP

data link processor

DMA

direct memory access

DMS

- Digital multiplex system
- The messaging control component of DMS-SuperNode. It consists of a pair of message switches.

DMS-100

end office (Class 5) switch

DMS-100F

DMS-100 Family switch

DMS-Core

- The call management and system control portion of DMS-SuperNode. It consists of a computing module and a system load module.
- An information storage, search, and retrieval system for Northern Telecom DMS-100 technical documentation. The information is stored on a read-only compact disc, which can store the equivalent of of 275,000 pages of text.

DMS-link

The networking software of DMS-SuperNode. It consists of open and standard protocols which enable DMS-SuperNode to function in a multi-vendor environment.

DMS-SuperNode

A central control complex for the DMS-100. The two major components of DMS-SuperNode are the computing module and the message switch. Both are compatible with the current network module, the input/output controller, and XMS-based peripheral modules.

DMSX

A link control protocol used with DS30A links for messaging between peripheral modules.

DN

Directory number

DNC

Dynamic network controller

DOC

dynamic overload control

DOD

- direct outward dialing
- The type of data on which a column can be defined.

DP

data port; dial pulse

D-Packet

Packet data that is carried on the D-channel between the packet handler and an ISDN BRA terminal.

DPC

destination point code

DPN

- data networking system
- data packet network
- digital packet network

DPN

Prefix for a series of packet data switches in the data networking system. May also refer to data packet network.

DPP

distributed processing peripheral

DRA

digital recorded announcement

DRAM

digital recorded announcement machine

drawer

A sliding container within a shelf in the DMS-100 cabinet. A drawer contains components such as cards to which easy access is required for maintenance and service requests.

DS

- data set
- data store
- digital signal

DS-0

- digital signal 0
- dingle 64 Kbps channel

DS-0A

56 kbit/sec standard CCS7 link messaging protocol

DS-1

- Digital signal 1
- 24 channel transmission pipe
- T1, 1.54 Mbit/sec, 8 bit, 24 channel protocol

DS30

- A 10-bit, 32-channel, 2.048 Mb/s speech-signaling and message-signaling link as used in the DMS-100 Family.
- The protocol by which DS30 links communicate.

DS30A

A 32-channel transmission link between the line concentrating module and controllers in the DMS-100 Family. DS30A is similar to DS30, though intended for use over shorter distances.

DS-512 fiber link

The fiber optic transmission link implemented in DMS-SuperNode. The DS-512 is used for connecting the computing module to the message switch. One DS-512 link is the equivalent of 16 DS-30 links.

DSN

dual shelf network

DSP

digital signal processor

DT

Digitone

DTC

- digital trunk controller
- digital trunk equipment (frame)

DTC7

digital trunk controller No. 7

DTCI

ISDN digital trunk controller

DTE

data terminal equipment

DTMF

dual-tone multifrequency

DTSR

dial tone speed recording

dual-tone multifrequency dialing

A service-related telephony feature that provides for the generation of address information from a telephone set in the form of DTMF signals by the manual depression of non-locking buttons. *See* Digitone; touchtone. Contrast with dial pulse.

dual-tone multifrequency (DTMF) signaling

A signaling method employing set combinations of two specific voice-band frequencies, one of which is selected from a group of four low frequencies, and the other from a group of three or four relatively high frequencies.

DUAQ

dial-up autoquote

Dump/restore

See local dump and restore; remote dump and restore.

duplex (DX)

In data communication, pertains to a simultaneous two-way independent transmission in both directions. Synonymous with full duplex. Contrast with half duplex.

duplex signaling

A signaling system that occupies the same cable pair as the voice path, yet does not require filters. One duplex signaling section is confined to 400 ohms of loop resistance, though several sections may be used in tandem.

DX

duplex

dynamic overload control (DOC)

- A network management control applied automatically in response to an external signal or an overload condition detected in the switch itself. *See* internal dynamic overload control; preplanned control.

- A family of applications that is part of Northern Telecom's dynamic network architecture. These applications generally provide an enhanced level of network control, and allow operating companies to develop their service management and administration system independently of the evolution of their network equipment.

E

Erlang

EA

equal access

EABS

exchange alternate billing service

EADAS

Engineering And Administrative Data Acquisition System

EAEO

equal access end office

EAOSS

equal access operator signalling system

EAS

extended area service

EBAF

enhanced Bellcore AMA format

EBS

electronic business set

EKTS

electronic key telephone services

Electromagnetic Interference (EMI) Feature

In DMS, refers to the hardware used to control the radiated and conducted energy from digital electronic equipment that might interfere with radio transmissions.

electronic business set

Telephone set that provides subscribers with push button access to various business features.

electronic telephone set (ETS)

An alternate name for electronic business set.

electronic key telephone service (EKTS)

A set of services for ISDN voice terminals on a BRA interface. EKTS provides shared directory numbers (DN), multiple DNs for each service profile, and conference and intercom calling.

E & M signaling

An arrangement whereby signaling between a trunk circuit and an associated signaling unit is effected over two leads: an M lead to transmit signals to the signaling unit, and an E lead to receive signals from the signaling unit. E & M signaling provides full time, two-way, two-level supervision.

Emergency Stand-Alone (ESA)

An emergency service feature that permits local calling within a remote line module or remote line concentrating module in the event of loss of communication with the host office.

Emergency Technical Assistance Service (ETAS)

A Northern Telecom department that provides technical support for emergencies, cutovers, software updates, and product verification.

EMI

electromagnetic interference

encoder

A device that encodes data. It consists of a number of input lines of which not more than one at a time may carry a signal and a number of output lines of which any number may carry signals, there being a one-to-one correspondence between the input signals and the combinations of output signals. Contrast with decoder.

end office (EO)

A switching office arranged for terminating subscriber lines and provided with trunks for establishing connections to and from other switching offices.

ENET

enhanced network

Engineering And Administrative Data Acquisition System (EADAS)

An operational measurements support system that collects data from many central offices. It has two components: EADAS for data collection and EADAS for network management.

Enhanced 800 Service (E800 Service)

A Common Channel Signaling No. 7 feature available in United States which allows the inter-exchange carriers equal access to the Basic 800 Service. E800 presents network intelligence at an access tandem office or

end office (EO) using an on-line database query system. *See* also 800 Service.

EO

end office

EPROM

erasable programmable read-only memory

equal access end office (EAEO)

A central office that provides access to several long distance carriers.

erasable programmable read-only memory (EPROM)

A read-only memory in which stored data can be erased by ultraviolet light, electricity, or other means, and re-programmed.

Erlang

An international (dimensionless) unit of the average traffic intensity (occupancy) of a facility during a period of time, usually a busy hour. 1 Erlang = 36 hundred call seconds.

error

In telephony, a detectable trouble condition that cannot be reproduced at will by the system or by external means; a transient or intermittent fault that does not yield consistent diagnostic test results. Compare with fault.

error message

An indication that an error has been detected.

ESA

emergency stand alone

estimated work-time (EWT)

The average work-time per call of a TOPS serving area expected at a specified future date.

ETS

electronic telephone set

EWT

estimated work time

exchange

The unit of an operating company used for the administration of telecommunications services in a specified area, usually a city, town, or village and its environs. It consists of one or more central offices together

with the associated plants used in providing service in that area. For classes of exchange, *see* office classification.

Functional name for the ISDN component that serves as the access termination for basic rate access and primary rate access interfaces. An exchange termination also provides circuit-switched services to the ISDN switch.

extension block

In DMS-100 call processing, used to provide additional data space for a call condense block or call data block.

external band (ExBand)

A number in the range 0 to 127 assigned to a set of sixteen voice circuits on a No. 6 link. *See* also local band.

E800

enhanced 800 Service

FADS

force administration data system

FAST II

First Application System Test No.2

fault

In telephony, a detectable trouble-condition that can be reproduced at will by the system or by external means. Compare with error.

fault detection (FD)

A signal that initiates the maintenance subsystem interaction protocol in the DMS-100 Family maintenance system.

F-Bus

frame transport bus; frame bus (LIU7)

FBE

frame bus extender

FBT

F-Bus terminator/repeater

FDM

frequency-division multiplex

FDX

full duplex

Feature Document

A document that describes in detail hardware/software features of the DMS Family of switches. Replaces design intent document.

FIC

F-Bus interface controller

field

Vertical column of a table.

FIFO

first in-first out

flag

In DMS, an operating system synchronization primitive that controls the shared limited resources that are allocated/deallocated by concurrent processes.

Flat-Rate Charge Service

A service-related telephony feature that, for a fixed monthly charge, permits an unlimited number of completed calls from a local non-coin line to a group of specified destinations. This group is referred to as a flat rate area, and is usually located within a geographic boundary surrounding the central office. Two or more flat rate areas may be specified for a central office with some destinations assigned to more than one flat rate area.

Force Administration Data System (FADS)

Data derived from TOPS operational measurements and used for force management and for operating performance calculation.

foreign area translation

Permits routing calls directly to offices in other numbering plan areas where there is more than one route available.

foreign exchange trunk (FX trunk)

A private branch exchange or an integrated business network foreign exchange trunk which provides access to a remote central office.

frame

- One complete cycle of events in time-division multiplexing. The frame usually includes a sequence of time-slots for the various channels, and extra bits, which are used, for example, for control or framing.

- A unit of hardware in DMS that contains usually one bay, but can contain two or more functionally-related bays.

frame supervisory panel (FSP)

Accepts the frame battery feed and ground return from the power distribution center and distributes the battery feed, by means of subsidiary fuses and feeds, to the shelves of the frame or bay in which it is mounted. The FSP also contains alarm circuits.

FRAR

F-Bus rate adapter and repeater

FS

functional signalling; frame supervisory panel

FTS

frame transport system

full duplex (FDX)

In data communication, pertains to a simultaneous two-way independent transmission in both directions. Synonymous with duplex. Contrast with half duplex.

function

In DMS call processing, refers to one of several procedure-types capable of accomplishing a specific task.

