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Issue 1
April 1993

DACS II
Digital Access and Cross-Connect System II Releases 1 Through 6.0

Customer Reference Manual

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Customer Reference Manual

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About This Document

Purpose

The *DACS II Customer Reference Manual for Releases 1 through 6.0* describes the features, applications, and operation of the Digital Access and Cross-Connect System II (DACS II) and the DACS II Integral Shelf Cross-Connect (DACS II ISX). It also includes detailed functional and physical descriptions. The system level operations philosophy and features are described in the chapters on operation and maintenance, commands and messages, and administrative links and operations systems. Other chapters provide information for system planning and ordering and summarize AT&T's extensive product support program.

Intended Audiences

This document is intended primarily for network planners and engineers. It can be used by anyone desiring specific information about the applications and ordering of the DACS II system, or anyone desiring to integrate DACS II into a network.

How to Use This Document

This document can be used as a reference manual that explains the DACS II system—both its hardware and software. The following describes each chapter and its contents:

- **Chapter 1 - System Overview and Benefits**

  This chapter introduces the DACS II and is intended to give readers an overview of the DACS II and it's benefits to the network.

- **Chapter 2 - Software Release Features**

  This chapter describes DACS II features that have been provided through new software releases since DACS II was introduced. The basis for the DACS II operation is the core software which provides the control, maintenance, and cross-connect functions. This software is updated with each release to provide operational enhancements, and feature packages are offered to provide additional DACS II capabilities.

- **Chapter 3 - Applications**

  This chapter describes how DACS II can be used. The functional advantages of DACS II permit easier management of today's network through the discussed applications. If you need additional information about any of the applications listed, see your local account executive.

- **Chapter 4 - Capabilities**

  This chapter describes in a broad fashion what DACS II can do. The discussions of these capabilities are brief and are intended to give a general overview. DS0 channel cross-connections are described in detail in the first part of this chapter. Subrate data channels (within DS0s) are also cross-connected into multiplexer or multipoint junction unit configurations using commands. The subrate processing that is done in the DSPU is discussed in the last part of the chapter. DS0 and clear-channel DS1 test access are also discussed along with maintenance and administration.

- **Chapter 5 - Product Support**

  This chapter describes the product support available for DACS II. This includes documentation, training, and technical support.

- **Chapter 6 - Functional Description**

  This chapter contains the functional description of DACS II and is intended to provide the reader with a general knowledge of the circuit pack functions and interworkings. Simplified block diagrams and terminology familiar to DACS II technicians are employed in this presentation to appeal to a large audience. Not only will this material benefit the technician, but it will also be useful to anyone looking for a general understanding of how the equipment works. This section is divided into two major headings: Common Equipment Circuit Blocks and Feature Functions.

- **Chapter 7 - Equipment Description**

  This chapter contains the physical description of the DACS II equipment. It is intended to acquaint the reader with the size and appearance of various DACS II frame configurations. Circuit pack codes are also listed in this chapter. Ordering is done from Equipment List Structure information maintained by AT&T Account Executives.

- **Chapter 8 - Ordering**

  This chapter includes information needed when ordering a DACS II system.

- **Chapter 9 - Growth and Capacity**

  This chapter gives the minimum equipage of mounting hardware and circuit packs for the DACS II and describes how DACS II can be grown to accommodate additional facility terminations and services. The facility and DS0 channel capacities of the fully equipped frames and the NPC numbering methods are also discussed.

- **Chapter 10 - Administrative Links and Operations Systems**

  This chapter describes the administrative links that allow communication with and control of the DACS II and names the typical OSs (Operations Systems) that connect to DACS II. The Operations Systems portion of the chapter describes the most commonly used OSs.

- **Chapter 11 - Commands and Messages**

  DACS II is an interactive system controlled by software commands. There are two message languages that can be used by a user to communicate with DACS II. These are the PDS (Program Documentation Standards) language and the MML (Man-Machine Language) languages. Each language has a set of input commands and output messages that are used to communicate with DACS II.

- **Chapter 12 - Operation and Maintenance**

  This section relates some of the operation and maintenance activities at the DACS II. Operation refers to the activities done from the administrative links to control and operate the equipment. Maintenance refers to activities done at the equipment in response to trouble conditions or messages. The only routine maintenance on the equipment itself is cleaning the heads on the backup tape drive.

- **Chapter 13 - Engineering Considerations**

  This chapter discusses considerations involved in engineering DACS II and its associated equipment. It is intended to provide the user with information concerning engineering philosophies, equipment requirements, and any problem areas that could arise as the result of improper engineering procedures.

- **Chapter 14 - 2.048-Mb/s Environment**

  This section provides a description of the 2.048 Mb/s transmission facility interface capabilities of DACS II. The information given in this section is unique to the 2.048-Mb/s interface. For general information about DACS II, refer to the other sections of this document.

- **Chapter 15 - DACS II Gateway**

  This chapter provides information concerning the DACS II Gateway feature.

- **Chapter 16 - DACS II ISX**

  This chapter provides information concerning the DACS II ISX which will be available in the third quarter of 1993.

  In addition, the following supplementary information is located at the end of this document:

  — List of acronyms

  — Glossary describing terms in this guide

  — Fully cross-referenced index.

Related Documentation

The following documents support the DACS II system:

- **DACS II Release 6.0 Installation Manual**

  Audience: Customers planning to install the equipment

  Content: Customer installation instructions.

- **DACS II Release 6.0 Operation and Maintenance** Manuals; document numbers AT&T 365-353: -001 (PDS), -011 (MML), -021 (PDS 2.048-Mb/s Interface) -031 (MML 2.048-Mb/s Interface)

  Audience: End-user maintenance personnel

  Contents: Procedures to operate and maintain the DACS II.

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- **DACS II Release 6.0 Command and Message Manuals; document numbers AT&T 365-353: -002 (PDS), -012 (MML), -022 (PDS 2.048-Mb/s Interface), -032 (MML 2.048-Mb/s Interface)**

  Audience: End-user maintenance personnel

  Content: Description of each software input message and its response along with a description of each system output report.

- **DACS II Releases 3.0 through 6.0 Quick Reference Guides; document numbers AT&T 365-353:-003 (PDS), -013 (MML), -023 (PDS 2.048-Mb/s Interface), -033 (MML 2.048-Mb/s Interface)**

  Audience: End-user maintenance personnel

  Content: Abbreviated list of system commands and parameters.

- **DACS II Release 6.0, Software Release Description; document number AT&T 365-352-005 (1.544 Mb/s), -105 (1.544 Mb/s BSS), -025 (2.048 Mb/s)**

  Audience: End-user maintenance personnel

  Content: Upgrade procedures for the new software release, status of problems fixed in previous releases, and operating issues for the specified software release.

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System Overview and Benefits

1

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System Overview and Benefits

1

Introduction

This chapter introduces the DACS II (Digital Access and Cross-Connect System II) and is intended to give readers an overview of DACS II and it's benefits are to the network.

What Is DACS II?

The DACS II is the current generation of equipment for access and cross-connection of DS0 channels. DS0 (Digital Signal Level 0) channels are defined as 64-kb bandwidth channels produced by PCM (pulse code modulation). The DACS II offers increased cross-connect capacity with no increase in physical size and effectively replaces the original DACS. The DACS II is software-based equipment compared to the firmware-based original DACS. The DACS II architecture is completely different, having both main and secondary controllers, centralized and distributed memory, and single-stage, nonblocking time-slot interchange circuitry. Small and large frame complexes and modular equipment design allow the DACS II to be economically deployed in both large and small installations.

What Does DACS II Do?

The name Digital Access and Cross-Connect System describes the main function of DACS II. It accesses DS0 information channels in the digital signals connected to it. These digital signals can be 1.544-Mb/s DS1 signals, 2.048-Mb/s signals, or 44.736-Mb/s DS3 signals. This access allows cross-connecting DS0 channels without decoding them to analog and allows channels to be brought outside the DACS II for testing. These cross-connect and test-access operations are initiated by commands entered on an administrative link.

DACS II uses a process called time-slot interchange to electronically cross-connect single DS0 (64-kb/s) channels or any continuous range of up to 24 DS0 channels (1.544-Mb/s DS1 facility) or 31 channels (2.048-Mb/s facility, NSA format) within the DACS II cross-connect network. If the DACS II CEF (capacity expansion frame) is equipped for 2,560 DS1 facilities, the DACS II can connect all 61,440 DS0 channels.

Up to four DS1 facility interfaces can be reserved for DS0 test access. DACS II allows test access of any channel within a facility without interfering with any other channel. Testing can be performed locally with standard test equipment at the distributing frame or remotely through the RTS-5A (Remote Test System-5A) or RMS-D1 (Remote Maintenance System-Digital 1) of SARTS (Switched Access Remote Test System). If the frame is at full capacity, the RMS-D1 system will have to be used because RTS-5A is too small to handle the full capacity requirements.

In addition, facility circuit packs can be software provisioned for clear-channel DS1 application and used for test access of other clear-channel DS1 facilities which terminate directly or terminate in DS3 signals. There is no restriction on the number of clear-DS1 NPCs (network processing circuits) that can be used for test access. There are 10 possible test access configurations, including monitor and split modes with unidirectional and bidirectional connections.

DACS II also monitors the performance of connecting 1.544-Mb/s, 2.048-Mb/s, and DS3 facilities, checking for loss of signal and transmission errors. Additional facility parameters using different error checking schemes are monitored on the DS1 signals (including those embedded in DS3) and the 2.048-Mb/s signals. Facility performance is reported in a daily summary message and on demand by entering a command. If the errors or counted activities exceed prescribed thresholds, the DACS II initiates office and remote alarms and/or alarm messages over the administrative links.

How Is DACS II Different From DACS?

DACS II provides up to 20 times the port capacity of DACS with various operational improvements and additional signal-processing capacity. Specific improvements are listed below:

- Compact Physical Design
- Reduced Cross-Connect Expense
- Reduced Operations Expense
- Economic Deployment Over Wide Range of Installation Sizes

- Greater Facility Termination Capacity
- Low Start-Up Cost and Modular Growth
- Completely Nonblocking to New Cross-Connections Under All Circumstances
- Faster Response on All Functions
- Flexible configuration for office customization
- Numerous Additional Types of Facility Terminations and Additional Types of Digital Signal Processing Circuits.

Basic DACS II Benefits

DACS II saves time, money, and space while providing new revenue opportunities. The following paragraphs describe the major benefits.

DACS II saves money and time by reducing administrative expenses. DACS II provisions and rearranges circuits electronically. Circuit orders can be implemented locally or remotely in minutes, saving the time and effort of manual changes and cross-connections. Individual trunks can be reconfigured electronically from a single provisioning center, eliminating the need to coordinate activity with a number of distant offices.

DACS II saves money by reducing maintenance expenses. Test access is integrated within DACS II. Operated locally or from a remote location, DACS II can help to sectionalize faults on the channels it cross-connects. Remote testing can be conducted from a central site; you do not have to spend time traveling to the DACS II location. DACS II reduces service interruptions by making it easy to provision redundant circuits and switch service to these circuits should a failure occur. DACS II helps reduce the possibility of such a failure by continually monitoring the digital facilities connected to it. Should a signal degenerate below a certain threshold, DACS II will report the condition.

DACS II reduces the need for other equipment. DACS II can assume the duties of existing equipment or equipment that would have otherwise been required, saving you money and office space. For example, the ability of DACS II to directly cross-connect DS0 channels eliminates the need for back-to-back channel banks and distributing frames. DACS II also allows segregation and consolidation of services without additional equipment. Segregation, the separation of message service channels from special service channels, permits direct cabling to staging areas and eliminates the need for IDFs (intermediate distributing frames). Consolidation, the collecting of channels together for increased fill on terminals and lines, reduces the number of lines and terminals you need. Service segregation and concentration are done electronically within DACS II, eliminating the need for back-to-back channel bank configurations. Additionally, DACS II offers integrated test access to channels.

DACS II increases the efficiency of existing facilities. Increased efficiency translates into greater return on facility investment. By electronically concentrating services, DACS II allows the greatest use out of existing terminals and facilities.

Benefits Provided by Software Releases

The following subheadings list the benefits derived from using the features that were introduced with software loads over the years. Beginning with Release 5.0, new software loads are referred to as releases to be consistent with the terminology for switching equipment and other software-based equipment. No effort has been made to go back and change existing document references to earlier releases because the use of generic is so widespread. DACS II features are marketed as software packages and all desirable features are carried along into subsequent feature packages.

Additional Benefits Provided in Release 2.0

- Operational savings can be realized through enhanced OA&M (operation, administration, and maintenance) capability and efficiency.
- In response to Bellcore and CCITT (International Telegraph and Telephone Consultative Committee) standards for the evolving digital network, DACS II Release 2.0 offers X.25 synchronous links and MML (man-machine language) link language.
- Administrative access to the DACS II frame can be increased and customized to meet specific user needs.
- Enhanced user friendliness of DACS II through multiple languages and new command input and output message formats.
- Rapid network reconfiguration capability supports network failure recoveries and offers new service revenue-generating opportunities.
- Provides compatibility with emerging X.25 packet operations networks.

Additional Benefits Provided by Release 3 Features

Direct *SLC*® Carrier Interface Benefits

- Direct interface to DACS II

- Elimination of back-to-back COTs (central office terminals) and D channel banks
- Test access at DACS II
- Full support of alarming, protection switching, and maintenance of *SLC* carrier circuits provided on the *SLC* carrier data link
- Electronic grooming of POTS and special service channels
- Digital integration of mixed-service TR-08 (per Bellcore Technical Requirement TR-TSY-08) remote terminals
- Mode I compatibility with *5ESS*® switch and DMS* 100 switch
- Administrative link operation with *SLC* Series 5 carrier craft interface unit for remote provisioning of Series 5 special channel units
- Support of *SLC* 96 carrier Mode I (POTS and specials or specials only), *SLC* 96 carrier Mode III (specials only), *SLC* Series 5 carrier Feature Package B with specials (POTS and specials or specials only), and *SLC* Series 5 carrier Feature Package C (specials only).

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* DMS is a registered trademark of Northern Telecom, Inc.

Subrate Feature Benefits

- Reduction or elimination of external subrate data processing equipment
- Full error correction capabilities for reliable end-to-end data transmission
- Full support of secondary channel capabilities
- New service opportunities through use of secondary channel features
- Subrate data channel test access
- High reliability of DDS (digital data service) services due to one-for-one equipment protection switching
- Simplified circuit design and administration due to built-in circuit layout features.

2.048 Mb/s Interface and Gateway Benefits

- Compatible termination of CCITT-defined 2.048-Mb/s facilities
- Cross-connection of channels between 1.544-Mb/s and 2.048-Mb/s facilities.

Additional Benefits Provided in Release 4

DS3 Signal Termination Benefits

- Simple, cost-effective DS3 termination at DACS II
- Supports up to six DS3s per DS3 unit
- Modular growth of DS3 terminations in each DS3U and of the DS3Us in the frame
- DS3 signal compatibility with existing DS3 coaxial transmission equipment such as DACS III-2000 and DACS IV-2000
- Independent provisioning of DS3 multiplexers and constituent DS1s by commands
- Provides DS3 and DS1 facility performance monitoring
- Demultiplexing into constituent DS1 and into DS0 signals for DS0 channel cross-connections
- Provisioning of clear-channel DS1s on the DS3 to allow cross-connections to other clear-channel DS1s to provide functionality for 3/1/0 cross-connections

- Provides DS3 AS&C (alarm surveillance and control) via TABS (telemetry asynchronous block serial) links
- Equipment protection switching to prevent loss of service because of a DS3U equipment failure.

Flexible Bay Benefits

- User definable IFTU, DS3U, and DSPU (digital signal processing unit) equipage in frames (full assignment flexibility in Release 4.1)
- Permits use of entire frame (or larger part of frame) for same type of unit assignments (for example, all DS3Us)
- Simplified equipment administration
- In-service change out of units to allow economical frame reconfiguration as needs change.

Clear-Channel DS1 Cross-Connect Benefits

- Termination and cross-connection of entire 193-bit bandwidth for applications such as transmission of video and encrypted signals
- Cross-connection of clear-channel DS1s provide functionality for 1/1/0 cross-connection (or 3/1/0 with DS3 interfaces)
- 1-way, 2-way, and broadcast cross-connection for clear-channel DS1s
- Test access (with monitor and split modes) to clear-channel DS1s.

Additional Benefits Provided in Release 4.1

- IFTU (integrated facility-terminating unit) which moves all the FTU equipment into the same shelf assembly so that up to three FTUs can be placed in one flexible interface bay.
- Fully-flexible assignment of unit positions in a flexible interface bay; any type of unit (that is, IFTU, DS3U, or DSPU) can now be placed in any unit position.
- MBER (minor bit error rate) detection to provide a deferred maintenance alarm corresponding to error rates in the 2.048 Mb/s TS0 (time slot 0) FAS (frame alignment signal).
- The *SLC* 96 Carrier Mode I pass-through 5:4 protection arrangement (no protection line between DACS II and the digital switch) replaces the 5:5 protection. This feature eliminates the digital switch port and the protection facility between the DACS II and the digital switch.

Additional Benefits Provided in Release 5.0

CEF (Capacity Expansion Frame)

- Expands the cross-connect capacity from 6 to 16 peripheral units.
- Requires only 7 bays for full expanded termination and cross-connection capacity.
- Requires only 1 hard disk and 1 tape drive for nonvolatile memory backup for the entire frame.
- Provides an efficient alternative to the use of interframe ties to provide large DACS II installations.
- Offers lower DS0 termination cost compared to installing additional conventional frames and common equipment to increase capacity.
- Offers power and cost reduction over conventional non-CEF cross-connect network. Power consumption does not exceed 190 Watts per ECCN (expanded cross-connect network) shelf.
- Enhanced circuit pack diagnostics to check cabling between peripheral units and ECCN to maintain the integrity of the frame when unit equipment is added in the field.

Additional Benefits Provided in Release 5.1

Software Convergence for CEF and Non-CEF Hardware

- New Software is capable of distinguishing between and controlling both CEF and Non-CEF hardware.
- Simplifies ordering of future releases.

High-speed Enhanced Communications Interface

- Provides synchronous X.25 administration links capable of operating speeds up to 56 kb/s.

Provisionable XON/XOFF Snider Links

- Allows temporary suspension of DACS II output messages for controlled viewing of long output messages.
- Automatic timer to re-enable output messages, preventing an erroneous XOFF character from locking out messages indefinitely.

Provisionable ENQ/ACK Snider Links

- Provides the ability to disable the ENQ/ACK protocol on such links to avoid link performance degradation.

X.25 Feature Enhancements

- Provides support for several optional user facilities for Switched Virtual Circuits (SVCs).

Tape Use Counter

- After each disk to tape transfer, this counter enables maintenance personnel to determine if the backup tape is nearing the end of its reliable life.

Tape Cleaning Enhancement

- Allows the operator to activate the tape drive for cleaning when using the restore tape command.

Additional Benefits Provided in Release 6.0

Electromagnetic Compatibility (EMC) Compliance

Beginning with Release 6.0, DACS II is offered in two additional frame configurations, an EMC compliant Enclosed Capacity Expansion Frame (ECEF) and an EMC compliant Enclosed Single Bay Frame (ESBF). These frames are cabinetized versions of the DACS II Capacity Expansion Frame (CEF) and Single Bay Frame (SBF) measuring 600mm X 2200mm (23.6"x23.6"x86.6") per bay. Frame extensions are available to increase the height of the frame to 2600mm (102.3").

Enhanced DS1 Interface

An enhanced DS1 interface is provided in a new, software downloadable Enhanced Dual Digroup Card (EDDC) circuit pack (TG-191) that supports ANSI T1.403 and Bellcore TR-TSY-000820 Performance Monitoring (PM). This capability is also provided for DS1s embedded within DS3s through the use of the new Enhanced Multiplexer (EMXR) and Enhanced Multiplexer Interface Units (EMIU) circuit packs. In addition to the enhancements provided by the EDDC, EMXR and EMIU, these circuit packs support many of the Pre-Release 6.0 Network Processing Circuit (NPC) types.

DS1/DS0 In-Service Roll

The DACS II Release 6.0 DS0 and DS1 Roll feature provides a means to roll live service from one DS1 facility to another. Rearrangement of customer's networks can generate numerous service orders each month which frequently involve grooming of DS0s to maximize DS1 facility fill. The DS0 Roll feature allows rearrangement of DS0s or groups of DS0s with service "hits" of less than one millisecond per DS0.

The DS1 Roll allows rapid rearrangement of 24 DS0s or a Clear DS1 with service outages of less than 24 milliseconds per DS1. DS1 Roll can be used to quickly restore a channelized DS1 (24 DS0 channels) to full service in the event of facility degredation or failure.

The DS1 Roll also provides the ability to easily perform in-service replacement of a faulty Dual Digroup Card (DDC) or upgrade the DDC for a new release.