Describes the portion of functional signaling that affects the supplementary services operating on calls that are in progress.

FX

foreign exchange

GA

general availability

GBH

group busy hour

general feature description (GFD)

A Northern Telecom customer document that describes all or part of a Northern Telecom software feature package for a particular batch change supplement.

general planning forecast (GPF)

A term referring to a forecast of requirements for telephone facilities, over a specified period, for Bell-operated territory.

General specification (GS)

A document that provides general information about the associated product so that it may be evaluated by marketing, programming, and engineering personnel.

GFD

general feature description

glare

A condition that results from the simultaneous seizure of a two-way trunk at both ends. Also known as double seizure.

GPF

general planning forecast

ground start line

A line circuit arrangement in which dial-tone is sent in response to a ground signal on the ring conductor applied by the calling station or PBX. This differs from the more common loop start configuration, in which seizure is accomplished by bridging the tip and ring conductors.

Twelve voice channels frequency-division multiplexed together into a single frequency band. Also known as channel group

group busy hour (GBH)

The hour when a line or trunk group carries the most traffic; used as a factor in traffic provisioning calculations.

HADS

HOBIC administrative (teletypewriter)

half duplex (HDX)

Data transmission in two directions, one way at a time. The choice of direction is controlled by the data terminal equipment. Contrast with duplex.

handshaking

An exchange of predetermined characters or signals between two stations to provide control or synchronization after a connection is established.

HDBH

high day busy hour

HDBHCA

high day busy hour call attempt

HDLC

high level data link controller

HDX

half duplex

header

A standard IBM label that is recorded on a magnetic tape data recording to identify the name, serial number, and other information that describes the contents of its associated data file.

HEX

Hexadecimal

hexadecimal (HEX)

A numerical system using base 16. HEX provides a convenient notation for 4-bit and larger binary numbers. The system uses ten numeric digits (0-9) and six alphabetic digits (A-F).

HIE

host interface equipment (shelf)

high day busy hour (HDBH)

The hour, not necessarily a clock-hour, that produces the highest load during busy season.

high usage (HU)

- Refers to a group of trunks which is the primary direct route between two points and, with respect to a particular parcel of traffic, is traffic-engineered to overflow to one or more subsequent circuit-groups, and ultimately to the final choice circuit-group.
- Trunks for which an engineered alternate route has been provided. Circuits in the HU trunk groups are heavily loaded with traffic in the busy hour, as the group operates efficiently with high occupancy.

HNPA

home NPA

HOBIC

hotel billing information center.

HOC

host operator centralization

holding time (HT)

- The length of time a communication channel is in use for each transmission, including both message time and operating time.

- A factor used when calculating provisioning requirements for some of the plug-in circuit cards in a trunk module or maintenance trunk module.

host interface equipment (HIE) shelf

Located in the remote line concentrating module(RLCM) frame, the shelf that provides interface circuits between the host office and the RLCM.

host office

- In DMS, a central office equipped to control peripheral modules at remote sites.
- Refers to the operating mode of duplicated units in the DMS-100 Family systems whereby both units simultaneously perform the same operations, but the output of only one is used. In the event of a failure, the other unit takes over the operations without processing loss. Contrast with load sharing.

hotel billing information center (HOBIC)

A centralized operator-attended location that provides:

- Quotation of call details to hotels for guest-dialed long distance calls.
- Quotation of time and charges to guests upon request.
- A centralized location for the reporting of hotel equipment problems and billing inquiries (optional).

Hotel/Motel Message Registers

A telephony feature that provides the capability to initiate the operation of a operating company client-premises message register in order to visually display the number of message units expended on certain calls from hotel/motel PBX lines arranged for message-rate service. Only chargeable completed calls within a local message-rate area are affected by this feature.

HT

holding time

HTL

hotel

HU

high usage

hundred call seconds (CCS)

Calculated by multiplying the average number of calls during busy hour by the average holding time in seconds, divided by 100. 36 CCS = 1 Erlang.

IA

intrabay

IAC

ISDN access controller

IBERT

integrated bit error rate test; integrated bit error rate tester (card)

IBN

integrated business network

IC

inter-exchange carrier

IDF

intermediate distribution frame

IDLC

integrated digital loop carrier

idler

In DMS call processing, a function-procedure that is used to idle an agent in the event of abnormal call processing behavior.

IDOC

internal dynamic overload control

IEC

inter-exchange carrier

IF

interface (card)

IML

inter-message switch link

Impulses per minute (IPM)

Interruption rate for call progress tones or supervisory lamps.

INC

incoming

initial period

See minimum charge duration.

input/output (I/O)

Refers to a device or medium that is used to achieve a bi-directional exchange of data. Data exchange in the DMS-100 Family system is performed in accordance with the input/output message system.

input/output controller (IOC)

An equipment shelf that provides an interface between up to thirty-six input/output devices and the central message controller. The IOC contains a peripheral processor that independently performs local tasks, thus relieving the load on the central processing unit.

input/output equipment (IOE) frame

Frame housing input/output devices.

integrated bit error rate test (IBERT)

A test that a MAP operator uses with an IBERT card to test the transmission quality of a selected data line. The card resides in the line drawer of a line concentrating module and generates the bit stream for an IBERT test. An IBERT test can be used to test most types of lines connected to the DMS, if the lines will support the T-link protocol.

Integrated Business Network (IBN)

Now known as Meridian Digital Centrex. A special DMS business services package that utilizes the data-handling capabilities of a DMS- 100 Family office to provide a centralized telephone exchange service. Many optional features are also available.

Integrated Services Digital Network (ISDN)

A set of standards proposed by the International Telegraph and Telephone Consultative Committee (CCITT) to establish compatibility between the telephone network and various data terminals and devices. ISDN provides a path for transmission of voice, data, and images.

Integrated Service Digital Network user part (ISUP)

Provides the signaling functions within a CCS7 network for voice and data services in an Integrated Services Digital Network (ISDN).

Integrated Services Digital Network line module (ISLM)

A line concentrating module that supports Integrated Services Digital Network line cards. The ISLM works in association with the ISDN access controller.

interbay (IR)

In the Intraswitching feature, refers to those calls between an originator and terminator connected to different bays of the same remote line module frame. *See* intrabay; Intraswitching.

interbay message link (IBML)

Provides a two-way path between mate bays of the remote line module frame for call processing message traffic. *See* also Intraswitching.

interface (IF) card

A designation identifying the type of circuit card used in a network module. The IF cards provide bi-directional interfaces between the bi-phase signals on the speech links and the serial data entering the incoming formatter and leaving the outgoing formatter.

interlink

Refers to DS-1 links between remote cluster controllers of a dual-plane combined core used for transmission of messaging and speech.

inter link-to-link protocol (ILLP)

A level two Common Channel Signaling 7 (CCS7) protocol that is used to detect message losses between CCS7 link interface units (LIU7). *See* CCS7 and LIU7.

intermediate distribution frame (IDF)

The frame that provides flexibility in allocation of a subscriber's number to the line unit or equipment in the office that is to be associated with the particular line.

internal dynamic overload control (IDOC)

A network management control, in which a signal is generated and transmitted by the controlling office in response to internally detected overload indicators. Its function is to reduce the load offered to the controlling office by requesting selected subtending or continuous offices to implement a predefined set of routing controls. *See* dynamic overload control; preplanned number control.

international traffic operator position system (ITOPS)

A call processing system made up of a number of operator positions. Each operator position consists of a visual display unit, a controller, a keypad, and a headset. ITOPS positions are used by toll operators to set up and monitor calls requiring operator assistance, and to enter routing and billing information. ITOPS is designed for use in the international environment.

interrupt

A jump out of one program into another due to an external event. In addition to such events in the input/output system, interrupts are allowed from clocks and timers, and for various malfunctions.

interswitch trunk (ISW)

A trunk between switching centers.

Intracalling (IAC)

A feature that permits a wide variety of connections to be made via the remote C cluster controller without using the network in the host office.

intraoffice trunk

A trunk connection within one central office.

Refers to calls completed between subscribers connected to the same central office or remote unit, such as the remote switching center.

Inward Wide Area Telephone Service (INWATS)

A telephony service that allows a subscriber to receive telephone calls originated within specified service areas without a charge to the originating party. *See* also outward wide area telephone service; wide area telephone service; Basic 800 Service.

INWATS

Inward Wide Area Telephone Service

I/O

input/output

IOC

input/output controller

IOC shelf

A hardware shelf that provides an interface between up to 36 input/output devices and the central message controller. *See* input/output controller

IOD

input/output device

IOE

input/output equipment (frame)

I/O interrupt

An interrupt generated by the central message controller when there is an incoming message or when an outgoing message has been sent.

IPL

initial program load

Protected data and program store allocated by the bilge modules. This type of store cannot be protected after the initial program load of these modules.

IPM

impulses per minute

IPML

inter-peripheral message link

ISDN

integrated services digital network

ISDN access controller (IAC)

A frame used to support Integrated Services Digital Network (ISDN) access between a DMS and voice and packet services.

ISDN line

Physical part of a BRA interface that connects the terminals to the network termination (NT1 or NT2).

ISDN line concentrating array (LCAI)

A shelf in the ISDN line concentrating module. It contains four physical line drawers. The LCMI consists of two line concentrating arrays, which operate in a load sharing mode with mutual takeover capability.

ISDN line concentrating equipment (LCEI)

A single-bay equipment frame containing two ISDN line concentrating modules (LCMI).

ISDN line concentrating module (LCMI)

A dual unit peripheral module which terminates ISDN lines. The LCMI will eventually replace the ISLM. Unlike those on the ISLM, however, LCMI B-channel connections are dynamic and may be used on a per-call basis.

ISDN line group controller (LGCI)

A peripheral module that interfaces DS30 links from the network.

ISDN signaling pre-processor (ISP)

Provides call control messaging and D-channel handler maintenance functions.

ISDN switch

A DMS switch configured to provide ISDN services. Its main functional components are the access termination and the packet handler.