Nx64 Kbit/s Test Access (for 1.544 Mbit/s and 2.048 Mbit/s)

The DACS II Release 6.0 Nx64 Kbit/s test access feature allows customers to grow and reconfigure up to 400 Nx64 Kbit/s Test Groups (TGs) on DACS II. A TG is composed of two separate bundles of N 64 Kbit/s channels. Customers can gain Nx64 Kbit/s test access regardless of the service channel arrangement within the facility (i.e., the service channels may be contiguous, alternate, or random within the facility).

The Nx64 Kbit/s test access feature also allows customers to test Nx64 Kbit/s services with value of N ranging between 1 and 24 for DS1s and 1 and 31 for 2.048 Mbit/s interfaces.

Enhanced 2 Mbit/s Performance Monitoring

DACS II Release 6.0 provides enhanced 2Mbit/s performace monitoring. This feature requires the Enhanced Dual Primary Card (EDPC) circuit pack.

The DACS II EDPC circuit pack supports the following 2 Mbit/s loop backs:

- Facility Loop Back
- Equipment Loop Back

The 2 Mbit/s loop backs are initiated and terminated by user commands entered via the DACS II administrative links.

Clear 2 Mbit/s Cross-Connect and Test Access

DACS II Release 6.0 supports the following types of clear 2 Mbit/s functions:

- One-way, two point cross-connection

- Two-way, two point cross-connection
- One-way broadcast connection
- Two-way broadcast connection with switched or looped return

2 Mbit/s Time-Slot Zero (TS0) to non-TS0 Cross-Connect

The DACS II Release 6.0 TS0 cross-connect feature allows customers to cross-connect the TS0 spare bits to non-TS0 channels (i.e., TS 1-TS31) on 2 Mbit/s interfaces. This ability enables network management systems to connect to a DACS II 2 Mbit/s port to exchange provisioning and maintenance information with far end network elements.

Elaboration of Particular Feature Benefits

Fully Flexible Feature

Fully flexible refers to the flexibility of equipping each of the unit positions in the mounting bay with any type unit (IFTU, DSPU, or DS3U). This assignment flexibility was enabled by the introduction of the IFTU in Release 4.1. The IFTU integrates the control and powering plug-ins with the facility processing plug-ins in the same shelf assembly. One of the assignment possibilities of full flexibility realized with the IFTU is that all three unit positions of a bay can be equipped with IFTUs.

The bays which mount the peripheral unit equipment are called interface bays; an interface bay can either be the original interface or flexible interface type. Figure 1-1 shows the Release 4.1 frame configuration with bay 1 as the original interface bay and bay 3 as the flexible interface bay. This frame arrangement results when an existing DACS II 2-bay frame is grown to three bays by the addition of a flexible interface frame. shows the Release 4.1 fully flexible configuration with both bays 1 and 3 as flexible interface bays. Release 5.0 installations use only the flexible interface bays.

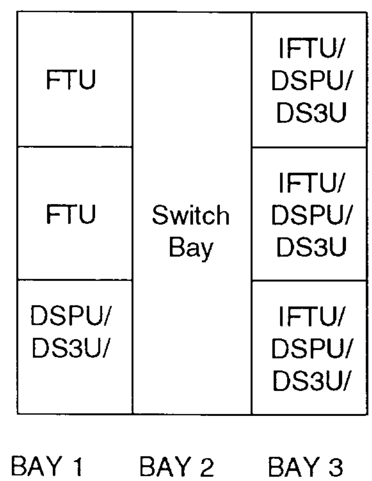

Figure 1-1. Release 4.1 Frame Configuration

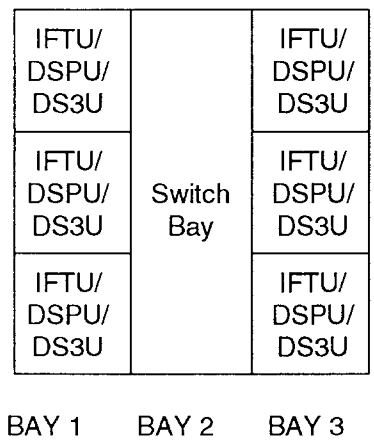

Figure 1-2. Release 4.1 Fully Flexible Frame Configuration

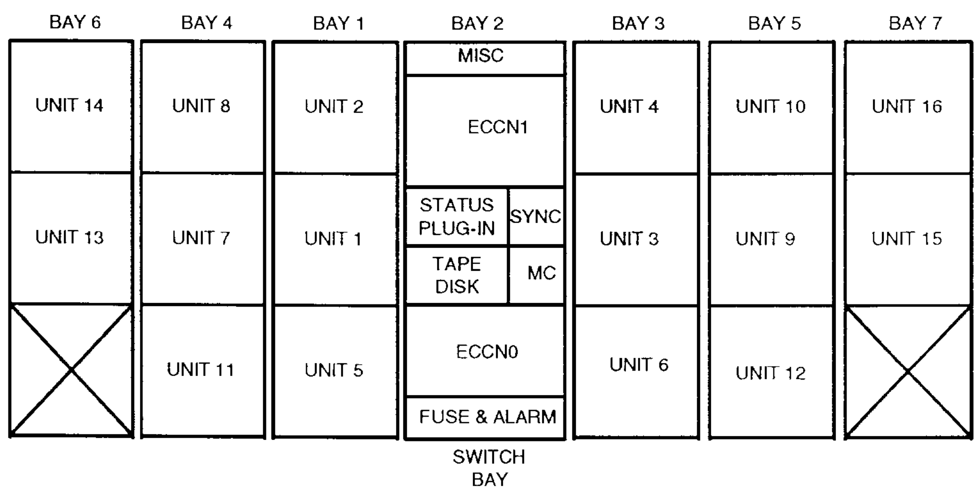

Figure 1-3. 7-Bay CEF Configuration

Capacity Expansion Frame

The CEF is designed to satisfy the needs of customers with large DACS II installations or large growth potential while still economically supporting smaller applications. The CEF better positions the DACS II in an environment with growing numbers of digital facilities and the growing list of feature options. Instead of adding more 3-bay DACS II frames for additional terminations and using interbay ties for connection to existing frames, the CEF can be installed. This frame provides the main controller and cross-connect capability for 16 peripheral units using only one common equipment switch bay. Equipment bays can be added to new CEF installations to reach an ultimate capacity of 7 bays for 16 units.

Central to the design of the CEF is the ECCN. Not only does the ECCN provide the expanded cross-connect capacity, but it represents a fundamental design improvement. This improvement in the network switching matrix allows a single ETSI (expanded time-slot interchanger) plug-in to connect each peripheral unit to every other unit in the frame. This design requires only 16 plug-ins per side. The CCN for the non-CEF frame required 6 TSIs to connect a peripheral unit to the 6 other units in the fully equipped frame; the design required 36 TSI plug-ins per side. The ECCN cross-connect network is duplicated for backup protection and is nonblocking to cross-connections.

Subrate Feature

When equipped with the subrate feature, DACS II can cross-connect, access for testing, and multiplex subrate (2.4-kb/s, 4.8-kb/s, and 9.6-kb/s) and 56-kb/s digital data channels. The Subrate feature offers the customer a modular system approach that minimizes the investment required to add digital data services to DACS II based networks. The Subrate feature is provided on plug-in circuit packs designed for use in the existing DACS II DSPU, and the flexibility to mix other DSP functions such as the digital multipoint bridge with the digital data functions is retained. This allows users to tailor the DACS II for the right amount of each function needed for their specific network applications.

The Subrate feature also allows customers to connect remote provisioning and maintenance operations support systems to the digital data equipment at the DACS II. This connection offers customers low operating expenses, improved service, and the opportunity for increased revenues through new services such as customer control.

Direct *SLC* Carrier Interfaces

The *SLC* carrier features provide a direct interface at DACS II for T1 lines from either *SLC* 96 carrier or *SLC* Series 5 carrier remote terminals. The channels from these remote terminal lines are then connected through DACS II to office equipment to provide the *SLC* carrier services while incorporating the benefits of DACS II. The DACS II provides *SLC* carrier alarm handling and facility protection switching so it can be placed in the route without altering the operation of the other equipment. For *SLC* 96 carrier, the direct interface supports both Modes I and III; for *SLC* Series 5 carrier, the interface supports Feature Package B with specials (also referred to as Enhanced Feature Package B) and FPC (special services only).

For *SLC* 96 carrier Mode I, mixed services (POTS and specials) residing on the same T1 line are brought to DACS II. Special service channels are packed and routed to the network, and the POTS channels are passed through the DACS II to the local digital switch. This interface allows integration of the Mode I systems carrying any number of both POTS and specials. DACS II also supports Mode I systems carrying special services only. DACS II terminates the *SLC* 96 carrier data link, packs the specials onto either DS1 or DS3 facilities, and routes the services to their destination. For the Mode III, the DACS II acts as a replacement for back-to-back COTs and D-channel banks. The Mode III facilities terminate directly on the DACS II, and the specials are routed to their destination in the network on either DS1 or DS3 facilities.

In the *SLC* Series 5 carrier FPC configuration, the DACS II connects nonlocally switched special service channels to network equipment in the office. Provisioning of the RT (remote terminal) channel units can be done over the facility data link with the Series 5 CIU (craft interface unit) connected at the DACS II. The DACS II continuously checks for discrepancies between the provisioning stored in it and the RT. The *SLC* Series 5 carrier FPB with specials interface supports the same functionality and feature set that the Mode I interface provides.

2.048 Mb/s Interface Feature

This feature allows DACS II to operate in telecommunication environments that are defined by CCITT for 2.048-Mb/s facilities.

The line signal rate and format described by the CCITT standards differ from the 1.544-Mb/s DS1 line standards. The line rate is 2.048-Mb/s, and the line format differs in the allocation of bits for signal framing and signaling. Furthermore, the technique used for encoding voice information into digital channels is the A-law type as opposed to the μ-law type used for DS1 signals. Signaling for the 64 Kb/s channels is carried in a single designated channel instead of in each channel at designated times as with robbed bit signaling used in most D-channel banks. This designated signaling channel is a true out-of-band method of signaling transmission.

Different facility plug-ins and and software provisioning produce the required line interface and signal format compatibility. These topics are discussed in Chapter 14.

DS3 Signal Termination Feature

This feature opens the DACS II to asynchronous DS3 signal connections. Up to six DS3s can terminate on a DS3 unit, and each DS3 can be grown as needed. With the modular DS3 unit equipment, the DS3 feature can be economically added for small-scale DS3 terminations, or with the flexible bay, the frame can be used to provide an alternative vehicle for substantial DS3 terminations. The cross-connections at the DACS II are done at the DS0 signal level so each incoming DS3 is demultiplexed to the constituent DS1s and DS0 channels. The constituent DS1s are individually monitored for facility performance just like direct DS1 terminations. The DS0 channels can be packed or groomed into other DS1 facilities by cross-connections. A clear DS1 is supported on the DS3 unit, thereby providing the functionality of a true DS3/DS1/DS0 system.

Software Release Features

2

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Software Release Features

2

2.2 Introduction

This chapter describes the DACS II features that have been provided through new software releases since the DACS II product was introduced. The basis for the DACS II operation is the core software which provides the control, maintenance, and cross-connect functions. This software is updated with each release to provide operational enhancements, and feature packages are offered to provide additional DACS II capabilities.

From its inception, the DACS II was designed to protect your short-term and long-term equipment investment. State-of-the-art technology with add-on capabilities is fundamental to the design. This design allows adding new software for future capacity and feature enhancements while maintaining standard interfaces, command languages, OS (operations system) compatibility, and reliability. As new feature packages become available, they will be offered in new software releases which retain the active features offered before and will include the operational enhancements made in previous releases as well.

DACS II is software-based and allows new features to be added quickly and easily in the future by downloading new software from a magnetic tape. Beginning with Release 5.0, new software loads are referred to as releases to be consistent with the terminology for switching equipment and other software-based equipment.

2.3 Release 1.0

This was the first release for DACS II and formed the core for future releases. Release 1.0 software offered the following features:

- 640 T1 facility termination capacity
- 1- and 2-way cross-connections
- DS0 broadcast capability
- Nonblocking at all levels of cross-connection
- Fast response times for all functions
- Multipoint bridging capability without loss of DS1 termination capacity
- D4, ESF, DMI/BOS, T1DM, and B8ZS format capability
- Software-based stored program control
- Maximum compatibility with existing OS interfaces
- Full performance monitoring and full test access.

2.4 Release 2.0

The next phase of the evolving DACS II system was the introduction of Release 2.0 software. Release 2.0 was introduced to add features to enhance the capabilities of the administrative links as well as the efficiency of provisioning circuits. These additional features are:

- DACS II synchronous protocol (X.25)
- MML (man-machine language) for administrative links
- Macro commands
- Alternate maps for rapid reconfiguration
- Command priority, login security, and message screening

These features offer the benefits gained through enhanced operation, administration, and performance monitoring. The X.25 protocol enhances the DACS II position in the evolving digital network by increasing the support capability from new operations system equipment. The MML feature enhances the user friendliness of DACS II through new commands and output formats. The administrative links can be individually provisioned for PDS (Program Documentation Standards) or MML. The alternate map and rapid reconfiguration features enhance network failure recoveries and offer new service and revenue-generating opportunities.

2.4.1 DACS II Synchronous Protocol (X.25)

The DACS II synchronous protocol feature is an optional DACS II administrative link interface intended to support operation, administration, and maintenance activities using the X.25 protocol. The hardware for this feature is the ECI (enhanced communications interface) which provides two synchronous links (5 and 6) and four asynchronous links. This synchronous protocol option can be retrofitted in the field by replacing the existing CI (communications interface) plug-in with the ECI plug-in.

The DACS II X.25 synchronous link feature supports simultaneous usage of up to 16 virtual circuits including PVCs (permanent virtual circuits) and SVCs (switched virtual circuits) on each administrative link. This X.25 capability enables multiple users to communicate over separate virtual circuits on the same physical interface. This translates into an increased administrative link capacity and, therefore, potential revenue-generating opportunities by enabling interconnection with outboard controllers for customer control services. Communication over the synchronous administrative link is synchronous and full duplex with data rates (externally timed) of up to 9600 bits per second.

2.4.2 MML (Man-Machine Language)

This command language is compliant with CCITT (International Telegraph and Telephone Consultative Committee) and Bellcore recommendations. Since Release 2.0, DACS II has offered both the MML and PDS message languages. The MML output messages give English language explanations of the error conditions in addition to giving the error code and message number. When the administrative links are established, the user selects the language if it is different from the default setting.

Both languages are supported by the on-line help (menu) mode of entering commands. This mode allows users to construct either the entire command or portions of the command using a step-by-step menu routine. The menu mode is invoked by entering a question mark at the administrative terminal and can be invoked at any point when entering commands and even when doing macro editing. Otherwise, the commands are entered directly for faster entry.

2.4.3 Macro Commands

The macro is a package of commands that are executed in sequence when the macro command is entered. As a result of the reduced input/output activity from the use of macro commands, users save time typing, reduce the probability of error, and speed up processing time. Macros can be created in PDS or MML.

There are two types of macros:

- ***Private:*** This is a macro created and executed only by its owner, but it can be deleted and queried by both its owner and the frame administrator.
- ***Public:*** This is a macro created by the frame administrator and accessible to all users. This macro can be deleted only by the frame administrator.

Any DACS II user that uses login access is permitted to create and execute macros unless otherwise restricted by the frame administrator. A macro name is assigned by the user at the time it is created. The macro name begins with a letter followed by an alphanumeric string.

Macros are initiated by a command which also allows the definition of variables in the macro. This use of the variable allows entering shortened macro component commands and allows specifying different channel terminations for the same macro package. Macros are deleted by another command.

2.4.4 Alternate Maps

The alternate map feature provides a means of rapidly making predefined simultaneous changes to the cross-connect configuration of a large number of circuits. Alternate maps can be created in PDS or MML. Only 2-point, 2-way TCON-type cross-connections can be included in alternate maps.

The alternate map feature is used for customer applications such as rapid service restoration following facility failure, for reference configurations, and for day/night reconfigurations. It may also have applications for load balance provisioning and circuit rearrangement activities.

Every DACS II user can create and use an alternate map unless otherwise restricted by the frame administrator. Execution of an alternate map is initiated by the user with the ACT command and the appropriate alternate map name. A user may delete an existing alternate map by executing the DLT command with the appropriate map name.

2.4.5 Command Priority, Login Security, and Message Screening

The I/O priority feature enables the user to specify the priority of execution of commands in the DACS II input command queue based on a priority list of action verbs. Command priority applies to input commands only and is handled on a per-link basis.

The screening feature enables output messages to be screened on a per-link or per-user basis. This allows a given user/link to receive only those output messages required by that user/link.

The security feature is a login/password capability that can be used to prevent unauthorized access to the main controller or to permit users with different access permissions onto the same link.

Priority, screening, and security are all user-settable options that can be optionally applied in accordance with the practices and procedures of the users' company.

2.5 Release 3

Release 3 offers all the features of Release 2 software with enhancements that resulted from the implementation of user requested modifications and expands the capabilities with feature packages. These features address some of the most demanding network needs in today's digital transmission environment. The expanded capabilities offered by Release 3.0 not only enhance its capabilities but also make DACS II compatible in the world market place. There were three major point releases to Release 3 which are outlined below:

2.5.1 Release 3.1 Features

- *SLC*® 96 Carrier Mode III Direct Interface
- Subrate Data Capabilities
- Basic 2.048 Mb/s Interface.

2.5.2 Release 3.2 Features

- *SLC* 96 Carrier Mode I pass-through to *5ESS*® digital switch
- *SLC* Series 5 carrier FPC (feature package C) Direct Interface
- Use of *SLC* Series 5 carrier craft interface unit for remote provisioning of Series 5 channel units
- Gateway (2.048 Mb/s plus DS1 terminations)
- Enhanced 2.048 Mb/s (includes basic 2.048 Mb/s plus additional capabilities for specific applications).

2.5.3 Release 3.3 Features

- *SLC* 96 Carrier Mode I pass-through to a *DMS** 100 switch
- Introduction of ZBTSI (zero byte time slot interchange) method of providing DS1 zero code suppression (that is, prevents low density of 1s on the line)
- Supports the use of TG186 plug-in to provide ZBTSI on lines using the ESF signal format
- New TG80B plug-in that replaces TG80 plug-in to provide improved zero code suppression on ESF lines and more economical termination for nondata link *SLC* 96 carrier digroups.

These features are offered in software packages that are loaded on tape at the time of manufacture to match customer orders. This feature packaging allows customers to order only the features that they desire, and in so doing they only buy the features they want. The features are discussed in the paragraphs that follow.

2.5.3.1 Direct *SLC* 96 Carrier and *SLC* Series 5 Carrier Interfaces

The *SLC* carrier features of Release 3 provide a direct interface at DACS II for T1 lines from *SLC* 96 carrier and *SLC* Series 5 carrier remote terminals. This is a direct interface without the previously needed SLIM (subscriber loop interface module). The channels from these remote terminal lines are connected through DACS II to office equipment to provide various *SLC* carrier services while incorporating the benefits of the DACS II. For *SLC* 96 carrier, the direct interface supports both the Mode I and Mode III configurations and services; and for *SLC* Series 5 carrier, the interface supports FPB (feature package B) with specials and FPC (special services only).

Operation in the *SLC* carrier environment required hardware and software design work to support the feature. The software enables: (1) protection switching, (2) addressing all 96 channels from different *SLC* carrier digroups on digroup A in commands, (3) provisioning of the *SLC* Series 5 carrier RT channel units from DACS II with the craft interface unit, and (4) auditing of the Series 5 provisioning in the near- and far-end data bases for discrepancies. The protection switching is accomplished at DACS II by automatically cross-connecting channels from a failed line to the standby protection line. The hardware provides: (1) the compatible DS1 line format for connecting *SLC* carrier equipment, (2) *SLC* carrier alarm handling and data link communications, (3) 9-state signaling for coin telephone circuits, (4) facility performance monitoring, and (5) line signal loopback capabilities.

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* DMS is a registered trademark of Northern Telecom.

2.5.3.2 Subrate Data Capabilities

The DACS II Subrate data feature allows access to subrate data channels (2.4, 4.8, and 9.6-kb/s) for multiplexing, bridging, and testing. This subrate capability adds to the existing 56-kb/s data cross-connect capability. Two circuit packs for the DACS II provide the multiplexing or bridging functions; the testing is a natural result of the cross-connect capability. The SRM (subrate multiplexer) plug-in provides subrate data multiplexing and error correction. It multiplexes incoming DS0A formatted digital data channels into DS0B formatted data channels and provides dataport error correction for efficient transport over interoffice facilities. The MJU (multipoint junction unit) performs digital data multipoint junction unit bridging of DDS (Digital Data System) and 56-kb/s data and provides dataport error correction for that data. These two circuit packs provide the essential functions required to configure, maintain, and administer digital data networks. The following is a list of the benefits derived from the Subrate Data capabilities of DACS II:

- Reduces or eliminates external subrate multiplexing and multipoint junction unit equipment
- Supports subrate data capabilities without reducing the DS1 processing capacity
- Provides full error correction capabilities for reliable end-to-end data transmission
- Offers flexible and powerful subrate processing capabilities in a single DACS II frame
- Provides flexible provisioning capabilities
- Provides flexible reconfiguration capabilities
- Allows for flexible allocation of subrate data capabilities and capacity by mixing and matching SRM and/or MJU circuit packs.

2.5.3.3 2.048 Mb/s Interface

This feature enables 2.048-Mb/s lines to be terminated at the DACS II for cross-connections. The hardware for the interface is a DPC (dual primary circuit) which contains the circuitry to terminate two 2.048-Mb/s lines. This 2.048-Mb/s interface is a CCITT-defined standard. The transmitted signal contains 32 channel time slots per transmitted frame which are assembled according to the CCITT specifications. Each of the 32 channels is a 64-kb/s time slot. Time slot 16 of the signal can be used to carry bit-oriented signaling associated with the other 30 message channels if the facility has been provisioned for CAS (channel associated signaling). Time slot zero is used to carry signal framing and alarm information.

DACS II provides the same basic functions for the 2.048 Mb/s interface that it provides for the current 1.544-Mb/s facility interface. It rearranges channels emanating from 2.048-Mb/s facilities, conveys the associated bit-oriented signaling throughout the network, provides test access to 2.048 Mb/s facilities, and supports network control via administrative links. DACS II also provides a host of performance monitoring and maintenance functions to ensure accurate service transport.

An enhanced version is available which supports specific 2.048-Mb/s applications in the 2.048-Mb/s environment. Enhanced 2.048 Mb/s offers additional capabilities to do C-bit processing and to utilize spare bits in time slot zero.

2.5.3.4 Gateway

Gateway refers to making connections between DS1 and 2.048-Mb/s lines which in some cases form the communications gateway between countries and nations. The gateway feature for DACS II allows the termination of both 1.544-Mb/s and 2.048-Mb/s facilities on the same DACS II frame and provides the signal translations for cross-connections between the two disjoint facilities.

The DACS II performs μ-law and A-law PCM (pulse code modulation) encoding translation, provides signaling conversion between domestic robbed bit and the international abcd bit signaling, and performs point-to-point as well as point-to-multipoint DS0 cross-connections. In addition, the DACS II provides a host of performance monitoring and maintenance functions for efficient and effective facility translation and transmission.

2.6 Release 4

This release offers all of the additional features of Release 3 with enhancements that resulted from implementation of user modification requests and offers new features. These features are outlined in the following list and are described in the following paragraphs.

2.6.1 Release 4.0 Features

- Introduction of the flexible bay concept which means the flexible assignment of peripheral units in flexible interface bays for DS1 or 2.048 Mb/s terminations, DS3 terminations, or digital signal processors
- Asynchronous DS3 signal termination in a DS3U type unit
- Enhanced interface unit capability for use of ESF data link in constituent DS1 signals in the DS3 signal
- Clear-channel (full, unframed) DS1 signal cross-connection and test access
- Expanded video teleconferencing commands and capabilities
- *SLC* Series 5 carrier Feature Package B with specials direct interface

- MBER (minor bit error rate) calculation for DMA (deferred maintenance alarm) and extended SFDT (signaling freeze delay time) for 2.048 Mb line terminations.

2.6.2 Release 4.1 Features

- Fully flexible frame configuration
- IFTU (integrated facility terminating unit)
- Programmable AIS (alarm indication signal) alarm
- Eight-character user identifier
- DS1 facility performance alarm enchancements - out-of-frame and change of frame alignment counters
- *SLC* 96 Carrier Mode I pass-through 5:4 protection arrangement
- 2.048 Mb/s feature enhancements.

2.6.2.1 Integrated Facility Terminating Unit

The IFTU (integrated facility terminating unit) mounts the facility terminating modules and all the associated unit control and power plug-ins in the same shelf assembly.

2.6.2.2 Flexible Bay Arrangements

The flexible bay arrangements are described in Chapter 7. Briefly outlined, this feature offers the customer flexibility in the assignment of unit types (IFTU, DSPU, or DS3U) placed in the flexible interface bay. This removes the restriction of only using units 5 and 6 as DSPUs as in original interface bay arrangements and allows filling the frame with all the same type units if desired. In Release 4.0, the flexible interface bay could only be used in bay 3 of a frame, which allowed the use of the equivalent-sized DSPU (digital signal processing unit) or DS3U equipment in any of the units. The original interface bay was used if FTUs were required. In Release 4.1, both bays 1 and 3 can be flexible and a fully-flexible arrangement is possible. The IFTU provides the hardware to move all the FTU equipment into the same shelf assembly which enables using 3 IFTUs in the unit positions of the flexible interface bay.

2.6.2.3 Programmable AIS Alarm

The programmable AIS alarm feature in Release 4.1 allows the user to select how the receipt of an AIS on a DS1 termination is reported (minor alarm, major alarm, or information message). This selection is made when the NPCs are grown or subsequently with a change command.

2.6.2.4 DS3 Signal Termination

The DS3U hardware allows terminating up to six asynchronous DS3 signals in a unit. These signals are demultiplexed into DS1 and component DS0 signals for connection to the cross-connect network. For each DS3 signal, the equipment can be provisioned for DS3 signal formats (C-bit parity and M13) that are compatible with existing DS3 equipment and DACS III-2000 and DACS IV-2000 equipment. The DS3U functional and hardware descriptions are furnished in Chapters 6 and 7.

2.6.2.5 DS1 Clear-Channel Connections

The software allows the NPC equipment to be provisioned for clear-channel use so that full bandwidth DS1 signals (193 bits) can be cross-connected in the DACS II. When provisioned for clear DS1s, the DS1 framing and 24-channel numbering format are not used. These clear DS1 channels are desirable for applications where extended bandwidth transmissions are required such as for encrypted data. Cross-connection of the clear DS1 produces a 1/1/0 functionality in the DACS II, and when DS1s on a DS3 are grown as clear DS1s, cross-connection results in a 3/1 functionality. The 1/1/0 functionality refers to the ability to cross-connect full DS1s or DS0 channels, and the 3/1 refers to connecting all the DS1s of a DS3 to other DS1s. The functionality for DS3 becomes 3/1/0 when the DS0 connections are considered. No new DACS II plug-in is required to terminate a clear-channel DS1 signal; new growth options for the NPC are supported by the software.

2.6.2.6 Direct *SLC* Series 5 Carrier FPB With Specials Interface

Like the *SLC* carrier features offered in Release 3, this is a direct interface at the DACS II without the need for any intervening module (such as SLIM). In the FPB w/S configuration, the DACS II connects the POTS channels directly to the digital switch and routes the special service channels to the network. This interface at the DACS II provides the benefits of replacing the central office terminal, providing digital channel pass-through to the switching equipment, and grooming the specials. The FPB w/S configuration is like the *SLC* 96 carrier Mode I configuration, but it includes the use of the newer, more compact Series 5 RT equipment.

2.6.2.7 Minor Bit Error Rate and Extended Signaling Freeze

These features are incorporated at the request of international customers with leased line applications. The MBER feature allows the NPC on a new TG187 circuit pack to be provisioned to calculate bit error rate, declare a deferred maintenance alarm (DMA), and optionally send a MBER remote indication upstream on the facility. The extended signaling freeze delay time (SFDT) introduces a delay of 2496 ms before overwriting signaling with consequent action codes when a facility problem is detected, and an extended delay before clearing the consequent action.

2.6.2.8 *SLC* 96 Carrier Mode I Pass-Through 5:4 Protection

This feature is intended to provide a cost effective interface that promotes maximum compatibility between DACS II and TR-08 digital switches. The new arrangement, known as the 5:4 protection switching, supports both the *SLC* 96 carrier Mode I and *SLC* Series 5 carrier Feature Package B with Specials applications. The 5:4 nomenclature refers to the five digroups interfacing to DACS II on the access side of the interface (four primary lines plus one protection line) and the four digroups interfacing to the digital switch on the office side of the interface (four primary lines). This architecture replaces the previous 5:5 architecture for Mode I or FPB w/S RTs interfacing to DACS II. Because the 5:4 architecture replaces the previous 5:5 arrangement, Release 4.1 allows customers to roll service from 5:5 architecture to 5:4 architecture. If the RT is not optioned for protection (for example, the RT resides in a fiber environment), the 4:4 pass-through architecture is used. The new 5:4 architecture alleviates the restriction requiring a protection line between the DACS II and the digital switch if there is a protection line between the RT and the DACS II. This new arrangement reduces the number of required digital switch ports and intra-office facilities.

2.6.2.9 *SLC* 96 Carrier Mode I and Feature Package B With Specials Interface

This feature allows *SLC* 96 carrier Mode I or *SLC* Series 5 carrier FPB w/S RTs equipped with specials only to terminate on DACS II. Because there are no locally switched services on the line, there is no switch in this application. DACS II communicates with the RT similar to the way it does in the pass-through configuration, and the specials are packed and routed to the network. This application of the DACS II *SLC* carrier interface provides a cost effective alternative to a central office terminal or SLIM configuration in the office.

2.6.2.10 Eight-Character User Identifier

Release 4.1 allows the specification of a user identifier of two to eight alphanumeric characters and outputs the user identifier (also two to eight alphanumeric characters) as part of the output data. Prior software allowed only six alphanumeric characters for the identifier.

2.7 Release 5.0

This release offers all of the features of Release 4 and provides the software to operate the CEF (capacity expansion frame). The additional capabilities of Release 5.0 are listed below and described in the associated paragraphs.

- Supports the capacity expansion frame.

2.7.1 Capacity Expansion Frame

The CEF includes an expanded main controller and expanded CCN to provide the additional termination and cross-connect capacity required for 16 peripheral units. The expanded main controller includes new plug-ins with greater circuit pack memory and a new hard disk and tape drive with the memory capacity to serve the entire frame. The ECCN includes new circuit packs for expanded cross-connect capacity and represents a fundamental design improvement. This improvement is in the network switching matrix which allows a single ETSI (expanded time slot interchange) circuit pack to connect a peripheral unit to every other unit in the frame. Further descriptions of the functioning and advantages of the ECCN are covered in other Chapters of this document.

2.7.2 Cabling Tests and Enhanced Circuit Tests

When the CEF is initially partially equipped and grown by the addition of bays and units in the field, the hardware will be added and connectorized cables installed. This is done without removing any existing service from the frame. To facilitate this growth and maintain the integrity of the frame, cabling tests have been added to the diagnostic tests of peripheral unit plug-ins (FC, FMT, and DSP). These tests detect any wiring problems in the added connections between the peripheral unit and the ECCN prior to service turn-over of the added equipment.

2.8 Release 5.1

This software release supports software convergence for CEF and non-CEF hardware. This enables the capability to distinguish between and control both CEF and non-CEF hardware. This also simplifies ordering of future releases.

Release 5.1 is fully compatible with today's CCN as well as the ECCN. By upgrading to this release, customers can benefit from new features and maintain the same software release throughout their entire network of embedded single bay, 2/3 bay, and CEF DACS IIs. DACS IIs operating with Release 4.1 (or any previous release) can be upgraded to this release. Hardware upgrade of the main controller is necessary to load the software on existing systems.

2.9 Release 6.0

2.9.1 Enhanced DS1 Interface

An enhanced DS1 interface is provided in a new, software downloadable Enhanced Dual Digroup Card (EDDC) circuit pack (TG-191) that supports ANSI T1.403 and Bellcore TR-TSY-000820 Performance Monitoring (PM). This capability is also provided for DS1s embedded within DS3s through the use of the new Enhanced Multiplexer (EMXR) and Enhanced Multiplexer Interface Units (EMIU) circuit packs. In addition to the enhancements provided by the EDDC, EMXR and EMIU, these circuit packs support many of the Pre-Release 6.0 Network Processing Circuit (NPC) types.

2.9.2 DS1/DS0 In-Service Roll

DACS II Release 6.0 DS0 and DS1 Roll feature provides a means to roll live service from one DS1 facility to another. Rearrangement of customer's networks can generate numerous service orders each month which frequently involve grooming of DS0s to maximize DS1 facility fill. The DS0 Roll feature allows rearrangement of DS0s or groups of DS0s with service "hits" of less than one millisecond per DS0.

The DS1 Roll allows rapid rearrangement of 24 DS0s or a Clear DS1 with service outages of less than 24 milliseconds per DS1. DS1 Roll can be used to quickly restore a channelized DS1 (24 DS0 channels) to full service in the event of facility degredation or failure.

The DS1 Roll also provides the ability to easily perform in-service replacement of a faulty Dual Digroup Card (DDC) or upgrade the DDC for a new release.

2.9.3 Nx64 Kbit/s Test Access (for 1.544 Mbit/s and 2.048 Mbit/s)

The DACS II Release 6.0 Nx64 Kbit/s test access feature allows customers to grow and reconfigure up to 400 Nx64 Kbit/s Test Groups (TGs) on DACS II. A TG is composed of two separate bundles of N 64 Kbit/s channels. Customers can gain Nx64 Kbit/s test access regardless of the service channel arrangement within the facility (i.e., the service channels may be contiguous, alternate, or random within the facility).

The Nx64 Kbit/s test access feature also allows customers to test Nx64 Kbit/s services with value of N ranging between 1 and 24 for DS1s and 1 and 31 for 2.048 Mbit/s interfaces.

2.9.4 Enhanced 2 Mbit/s Performance Monitoring

DACS II Release 6.0 provides enhanced 2Mbit/s performace monitoring. This feature requires the Enhanced Dual Primary Card (EDPC) circuit pack.

The DACS II EDPC circuit pack supports the following 2 Mbit/s loop backs:

- Facility Loop Back
- Equipment Loop Back

The 2 Mbit/s loop backs are initiated and terminated by user commands entered via the DACS II administrative links.

2.9.5 Clear 2 Mbit/s Cross-Connect and Test Access

DACS II Release 6.0 supports the following types of clear 2 Mbit/s functions:

- One-way, two point cross-connection
- Two-way, two point cross-connection
- One-way broadcast connection
- Two-way broadcast connection with switched or looped return

2.9.6 2 Mbit/s Time-Slot Zero (TS0) to non-TS0 Cross-Connect

The DACS II Release 6.0 TS0 cross-connect feature allows customers to cross-connect the TS0 spare bits to non-TS0 channels (i.e., TS 1-TS31) on 2 Mbit/s interfaces. This ability enables network management systems to connect to a DACS II 2 Mbit/s port to exchange provisioning and maintenance information with far end network elements.

Applications

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Applications

3

Introduction

This chapter describes how DACS II can be used. The functional advantages of DACS II permit easier management of today's network through the applications discussed below. If you need additional information about any of the applications listed, see your local account representative.

Consolidation and Segregation (Grooming) of Digital Facilities

DACS II can be used to provide maximum efficiency of digital carrier facilities. It allows you to segregate and concentrate services without

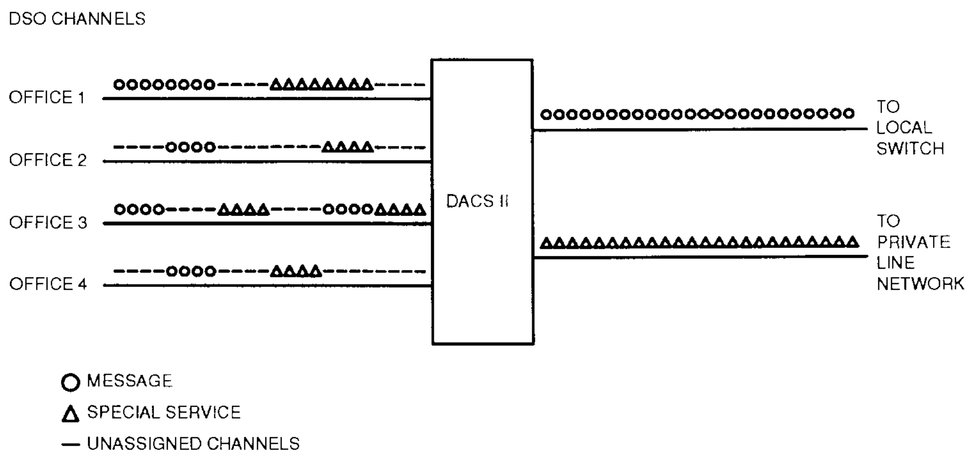

Figure 3-1. Consolidation and Segregation of Digital Facilities

Segregation, or grooming, is the separation of message service channels from special service channels. Segregation permits direct cabling to staging areas and eliminates the need for IDF (intermediate distribution frames). Consolidation, the collecting of channels together for increased fill on terminals and lines, reduces the number of lines and terminals you need. Service segregation and consolidation are done electronically within DACS II, thus eliminating the need for back-to-back channel bank configurations.

Back-to-Back Channel Bank Replacement

In both end offices and intermediate offices, DACS II replaces back-to-back channel banks used to provide consolidation for special services Channel connections are completely digital; there is no digital-to-analog-to-digital signal conversion with its accompanying signal degradation. Intermediate distributing frames are eliminated along with their cabling and wiring. The OS (Operations System) interfaces are centralized on DACS II. Channels can be provisioned and accessed for testing from a remote location.

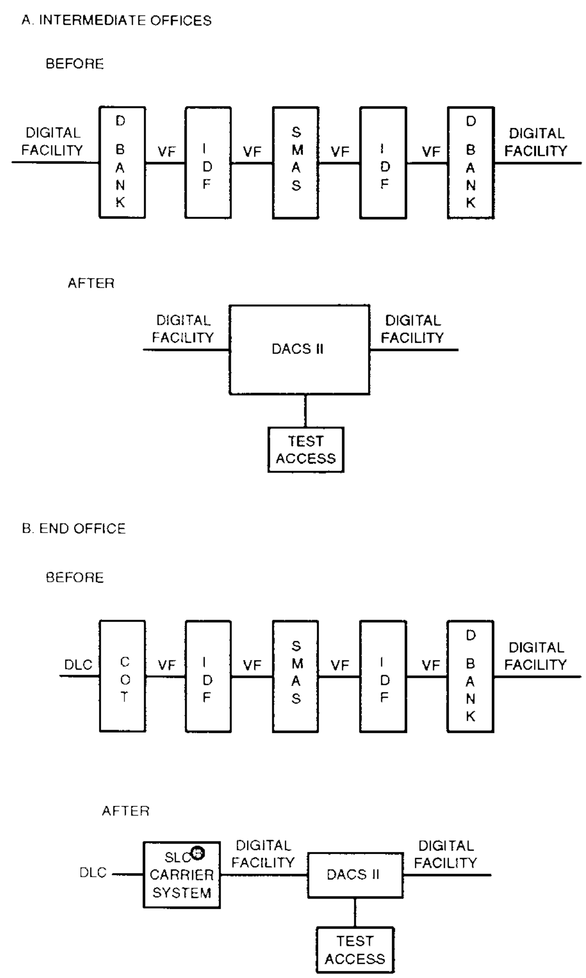

Figure 3-2. Back-to-Back Channel Bank Replacement by DACS II

Integrated Network Access

Many businesses are taking responsibility for providing their own communications services. They are installing digital PBXs, local network facilities, and other communications equipment on their premises. A variety of services can be integrated into one common digital bitstream and delivered in bulk to the telecommunications network. Delivery of these customer services is over wideband digital loop facilities as shown in

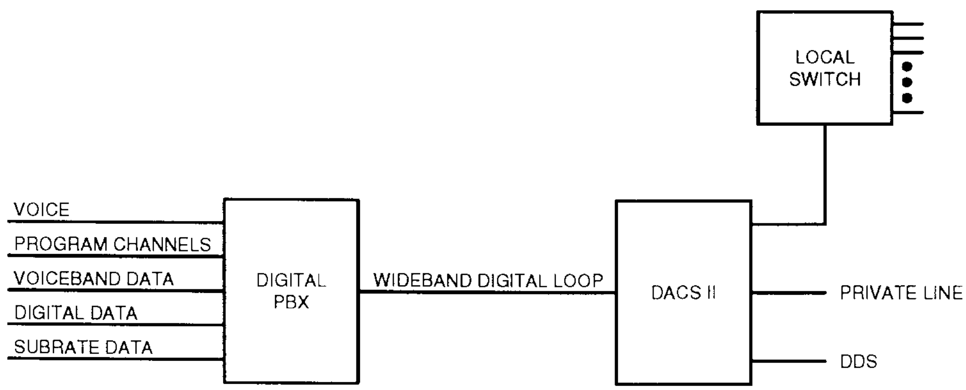

Figure 3-3. DACS II Integrated Customer Interfaces

DACS II provides an excellent interface between the digital facilities from the customer and the telecommunications network. It continually monitors facilities for proper performance and provides individual service cross-connection and test access. DACS II can also serve as a timing reference for digital PBXs at the customer premises.