ISDN terminal

Digital telephone or personal computer that is connected to a customer premises loop which forms part of a BRA interface.

ISLC

ISDN line card

ISLM

integrated services line module

ISN

integrated service node (S/DMS or optic fiber center)

ISP

ISDN signaling pre-processor

ISUP

integrated services digital network user part

ISW

interswitch trunk

IT

intertoll

ITB

incoming trunk busy

ITOPS

International Traffic Operator Position System

JF

journal file

JNET

junctor network

journal file (JF)

A facility that preserves, on a recording device, changes made to the data tables of the DMS-100 Family systems. The JF provides a means of restoring the tables should it be necessary to reload office software from a backup image.

junctor

The interface equipment, at the end of any interoffice circuit or intraoffice trunk, that provides circuit and signaling compatibility.

key-pulse (KP)

To transmit information using a key-set as opposed to dialing.

key telephone set (KTS)

A multi-line telephone set where lines can be selected and/or placed on hold by push-buttons. Features of the system include pickup and holding,

intercommunications, visual and audible signals, cutoff, exclusion, and signaling.

Key telephone system (KTS)

An arrangement of multiline telephone station apparatus and associated equipment that allows a user to selectively originate, answer, or hold calls over a specific central office or PBX line. Lines are selected or held by operating buttons (or keys) connected with the station apparatus.

Keyboard send/receive (KSR)

An input/output printer that is equipped with a keyboard for transmitting as well as receiving information.

KP

Key-pulse

KTS

Key telephone set; key telephone system

LAMA

local automatic message accounting

LAN

local area network

LAPB

link access procedure balanced

LAPD

link access procedure on the D-channel

large business remote (LBR)

A DMS-100 that is configured to serve as a remote switching unit.

last trunk busy (LTB)

Condition when the last of a group of circuits is busy. If the group has automatic alternative routing, an attempt is made automatically to route additional calls another way.

LATA

local access and transport area

LBAND

local band

LBR

large business remote

LC

line card

LCA

line concentrating array

LCAI

ISDN line concentrating array

LCC

line class code; link control card

LCD

line concentrating device

LCE

line concentrating equipment (frame)

LCEI

ISDN line concentrating equipment

LCM

line concentrating module; line carrier module

LCME

enhanced line concentrating module

LCMI

ISDN line concentrating module

LD

line drawer

LDR

local dump and restore

LEAS

LATA equal access system

least significant bit (LSB)

In binary numbers, refers to the bit representing the lowest power of 2.

LEN

line equipment number

LGC

line group controller

LGCI

- ISDN line group controller
- line group equipment (frame)

LIDB

line information data base

LIM

link interface module

link interface module (LIM)

A peripheral module that controls messaging between link interface units (LIU) in a link peripheral processor (LPP). The LIM also controls messages between the LPP and the DMS-bus. A LIM consists of two local message switches (LMS) and two frame transport buses (F-bus). Each LMS normally operates in a load-sharing mode with the other LMS. This ensures LIM reliability in the event of a LMS failure because each separate LMS has adequate capacity to carry the full message load of a LPP. Each LMS uses a dedicated F-bus to communicate with the LIU in the LPP.

link interface unit (LIU)

A peripheral module that processes messages entering and leaving a link peripheral processor through an individual signaling data link. *See* CCS7 link interface unit.

link peripheral processor (LPP)

The DMS SuperNode equipment frame contains two types of peripheral modules: a link interface module (LIM), and link interface units (LIU). For DMS-STP applications, CCS7 link interface units (LIU7) are used in the LPP. *See* link interface module and CCS7 link interface unit.

line and trunk maintenance (LTM)

A class of operating company personnel with limited access to the DMS-100 Family input/output system. LTM is restricted to commands applicable to testing and maintaining line and trunk facilities.

line card

One of the line circuit cards contained in a line drawer. *See* also data line card, voice line card.

line circuit (LC)

A hardware entity that provides an interface between subscriber lines and the digital switch. Each subscriber line has a dedicated line circuit. *See* line drawer.

line class code (LCC)

An alphanumeric code that identifies the class of service assigned to a line.

line concentrating array (LCA) shelf

A unit of the line concentrating module. An LCM has two LCA shelves.

line concentrating device (LCD)

The generic term for all modules (such as line module, line concentrating module, remote line module, and remote concentrating SLC-96 that can accommodate a subscriber line card.

line concentrating equipment (LCE) frame

A single-bay frame containing two line concentrating modules.

line concentrating module (LCM)

A peripheral module which interfaces the line trunk controller or line group controller and up to 640 subscriber lines, using two to six DS30A links.

line drawer (LD)

A hardware entity, located in the line module and line concentrating module, that contains line circuit cards. *See* line circuit.

line equipment number (LEN)

A seven-digit function-reference used to identify line circuits.

line group controller (LGC)

A peripheral module that interfaces DS30 links from the network to line concentrating modules.

line group equipment (LGE) frame

A single-bay frame containing line group controller modules.

line hunting

Procedure for searching a number of lines to find one that is idle. *See* Directory number Hunt; Distributed Line Hunt; Multiline Hunt.

line load control (LLC)

Selective denial of call origination capability to specified subscriber lines when excessive demands for service are offered to a switching center. It does not affect the capability to receive calls.

line module (LM)

A peripheral module that provides speech and signaling interfaces for up to 640 subscriber lines. It consists of line drawers, a line module controller, and a frame supervisory panel.

line module controller (LMC)

The controller shelf for the line module. LMC performs the peripheral processor functions.

line module equipment (LME) frame

A double-bay frame containing a supporting pair of line modules.

A group of up to thirty-two line cards in a drawer of the line concentrating module. Two line subgroups are contained in each drawer.

line test position (LTP)

A maintenance and administration position that has been specially equipped for performing line tests.

line test unit (LTU)

A pair of circuit cards, located in a maintenance trunk module, that connects to the line circuits by means of metallic connections, and performs tests on both the line circuitry and the subscriber loop.

line trunk controller (LTC)

A peripheral module that is a combination of the line group controller and the digital trunk controller, and provides all of the services offered by both.

line trunk equipment (LTE) frame

Frame containing up to two dual-shelf line trunk controllers.

link

- In DMS, a connection between any two nodes. *See* node.
- A four wire group of conductors providing transmit and receive paths for the serial speech or message data between components of DMS-100 Family systems. Speech links connect peripheral modules to the network modules. Message links connect network message controllers or input/output controllers to the central message controller.

link access procedure on D-channel (LAPD)

ISDN access protocol that is used with links established on a D-channel.

link control card (LCC)

A card within a remote line concentrating module that provides an interface between RLCM and the host office equipment.

link protocol

A set of rules for data communication over a data link. Link protocols exist for transmission codes, transmission nodes, and for data control and recovery procedures.

LIS

link interface shelf

LIT

line insulation test

LIU

link interface unit

LIU7

CCS7 link interface unit 7

LLC

line load control

LM

line module

LMC

line module controller

LME

line module equipment (frame)

LMS

local message switch

load sharing

Refers to the operating mode of duplicated units in the DMS-100 Family systems whereby the two units share processing operations. In the event of a failure in one of the units, the other can take over the entire load. Contrast with hot standby.

local access and transport area (LATA)

A geographical area, called an exchange or exchange area in the MF5, where an operating company offers telecommunication services. LATA is used in the United States only.

local automatic message accounting (LAMA)

A system similar to automatic message accounting, but providing local collection and recording of billing information. LAMA consists of a

combination of AMA equipment and automatic number identification equipment in the same office. Such a system can automatically process a subscriber-dialed toll call without operator assistance. Contrast with central automatic message accounting (CAMA).

local office

A switching office arranged for terminating subscriber lines and provided with trunks for establishing connections to and from other switching offices. Synonymous with central office; class 5 office; end office. *See* office classification.

log system

Used by DMS software to record the occurrence of all significant events (for example, equipment failure), and then report the events to the operating company.

- A local circuit between a central office and a subscriber telephone station. Synonymous with subscriber loop and local loop.
- A signaling method whereby on-/off-hook signals are transmitted by bridging the loop on a two-wire trunk or circuit. Signals are received by detecting the flow of loop current. In a trunk, LP signaling occurs in one direction at a time.

loop-around (L/A)

A test circuit where the transmit path of a trunk or line circuit is connected to the receive path. L/A tests are applied by DMS-100 Family software during diagnostic and maintenance procedures.

LP

loop

LPP

link peripheral processor

LRAM

local random access memory

LSB

least significant bit

LTC

line trunk controller

LTCI

ISDN line trunk controller

LTE

line trunk equipment (frame)

LTS

line trunk server

machine busy

See system busy.

MADN

Multiple Appearance Directory Number

MADN-MCA

Multiple appearance directory number-multiple call arrangement. *See* multiple call arrangement (MCA).

MADN-SCA

Multiple appearance directory number-single call arrangement. *See* single call arrangement (SCA).

magnetic tape drive (MTD)

In DMS, a device used to record DMS-100 Family data. An MTD may be mounted on either a magnetic tape center frame or an input/output equipment frame.

magnetic tape unit (MTU)

A general term used to describe the magnetic tape recording function as a maintenance tool. The MTU can be any type of magnetic tape drive that functions in this way.

main distribution frame (MDF)

A frame containing terminal blocks where cables from outside plant and office equipment are terminated. Outside plant equipment is terminated on vertical rows of blocks and office equipment on horizontal rows. Cross-connection flexibility and organization is provided by jumper pairs between horizontal and vertical terminal blocks.

maintenance and administration position (MAP)

A group of components that provide a man-machine interface between operating company personnel and the DMS-100 Family systems. A MAP consists of a visual display unit and keyboard, a voice communications module, test facilities, and MAP furniture. MAP is a trademark of Northern Telecom.

man-machine interface (MMI)

The series of commands and responses that are used by operating company personnel to communicate with the DMS-100 Family system machines. MMI is achieved through the maintenance and administration position and other input/output devices.

maintenance trunk module (MTM)

An input to the DMS-100 Family maintenance system from the visual display unit. *See* action request; diagnostic request; status request.