Hubbing

Hubbing is the routing of each branch of a network to a common central point, a hub, for appropriate cross-connection and test access. Hubbing offers significant advantages over point-to-point routing in which each office in the network is directly connected to all the other offices. DACS II is an excellent vehicle for a hubbing network.

The DACS II hubbing concept results in a flexible network that is less expensive, easily administered, and highly responsive to new service needs.

Point-to-point networks Service forecasting and facility engineering must be done point-to-point. If the circuit capacity needed between offices does not exist, circuits must be routed through one or more intermediate offices, often on an expensive back-to-back channel bank basis.

Since point-to-point networks are not flexible, a high level of extra service capacity, or margin, must be planned for and maintained to meet unforeseen demand. This results in a high circuit overhead and inefficient use of transmission facilities.

DACS II simplifies circuit routing when it is used in a network hub between offices, circuits are placed on these direct routes until capacity is exhausted. Additional circuits are then routed through the hub via DACS II. If direct capacity does not exist, circuits are initially routed through the DACS II hub.

DACS II improves the efficiency of your facilities. Small cross-section point-to-point circuits can be consolidated on hub routes, improving facility fill. Network margin requirements can also be collected on hub routes, reducing the costly overhead of providing for forecast uncertainty.

DACS II easily accommodates network growth. When the number of circuits routed through a DACS II hub reaches a certain level, a new direct carrier system between the two points can be brought into service. This direct facility is used for new growth. Circuits routed through the DACS II hub can also be moved to the direct facility, increasing its fill and freeing circuit capacity on the hub route.

Hubbing Networks

The advantages of DACS II hubbing can be extended to larger networks such as the one shown in digital routes are installed between certain offices. Other circuits are routed to a regional hub, called a primary cluster point, which provides interconnection within that region as well as intra-LATA (Local Access Transport Area) cross-connections. Hubs in the network are often interconnected by high capacity digital routes.

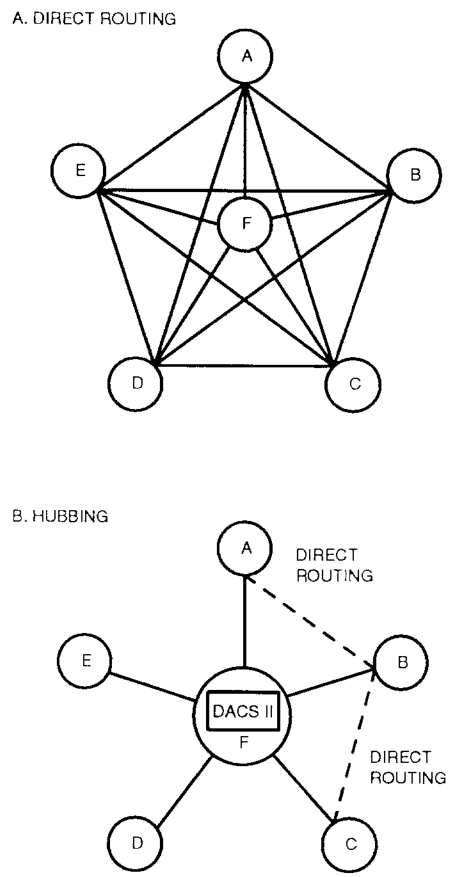

Figure 3-4. Hubbing

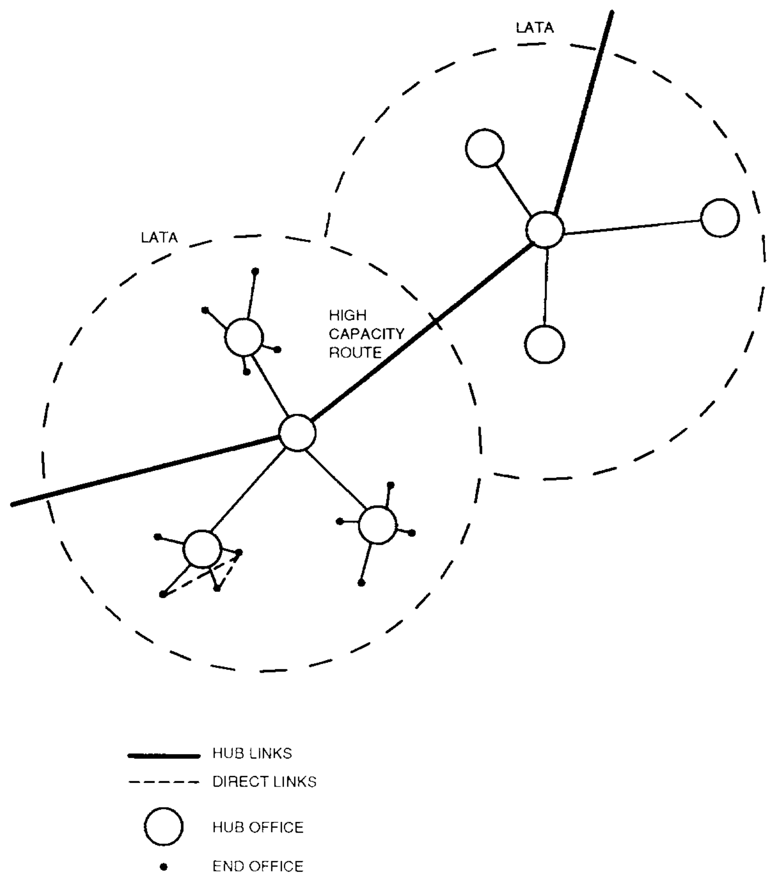

Figure 3-5. Hub Network

The hubbing network is easy to manage and control. As a hub vehicle, DACS II provides the required digital cross-connect, test access, and facility maintenance capabilities. DACS II's ability for remote operation enables centralized provisioning, testing, and monitoring for the entire network.

Digital Switch Cutover

The cutover of a local digital switch can be complicated. Cutover requires segregation (grooming) of message and special service circuits and the transfer of circuits from the old switch to the new. Initially, nonswitched special services cannot terminate directly on a local digital switch and must be segregated from message services. Without DACS II, these circuits must be cut over manually on a channel-by-channel basis requiring the addition of message trunks to each office

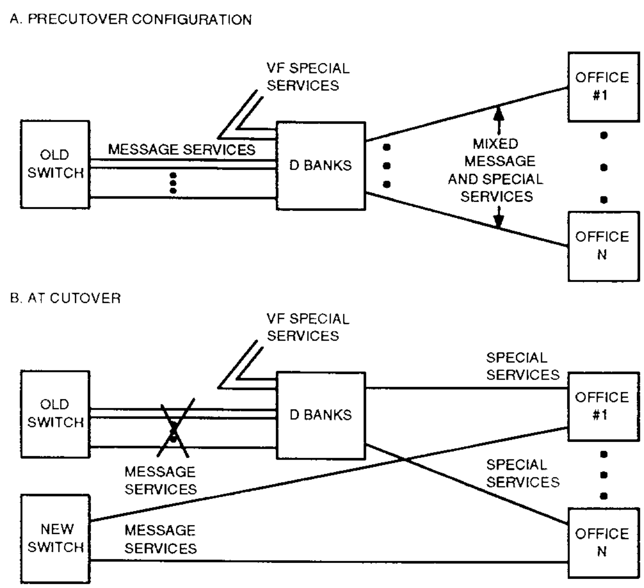

Figure 3-6. Local Digital Switch Cutover Without DACS II

DACS II-assisted cutover of a local digital switch

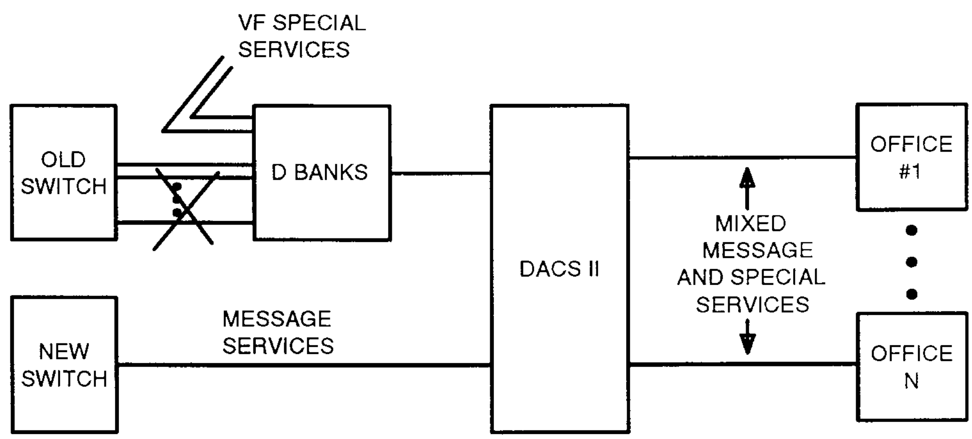

Figure 3-7. Local Digital Switch Cutover With DACS II

DACS II simplifies precutover testing. It can electronically move individual message circuits onto the local digital switch, test them, and return the circuits to the old switch. The cost of building excess facilities that remain surplus is saved.

DACS II allows you to segregate services electronically. Circuits not being moved to the new switch, special service circuits for example, are not disrupted. No extra message trunks are needed for each far-end office.

Circuit cutover with DACS II is electronic. Circuits are switched quickly. Individual circuit reconnections occur almost instantaneously, and cutovers can be reversed quickly if necessary by restoring original DACS II cross-connections.

With DACS II remote control capability, the cutover process can be coordinated from a single office.

After cutover, you continue to benefit from DACS II. Its electronic cross-connection, test access, and monitoring and remote control capabilities promote a flexible network.

DCS to DACS II Cutover Tool

The DACS (and equivalent digital cross-connect equipment from various vendors) is being retired from use in favor of the DACS II with its larger capacity and additional features. To expedite cutover, AT&T offers a cutover service using a PC cutover software tool to transfer the cross-connections to the DACS II. This service offers smooth cutover both in flash cuts (using only DSX-1 patching) and DACS II supported cuts. The cutover software works with various vendor equipment and different types of cross-connections, including multipoint bridge and subrate data. With a PC connected to an administrative port, the operator uses the cutover software to extract the DACS data base maps and formulate the required commands to reproduce the cross-connections at the DACS II. The PC and software tool then generates the commands which are sent on a DACS II administrative link. This method of transferring the cross-connections saves considerable time and effort and enables quicker transition to the physical cutover.

SLC® Carrier Direct Interface Applications

If your company is deploying *SLC* 96 carrier, *SLC* Series 5 FPBw/Specials, or *SLC* Series 5 carrier systems, DACS II can be equipped to serve as an economical interface between the *SLC* carrier remote terminals and the central office.

The direct *SLC* 96 carrier interface can operate in either Mode I (mixed services mode) or Mode III (special services mode). Without DACS II, there are two basic Mode I configurations

- Universal *SLC* 96 carrier services — T1 lines from RTs (remote terminals) are terminated on the COT (central office terminal).
- Integrated *SLC* 96 carrier services — T1 lines from an RT are terminated on a digital switch. Special service channels are either segregated at the RT or nailed up at the switch. RT segregation requires wiring changes at field locations. Switch nail up increases blockage at the switch and makes the OA&M (operation, administration, and maintenance) of special circuits unavailable.

direct *SLC* carrier interface eliminates all the intermediate equipment between the RT (remote terminal) and the local switch for POTS circuits and between the RT and office equipment for special service circuits. The *SLC* 96 carrier Mode I interface is shown in this figure, but the same type of interface is provided for *SLC* Series 5 carrier equipment with the FPB (feature package B) interface. *SLC* 96 carrier Mode III configuration and the direct interface at DACS II for Mode III and *SLC* Series 5 carrier FPC. The elimination of intermediate equipment with the direct *SLC* carrier interface of DACS II reduces capital outlays and depreciation expenses, reduces operating expenses, and increases network flexibility by providing end-to-end digital connectivity.

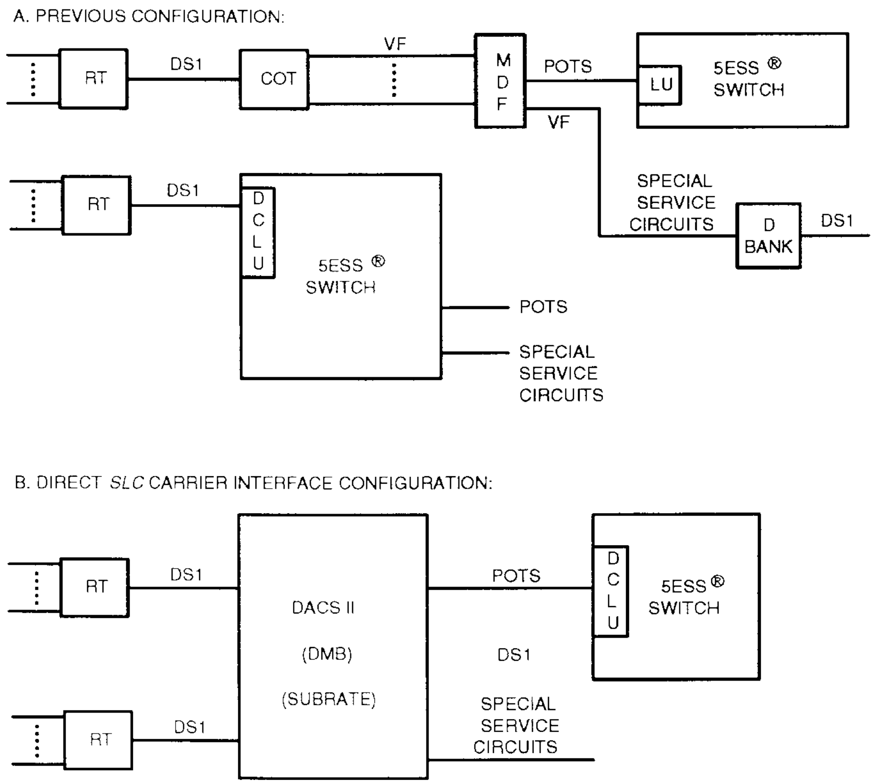

Figure 3-8. ***SLC*** **96 Carrier, Mode I Interface**

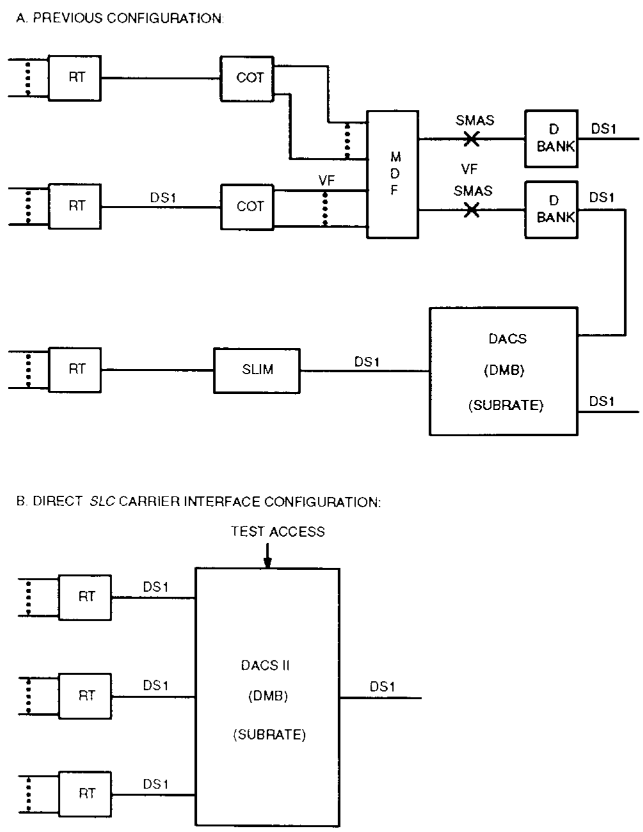

Figure 3-9. ***SLC* 96 Carrier, Mode III Interface or *SLC* Series 5 Carrier FPC Interface**

DS3 Signal Termination

The DS3 termination at the DACS II conforms to the ANSI standards and, as such, allows various DS3 equipment to be connected to the DACS II without any intervening DS3 equipment. Including the DACS II in the DS3 routing expands the capabilities in the office because the DACS II offers a variety of DS0 channel cross-connections, test access modes, and channel processing such as bridging, conference broadcasting, and subrate data processing. In addition, the DACS II offers connection to DS1 lines with specialized line formats for line formats from *SLC* 96 carrier or *SLC* Series 5 carrier equipment and the Digital Data System. When the DACS IV-2000 connects to the DACS II, the DS1 signal rearrangements and routing are done at the DACS IV-2000, and all required DS0 channel processing is done at the DACS II. The connection to DACS II is over coaxial cable and is cost-effective because the selected DS1s are concentrated into dedicated connecting DS3 signals and no intervening DS3 terminal equipment is needed. With the DACS III-2000, all the DS3 facilities are collected and routed at the DACS III-2000 while the DACS II performs DS1 signal monitoring and all required DS0 signal processing.

For C-bit parity framed DS3 signals, the DACS II performs performance monitoring and transmits performance information on outgoing C-bit parity data bits to far-end DS3 equipment. The performance monitoring consists of both detected errors and Types A, B, and C errored seconds, and the performance information includes FEBE (far-end block error) and X-bit data counts. This transmitted information gives far-end DS3 equipment (with C-bit parity capabilities) information on CP-bit errors and OOF/AIS occurrences.

The DS3 termination feature of the DACS II also enables connection to lightwave systems. This capability increases the connection possibilities and flexibility within an office, particularly in small end offices (or at customer premises installations) with limited transmission equipment. The DS3 signals can connect to the following lightwave transmission equipment: DDM-1000, DDM-2000, and FT Series G. With the DDM-1000, the DS3 signal connects to low-speed interfaces (DS3U1 or DS3U2) and eliminates the need for additional DS1 low-speed interfaces at the DDM-1000. The DS3U1 interface is for use with C-bit parity framed DS3 for performance monitoring. With the DDM-2000, the DS3 signal is connected to the SONET (synchronous optical network). With the FT Series G, the DS3 signal connects to the low-speed side of the multiplexer and eliminates the need for an intervening multiplexer such as the DDM-1000.

Cellular Systems

Cellular radio is a burgeoning enterprise throughout telephony. Traditionally, the telecommunication systems to support cellular were limited to the cell site and MSC (mobile switching center) equipment and leased facilities, but the concept has grown to include the benefits of other transmission equipment. The DACS II lends itself well to this changing system environment because it allows rapid changes and service grooming. The DACS II capabilities also allow packing of channels into DS1 signals for maximum utilization of existing terminal equipment and facilities. This optimum utilization ensures better cellular service. Collocated with the MSC, the DACS II is used to groom the incoming DS1s and to more effectively utilize the ports on the cellular switch. At larger cell sites, the DACS II is used to pack DS1 facilities being sent to the MSC.

The AT&T *AUTOPLEX*® System 1000 offers high quality cell site and MSC equipment for cellular systems and can be coupled with existing AT&T digital transmission equipment. In addition to the DS1 cable and radio facilities, lightwave transmission is being used between the cell sites and the MSC. The DDM-Plus equipment is well suited for this and multiplexes four DS1s into a DS2 for transmission over the lightwave facility. With its DS3 termination feature, the DACS II can be connected to DDM equipment to produce a very flexible cellular system. At cell site clusters, the DACS II can be used to multiplex DS1 signals from connecting cell sites to the DDM-2000 for transmission over the SONET lightwave system to the MSC. At the MSC, the DS3 electrical signal from the DDM-2000 can be connected to the DACS II for routing to other cell sites (add/drop function) and to the cellular switch for connection to the public switched network.

LBRV (Low Bit Rate Voice) Applications

DACS II can be used as a hub vehicle in an LBRV (low bit rate voice), 384-kb/s bundled network compression multiplexer) receives two DS1 signals and multiplexes them into one DS1 signal consisting of four bundles. Each bundle uses six DS0 channels but contains information of twelve DS0 channels if all four bundles have the same end destination. Otherwise, each bundle contains eleven DS0 channels plus a delta channel with the signaling. DACS II is fully nonblocking for bundle routing without disconnecting any other connections and can switch these bundles to different locations, quickly and easily changing the LBRV network to meet changing needs. In addition, the bundles can share facilities with other services, saving the costs of dedicated facilities.