MAP

maintenance and administration position

MAPCI

MAP command interpreter

master processor (MP)

In DMS, the processor containing the instruction set that implements the tasks assigned by the central control software. The MP carries out all high-level tasks.

MBI

message billing index

Mb/s

megabits per second

MC

message controller

MCCS

Mechanized Calling Card Service

MCS

Micro Controller Subsystem

MC68020

Motorola Corporation microprocessor

MC68030

Motorola Corporation microprocessor

MDC

Meridian Digital Centrex; message and device controller

MDF

main distribution frame

Mechanized Calling Card Service (MCCS)

A service that enables a subscriber, by using a credit card and entering the special billing information, to make chargeable long distance calls without operator assistance.

Mechanized Force Administration Data System (MFADS)

- A minicomputer system that extracts force management operational measurements from a pollable port every half-hour. The system returns service and force summaries, as well as projections of operators required, to traffic office managers.
- Expresses the rate of transmission of serial data bits in a time division multiplexed frame format.

MEMCALC

automated DMS memory analysis system

memory extension (MEX) frame

A frame containing an extension to the data store. MEX is used when the central control complex does not have sufficient space to accommodate an expanded data store.

Meridian Digital Centrex (MDC)

A special DMS business services package that utilizes the data- handling capabilities of DMS-100 Family offices. Provides a centralized telephone exchange service. Formerly known as Integrated Business Network (IBN).

message

- The unit of information-transfer between nodes in the DMS-100 system. A message is incoming if it is sent from a peripheral to the central control, and outgoing if sent from the CC to a peripheral.
- (MSG) A type of control message used in the input/output message system of the DMS-100 Family. The MSG byte specifies that the information to come is a data message.

A controller with data store that controls internal message paths between the central processing unit and other units of the DMS-100 Family system. MDC also provides an I/O controller function for small offices.

message billing index (MBI)

Permits identification of a completed toll message for the purpose of billing the calling party.

message controller (MC)

A node that is connected to the peripheral side of a central message controller.

message switch (MS)

A high capacity communication facility that functions as the messaging hub of DMS-SuperNode. The message switch allows DMS-100 components to communicate freely. For the purposes of redundancy, the MS utilizes two planes. Each plane interfaces with the two planes of the computing module.

message switch and buffer (MSB)

A peripheral module used by the DMS-100 Family, along with a signaling terminal (ST), to interface and operate within a common channel signaling environment. The MSB supports the ST and routes the messages received by the ST through the network module to the digital trunk controller. The MSB also receives messages sent from the central control and routes them to the signaling link through the ST. There is a different configuration of the MSB for each of the two protocols used to implement common channel signaling: the Message Switch and Buffer 6 (MSB6) for CCITT6 and CCIS6 protocol and the Message Switch and Buffer 7 (MSB7) for CCS7 Signaling protocol.

message switching

An arrangement whereby a message is received, stored until the proper outgoing line is available, and then retransmitted. Contrast with circuit switching. *See* also store and forward mode.

message system (MS)

- In the DMS-100 Family, provides the media and protocol for the transmission of inter-module control messages.
- Provides a connection-less transport system for carrying Common Channel Signaling System No.6 (CCITT6), Common Channel Interoffice Signaling No.6 (CCIS6) and Common Channel Signaling System No.7 (CCS7) signaling messages between user locations or applications functions.

message type

Identifies the function of a message. Stimulus call control has only one message type - information. Functional call control has a number of message types related to call establishment, call disestablishment, and call status.

MF

multifrequency

MFADS

mechanized force administration data system

MLH

multiline hunt

MMI

man-machine interface

MMU

memory management unit

mobile telephone exchange (MTX)

In DMS, refers to a DMS-100 Family system configured as a cellular mobile radio switch.

mobile telephone service (MTS)

- Telephone service between a fixed base station and mobile vehicle stations.
- Telephone service between mobile vehicle stations and the commercial telephone network.

modem

Contraction of modulator/demodulator; a device that modulates and demodulates signals for transmission and reception, respectively, over communication facilities. A modem is used to permit digital signals to be sent out over analog lines. Synonymous with data set.

modem interface card (MIC)

- The interface between a modem and the network module. The MIC is located in the trunk module.
- The basic building block of software structure. A module consists of interface and implementation sections.
- A discrete hardware package, designed for use in conjunction with other components.

MP

- multi-purpose
- master processor

MPC

multi-purpose card

MS

message system; message switch

MSB

message switch buffer

MSB7

message switch and buffer No. 7

MSU

message signal unit

ms

millisecond

MSG

message

MTD

magnetic tape drive

MTM

maintenance trunk module

MTS

mobile telephone service

MTU

magnetic tape unit; metallic test unit

multifrequency (MF)

A method that makes use of pairs of standard tones to transmit signaling codes, digit pulsing, and coin-control signals.

Multiline Hunt

A service-related telephony feature that permits calls to a busy line to be routed to other specified lines without assigning a directory number to each line. Refer to line hunting.

Multiple Appearance Directory Number (MADN)

A directory number that appears on more than one Meridian Digital Centrex station. The stations that are assigned these numbers are referred to as a MADN group. MADN groups can be assigned as either single call arrangement or multiple call arrangement.

Multiple Call Arrangement(MCA)

An MDC feature that allows more than one telephone set to be active on a multiple appearance directory number simultaneously. The number of simultaneous calls is restricted only by the number of members in the MADN group. *See* multiple appearance directory number. Contrast with single call arrangement.

To interweave or simultaneously transmit two or more messages on a single carrier.

multiplexer (MUXER)

A device that provides a means of transmitting two or more signals over the same transmission path, or enables a single receiver to be shared among several signals.

Multi-unit Message Rate (MUMR) service

A service that permits an operating company to charge local calls on a basis other than a flat rate.

MUMR

Multi-unit Message Rate (service)

MUX

multiplex

MUXER

multiplexer

nailed-up connection (NUC)

A permanently assigned network connection that forms part of the speech path between suitably-equipped peripheral modules.

NCN

non-coin

NET

network

NETC

network frame planes combined

network

- An organization of stations capable of intercommunication but not necessarily on the same channel.
- Two or more interrelated circuits.
- A combination of terminals and circuits in which transmission facilities interconnect user stations directly.
- A combination of circuits and terminals serviced by a single switching or processing center.
- An interconnected group of computers or terminals.
- (NET) The network module frame of the DMS-100 Family system.

Network Administration System (NAS)

A stand-alone computer that is involved in operation, administration and maintenance for ISDN services. The NAS uses data on service and system operation to generate files that contain information on alarms, accounting, billing, and network operation.

network interface (NI)

A circuit card used in the network modules that provides an interface between a peripheral module and the crosspoint switches in the network module. Also known as a speech interface card.

network management (NWM)

A set of facilities that controls operation of a DMS-100 Family network, with the objective of making optimum use of available resources in conditions of overload or facility failure. NWM is exercised from the network management position.

The location from which maintenance personnel monitor a switched network. Facilities are provided for fault-correction and handling special traffic conditions.

network message controller (NMC)

A group of circuit cards, located in the network module, that communicates with the central message controller and, by directing messages to the peripheral modules or interpreting connection instructions to the crosspoint switches, organizes the flow of internal messages.

network module (NM)

The basic building-block of the DMS-100 Family switching network. The NM accepts incoming calls and, using connection instructions from the central control complex, connects them to the appropriate outgoing channels. Activities in the NM are controlled by the network message controllers.

Network Operator Trouble Information System (NOTIS)

Facilities, provided at a TOPS position, that enable an operator to report trouble conditions by keying a previously defined 1-digit or 2-digit code. This code is then translated into an output message through an operating company client-controlled table and the trouble condition is logged.

network termination 1 (NT1)

Access point for basic rate access to ISDN. This component is situated on customer premises, and is typically located between the terminals and the exchange termination. An NT1 is required when IS lines are terminated by U-line cards.

network termination 2 (NT2)

Access point for basic rate access (BRA) to ISDN, situated in the exchange termination. This type of network termination is used when ISDN lines are terminated by S/T cards. (No NT1 is required.)

NI

network interface

NM

network module

NMC

network management center; network message controller

NMP

network management position

node

The terminating point of a link. Node is a relative term; its meaning depends entirely on the context within which it is used. For example, a circuit may be a node in the context of another circuit within a module; the module itself may be a node in the context of another component of the network, and so forth. Some common applications are:

- In network topology, a terminal of any branch of a network or a terminal common to two or more branches of a network.
- In a switched communications network, the switching points, including patching and control facilities.
- In a data network, the location of a data station which interconnects data transmission lines.
- A unit of intelligence within a system; in DMS, includes the central processing unit, network module, and peripheral modules.

NOP

network operations protocol

Northern Telecom (NT)

Part of the tri-corporate structure consisting of Bell-Northern Research, Bell Canada, and Northern Telecom Ltd.

Northern Telecom practice (NTP)

A document that contains descriptive information about the DMS-100 Family hardware and software modules, and performance oriented practices for testing and maintaining the system. NTP are supplied as part of the standard documentation package provided to an operating company.

NOTIS

Network Operator Trouble Information System

NPA

numbering plan area

NSG

network sub-group

NT

Northern Telecom

NT40

DMS-100F front end processor; see central control CPU

NTP

Northern Telecom practice

NUC

nailed-up connection

numbering plan area (NPA)

Any of the designated geographical divisions of the U.S., Canada, Bermuda, the Caribbean, Northwestern Mexico, and Hawaii within which no two telephones will have the same seven-digit number. Each NPA is assigned a unique three-digit area code. Also known as area code.

NWM

network management

OA

operator assisted

OAM

operations, administration and maintenance

OBH

office busy hour

OC

operator centralization

occupancy

- Refers to the percentage of time a circuit or facility is in use. One circuit in continuous use represents 1 Erlang, or 36 hundred call seconds, of traffic.

- The ratio of that portion of operator time spent on call-handling to the total amount of time operators are assigned TOPS positions for the purpose of handling calls.

Oct

octet (8 bit byte)

off-hook

- In telephone operations, the condition existing when the receiver or handset is removed from its hook-switch.
- One of two possible signaling states such as tone or no-tone, or ground connection or battery connection.
- The active state (closed loop) of a subscriber or PBX line loop. Contrast with on-hook.

office classification

Numbers assigned to offices according to their function in the North American direct distance dialing network. The following class numbers are used:

- Class 1 - regional center (RC)
- Class 2 - sectional center (SC)
- Class 3 - primary center (PC)
- Class 4 - toll center (TC) if operators present, otherwise toll point (TP)
- Class 5 - end office (EO)

OG

outgoing

OH

operator handled

OM

operational measurements

on-hook

- In telephone operation, the condition existing when the receiver or handset is resting on its hook-switch.
- One of two possible signaling states such as tone or no-tone, or ground connection or battery connection.
- The idle state (open loop) of a subscriber or PBX line loop. Contrast with off-hook.

ONI

operator number identification

OPC

originating point code

OPDU

operational protocol data unit

operating company

The owner/operator of a DMS switch.

operating company client

A person, group, or organization that, under a contractual agreement with an operating company, uses part or all of the DMS switch that is owned/operated by the operating company.

operational measurements (OM)

The hardware and software resources of the DMS-100 Family systems that control the collection and display of measurements taken on an operating system. OM organize the measurement data and manages its transfer to displays and records on which maintenance, traffic, accounting, and provisioning decisions are based.

operator centralization (OC)

An extension of the operator services provided by TOPS. OC enables the operating company to handle traffic in several remote toll centers as though they were operator centers.

operator number identification (ONI)

The equipment used to bring an operator into the circuit to check the calling number when a subscriber has direct-dialed a long distance call that is to be charged on an itemized bill basis by CAMA equipment. Contrast with automatic number identification.

OPM

outside plant module

originator

In DMS call processing, an agent that starts a call by detecting an origination request.

OS

operating system

OSS

operations support system

outgoing (OG)

Refers to the direction of a signal with respect to the module or unit being described. An OG signal is on the transmit path from the unit. Contrast with incoming.

outgoing message buffer (OMB)

Registers in which control and data messages between components of the central control complex, network message controllers, and peripheral modules are stored. Each OMB is associated with the transmit path of a message link and stores the message while the input/output protocol is performed.

outside plant module (OPM)

A stand-alone, weather-proofed enclosure equipped to interface between two and six DS1 links from a line group controller at a host office and up to 640 locally-connected subscriber lines. An OPM consists of one line concentrating module, a remote maintenance module, a host interface equipment shelf, a power supply, environmental control equipment, and a cable cross-connection for up to 1280 pairs.

Outward Wide Area Telephone Service (OUTWATS)

A telephony service, provided over one or more dedicated access lines to the serving central office, that permits subscribers to make calls to specified service areas on a direct dialing basis for a flat monthly charge or for a charge based on accumulated usage. Outward WATS lines have special directory numbers. *See* also inward wide area telephone service; wide area telephone service.

OUTWATS

Outward Wide Area Telephone Service

overflow

Traffic, in excess of the capacity of the circuits on a particular route, that is offered to an alternative route.

OVS

overseas services

PABX

private automatic branch exchange

packet

A group of binary digits, including data and call control signals, that are switched as a composite whole. Data, call control signals, and possible error control information are arranged in a specified format for transmission through the network.

packet assembler/disassembler (PAD)

Functions of a PAD include assembling characters into packets, forwarding data packets, handling virtual call setup and clearing, and disassembling the user data in packets for delivery to the start-stop data terminal equipment (DTE).

packet handler (PH)

The CCITT term for the component of an Integrated Services Digital Network switch that provides packet switching services.

packet handler interface (PHI)

Functional name of the device in an exchange termination used for multiplexing low-speed packet data on the D-channel into DS1 format for links joining the exchange termination to the packet handler. The PHI also performs the reverse operation.

The transmission of data by means of addressed packets, whereby a transmission channel is occupied only for the duration of transmission of the packet.

packet switching network

A communications system designed to carry packet data. In a packet switching network, packet data in different formats can be handled by external interfaces. Network conversion of these formats occurs through an interface computer.

paddle board (PB)

A short circuit pack, based on the standard circuit pack. The PB carries the cable interfaces and/or local service functions such as local clock sources and bus terminations, located on the back of a DMS-SuperNode shelf.

Pulse amplitude modulation

parallel

- Concurrent or simultaneous transmission on different paths.
- The concurrent or simultaneous operation of two or more devices or two or more activities within a device. (3) Concurrent or simultaneous processes. Contrast with serial.

party line

A central office line serving more than one subscriber. The most common arrangements are for two, four, eight, and ten subscribers. *See* four-party line, eight-party line, ten-party line, two-party line.

PB

paddle board

P-Bus

processor bus

PBX

private branch exchange

PBX message register (PBM)

A message register, associated with the operational measurements system, that provides peg counts from 0 to 32767, then resets automatically to 0.

PC

- primary center
- partially compliant
- point code

PCM

pulse code modulation

PCM30

- A 32-channel, 2.048 Mb/s speech-signaling and message-signaling link, used in international trunks.
- The protocol by which PCM30 links communicate.

PCM30 digital trunk controller (PDTC)

A digital trunk interface that has the hardware configuration of an international digital trunk controller, but runs the software of a digital trunk controller.

PCP

printed circuit pack

PDTC

PCM30 digital trunk controller

PFI

Processor F-Bus interface

PE

Phase encoded, peripheral equipment

PEC

Product engineering code

Peripheral module (PM)

A generic term referring to all hardware modules of the DMS-100 Family systems that provide interfaces with external line, trunk, or service facilities.

PM contain peripheral processors which perform local routines, thus relieving the load on the central processing unit.

Peripheral processor (PP)

Hardware devices contained in the peripheral modules that perform local processing functions independent of the central processing unit. Peripheral processors are driven by read-only memory in the PM, thus releasing CPU run-time for higher level activities.

Peripheral processor message processor (PPMP)

Supervises transmission and reception of the channel supervision message speech channels of the line module controller. PPMP also checks parity on speech channels.

peripheral processor terminal

The point in a peripheral module at which it is connected to other components. Each peripheral processor terminal has a set of basic capabilities regardless of the particular hardware that is attached. Two terminals on each peripheral module are reserved for central control and peripheral processor communication, and do not have hardware attached.

peripheral side (P-side)

The side of a node facing away from the central control and towards the peripheral modules. Contrast with C-side.

permanent signal

- A signal received by central office equipment indicating that a subscriber has gone off-hook, but is sending no dial pulses. This is usually due to a fault condition on the subscriber's line.
- A telephony feature that tests for the reception of digits after dial tone has been returned to the originating line. If no digits are received within a specified period of time, the line is considered to be in a permanent signal state (off-hook) and permanent signal treatment is applied.

permanent store (PERM)

Unprotected data store type that can be written to directly and remains allocated over all restarts. The network maps and error-report logs are kept in PERM.

PH

packet handler

PHI

packet handler interface

PIU

port interface unit

plain ordinary telephone system (POTS)

POTS is an acronym used in the telephone industry to denote basic, conventional telephone services.

PM

peripheral module

PMBX

private manual branch exchange

point-to-point (PTP)

Used in calculating rate steps, refers to an operating company designated single rate step applied to calls from a specified point in the originating serving area to a specified terminating point. *See* rate step.

polling

In data communications, the process of inviting data stations to transmit information, one station at a time. The polling process usually involves the sequential interrogation of several data stations.

pool

An operating system facility that allows processes to define a new data type and to allocate groups of these items. Items in a group or pool are all of the same size and type.

port

In DMS, the point at which a speech or message link is connected to a peripheral module, network module, input/output controller, or central message controller.

position

That part of a switchboard normally controlled by an operator.

POTS

plain ordinary telephone service

P-Phone

Meridian Business Set (previously: Electronic Business Set)

PPMP

peripheral processor message processor

PPSN

public packet switched network

PRA

ISDN primary rate access (23B+D)

preplanned control (PPLN)

A network management control that applies remote dynamic overload controls in response to an external signal from a subtending office. This feature consists of preplanned controls that are activated by scan point or through the MAP; also known as remote dynamic overload control. *See* dynamic overload control; internal dynamic overload control.

preroute peg count (PRP)

A network management control for studying traffic levels to various destination codes, thus giving an indication of when code blocking controls should be applied.

PRI

primary rate interface card

primary center (PC)

A class 3 toll office. It may home on sectional centers, regional centers, or both. *See* office classification.

primary rate access (PRA)

An interface to ISDN that connects an external network device such as a PBX to an ISDN switch. Access is provided by a number of bi-directional, digital channels that are time-division multiplexed. In North America, these channels are arranged as 23 B-channels and one D-channel, often referred to as 23B + D.

primary rate interface card (PRI)

Provides the physical interface to the DS-1 for the MSL-1.

private automatic branch exchange (PABX)

Local automatic telephone office serving extensions in an organization and providing access to the public network.

private automatic exchange (PAX)

An automatic telephone exchange that provides telephone service within an organization but does not provide connections to the public network.

private branch exchange (PBX)

A private telephone exchange, either automatic or attendant-operated, serving extensions in an organization and providing access to the public network.

private exchange (PX)

A telephone exchange, either automatic or attendant-operated, that provides telephone service within an organization but does not provide connections to the public network.

process

In DMS, an executable instance of a specified program. Each process has its own process control block which is used by the support operating system to keep track of information specific to that process.

product engineering code (PEC)

An eight-character code that provides a unique identification for each marketable product manufactured by Northern Telecom Ltd.

program

In DMS, consists of a named set of loaded modules that are either:

- Named specifically in the definition of a specific program via a loader control file.
- Implicitly included as part of the program because they are used by other modules in the program.
- In DMS, programmed instructions for the various procedures required to perform processing, administration, and maintenance.

programmable read-only memory (PROM)

A type of read-only memory in which the microcode is not hard-wired, and may be programmed by external equipment.