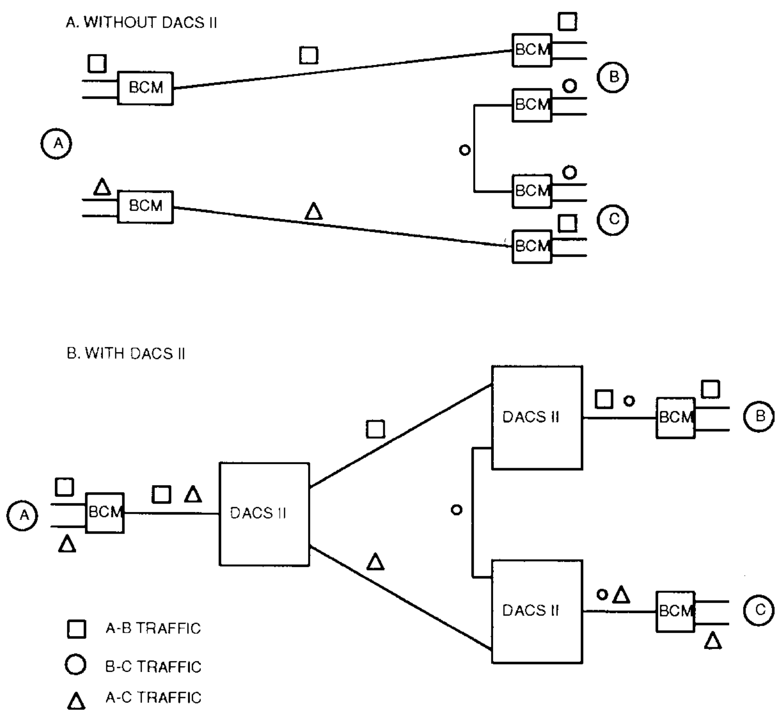

Figure 3-10. LBRV (Low Bit Rate Voice) Application

Voiceband Data Transport: Multipoint Circuits

DACS II can connect voice and voiceband data channels into multipoint circuits. Bridging is completely digital, with no conversion to analog signals. Circuit provisioning is electronic, quick, and flexible. With DACS II, bridging circuits can be provisioned and tested from remote locations.

shows two typical broadcast bridging circuits. One bridging circuit uses conventional analog bridging techniques; the other bridges circuits through DACS II with the DMB (digital multipoint bridge). It can be seen that DACS II with the DMB eliminates analog bridges, SMAS (switched maintenance access system) test points, and the many analog-to-digital conversions. Use of the DMB also eliminates operational costs associated with the design, provisioning, and maintenance of complex analog bridging circuits.

The DACS II can form the following multipoint circuits:

- Symmetrical Voice Conference Circuits
- Pure Broadcast Circuits
- Polling Data Circuits
- Broadcast Network with Switched or Looped Return
- 1-Way Broadcast Circuits.

The Pure Broadcast and 1-Way Broadcast multipoint circuits do not require the use of a DMB, but are formed directly in the cross-connect network using virtual NPC numbers in the commands. A multipoint circuit can be spread across several bridges in different DACS II frames.

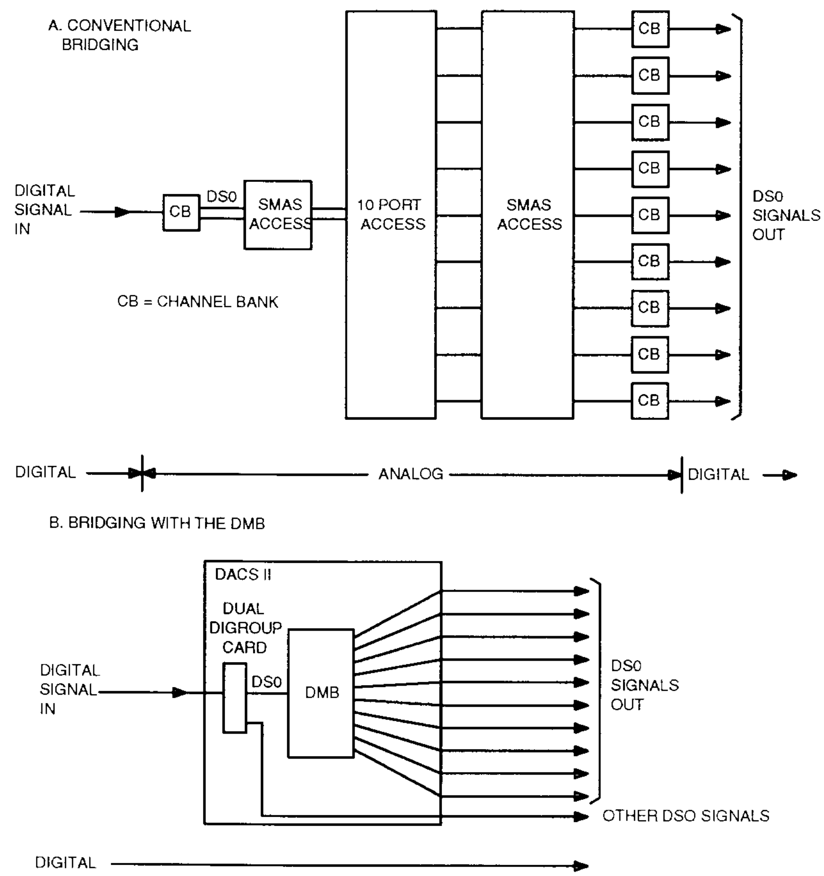

Figure 3-11. Typical Broadcast Bridging Networks

Bridging circuits are always duplicated continuity if a failure occurs. Should a failure occur, these duplicated circuits will automatically be switched into service. (For further details on multipoint circuits, refer to Chapter 4).

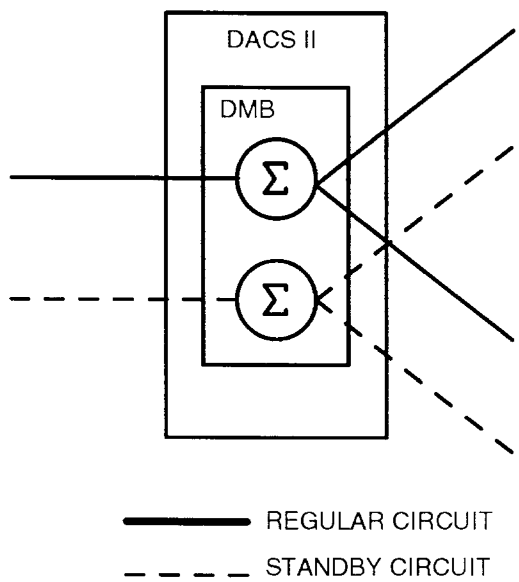

Figure 3-12. Duplex Operation of a Bridging Circuit

DACS II Subrate Feature Applications

DACS II with the Subrate feature can be applied in a variety of ways within suburban and metropolitan digital networks. It can support digital data offerings ranging from local data services to interstate high performance services. In each application, DACS II with the Subrate feature serves as a network node from which circuits can be economically provisioned, administered, and tested. Network nodes can be connected to form complex hubbing networks that provide users with advanced remote reconfiguration and monitoring features to create a highly flexible automated network. The nodes can be classified as hubbing and grooming nodes or collection and concentration nodes.

Hubbing and Grooming Nodes

In this application, DACS II with the Subrate feature serves as a digital data cross-connect device. In this capacity, DACS II rearranges through circuits on different interoffice facilities and adds and drops local circuits as required. This application is shown in If data arriving at these nodes is not already efficiently packed in dedicated facilities, DACS II can groom the integrated service facilities into dedicated service facilities. One example of this application is a regional office hub that serves as a POI (point of interface) to one or more inter-LATA carriers. In this case, DACS II with the Subrate feature terminates the multiplexed intra-LATA facilities that serve a wide geographic area, grooms the digital data circuits destined for each inter-LATA carrier, and passes them on to inter-LATA access links. Intra-LATA circuits are similarly cross-connected between the various intra-LATA facilities. The add/drop capability is used to serve circuits terminating at the hub.

With the modularity of the subrate feature, the hubbing nodes need not be constrained to large inter-LATA POI locations. Similar hubs can be embedded in the intra-LATA network as part of special services hubbing networks to improve facility use and response times and to offer customer control and reconfiguration services.

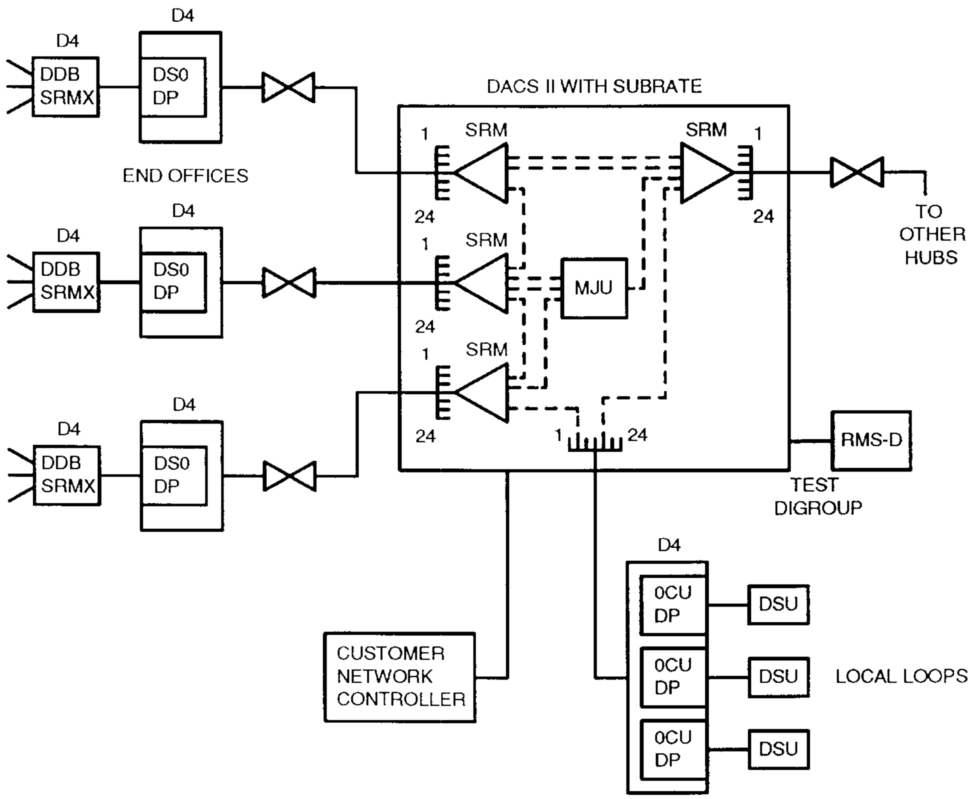

Figure 3-13. DACS II With Subrate Feature Hubbing Application

Collection Node

In this application, shown in feature serves to collect individual circuits from facilities carrying a few data circuits and concentrates them onto facilities carrying many circuits. Frequently, this node also collects many of its circuits from local loop facilities for transport on interoffice facilities or connection to other local loop facilities serving the same office.

An example of this application is an end office that homes onto one or more larger hubs. Circuits destined for inter-LATA carriers are packed onto facilities to the POI hub. These circuits may have originated from local loops served at the collection node or from dataport facilities serving other smaller locations. In the latter case, error correction plays a major role in maintaining high quality service.

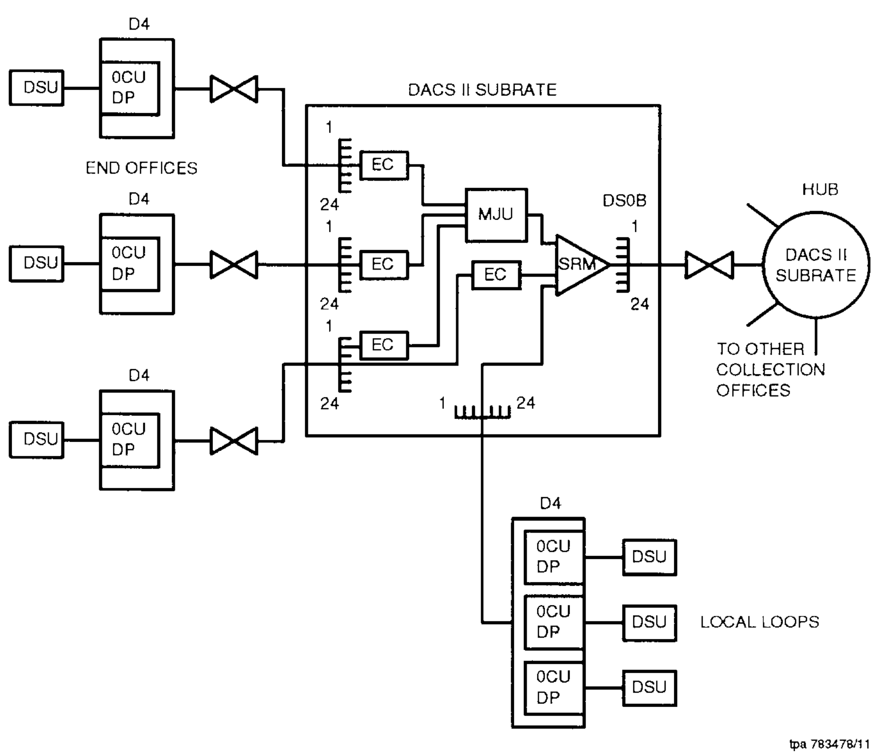

Figure 3-14. DACS II Subrate Feature Collection Office Application

International Gateway Interface

DACS II can serve as a Gateway interface between 2.048 Mb/s and 1.544 Mb/s facilities. In this application, DACS II terminates both the 2.048 Mb/s and the 1.544 Mb/s facilities and provides A-law to μ-law conversion between the two signals. DACS II also performs signaling conversion between the "abcd" signaling bits of the 2.048 Mb/s signal and the "ab" signaling bits of the 1.544 Mb/s signals. With the CAS (channel associated signaling) format, signaling is carried out-of-band in time slot 16 of the 2.048 Mb/s signal, and with DS1 robbed-bit signaling, the signaling is carried in-band by bits that have shared use for both voice and signaling encoding.

Also in the Gateway application, DACS II becomes an integral component of the International Transmission Maintenance Center that is specified by CCITT (International Telegraph and Telephone Consultative Committee) recommendations. In this capacity, DACS II performs the following functions:

- Efficient testing of international circuits
- Automatic service quality monitoring of international circuits
- Alternate mapping for quick disaster recovery.

Centralization and Automation

The automation built into DACS II allows remote centralized operations. As shown in include provisioning, maintenance, and administrative functions. This can significantly reduce the network operations expenses. These operational capabilities are discussed in the following paragraphs.

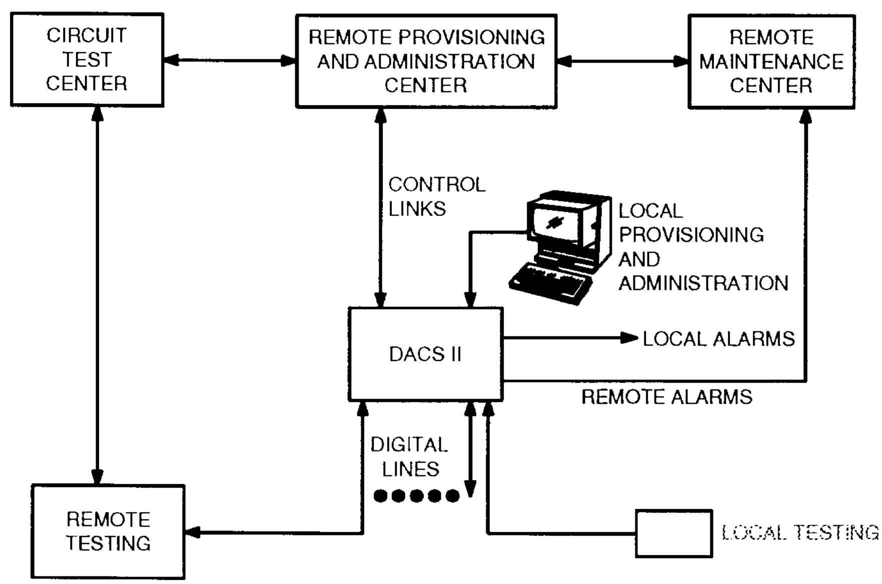

Figure 3-15. Centralization and Automation With DACS II

Provisioning

The deployment of DACS II as a remotely controlled cross-connect system allows the automation of the DS1 facility and service provisioning process. A central OS can communicate with the DACS II to bring new circuits into service, retire unused circuits, and redirect previously provisioned circuits. This capability reduces operational expenses and speeds up the provisioning procedure, reducing costly waiting time between order receipt and service cutover.

Maintenance

DACS II monitors facility signals connected to it for alarm conditions due to the loss of signal or framing and for transmission errors. For DS1 signals, additional facility performance parameters are monitored and errors are calculated using different methods including CRC (cyclic redundancy checking) where applicable. These additional parameters are also monitored on the individual DS1 signals embedded in a DS3 signal termination. The facility parameters can be read by utilizing various DACS II commands and are used to activate alarms when the counts reach alarm threshold levels. Signal loopbacks are possible with the *SLC* carrier direct interface to isolate facility troubles. DACS II can be used to both monitor and split the DS0 channels and 193-bit clear DS1 signals, thus providing a convenient test access point in the network.

Since the DACS II is controlled by commands sent over administrative links, it can be placed at key points in a network to monitor and control a network from centralized points.

DACS II continuously monitors its own health to ensure reliable operation. Hardware errors are detected and monitored to eliminate transients, and, if they are persistent, they are analyzed by DACS II to register the appropriate alarm and analysis messages. As part of this error recovery operation, internal switching to duplicated equipment is done to maintain service and allow maintenance on failed equipment. Equipment redundancy is provided for power supplies and for circuit groups that affect more than 120 DS0 channels such as the CCN and the synchronizer that affects the whole frame. Failures are diagnosed down to a faulty circuit pack, and analysis information can be sent to a work center over one of the administrative links for technical attention.

Administration

DACS II maintains a data base of the frame equipage and all cross-connections that have been established. This data base can be queried from a central administration center over one of the administrative links.

Primary and secondary memory backup is provided by the DACS II disk and magnetic tape drives. This backup can be used as a recovery mechanism.

Feature enhancements for DACS II via a new DACS II software release can be downloaded from magnetic tape. The ease of transport and storage of magnetic tape and the ease of implementation from magnetic tape simplify the feature enhancement process.

Capabilities

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Capabilities

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Introduction

This chapter describes in a broad fashion what DACS II can do. The discussions of these capabilities are brief and are intended to give you a general overview. DS0 channel cross-connections are described in detail in the first part of this chapter. Subrate data channels (within DS0s) are also cross-connected into multiplexer or multipoint junction unit configurations using commands. This subrate processing that is done in the DSPU is discussed in the last part of the chapter. DS0 and clear-channel DS1 test access is also discussed along

Cross-Connection of DS0 Channels

DACS II electronically cross-connects DS0 (64 kb/s) channels. Cross-connection is entirely digital with no conversion to analog signal format. All the channels of a line signal can be cross-connected using the range field of the commands, and with clear 193-bit DS1 terminations (no channels), the entire DS1 bandwidth can be cross-connected.

FTUs equipped with digroup cards can terminate up to 160 DS1s. FTUs equipped with 2.048 Mb/s signals can terminate up to 128 2.048 Mb/s signals. Units equipped to terminate DS3 signals terminate up to six DS3 signals, each of which contains 28 DS1 signals. This equates to a DS1 capacity of 168 per DS3U which is 8 more than available with a DS1 FTU. Any of the DS0 channels appearing at DACS II can be cross-connected to any other channel. These cross-connections are established by commands entered at an administrative terminal or received from an Operations System.

DACS II can produce the following types of cross-connections:

- Two-Point Cross-Connections
- Multipoint Cross-Connections
- Terminate and Leave Cross-Connections.

2-Point Cross-Connections

Either one-way or two-way cross-connections can be made. With two-way, both directions are connected by a single command With one-way, direction of data flow is given by the assignment in the FROM and TO fields of the command The other direction of the DS0 channel may be independently connected to form another one-way circuit Individual or continuous ranges of DS0 channels can be entered in a single command for either one-way or two-way cross-connections.

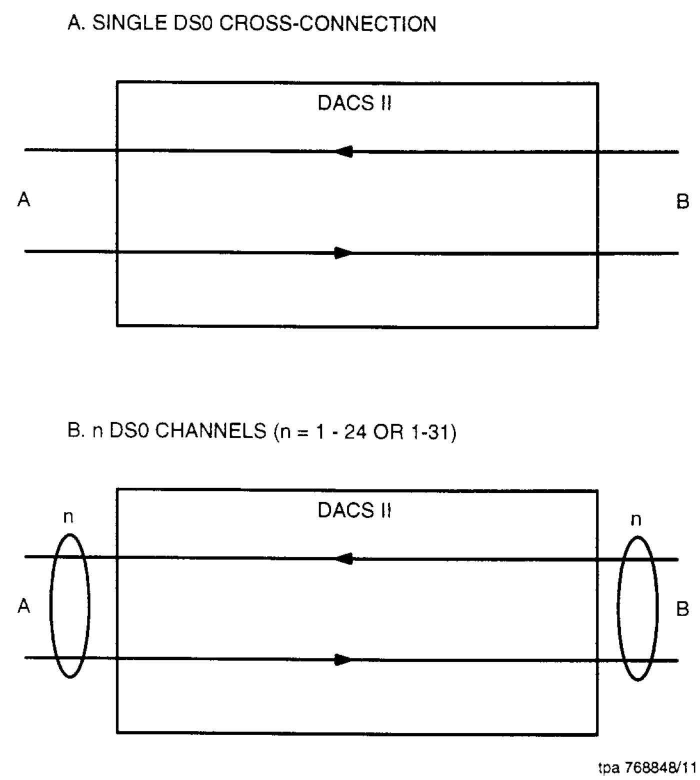

Figure 4-1. Point-to-Point, Two-Way Cross-Connect Circuits

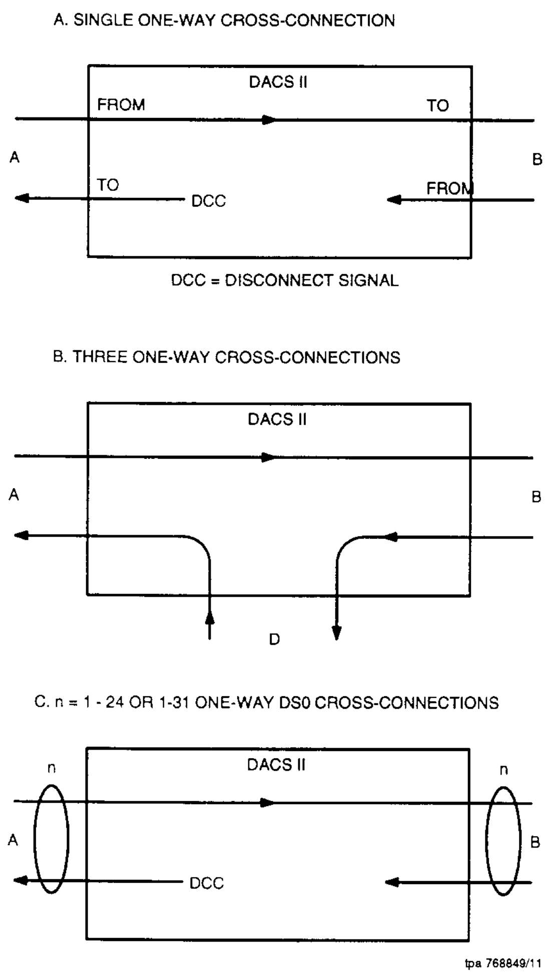

Figure 4-2. Point-to-Point, One-Way Cross-Connect Circuits

Multipoint Cross-Connections

DACS II can cross-connect DS0 channels into multipoint networks without decoding the channels to analog format. No external equipment is required. DACS II also provides test access of any facility leg of any multipoint circuit (except a DS0 broadcast network).

Multipoint circuits are produced in DMBs (digital multipoint bridges) and, for broadcast circuits, in the cross-connect network of the frame. DMBs are installed in a DSPU (digital signal processing unit). Each DSPU when fully equipped with 8 DMBs has a capacity of 4096 bridge legs.

The DMB pack provides μ-law companding for bridging DS1 channels, level adjustment, noise, and echo control. For gateway connections involving the bridging of DS1 and 2.048 Mb/s channels, the NPC pack for the 2.048 Mb/s facility leg provides μ-law to A-law conversions, and the DMB is not used.

DACS II can form five types of multipoint circuits:

- Symmetrical Voice Conference Circuits
- Pure Broadcast Circuits
- Polling Data Circuits
- Broadcast Network with Switched or Looped Return
- One-Way Broadcast Circuits.

With the Subrate data feature, the bridging of customer data legs with a control leg is done by an MJU (multipoint junction unit). This pack, which is mounted in the DSPU, produces multipoint circuits that are equivalent to external MJU equipment.

Symmetrical Voice Conference Circuits

Each circuit leg of the symmetrical voice conference circuit can transmit to and receive from all other circuit legs. Up to 512 channels can be bridged in a single DMB pack. These channels can all be connected in one conference or distributed over up to 170 separate conference circuits per DMB. The DMB can be provisioned to provide required amounts of transmission level adjustment, noise guard, and echo suppression.

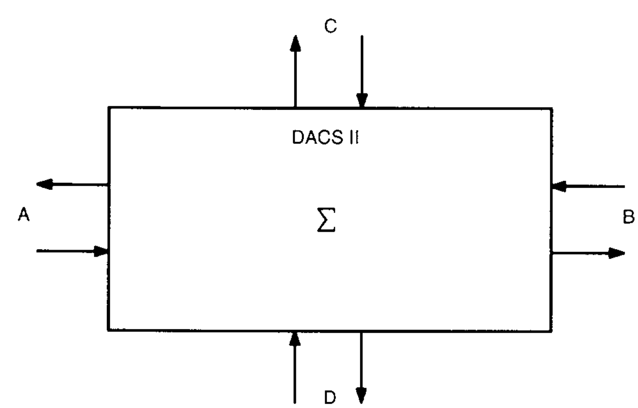

Figure 4-3. Symmetrical Voice Conference Circuits

Pure Broadcast Circuits

In a pure broadcast multipoint circuit a single circuit leg, the backbone, transmits to all other legs, or tributaries, in the network. These circuits are established in the CCN. The DMB is not needed in this application.

Polling Data Circuits

The backbone of a polling data multipoint circuit transmits to its tributaries; the tributaries return information to the backbone. The signal of the tributaries is summed in DACS II and processed for gain and noise and echo suppression. The DMB is used to provide this application.

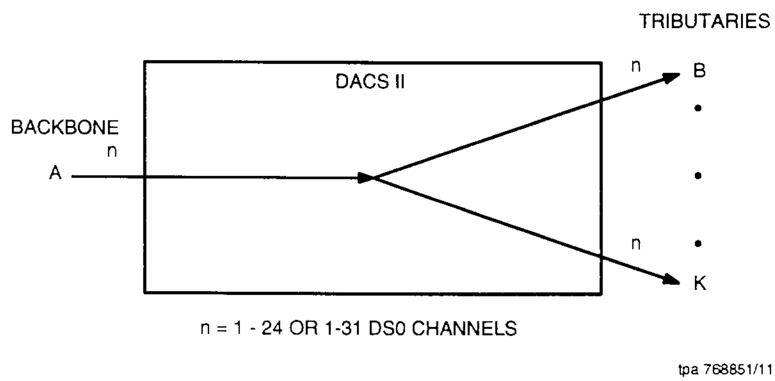

Figure 4-4. Pure Broadcast Circuit

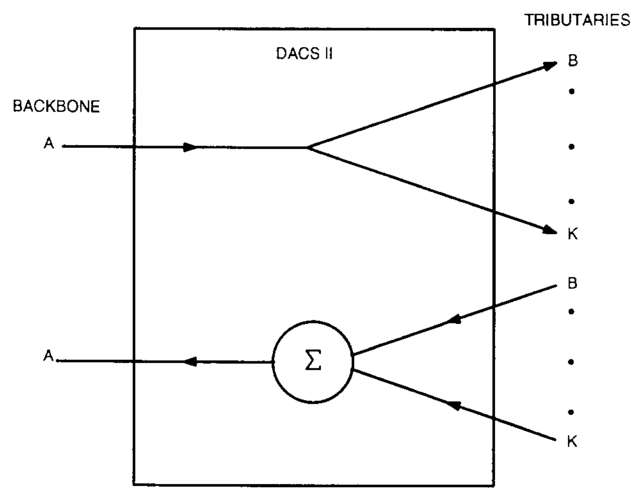

Figure 4-5. Polling Data Circuit

Broadcast Network with Switched or Looped Return

A broadcast network with a switched return has *only one* tributary that communicates with the backbone. The other tributaries are broadcast-only. In a broadcast network with a looped return from the backbone loops back on itself. The range of channels to be broadcast is entered in the broadcast command, and up to eight tributaries can be named in a single command.

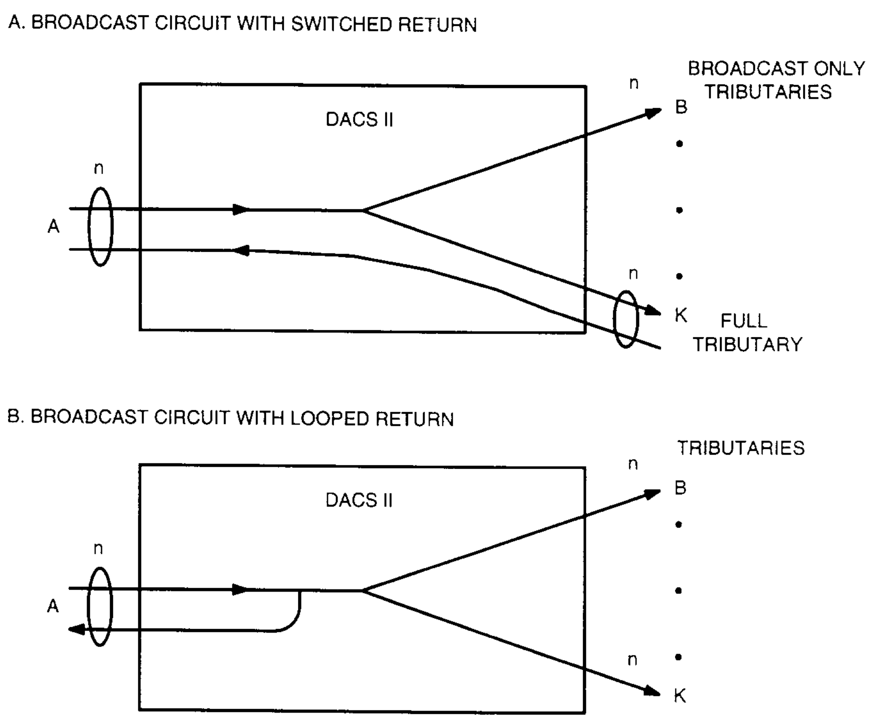

Figure 4-6. Broadcast Network with Switched or Looped Return

One-Way Broadcast Circuits

One-way multipoint circuits are pure broadcast circuits composed of one-way channels. In such a circuit, the backbone broadcasts information to its tributaries.

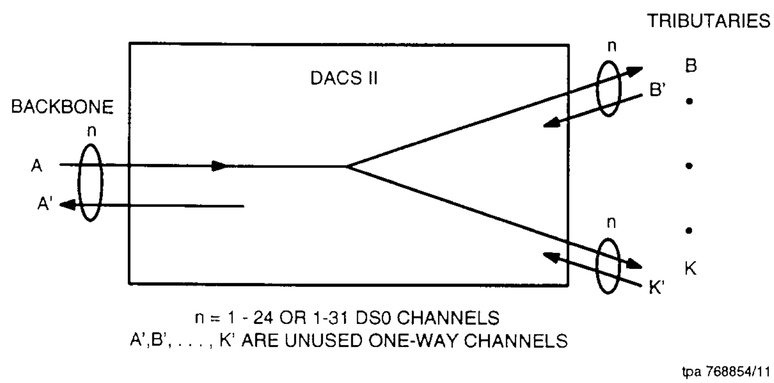

Figure 4-7. One-Way Multipoint Circuits

A one-way channel uses only one direction of transmission of a DS0 signal. The other direction, the other one-way channel, may be independently connected. Therefore, the other one-way channels associated with the backbone and tributaries may be connected to other one-way channels.

Terminate and Leave Cross-Connections

DACS II can cross-connect two-point or multipoint circuits with transmission terminated (shut off) in one or both directions. You can install and test a new circuit, setting trunk conditioning and circuit parameters before turning it over to regular service. Individual legs of a multipoint circuit can be tested and added to the network. Any noisy leg can be identified and fixed before it is added. When the operator receives the connect order, a single command brings a terminated circuit or circuit leg into service.

DACS II Test Access

DS0 Channel Test Access

DACS II allows you to access any DS0 channel within the DACS II for voice or data testing without interfering with any other DS0 circuit. In some of the paragraphs that follow, the terms FROM and TO identify the two sides of a cross-connected circuit. This is how the sides are identified for test access purposes and how the sides are entered in the cross-connect command. However, these terms do ***not*** indicate data flow; for example, there is data flow in both directions of a two-way circuit even though the two sides are entered in FROM and TO fields of the command.

For DS0 test access, up to 48 dynamic test ports can be established at the DACS II for connection to external test positions; D-bank for analog conversion or a digital test facility for testing. Four NPCs can be designated as test access digroups or test access primaries (for 2.048 Mb/s lines) to provide these test ports. Any four NPC positions in the FTUs can be used for these test access digroups or primaries, but grouping them together for ease of connecting them to external equipment and using prominent locations (for example, NPC 001) helps the user remember which positions were assigned. Each test port consists of two DS0 channels to permit access to both sides of a cross-connected circuit when the circuit is split. The circuit is first accessed in the monitor or bridging mode to prevent inadvertently interrupting any service on the accessed circuit. Special considerations on test access using 2.048 Mb/s test access primaries for accessing 2.048 Mb/s and gateway circuits are given in Chapter 14.

The Release 6.0 Nx64 Kbit/s test access feature allows customers to grow and reconfigure up to 400 Nx64 Kbit/s Test Groups (TGs) on DACS II. A TG is composed of two separate bundles of N 64 Kbit/s channels. These bundles are referred to as the East bundle and the West bundle of the TG and allow an Nx64 Kbit/s circuit to be tested simultaneously in both directions of transmission.

In addition to the maximum of 400 TGs, Release 6.0 continues to support creation of Test Ports (TPs) and Test Access Digroups (TADs or NPCTPs). The maximum number of NPCTPs has been increased to 8 in Release 6.0 (up from the maximum of 4 provided for in previous releases) yielding a total of up to 96 TPs.

Clear-Channel DS1 Test Access

With 193-bit clear-channel DS1 terminations provided in DACS II Release 4, NPCs can also be designated for clear DS1 test access. These facility access digroups must be provisioned for clear-channel operation and are separate from and in addition to those designated for DS0 channel test access. The number of

NPCs designated for clear DS1 test access is not limited as it is for DS0 test access. Monitor and splitting modes of test access are available for clear-channel DS1 signals and are described with the DS0 channel counterparts in the following paragraphs. One facility access digroup is required for 1-way monitoring or splitting, and two facility access digroups are required for 2-way monitoring or splitting.

Monitor Mode

This mode provides a bridged connection to the circuit for monitoring before breaking the circuit for testing. Figure 4-8A illustrates monitoring both directions of a DS0 cross-connected circuit.

A circuit terminated with a Terminate and Leave command can also be monitored for signal quality. In the terminated state, DACS II sends a disconnect signal (DCC) to the TO side of the circuit. This signal loops back at the far end, returns to the DACS II for monitoring, and passes to the far end on the FROM side. DACS II monitors the signal returning from the FROM side.

Monitoring for clear DS1 test access can either be one-way or two-way. With one-way, only one facility access digroup is used and the receive signal from one side or the other is selected. These sides are referred to in terms of the orientation, either toward the office equipment side or the network transmission side.

Split Mode

This mode breaks the cross-connected circuit or provides access to both directions of an unassigned termination to allow two-way testing of transmission or signaling. Figure 4-8B illustrates the splitting access for a DS0 circuit. Terminated split access allows you to apply a disconnect signal to one side of the circuit and monitor the returning signal quality.

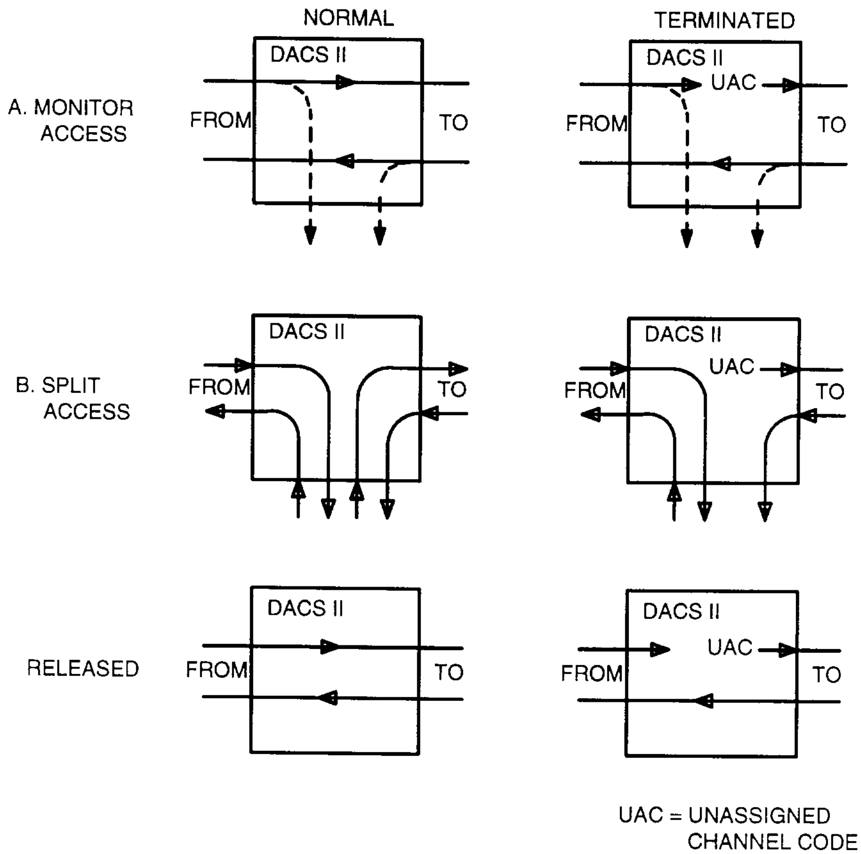

Figure 4-8. Monitor and Split Access of a 2-Way Circuit

Split access of a one-way cross-connected circuit (Figure 4-9) provides access to the TO side of the cross-connection and permits testing and monitoring in the TO direction.

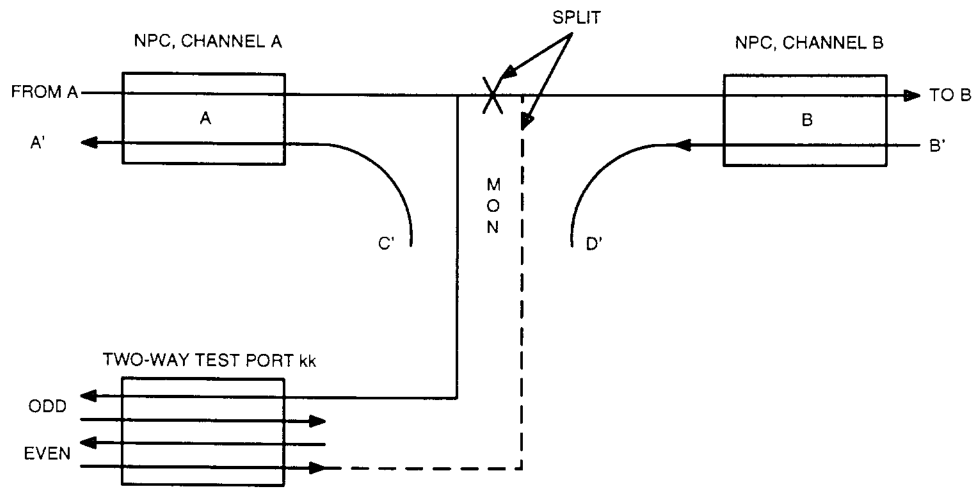

Figure 4-9. Monitor and Split Access of a 1-Way Circuit

For clear DS1 test access, splitting encompasses several possible configurations because the circuit can be split either into separate unidirectional test paths or into separate sides. The possible configurations are: equipment-side unidirectional, network-side unidirectional, equipment-side bidirectional, network-side bidirectional, or both bidirectional on both sides (using two test access digroups).

For the unidirectional types, only one direction of transmission is split with the signal coming from the respective side to the test access equipment and with a signal applied toward the other side from the test equipment. Figure 4-10 shows an example of the unidirectional splitting (RTU in the figure means remote test unit). For the bidirectional types, both directions of transmission for the accessed side are connected to the test access equipment. When only one side is split for bidirectional testing, a quasi-random signal source or AIS idle code is sent out over the disconnected facility to maintain far-end connections. Figure 4-11 shows an example of the bidirectional splitting.