PROM

programmable read-only memory

PROT

protected store

protected store (PROT)

In DMS, data store type that must be explicitly unprotected prior to any write-operation and protected again afterwards. This type of store remains allocated over all restarts. PROT is used to hold the office data base and translation data equipment configurations.

PROTEL

Procedure oriented type enforcing language. The high-level programming language used to write software for the DMS-100 Family systems.

PRTCALC

Peripheral pc-based real time tool

PS

program store

PSDS

public switched data service

P-Side

- peripheral side
- the line or trunk side of the peripheral

PSPDN

packet switched public data network

PTP

- point-to-point
- Any common carrier network designed to carry data in the form of packets between public users.

PTS

per trunk signaling

public switched data service (PSDS)

Any common carrier network designed to switch data, not necessarily in packet form, between public users.

pulse amplitude modulation (PAM)

A modulation system in which the magnitude and polarity of an analog waveform at a series of sample instants is represented by pulses of equivalent magnitude and polarity at the same relative instants of time.

pulse code modulation (PCM)

Representation of an analog waveform by coding and quantizing periodic samples of the signal such that each element of information consists of a binary number representing the value of the sample.

PVN

private virtual network

PVT

private (calls)

PX

private exchange

Q.921

CCITT recommendation that defines protocols at the datalink layer.

Q.931

CCITT recommendation that defines protocols for circuit-switched call control at the network layer.

RA

rate adaptor

RADR

receiver attachment delay recorder

RAM

random access memory

random access memory (RAM)

A memory system in which information is stored in discrete, individually addressable locations such that access time is independent of location.

RAO

revenue accounting office

RCA

remote controller array (shelf)

RCC

remote cluster controller

RCE

remote controller equipment (frame)

RCS

remote concentrator SLC-96

RCT

remote concentrator terminal

RCU

remote carrier urban

read-only memory (ROM)

A memory system in which data is stored in a permanent, non-erasable form. Applications in DMS include driving the peripheral processors.

read/write (R/W) memory

A memory system in which data may be stored and from which data may be extracted.

ready to manufacture (RTM)

Refers to a BCS load that has been approved for release to Northern Telecom for manufacture.

ready to order (RTO)

Refers to a BCS load that has been released to Northern Telecom for manufacture, and for which operating companies may place orders.

ready to order-in service (RTOIS)

Refers to a BCS load, already in service in the field, that is available for order by Northern Telecom operating companies.

ready to order-not in service (RTONIS)

Refers to a BCS load, not yet in service in the field, that is available for order by Northern Telecom operating companies.

REAL::TIME

NT-40, DMS-Core pc-based real time tool

receive only (RO)

Refers to a teleprinter or visual display unit that receives data via the input/output controller. This data consists of such items as operational measurements and maintenance output reports from the DMS-100 Family system. RO printers are located in maintenance and traffic-management areas.

receiver attachment delay recorder (RADR)

A network management feature that provides a method of measuring machine congestion. Test call originations are generated to measure the interval between the original request for attachment to a receiver and the actual time of connection.

record

A collection of data transcribed, or in a form suitable for transcription, between computer main memory and a storage medium.

recording completing (RC)

A type of trunk circuit used to interface with a recording machine.

regional center (RC)

Class 1 office; the highest level toll office in the North American switching hierarchy. Regional centers form the basic upper-level network for long distance traffic. *See* office classification.

register

- The apparatus in an automatic switching system that receives address signals and controls the subsequent switching operation.
- The first unit in the assembly of common control equipment in an automatic central office. The register receives address information and stores it for possible conversion or translation. A register frequently operates in conjunction with a sender.
- A storage device having a specified storage capacity such as a bit, a byte, or a computer word, and usually intended for a special purpose.

reinitialize interrupt

An interrupt generated when the need for a restart is detected.

REL

release complete

reload-restart

Refers to the setting of software pointers in a program to simulate actual reload of software into DMS-100 Family switches. Office configuration and translation data is retained but all dynamic data is cleared.

Remote Call-forwarding Service

A service-related telephony feature that permits all calls placed to a local directory number to be forwarded to a remote station. No physical telephone station need be associated with the local number.

remote concentrator SLC-96 (RCS)

A peripheral module that provides remote subscriber loop concentration for the AT&T Technologies SLC-96 subscriber carrier system. The RCS supports up to 96 subscriber lines over two to four DS1 links.

remote carrier urban (RCU)

A peripheral module that provides remote subscriber loop concentration for a DMS-1 urban carrier system. The RCU uses high-level message protocol to message over one or two message channels, and, in configuration with a digital switch, supports up to 560 subscriber lines over up to eight DS1 links.

remote cluster controller (RCC)

A dual-shelf peripheral module that provides a master controller for all units at the remote switching center, and is in turn controlled by the host line trunk controller.

remote concentrator terminal (RCT)

In the DMS-1 system, a peripheral module that provides remote subscriber loop concentration, over two DS1 links, for up to 256 subscriber lines.

remote controller array (RCA) shelf

A unit of the remote cluster controller. An RCC consists of two RCA shelves.

remote controller equipment (RCE) frame

A single-bay frame containing two remote maintenance modules and a dual-shelf remote cluster controller.

remote dynamic overload control (RDOC)

See preplanned control.

remote dump and restore (RDR)

A software change process in which operating company data that is integrated with an active software release is dumped and temporarily stored, pending an update of that software. This procedure is performed remotely, from a Northern Telecom facility. Contrast with local dump and restore.

remote line concentrating module (RLCM)

An equipment frame that interfaces between from two to six DS1 links from the line group controller at the host office and up to 640 subscriber lines connected locally. RLCM is equipped with one line concentrating module, a remote maintenance module and a host interface equipment shelf.

remote line controller (RLC)

Basic control-unit in the remote line module. Its operation is similar to that of the line module controller.

remote line module (RLM)

Refers to a pair of remotely located line modules that interface, over from two to eight DS1 links, between a digital carrier module at the host office and up to 1280 subscriber lines.

remote maintenance module (RMM)

A peripheral module, with a configuration similar to that of the maintenance trunk module, that accommodates up to twelve service and test cards.

remote make-busy (RMB)

A status signal, received on a two-way trunk from the far-end trunk circuit, indicating that the affected circuit is classed as made-busy to incoming traffic.

remote-off-remote equipment

Permits equipment at one remote site to share facilities with another remote site without being directly connected to the host office. Equipment at the remote-off-remote site can consist of an indoor remote line concentrating module or a weather proof outside plant module. Either type of unit interfaces with up to 640 analog lines.

report

A message from a peripheral module to the central control reporting an event or transferring data.

residential enhanced services

Software which provides a platform for the implementation of sophisticated phone services to residential subscribers and small businesses previously serviced on a POTS (1FR or 1MR) line.

restart

To re-establish the process of executing a routine after a program or data error or machine malfunction. Restarting usually involves returning to checkpoints placed at appropriate intervals such that, in the event of a failure, a job can be resumed without starting at the beginning of the run. A restart has a severity associated with it that reflects the importance of the resources being reset. *See* also cold restart; warm restart.

RG

ringing generator

ringing generator (RG)

A programmable generator that can output a variety of ringing waveforms on receipt of a suitable drive-signal.

RLC

release with cause

RLCM

remote line concentrating module

RLM

remote line module

RMM

remote maintenance module

RO

receive only

ROM

read-only memory

route

A path into the signaling network that accesses a destination. This path follows a linkset into the signaling network.

route-ID

A translation result that specifies, in a route list, a number of possible routes that can be used to complete a call.

route table

A table, maintained by the input/output system, of all possible routes to each node in the DMS-100 Family system. Whenever a node or link is put into or taken out of service, the maintenance subsystem responsible for the node or link informs the I/O system, which then makes appropriate adjustments to the route table.

routing

A telephony function that selects and connects a path from the originating terminal to a destination based upon an analysis of the digits received and the screening of a line as required.

routing code

An address, or group of characters, in the heading of a message defining the final circuit or terminal to which the message has to be delivered. Also known as routing indicator.

routing table

A table, associated with a network node, that states, for each message or packet destination, the preferred outgoing link available to the message.

RP

resource processor

RSC

remote switching center

RTIF

reset terminal interface

RTM

ready to manufacture

RTO

ready to order

RTOIS

ready to order in service

RTONIS

ready to order not in service

RTP

Research Triangle Park

RTS

return to service

R/W

Read/write (memory)

S/A

stand-alone

SAPI

service access point identifier

SAPI 0

service access point identifier (call signalling on D-channel associated with circuit switched B-channels)

SAPI 16

service access point identifier (low speed D-channel packet data)

SC

sectional center

scan points

Read-only bits in the trunk logic circuit that indicate the status of the hardware.

SCCP

signaling connection control point

scheduler

A component of the operating system that arranges sharing of the central processing unit among the system processes, based on a preemptive priority scheme.

schema

In DMS, the representation of data in the system as seen by the various users. It includes both tables and associated operations.

SCLLI

short common language location identifier

SCM

subscriber carrier module

SCP

service control point

SCCP

signaling connection control part

SCLC

SCCP connectionless control

SCMG

SCCP management

SCP

service control point

SCPII

DMS-Core SCP product

SCRC

SCCP routing control

screening

A telephony function that determines the eligibility to complete a call as dialed, based upon class of service information associated with the line.

SD points

- signal distribution points
- Pertains to the occurrence of events in time-sequence, with no simultaneity or overlapping of events. Contrast with concurrent; simultaneous. Compare with consecutive.

SDL

signaling data link

S/DMS

SONET/digital multiplex system

SEB

system engineering bulletin

serial

- Pertains to the sequential or consecutive occurrence of two or more related activities in a single device or channel.
- Pertains to the sequential processing of the individual parts of a whole such as the bits of a character, or characters of a word - using the same facilities for successive parts. Contrast with parallel.

service access point identifier (SAPI)

Identifier that is used by datalink layer (layer 2) protocol to define the type of service allowed to an ISDN terminal.

service control point (SCP)

A node in a CCS7 signaling network that supports application databases. The function of an SCP is to accept a query for information, retrieve the requested information from one of its application databases, and send a response message to the originator of the request.

service order (SO)

A facility consisting of commands that can be used to change subscriber line service tables.

Service Order System (SERVORD)

A man-machine interface used to change, add, or delete a subscriber line. Standard telephone industry command-format is used.

service position (SP)

- A type of trunk circuit with the capability of interfacing with a traffic service position.
- A Common Channel Signaling No.7 (CCS7) signaling node which interacts with the service control point (SCP) to implement special service code features.

SF

single frequency

shelf

A container for drawers, cards, or both.

short common language location identifier (SCLLI)

Shortened version of the CLLI, used in data tables to identify the physical transmission paths between offices.

signal distribution (SD)

A method of converting digital control messages addressed to a trunk or service circuit into supervisory signals compatible with the characteristics of the associated trunk or service facility.

signal distribution points (SD points)

Writeable bits in the trunk logic circuit that usually correspond to relays in the hardware. They are used to control activities in the hardware.

signaling processor (SP)

The interface between a master processor and the control circuits in the line-side of a line module. Through the SP, the line circuits, ringing multiplexers, programmable ringing generators, and the activity circuit are controlled, and their status reported.

signaling point

A node in a Common Channel Signaling 7 (CCS7) network that originates, terminates, or transfers signaling messages from one signaling link to another.

signaling System 7

A version of Signaling System #7, developed for North American use.

signaling System #7

An International Signaling System No. 7. Based on the International Telegraph and Telephone Consultative Committee (CCITT) specification of Signaling System No. 7.

signaling terminal equipment number 7 (ST7E)

A frame containing the extra signaling terminal cards required when a basic rate access office is equipped with a large number of ISDN lines or terminals equipped with D-packet service.

signaling terminal number 7 (ST7)

A dual processor device with an 8085-based master processor (MP) and an 8031-based data link processor resident in a single card in the MBS7 frame. In CCS7, ST7 is the same as a signaling terminal controller.

signaling transfer point (STP)

- A node in a Common Channel Signaling 7 (CCS7) network that routes messages between nodes. Signal transfer points transfer messages between incoming and outgoing signaling links, but with the exception of network management information, do not originate or terminate messages. Signal transfer points are deployed in pairs. If one STP fails, the mate takes over, ensuring that service continues without interruption.
- Pertains to the occurrence of two or more events at the same instant of time. Contrast with consecutive; sequential. Compare with concurrent.

Single Call Arrangement (SCA)

In a multiple appearance directory number group, single call arrangement allows only one station to be active, either originating or terminating calls, on the MADN at any given time. *See* also multiple appearance directory number. Contrast with Multiple Call Arrangement.

single frequency (SF)

- A signaling method using a 2600 Hz tone to transmit and receive on-/off-hook address and supervisory signals. SF is used in conjunction with E & M signaling on four-wire trunk facilities.
- The basic element of the DMS-100 packaged system. SNPC is a two-way unit containing a central control complex and one switching network module.

SL

signaling link

SLC

signaling link code

SLC-96

A subscriber loop carrier that can provide service to 96 subscribers over two to four DS1 links running from a remote terminal to an central office. SLC is a registered trademark of AT&T Technologies, Inc.

sleeve lead control

A feature that permits, by means of a third wire, operation of a device in an equipment unit external to the switching system but directly associated with the line. Sleeve leads are used to operate or release auxiliary circuits such as remote message registers, INWATS lines, and emergency lines.

SLM

system load module

SLU

subscriber line usage; system load unit

SMR

subscriber module rural

SMU

subscriber module urban

SN

DMS-SuperNode

SO

- service order
- signaling office
- switching office
- In DMS, a system that allows tracking and capture of the various activities - for example, testing and problem reporting - in the software product development cycle.

SOC

system overload control

SONET

synchronous optical network

SOS

support operating system

SP

signalling processor; signaling point

SPC

stored program control

special tone table (STN)

Table containing all relevant information (for example, characteristics and codes) concerning the tones utilized in various features available in the DMS-100 Family systems.

speech link connecting (SLC) frame

The frame in which the speech link connections between peripheral modules and network modules are organized. The pattern of connections is determined by interchangeable patch cards and panels.

speed of answer

In DMS, the length of time an average call is delayed awaiting connection to a TOPS. Measurements are taken during a specified period.

SR512

Subrate DS512 (128/256 channels)

SRAM

Static RAM

S/RSC

Sonet remote switching center

SS7

Signaling System 7

SS#7

Signaling System #7

SSN

Subsystem number

SSP

Service switching point

ST7

Signaling terminal No. 7

Standard work time (SWT)

Average work time per call over all calls and operators at a TOPS serving area.

Start Dial

A telephony feature, in a system arranged with the Delay Dial signaling feature, that generates a signal to a far-end trunk circuit to request that signaling be sent.

STN

special tone table

stop-go (SG)

A method of operation used for supervisory signaling where a step-by-step office is a tandem between two common control offices. The originating common control office dial-pulses the address information; an off-hook signal returned to the originating office within the inter-digital intervals stops outpulsing until the on-hook condition returns.

storage allocation

That part of the operating system that manages the allocation of store in the DMS-100 Family machines.

stored program control (SPC)

- Control of an automatic switching arrangement in which the call processing is determined by a program stored in an alterable memory.
- Control of a function by sequentially interpreting information stored in a memory whose structure is independent of the function to be performed.

STP

signaling transfer point

STP/SSP

integrated node (STP/SSP)

subscriber

An individual user of a telephone station set that is connected to a DMS switch. Also known as end user.

subscriber access multiplexer (SAM)

A subscriber premises modem that provides an interface to the data above voice system for the subscriber's telephone and data terminal equipment.

subscriber carrier module (SCM)

- A subscriber carrier module that interfaces between the remote concentrator terminal of a DMS-1 and the central office of a DMS-100 Family switch.
- In DMS, refers to the SCM-100, a family of 3 peripheral modules, the subscriber module rural, the subscriber module SLC-96, and the subscriber module urban, that interface 3 types of remote terminals with the DMS-100 Family switches.

subscriber module SLC96 (SMS)

A subscriber carrier module that interfaces between the remote concentrator SLC-96 of a SLC-96 system and the central office of a DMS-100 Family switch.

subscriber module urban (SMU)

A subscriber carrier module that interfaces between the remote concentrator urban of a DMS-1 and the central office of a DMS-100 Family switch.

subsystem

An application within a node that uses the routing functions of the signaling connection control part (SCCP). Subsystems are addressable entities.

A signal used to indicate and control the various operating states of the circuits involved in a connection.

SWAct

Switch activity

switching office(SO)

A node in the Common Channel Signaling No.7 (CCS7) network that originates and terminates signaling messages related to the setup and take down of associated Integrated Services Digital Network user part (ISUP) trunks.

synchronous transmission

A transmission process such that between any two significant instants in the overall bit stream, there is always an integral number of unit intervals. Transmitting and receiving equipment are maintained in step by timing signals, which eliminates the need for start and stop elements (as used in asynchronous transmission) and significantly increases data throughput rates.

System Administration Data System (SADS)

Refers to the teletypewriter that records data derived from TOPS operational measurements used for management of a single-office operation.

system load module (SLM)

A mass storage system in DMS-SuperNode that is used to store office images. From the SLM, new loads or stored images can be booted into the computing module.

system log (SYSLOG)

The log containing a selection of reports from various logs following a reload-restart. SYSLOG is the only log whose contents survive reload-restarts; thus it is useful if the reload was unintentional.

TA

terminal adapter

table

- Two-dimensional entities in which the data associated with the hardware and software systems of the DMS-100 Family are stored.
- Software used to manipulate tables in the DMS-100 Family systems.

table editor (TE)

In DMS, software that supports an enhanced set of table control functions at the man-machine interface, using data dictionary, formatter, and table control. operating company personnel can modify or add tuples to a table. *See* partitioned table editor.

tandem office

An office used to interconnect the end offices in a densely settled exchange area. This is done over tandem trunks, where it is uneconomical for an operating company to provide direct interconnection between all end offices.

tandem trunk

A trunk, between Class 5 offices, that permits calls to be routed from office A to office B, or A to C through B, on the same trunk.

tape unit

See magnetic tape unit.

TAS

technical assistance service

TASC

technical assistance and surveillance center

TASI

time assigned speech interpolation

T-Bus

transaction bus

T&C

time and charges

TCAP

transaction capabilities application part

TDF

trunk distribution frame

TE

table editor

technical assistance and surveillance center (TASC)

Monitors the activities of unattended DMS-100 Family systems, and provides technical assistance to switch-maintenance personnel as required. The TASC class of operating company personnel has access to data and input commands applicable to switch maintenance.

technical assistance service (TAS)

Northern Telecom's technical services organization for customers in the United States. TAS handles all emergency and non-emergency support,

technical queries not related to pricing and product availability, cutovers, and software updates (including patches).

telescoping

Refers to the method by which successively lower levels can be accessed on a maintenance and administration position display to pinpoint a fault.