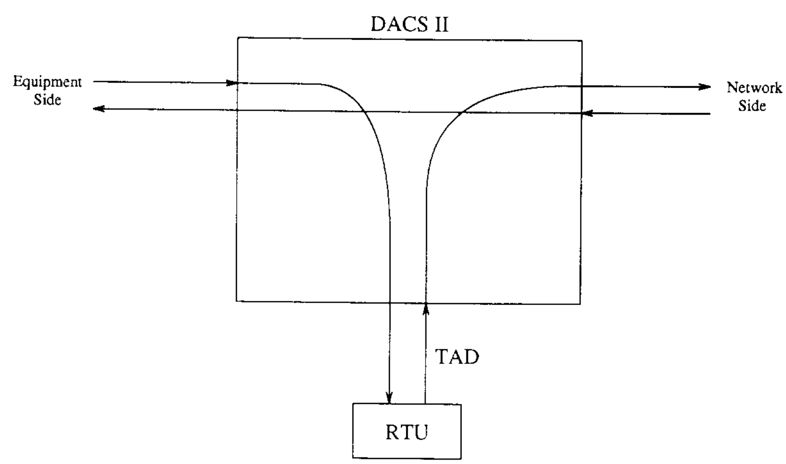

Figure 4-10. Clear DS1 Equipment-Side Unidirectional Split Mode

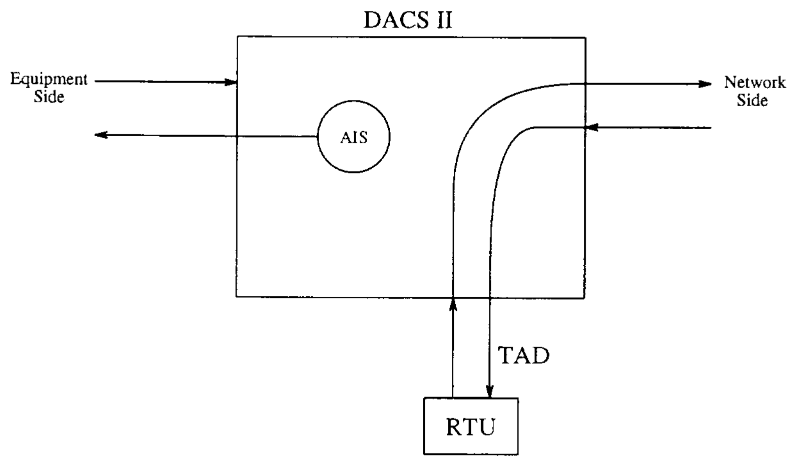

Figure 4-11. Clear DS1 Network-Side Bidirectional Split Mode

Maintenance and Administration

Digital Facility Performance Monitoring

DACS II continuously monitors facilities connected to it and registers alarms when thresholds are reached. These thresholds are programmable, and various facility parameters are monitored on different rate lines. DACS II checks the DS3 lines for loss of signal, bit errors, and loss of framing, and checks the DS1 and 2.048 Mb/s lines for additional parameters including timing slips, framing losses, and various errors calculated using different methods. The facility performance parameters can be read on demand and those that are enabled in a time-of-day command will appear in a daily report. Carrier failure conditions automatically generate a CFA (carrier failure alarm) and appropriate trunk conditioning.

A separate protection facility can be used with the *SLC*® carrier feature for facility protection switching. With the DS3 feature, there is no facility switching, but there is equipment switching in the DS3U to protect against the loss of service due to a single equipment failure.

Programmable AIS Alarm

The programmable AIS alarm option provided in Release 4.1 allows the user to select how the alarm indication signal from the far end will be reported. The DACS II user can select whether a major alarm or minor alarm (to be accompanied with an autonomous alarm message to be output on the administrative links) or no alarm is generated (but an information message is output on the administrative links). This selection is made when the NPCs are grown or subsequently with a change command. Release 4.0 alarm escalation rules will be applied for the AIS alarms.

DACS II Self-Maintenance

DACS II is a self-monitoring system that is able to diagnose single faults to the circuit pack level. The DACS II responds to hardware errors according to an error recovery scheme that involves the following autonomous operations:

- Exercises its hardware
- Detects hardware errors and verifies that they are not transient
- For duplex circuit groups, switches service to the duplicated path to maintain service once the pack is removed from service (NPCs are not duplicated)
- Removes the failed pack from service and performs defined diagnostic tests on the pack.
- Isolates faults to a few circuit packs indicated in an analysis message
- Sends out appropriate maintenance messages in addition to local and remote alarms.

Manual diagnostics are used to test specific circuits during troubleshooting. No manual testing of the equipment is required. The only routine maintenance is to clean the tape drive head and to check the reported status of the equipment and facilities.

Remote/Local Administration

DACS II provides six administrative ports/links for local or remote operations support interfaces. Commands are available to restrict the use of the links, to establish the priority for executing command groups, and to screen the messages that are received from other links. The frame administrator can restrict the use of the links so that log-in access is required, and various users can have different command sets available to them.

DACS II can interact with a variety of Operations Systems. Included in this group are:

- No. 2 SCCS (No. 2 Switching Control Center System)
- SARTS (Switched Access Remote Test System)
- TCAS (T-Carrier Administration System) via No. 2 SCCS
- TIRKS* System
- OPS/INE
- TASC (Telecommunications Alarm Surveillance and Control System)
- RMS (Remote Measurement System)
- DACS Controller (International Use Only)
- GTP (General Telemetry Processor).
- I-2000/DACS II

For more information on DACS II and operations systems, see Chapter 10, *Administrative Links and Operations Systems.*

Two of the six links can be provisioned for the connection of equipment that uses X.25 synchronous protocol. Also, two of the asynchronous links can be provisioned for TABS (Telemetry Asynchronous Block Serial) protocol.

* Registered trademark of Bell Communications Research, Inc.

Protected Data Base

In its memory, DACS II contains cross-connect maps, equipment provisioning information, and the functional status of the equipment. This memory is backed up by a hard disk. This disk is kept current with all transactions. This disk itself is backed up by an internal magnetic tape storage system. In the event of a power failure, the disk or its tape backup can be used to restore DACS II to its configuration before the failure.

Stored Program Control

The software that operates DACS II is stored on hard disk. Software updates are loaded onto the disk from tapes distributed to DACS II locations. The use of tapes for software updates results in the following benefits:

- Elimination of returning firmware circuit packs
- Faster updates
- Simplified change administration
- Greater feature flexibility
- Reduced circuit pack inventory.

Facility Termination Capabilities

DACS II-Compatible Facility and DS1 Line Formats

DACS II can terminate up to twenty-five hundred and sixty 1.544-Mb/s signals of 24 DS0 channels each in Release 5.0 or two-thousand and forty-eight 2.048-Mb/s signals of 31 DS0 channels each and is compatible with the facility formats of:

- D1D, D2, D3, D4, and D5 Channel Banks
- LT1-B terminal
- LT2 terminal
- DIF (Digital Interface Frame)
- DFI (Digital Frame Interface)
- DT (Digroup Terminal)
- DCT (Digital Carrier Trunk)

- DS1 Extended Superframe
- T1DM (T1 Digital Multiplexer)
- DMI/BOS
- BCM 32000
- CCITT G.704 (2.048 Mb/s interface)
- *SLC* 96 carrier Fs' format
- *SLC* Series 5 carrier FPC data link format.

DACS II is also compatible with the following line formats:

- D4 type zero code suppression (optional)
- ZBTSI (zero byte time slot interchange)
- B8ZS (bipolar with 8 zero substitution)
- HDB3 (high density bipolar) format for 2.048 Mb/s signal.

The DACS II is currently not compatible with:

- DS1C signals, the sources of which are: D4 Channel Bank Modes 1 and 2, D5 Channel Bank Mode 2, or M1C-type multiplexers
- DS1 signals from D1A, D1B, or D1C Channel Banks
- DS1 signals from *SLC* 40 carrier (delta modulation)
- *SLC* carrier formatted DS1s embedded in DS3s
- *SLC* carrier Mode II.

DS3 Signal Termination

DACS II with associated DS3U hardware allows the termination of DS3 asynchronous signals on the frame and the demultiplexing of the constituent DS1s and DS0 signals for DS0 cross-connections. A unit equipped as a DS3U terminates up to six DS3 signals and contains the circuit packs to process these signals and provide protection switching of this equipment to prevent the loss of service owing to the failure of any single circuit pack. The DS3 interfaces are compatible with the DSX-3 cross-connect wiring bay and handle both the M13 and C-bit parity signal formats to allow connection to existing DS3 equipment and the DACS III-2000 and DACS IV-2000 equipment. As with DS1 terminations, the DACS II monitors the DS3 signal for loss of signal and high error rate conditions and monitors the individual constituent DS1s for various facility performance parameters. When alarm thresholds are exceeded, DACS II declares the appropriate alarm. Current facility parameter counts can be read at an administrative terminal.

DACS II *SLC* Carrier Direct Interface

General

The *SLC* carrier features provide a direct interface at DACS II for connecting T1 lines from *SLC* carrier RTs (remote terminals) and from the local digital switch (*5ESS*® switch or *DMS* 100* switch). This is a direct line interface without any previously needed interface module (that is, SLIM). For *SLC* 96 carrier, this interface supports both the *SLC* 96 Carrier Mode I and III configurations that are described in later paragraphs. For *SLC* series 5 carrier, the interface supports FPBw/specials (feature package B with specials) or FPC.

The DACS II software enables:

- Service switching to protection facility by channel cross-connections
- Addressing all 96 channels from the different *SLC* carrier digroups on digroup A in the DACS II commands
- Remote provisioning of the Series 5 FPC RT channel units from the DACS II with the craft interface unit
- Auditing of the Series 5 FPC provisioning information in the DACS II and RT data bases for discrepancies.

The protection switching is done automatically at DACS II by cross-connecting channels from the failed line to the standby protection line. The provisioning of the Series 5 FPC RT channel units from the DACS II is done by connecting the CIU (craft interface unit) to an administrative link that has been conditioned for modified Snider protocol.

The hardware for direct carrier connections consists of NPCs that can be grown as DS types. These packs can be used in any of the slots of FTUs and provide the following characteristics:

- For digroups with data link, DS1 line signal with either the Fs format (for S96D pack) or ESF (extended superframe for SS5D pack) data link
- X.25 synchronous protocol handling for ESF data link (with SS5D pack)
- 9-state signaling for coin telephone circuits
- *SLC* carrier alarm handling and data link communications
- Facility performance monitoring

* Registered trademark of Northern Telecom, Inc.

- Line signal loopback capability.

Line Loopbacks

When the *SLC* carrier interface NPCs detect loss-of-signal, out-of-frame, or excessive bipolar violations, the NPC automatically initiates a line interface loopback to test itself. Based on the results of the loopback and presence of other alarms, the NPC declares one of the following alarm locations: NE (near-end, DACS II), CLF (carrier line failure), or FE (far-end). The DACS II communicates alarm information, remote loopback requests, and protection switching setup information over the carrier data link. Line loopbacks can also be established at the DACS II by entry of a local command or in response to a command from the connecting equipment. Similarly, remote loopback commands can be sent to the connecting equipment. These loopbacks allow single-ended line testing from different points in the facility.

SLC 96 Carrier Mode I and *SLC* Series 5 FPB with Specials Interfaces

With these interfaces, the DACS II connects POTS channels directly to the digital switching equipment and connects the special service channels to the network. Both interfaces include specials, and the DACS II provides the grooming of the specials; the DACS II also replaces the COT and provides a digital channel pass-through of the POTS channels. The specials are packed and routed to the network, and the POTS channels are sent to the digital switch (*5ESS* switch or *DMS 100* switch); see Figure 4-12. The special service channels are connected to other digital transmission equipment or can be terminated at a D channel bank. Four primary lines from the RT connect to the DACS II. For releases before Release 4.1, an optional protection line is provided on both sides of the DACS II. For a failure on the RT side, the DACS II performs the cross-connections to maintain the service on the special and switched circuits. For a failure on the switch side, protection switching occurs on the channels going between the DACS II and the switch. If a failure occurs on digroup A (data link resident) on either side of the DACS II, protection switching occurs on both sides of the DACS II. This protection switching arrangement has been modified in Release 4.1 to provide the 5:4 architecture as described in Chapter 4 "DACS II *SLC* Carrier Direct Interface." The DACS II intercepts and overwrites information from the connecting equipment in the alarm and protection fields of the data link as required to produce the segment alarming and protection switching.

Circuit testing of the POTS channels is done from the switching machine using a dial-up test controller (for example, PGTC, XTC), and local channel testing of the specials is done using DACS II test access.

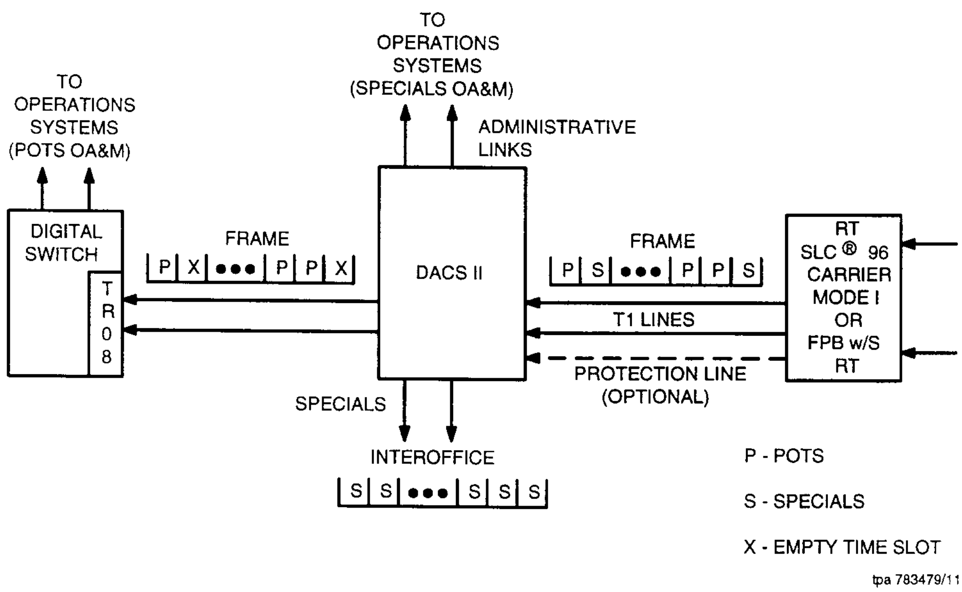

Figure 4-12. Mode I Interface, 5:4 Protection Configuration

SLC 96 Carrier Mode I Pass-Through 5:4 Protection Feature

Beginning with DACS II Release 4.1, software will not support the *SLC* 96 carrier Mode I 5:5 protection arrangement; however, a 5:4 protection will replace the existing 5:5 arrangement. There is no protection line between DACS II and the DCLU with the 5:4 arrangement; all protection switching is done between the RT and the DACS II with no end-to-end switching. Every digroup (including the A digroup) is protected between DACS II and the RT, and no protection switching is performed on the digroups between the DACS II and the digital switch.

Following are different possibilities for evolving to a 5:4 protection architecture:

- From a 4:4 configuration (a protection line must be added to the RT).
- From a Mode I specials-only configuration (a Mode I system with protection was carrying specials only, but now the DCLU must be provisioned to add POTS channels).
- From a current 5:5 architecture. This 5:4 protection feature enables a non-service-affecting "roll" from any 5:5 configurations to the new 5:4 configuration.

This feature provides savings on the digital switch port as well as savings on the facility within the office.

SLC 96 Carrier Mode III Interface

In this mode, the DACS II is used to connect the two primary T1 lines from the *SLC* 96 carrier Mode III RT to other digital network equipment. This mode is the special services mode in which none of the specials are locally switched at the DACS II office. These may either be nonswitched services or just services that are not locally switched. If used, the protection switching line terminates at the DACS II so that the protection is provided between the RT and the DACS II. Since the special circuits are not locally switched, the circuits cannot be tested using a dial-up test controller (for example, PGTC, XTC), but the channels can be accessed using DACS II test access.

SLC Series 5 FPC Interface

In this configuration, the DACS II is used to connect the four primary T1 lines from the RT and digital network equipment in the office. This configuration is the special services mode in which none of the specials are locally switched at the DACS II office. These specials may be either nonswitched services or just services that are not locally switched. The Series 5 FPC configuration is similar to the *SLC* 96 carrier Mode III configuration with the following exceptions: four primary digroups (A, B, C, and D) are used, and the TG184 code of NPC is used for lines going to the RT equipment. Among the functional differences is that the Series 5 uses both the odd and even channels on the digroups. The protection switching line terminates at the DACS II so that the protection is provided between the RT to the DACS II. Since the special circuits are not locally switched, the circuits cannot be tested using a dial-up test controller (for example, PGTC, XTC), but the channels can be accessed using DACS II test access.

The DACS II allows connection of the *SLC* Series 5 carrier CIU (craft interface unit) to an administrative link to load or change the provisioning of the *SLC* Series 5 channel units. This administrative link must be established for use with modified Snider protocol, and the information is conveyed over the ESF data link in the DS1 signal. After the provisioning is loaded either at the DACS II end or at the RT, the DACS II data base becomes the master and the DACS II monitors both data bases for discrepancies that are reported in messages.

Subrate Data Cross-Connect Capabilities

The Subrate feature offers customers an extremely modular approach that minimizes the investment required to add digital data services to an existing DACS II-based network. To achieve this, the digital data processing functions are provided on circuit packs designed for use in the DACS II DSPU (digital signal processing unit). Complete flexibility to mix other DSP functions with digital data functions is maintained. This allows customers to easily tailor the DACS II to meet their specific network application needs. The subrate data processing is the perfect adjunct to the T1DM line format capability that was previously available at the DACS II.

The DACS II Subrate digital data cross-connect feature provides full support of DDS (digital data system) and 56-kb/s data transmission via the DSPU. Two types of circuit packs provide the DACS II Subrate capability. An SRM (subrate multiplexer) pack provides multiplexing and error correction for 2.4-kb/s, 4.8-kb/s, 9.6-kb/s, and 56-kb/s digital data channels. The SRM multiplexes incoming DS0-A formatted data channels into DS0-B formatted data channels and provides dataport error correction for efficient transport over interoffice facilities. An MJU (multipoint junction unit) circuit pack performs standard digital data multipoint bridging of DDS and 56-kb/s data channels and provides dataport error correction for the channels. In addition, the SRM and MJU circuit packs transparently pass DDS secondary channels for customer use. The Subrate feature of DACS II provides the essential functions of configuring, maintaining, and administering digital data networks. The following benefits are realized by supporting Subrate capabilities in DACS II:

- Complete circuit pack redundancy for protection (1:1)
- Reduction or elimination of external Subrate data processing equipment
- Full error correction capabilities for reliable end-to-end data transmission
- Full support of secondary channel
- Flexible and powerful Subrate data processing capabilities in a single DACS II system
- Flexible provisioning and reconfiguration capabilities for Subrate data channels
- Full support of test access of Subrate data channels.

Synchronized Operation

DACS II is normally at Stratum level 3 in the digital hierarchy but can be optionally equipped for Stratum level 2. At Stratum level 3, DACS II receives timing from a Stratum-3 or higher source that has timing traceable to a Stratum-1 frequency standard. DACS II can also be used as a timing source. If a timing reference is unavailable in an office, DACS II can be equipped to distribute timing to other equipment within an office.

Product Support

5

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Product Support

5

Introduction

AT&T provides comprehensive product support for DACS II in four main areas:

- Technical Support
- Training Support
- Documentation Support
- Warranty Support

This chapter describes the support services available in each of these areas.

Technical Support

Technical support for DACS II begins at the user level with the COACH system. The COACH system provides on-line information and trouble resolution features. Troubles that cannot be resolved at the local level with the COACH system or documentation can be escalated through the following technical support organizations:

- The Regional Technical Assistance Center (RTAC)
- The Technical Support Organization (TSO).

The following paragraphs describe each of these technical support aspects.

COACH System

AT&T provides its customers with dial-up, on-line technical support through COACH (Customized On-Line Aid for Customer Help). Following is a list of some of the tools this easy-to-use system provides:

- Diagnostic Dictionary — This is a history of symptoms, problems, temporary fixes, cautions, and solutions which could be of use in diagnosing, correcting, and avoiding present and future problems.
- Compatibility Data — This feature provides hardware compatibility information for each software release.
- News and Bulletin — News provides the latest general information. Bulletins are information of a more urgent nature. Bulletins are displayed immediately after login.
- COACH User's Guide — This feature provides instructions that explain how to use COACH. It also explains the differences between issues of COACH.

Anyone interested in gaining access to COACH should contact their technical coordinator. If a coordinator is not available, call AT&T Customer Service.

Regional Technical Assistance Center

Technical assistance can be obtained by calling the RTAC (Regional Technical Assistance Center) at 1-800-225-RTAC. This telephone number is monitored 24 hours a day, 7 days a week. During regular business hours, your call will be answered by your local regional RTAC. Outside of normal business hours, all calls will be answered at a centralized technical assistance center where service-affecting problems will be dispatched immediately to your local RTAC. All other problems will be referred to your local RTAC on the next regular business day.

Technical Support Organization

Problems that cannot be resolved by RTAC can be escalated by RTAC to the Technical Support Organization (TSO). The TSO can request assistance from other AT&T entities including AT&T Bell Laboratories to resolve the problems.

Extended Technical Support

Extended technical support can be provided after the warranty coverage has expired. It is available at additional cost.