Teletypewriter (TTY)

An electric typewriting device that generates a coded signal corresponding to each typed character. TTY also receives and converts coded signals into typewritten copy.

temporary store (TEMP)

Unprotected data or program store that can be written to directly, and is deallocated over all restarts. TEMP is used for loading temporary programs.

ten high-day busy hour (10 HDBH)

The hour, not necessarily a clock-hour, that produces the highest average load for the ten highest business-day loads in a busy season.

terminal

- The point of origination or termination in a communications network.
- Any device capable of sending and/or receiving information over a communication channel.
- Also, in DMS, the smallest unit of address space within the input/output system.

tie trunk

A trunk directly connecting two private branch exchanges.

time assigned speech interpolation (TASI)

A technique used on certain long frequency-division Multiplex links to make better use of voice channels. An additional subscriber may be switched onto a channel temporarily idled by the pauses in the original subscriber's speech; when speaking resumes, it will in turn be switched to any channel that happens to be idle.

time-division multiplex (TDM)

A means of obtaining a number of channels over a single path by dividing the path into a number of time slots and assigning each channel its own intermittently repeated time slot. At the receiving end, each time-separated channel is re-assembled. The system is ideally suited for the transmission of digital data, and is now used for digitized speech and other signals. The time slot allocation may be repeated regularly (fixed cycle) or made according to demand (dynamic).

time-division switching

A switching system whereby the information content of each incoming time slot may be delayed and switched to any of a number of outgoing time slots; the switching of inlets to outlets using time-division Multiplex techniques.

time switch (TS)

In DMS, a generic term referring to both incoming and outgoing crosspoint switches in the network module. A time switch operates by reassigning time slots of sampled speech signals which have been converted to digital data.

timer

A register whose content is changed at regular intervals so as to measure time. Synonymous with clock register; time register.

T-link

A full duplex byte-oriented adaption protocol designed to transfer synchronous or asynchronous data over a digital circuit at digital trunk equipment data rates of up to 64 kbps.

TM

trunk module

TME

trunk module equipment (frame)

TM2

A trunk module with 30 pairs (2-wire circuits) of conductors wired to the distribution frame.

TM4

A trunk module with 60 pairs (4-wire circuits) of conductors wired to the distribution frame.

TM8

A trunk module with 120 pairs (8-wire circuits) of conductors wired to the distribution frame.

toll center (TC)

A Class 4 office; a central office where toll-message circuits terminate, and operator-services are provided. *See* office classification; toll point.

toll completing (TC)

In DMS, a trunk circuit capable of interfacing with a toll connecting trunk facility.

toll connecting trunk

A trunk used to connect a Class 5 office to the direct distance dialing network.

toll point (TP)

A Class 4 office where switching is performed without provision for operator functions, or in which operators handle outward calls only. *See* office classification; toll center.

toll switching (TS)

In DMS, a trunk circuit capable of interfacing with a toll connecting trunk facility.

toll tandem (TT)

A type of trunk circuit used to interface with an intertoll or toll tandem trunk.

tone receiver

An electronic detector on an incoming line or trunk that decides whether DTMF or MF address signals are present and, if so, delivers marks indicating the value of the digits received to a register.

TOPS

Traffic operator position system

touchtone dialing

A service-related telephony feature that permits a subscriber to send dual-tone multifrequency address signals to the system. Synonymous with Dual-Tone Multifrequency Dialing. Touchtone is a trademark of AT&T.

TPS

Transaction processing system

Traffic Administration Data System (TADS)

Refers to the teletypewriter that records data derived from TOPS operational measurements used for traffic-office management.

traffic office

A group of operator-attended positions, maintained for various service-related functions.

Traffic Operator Position System (TOPS)

A call processing system made up of a number of operator positions. Each operator position consists of a visual display unit (VDU), a controller, a keyboard, and a headset. TOPS is a trademark of Northern Telecom Ltd.

Traffic Separations Measurement System (TSMS)

An operational measurements feature that measures in detail the use of different parts of the DMS-100 Family system for different types of calls. TSMS enables division of revenue for long distance calling.

Traffic Service Position System (TSPS)

A toll operator's position consisting of a push-button console.

transaction bus (T-bus)

Internal bus in the duplicated message switches of DMS SuperNode. Messages are transmitted from port to port over the T-bus, a synchronous bus operating at 4.096 megabits per second.

Translation Description Manual (TDM)

A document produced by Northern Telecom that provides guidelines for preparing, understanding, and using DMS-100 translations.

translator

In DMS call processing, a function-procedure used to coordinate the translation of dialed digits.

TRAVER

The translation verification utility is a diagnostic tool that allows the operating company to simulate a telephone call in software, and display the line, trunk, or position to which a call is routed.

TRU

TOPS recording unit

trunk distribution frame (TDF)

A distribution frame dedicated to trunk circuits.

trunk module (TM)

A peripheral module, in a trunk module equipment frame, that provides speech and signaling interfaces between a DS30 network port and analog trunks.

trunk module equipment (TME) frame

A frame containing one or more trunk modules, maintenance trunk modules, or office alarm units.

TS

time switch; toll switching

TSPS

traffic service position system

TT

toll tandem

TTP

trunk test position

TTTN

tandem tie trunk network

TTY

Teletypewriter

tuple

- Horizontal row of a table.
- A common line arranged to serve two main stations. Automatic originating identification of each party and individual ringing capabilities may be provided. A two-party line may be used to provide telephone service to subscribers in residential and business locations. Service-related features may vary between parties sharing the line. Reverting calls between two-party subscribers sharing the same line are treated in accordance with the reverting calls feature.

T1

The standard 24-channel, 1.544 Mb/s pulse code modulation system as used in North America. This digital carrier carries a signal whose designation is DS1.

U-interface

CCITT term for the U-loop.

U-loop

Portion of a BRA interface that connects an NT1 to an ISDN line concentrating module (LCMI). The U-loop is also called a U-interface by CCITT.

uniform call distribution (UCD)

A Meridian Digital Centrex feature which allows calls to be evenly distributed to a number of predesignated stations known as UCD stations or UCD positions. This feature is used to queue incoming calls to the message desk.

unit

In DMS, one of two parts of an XMS-based peripheral module or a line concentrating module. Each unit has independent processing capabilities.

user

A person, group, or organization that uses the services of a DMS switch.

utility

In DMS software, a module that provides resources that it can allocate on request and recover when filed. It also controls access to data structure.

UTR

universal tone receiver

V.35

signaling protocol, 2.4 Kbps - 56 Kbps

VDU

visual display unit

verification office (VO)

A central office in which new equipment and/or features are tested prior to general release.

vertical-horizontal (V-H) co-ordinate system

Used in calculating rate steps, consists of a theoretical grid of vertical and horizontal lines covering Canada, the U.S.A., and part of Mexico. *See* rate step.

VF

voice frequency

V-H

- vertical-horizontal (co-ordinate system)
- In packet switching, a network facility used for transferring data between those data stations emulating physically-connected stations.

visual display unit (VDU)

An electronic output device that presents data to a terminal user in the form of a television picture. In DMS, the VDU is one of the components of the maintenance and administration position, and, along with a keyboard, provides the main man-machine interface in the DMS-100 Family systems.

VLC

voice line card

VO

verification office

voice frequency (VF)

The band of frequencies from 300 to 3400 Hz used for telephony transmission; known commonly as the commercial speech band.

voice-quote (VQ)

A service provided for hotels/motels not equipped with auto-quote, whereby guest billing information is transmitted to a receive-only Teletypewriter in the hotel billing information center. The HOBIC operator telephones the hotel and verbally quotes call details. *See* autoquote; HOBIC administrative teletypewriter; record teletypewriter.

VQ

voice-quote

warm restart

An initialization phase during which temporary storage is deallocated and cleared. Transient calls are dropped while calls in the talking state continue. *See* cold restart.

WATS

Wide Area Telephone Service

Wide Area Telephone Service (WATS)

A special direct distance dialing service that permits, for a flat monthly charge or a charge based on accumulated usage, either inward or outward dialing between a subscriber and specified areas. *See* also inward wide area telephone service; outward wide area telephone service.

wink (WK)

A method of signaling between trunk circuits whereby, when idle, trunks signal off-hook towards each other. A WK signal consists of timed off-hook signals transmitted to the calling end after connection is made. *See* also multiwink.

wink operation

A timed off-hook signal, normally of 140 ms, that indicates the availability of an incoming register for receiving digital information from the calling office.

wink signal

- A short interruption of current to a switchboard lamp to indicate that the circuit is busy.
- On key telephone sets, a flashing lamp that indicates that a line is being held.
- An indication of change of state between an on-hook and off-hook condition.

wink Start

A telephony feature that provides control for address signaling. The Wink Start signal is used to inform the calling office that the called office is prepared to receive address signals, and consists of an on-hook to off-hook to on-hook transition, with the off-hook to on-hook state representing the start dial signal.

word

A bit-string or character-string considered as a unit.

X.25

CCITT-defined, network layer protocol that is used in packet switching to establish, maintain, and clear virtual circuit connections between an ISDN terminal and a destination in the packet-switched network.

X.28

CCITT-defined protocol for terminal user control of a packet assembler/disassembler (PAD). The CCITT recommendation defines the establishment of an information path, and the exchange of control information and user data between start-stop digital trunk equipment (DTE) and a PAD.

X.29

CCITT-defined protocol for host control of a remote packet assembler/disassembler (PAD). The CCITT recommendation defines the exchange of user data and PAD control information between the PAD and the network.

X.3

CCITT-defined set of internal variables, called packet assembler/disassembler (PAD) parameters, that govern the operation of a PAD.

XMS

extended multiprocessor system

XPM

XMS-based peripheral module

XPAM

transmit pulse amplitude modulation

XPM

XMS-based peripheral module

XPT

crosspoint

zero suppression

- The elimination of insignificant zeros from a number. These include zeros to the left of the left-most non-zero digit on the left side of a decimal point, and those to the right of the right-most non-zero digit on the right side of a decimal point.
- In telephone digital transmission, refers to the insertion of pulses to break up a string of 0 bits, when the string is sufficiently long to disrupt clock synchronization.

1FR

single party flat rate

10 HDBH

ten high-day busy hour

3.1 kHz audio

Bearer capability that allows data to be carried on a voice channel when a modem or equivalent is used.

68020

Motorola Corporation MC68020 32-bit microprocessor.

800+

800 Plus Service

800 Plus Service (800+)

A Common Channel Signaling No.7 (CCS7) feature available in Canada providing a network intelligence at a toll office or end office (EO) using an on-line data base query system. See also Basic 800 Service.

800 Service

An inter-toll office service in which the called party subscribes to the service and pays for toll calls. Also called inward wide area telephone service (INWATS).

8080

In DMS, the number used instead of zero when data store is initialized.

DMS-100 Family

Capacity

Engineering Manual

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