Extended technical support includes day-to-day operational and procedural product support, as well product problem diagnosis and resolution. It includes:

- Personnel whom customers may contact to register reasonable requests for information or for assistance with our products or services.
- Technical support personnel who promptly respond to the customer acknowledging receipt of the assistance request, obtaining a verbal description of the need for support services, and mutually determining the urgency of the request.
- Technical support personnel, remotely or on-site, as deemed necessary by AT&T and the customer (at additional travel and living cost to the customer), who assist the customer in analysis, localization, diagnosis, and, if applicable, resolution of the assistance request.
- Technical support personnel who serve as a single point of contact for customers for any reasonable request for information about AT&T's embedded transmission products and software.
- Technical support personnel who provide customer assistance request resolution management for all components of AT&T's transmission system.
- Technical support personnel who provide customers with any mutually agreed-upon metrics and reports relating to support services quality.
- Remote access to a diagnostic dictionary, on-line documentation, and compatibility data offered in COACH.

Value-Added Services

AT&T can provide additional services on either a one-time or ongoing basis to facilitate the implementation of a product, network application, or special request to enhance your operating capabilities. These optional services are described in this section.

For more information, contact your AT&T Account Executive.

Troubleshooting Problems Between Products From Multiple Vendors

AT&T will troubleshoot reported technical problems between AT&T and non AT&T products and help you resolve problems.

Multivendor Solution Network Testing

AT&T will perform network testing among different vendor's equipment and deliver test findings.

Non-AT&T Installation Support Services Procedures

AT&T will support you with service procedures to install non-AT&T equipment and integrate it with AT&T transmission products.

Office Studies

AT&T will analyze your specific office needs and compare the existing design with an AT&T solution. Recommendation will detail an evolution path to meet future network requirements.

Disaster Recovery

AT&T will work with you to evaluate and plan what steps to take in the event of a catastrophe.

Preventative and Remedial Maintenance

AT&T will provide regular scheduled maintenance, which is a means to reduce the liklihood of unexpected downtime. Also, AT&T will review installed equipment and provide service to older network elements to help bring equipment back to specifications.

Provisioning

AT&T will assist in the delivery of new services during your design and cutover stages of the implementation process.

Inventory Control

AT&T will design and manage the investment of spare parts required to meet your network requirement.

Facility Cutover Tools

AT&T will deliver network tools that will assist in the cutover phase of network implementation.

Operational Review

AT&T will provide technical expertise in analyzing and evaluating your networks or specific situations and will share its findings and recommendations.

Database Conversion

AT&T will assist in your conversion process of integrating an existing database with new network designs and products.

Test Lab Facilities

AT&T will provide you with access to a lab and testing expertise for evaluating and verifying the features, applications, compatibility, and procedures of transmission products.

Customer Database Tools

AT&T will work with you to develop custom software tools that assist you in the conversion/integration process.

Network Performance Analysis

AT&T will assist in network design, which may include other vendors' equipment, for optimal risk management and diversity.

Turnkey Services

AT&T will assist you in bringing together components into an in-service working system.

Network Documentation

AT&T will provide information for connecting AT&T's transmission equipment to other vendors' products.

Internal Test Plans/Results

AT&T will provide internal test plans and results.

Network Growth Planning

AT&T will assist in growth and migration plans to match future objectives and budgets.

Custom Network Designs

AT&T, at your request, will provide a design of nonstandard AT&T products geared to a special network/customer need.

Special Requests

AT&T will investigate your requests regarding a special network or service requirement.

Training Suppport

Training support is provided by the AT&T National Product Training Center in Dublin, Ohio. Courses are either offered at the Training Center or suitcased to other locations. The following are the DACS II training courses.

DG3000– **DACS II Overview**

COURSE DESCRIPTION: This course is designed to familiarize the student with equipment, applications, operations, and administration of the DACS II. The descriptions of size, capacity, and flexibility provide an understanding of the functions and implementation of the DACS II in the network.

PREREQUISITES: A background in telephony and a basic understanding of digital transmission principles/concepts such as provided by *TR1001 Digital Transmission Principles and Applications.*

DG3030– **DACS II Advanced Operation and Maintenance**

COURSE DESCRIPTION: This course is designed to enable the student to perform advanced operation and maintenance of the DACS II. All aspects of DACS II Operation and Maintenance are covered from normal day-to-day operations to detailing of the equipment's subassemblies.

PREREQUISITES: A background in the operation and maintenance of digital transmission equipment and an understanding of electronic principles, digital transmission theory, and schematic drawings.

DG3900– **DACS II International Overview**

COURSE DESCRIPTION: This course is designed to familiarize the student with equipment, applications, operation, and administration of DACS II in a 2.048 Mb/s or Gateway installation. The description of size, capacity, and flexibility provide an understanding of the functions and implementation of DACS II in the network.

PREREQUISITES: A general knowledge of digital carrier terminology and equipment.

DG3930– **DACS II International Advanced Operation and Maintenance**

COURSE DESCRIPTION: This course is designed to prepare the student to perform technical support of the DACS II. All aspects of DACS II operation, provisioning, and system administration are covered.

PREREQUISITES: A general knowledge of digital carrier transmission and equipment. Also, an understanding of electronic principles, digital transmission theory, and schematic drawings is necessary.

TR3521– **DACS II Operation and Maintenance**

COURSE DESCRIPTION: This course is designed to enable the student to operate and maintain the basic DACS II. The student interprets messages, provisions equipment, establishes cross-connections, and clears trouble using system documentation. Also, system administration, daily routines, and memory transfer operations are performed.

PREREQUISITES: Experience with digital carrier or course number TR0510, Transmission Principles.

TR3523A– **DACS II SRDC Operation and Maintenance**

COURSE DESCRIPTION: This course is designed to enable the student to operate and maintain the subrate data circuits in the DACS II. The student provisions equipment, establishes cross-connections, and clears trouble using system documentation.

PREREQUISITES: Experience with operating and maintaining a DACS II as covered in *TR3521 DACS II Operation and Maintenance* or *DG3030 DACS II Advanced Operation and Maintenaance.* Student should also have an understanding of digital subrate data.

TR3525– **DACS II DS3U Operation and Maintenance**

COURSE DESCRIPTION: This course covers the DS3U hardware, provisioning procedures, and cross-connections.

PREREQUISITES: This course is designed for students who have had previous training on a DACS II and will be working with the DS3 Facility Terminating Unit.

TR3621– **DACS II 2.048-Mb/s Interface Operations and Maintenance**

COURSE DESCRIPTION: This course is designed to enable the students to perform all aspects of DACS II 2.048 Mb/s interface operations and maintenance required during day-to-day activities.

PREREQUISITES: The student needs a general knowledge of digital carrier transmission and equipment.

TR3624– **DACS II Gateway Operations and Maintenance**

COURSE DESCRIPTION: This course is designed to enable the students to perform all aspects of DACS II Gateway operations and maintenance required during day-to-day activities.

PREREQUISITES: A general knowledge of digital carrier transmission and equipment.

To obtain more information or register for these courses, call:

1-800-TRAINER (select option 2)

In Canada call: 1-800-221-1647

Or write to:

AT&T National Product Training Center
Transmission Marketing Department
5151 Blazer Memorial Parkway
Dublin, Ohio 43017

Documentation Support

The following sections provide descriptions of the following types of DACS II documents:

- Customer Reference Manual
- Operation and Maintenance Manual
- Command and Message Manual
- Quick Reference Guide
- Customer Information Releases.

Customer Reference Manual

This manual provides the overall description of the DACS II and DACS II ISX equipment and features including physical, functional, application, and capability considerations and administrative link connections.

Table 5-1 lists the Customer Reference Manual by select code, subject, issue number, and applicable software release.

Table 5-1. Customer Reference Manual

Select Code	Subject	Iss.	Release					
			1	2	3	4	5	6
365-301-002	DACS II Customer Reference Manual	1	X					
		2			X			
		3			X	X		
		4				X	X	
365-352-000	DACS II Customer Reference Manual	1	X	X	X	X	X	
365-353-000 *	DACS II Customer Reference Manual	1	X	X	X	X	X	X

* Most recent version.

Operation and Maintenance Manuals

The operation and maintenance manuals contain instructions on how to operate the DACS II and how to clear trouble messages. These manuals are intended to be the guide for daily use and for troubleshooting before requesting technical help. The operation and maintenance manuals for the basic core software and all feature packages are available in both MML and PDS versions.

Table 5-2 lists the Operation and Maintenance Manual by select code, subject, issue number, and applicable software release.

NOTE:
The following Release 6.0 Operation and Maintenance Manuals (365-353-011, 365-353-001) contain information for all DS-1 features.

Table 5-2. Operation and Maintenance Manual

Select Code	Subject	Iss.	Release 1	Release 2	Release 3	Release 4	Release 5	Release 6
365-301-601	DACS II Operation and Maintenance Manual	1	X					
365-301-605	DACS II (PDS)	1		X				
365-301-606	DACS II (MML)	1		X				
365-301-615	DACS II (PDS)	1			X	X		
365-301-616	DACS II (MML)	1			X	X		
365-301-617	DACS II (PDS) Subrate Feature	1			X	X		
		2			X	X	X	
365-301-618	DACS II (MML) Subrate Feature	1			X	X		
		2			X	X	X	
365-301-619	DACS II (PDS) *SLC*® 96 Carrier Feature	B			X	X		
		2			X	X	X	
365-301-620	DACS II (MML) *SLC*® 96 Carrier Feature	A			X	X		
		2			X	X	X	
365-301-615AI	DACS II (PDS) 2.048 Mb/s and Enhanced 2.048 Mb/s Features	Prel.			X			
		1			X	X		
365-301-616AI	DACS II (MML) 2.048 Mb/s and Enhanced 2.048 Mb/s Features	1			X			
		2			X	X		
365-301-621	DACS II (PDS) Gateway Feature	1			X	X		
365-301-622	DACS II (MML) Gateway Feature	1			X	X		
365-301-623	DACS II PDS Domestic	2				X		

Table 5-2. (Continued)

Select Code	Subject	Iss.	Release					
			1	2	3	4	5	6
365-352-001	DACS II PDS Domestic	1				X	X	
365-352-011	DACS II MML Domestic	1				X	X	
365-352-021	DACS II PDS 2.048 Mb/s	1				X	X	
365-352-031	DACS II MML 2.048 Mb/s	1				X	X	
365-301-627	DACS II Capacity Expansion Frame, (PDS) Core with DS1, DS3, and Gateway Features	1					X	
365-301-627AI	DACS II Capacity Expansion Frame, (PDS) Core with 2.048 Mb/s and Enhanced 2.048 Mb/s Features	1					X	
365-301-628	DACS II Capacity Expansion Frame, (MML) Core with DS1, DS3, and Gateway Features	1					X	
365-301-628AI	DACS II Capacity Expansion Frame, (MML) Core with 2.048 Mb/s and Enhanced 2.048 Mb/s Features	1					X	
365-353-001	DACS II PDS Domestic	1						X
365-353-011	DACS II MML Domestic	1						X
365-353-021	DACS II PDS 2.048 Mb/s	1						X
365-353-031	DACS II MML 2.048 Mb/s	1						X

Command and Message Manuals

The command and message manuals are the reference documents for all the input and output messages and explanations of all message fields. These manuals were titled Input/Output Reference Manuals in previous software releases. These manuals are available in both MML and PDS versions.

NOTE:
The following Release 6.0 Command and Message Manuals (365-353-002, 365-353-012) contain information for all DS-1 features.

Tables 5-3 and 5-4 list both the Input/Output Reference Manuals and the Command and Message Manuals by select code, subject, issue number, and applicable software release.

Table 5-3. Input/Output Reference Manual

Select Code	Subject	Iss.	Release					
			1	2	3	4	5	6
365-301-603	Volumes I and II	1	X					
365-301-606	DACS II PDS	1		X				
365-301-610	DACS II MML	1		X				
365-301-651	DACS II (PDS) Core	1			X	X		
365-301-651AI	DACS II (PDS) 2.048 Mb/s and Enhanced 2.048 Mb/s	1			X	X		
365-301-652	DACS II (MML) Core	1			X	X		
365-301-652AI	DACS II (MML) 2.048 Mb/s and Enhanced 2.048 Mb/s	1			X	X		
365-301-653	DACS II (PDS) Subrate Feature	1			X	X		
365-301-654	DACS II (MML) Subrate Feature	1			X	X		
365-301-655	DACS II (PDS) *SLC*® Carrier Feature	1			X	X		
365-301-656	DACS II (MML) *SLC*® Carrier Feature	1			X	X		

Table 5-3. (Continued)

Select Code	Subject	Iss.	Release					
			1	2	3	4	5	6
365-301-657	DACS II (PDS) Gateway Feature	1			X	X		
365-301-658	DACS II (MML) Gateway Feature	1			X	X		
365-301-661	DACS II (PDS)	1			X	X		
365-301-662	DACS II (MML)	1			X	X		
365-301-661AI	DACS II (PDS) 2.048 Mb/s	1			X	X		
365-301-662AI	DACS II (MML) 2.048 Mb/s	1			X	X		
365-301-663	DACS II (PDS)	1					X	
365-301-663AI	DACS II (PDS) 2.048 Mb/s	1					X	
365-301-664	DACS II (MML)	1					X	
365-301-664AI	DACS II (MML) 2.048 Mb/s	1					X	

Table 5-4. Command and Message Manual

Select Code	Subject	Iss.	Release					
			1	2	3	4	5	6
365-352-002	DACS II PDS 24 Channel	1				X	X	
365-352-012	DACS II MML 24 Channel	1				X	X	
365-352-022	DACS II PDS 2.048 Mb/s	1				X	X	
365-352-032	DACS II MML 2.048 Mb/s	1				X	X	
365-353-002	DACS II PDS 24 Channel	1						X
365-353-012	DACS II MML 24 Channel	1						X
365-353-022	DACS II PDS 2.048 Mb/s	1						X
365-353-032	DACS II MML 2.048 Mb/s	1						X

Quick Reference Guides

These guides contain frequently used commands organized into categories of functions, tables and illustrations of cross-connections, a summary of corrective action for frame audit messages, and for PDS, the meanings of the command denial condition codes. The guides are intended to support the experienced user and to serve as a handy reference for commands. Different guides cover two feature sets: (1) 2.048 Mb/s interface alone and a (2) subrate, SLC® carrier, DS1, DS3, and clear-DS1. Both MML and PDS versions are available for each feature set.

Table 5-5 lists each Quick Reference Guide by select code, subject, issue number, and applicable software release.

Table 5-5. Quick Reference Guides

Select Code	Subject	Iss.	Release					
			1	2	3	4	5	6
365-301-602	DACS II Quick Reference Guide	1	X					
365-301-607	DACS II PDS	1		X				
365-301-608	DACS II MML	1		X				
365-301-625	DACS II (PDS) 24 Channel	1			X			
		2			X	X		
		3					X	
365-301-626	DACS II (MML) 24 Channel	1			X			
		2			X	X		
		3					X	
365-301-625AI	DACS II (PDS) 30 Channel	1			X	X		
		2					X	
365-301-626AI	DACS II (MML) 30 Channel	1			X			
		2			X	X		
		3					X	
365-352-003	DACS II PDS 24 Channel	1				X	X	
365-352-013	DACS II MML 24 Channel	1				X	X	
365-352-023	DACS II PDS 2.048 Mb/s	1				X	X	
365-352-033	DACS II MML 2.048 Mb/s	1				X	X	
365-353-003	DACS II PDS 24 Channel	1						X
365-353-013	DACS II MML 24 Channel	1						X
365-353-023	DACS II PDS 2.048 Mb/s	1						X
365-353-033	DACS II MML 2.048 Mb/s	1						X

Customer Information Releases

Customer Information Releases (CIRs) are designed both to assist sales personnel and as a vehicle to provide new feature information to customers. These documents can be ordered through the AT&T Customer Information Center.

Table 5-6 lists CIRs by select code, subject and issue.

Table 5-6. Customer Information Releases

Select Code	Subject	Iss.
365-099-031NP	Digital Access and Cross-Connect System II	2
365-099-032NP	Multiple DACS Complex	1
365-099-053TS	DACS II, Technical Specification	1
365-099-055TD	DACS II, Release 2 Features	1
365-099-059TD	DACS II, Stratum 2 Clock	1
365-099-091NP	DACS II, Release 2 Features	1
365-099-093TD	DACS II, Release 3 Features	1
365-099-095IR	DACS II Communication Interfaces Circuit Pack Ordering Information	1
365-099-098IR	New DACS II Dual Digroup Card Announcement and Ordering Information	1
365-099-100MA	Normal Tape Operations for the DACS II, DACS III-2000, and DACS IV-2000 Systems	1
365-099-105TD	DACS II Release 4 Technical Description	1
365-099-111TD	DACS II Release 5.0 Technical Description	1
365-099-123IR	UL Listed DACS II Digital Access and Cross-Connect System	1

Table 5-6. (Continued)

Select Code	Subject	Iss.
365-099-124TD	DACS II Release 5.1 Technical Description	1
365-099-126TS	Digital Access and Cross-Connect System II (DACS II) Release 5.0 Technical Specification	1
365-099-127TD	DACS II DS1 Multipoint Junction Unit Shelf Technical Description	1
365-099-128TS	DACS II DS1 Multipoint Junction Unit Shelf Technical Specification	1
365-099-130TD	DACS II Release 6.0 Technical Description	1
365-099-131TS	DACS II Release 6.0 Technical Specification	1
365-099-132TD	DACS II ISX Release 1.0 Technical Description	1

Product Warranty

AT&T provides a limited two-year warranty for this product. Technical support is provided with the warranty for a specific time period. Your AT&T Account Executive serves as a single point of contact if you encounter difficulties in any area of product support.

Functional Description

6

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Functional Description

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Introduction

This chapter contains the functional description of the DACS II and is intended to provide the reader with a general knowledge of the circuit pack functions and interworkings. Simplified block diagrams and terminology familiar to DACS II technicians are employed in this presentation to appeal to a large audience. Not only will this material benefit the technician, but it will also be useful to anyone looking for a general understanding of how the equipment works. This section is divided into two major headings: Common Equipment Circuit Blocks and Feature Functions.

Common Equipment Circuit Blocks

General

The basic function of DACS II is to provide access to incoming digital signal bit streams to interchange and interconnect (cross-connect) DS0 channels. This is done electronically within the circuitry without making any digital-to-analog conversions. Access to the channels for testing is also done by cross-connections. For test access, the time slots to be tested are cross-connected (mapped) to the time slots in the test access facility. Direct digital testing can be done by using the RTS-5A (remote test system 5A) or RMS-D1 (remote maintenance system-digital) test facility. When using RTS-5A, conversions to analog are required to allow testing voice channels. This conversion may be done externally to the DACS II in the channel bank equipment that terminates the test access facility.

The major circuit blocks of the DACS II are synchronization circuits to produce precise timing waveforms needed to maintain time-slot alignment, the cross-connect network to accomplish the time-slot connections, and microprocessors to manage internal and external operations. Since multiplexing the signal time slots to form higher capacity bit streams is inherent in the cross-connect process, circuit redundancy is needed to protect against the loss of service should a failure occur in a high-channel-capacity pack. Accordingly, all circuit packs carrying more than a 64 DS0 channels are duplicated. Similarly, because of their importance, the synchronizers and power supplies are duplicated. The synchronizers also have the capability of temporarily operating in a stable, free-running mode. Nonvolatile memory is provided to protect against the loss of circuit memory if there is a power failure. Interface plug-ins are provided for communications within the DACS II, with administrative links to external systems, and with the office frame alarms system.

To support the increased capacity of the DACS II CEF (capacity expansion frame), expanded versions of two of these circuit blocks are needed. The two expanded circuit blocks include the EFC (expanded frame controller) and the ECCN (expanded CCN), while the Synchronizer (SYNC) remains unchanged. When the functions of the plug-ins for the new blocks are the same as the corresponding plug-ins for the non-CEF frame, the plug-ins will be described together. Table 6-1 lists the expanded equipment for convenient reference.

Table 6-1. Expanded Plug-ins

Circuit Block	Circuit Pack
EFC	4-Mbyte CPU 8-Mbyte EBX (Expanded Bus Extender) EMTC (Expanded MTC) 8-Mbyte CI 8-Mbyte ECI 40-Mbyte Hard Disk 24-Mbyte Tape SSC for 40-Mbyte Disk
ECCN	Expanded TSI Clock Control Interface Bus Terminator

The DACS II circuit blocks are illustrated in the system architecture block diagram in Figure 6-1 which shows both the non-CEF and CEF alternatives. At the center of this diagram is the main controller with its connections to the other controllers and circuitry in the frame. The units of facility terminating and digital signal processing plug-ins and the duplex CCN (cross-connect network), all of which carry the customer service, are shown across the top of the figure. This figure shows the use of any type unit in the unit positions that requires the fully flexible feature.

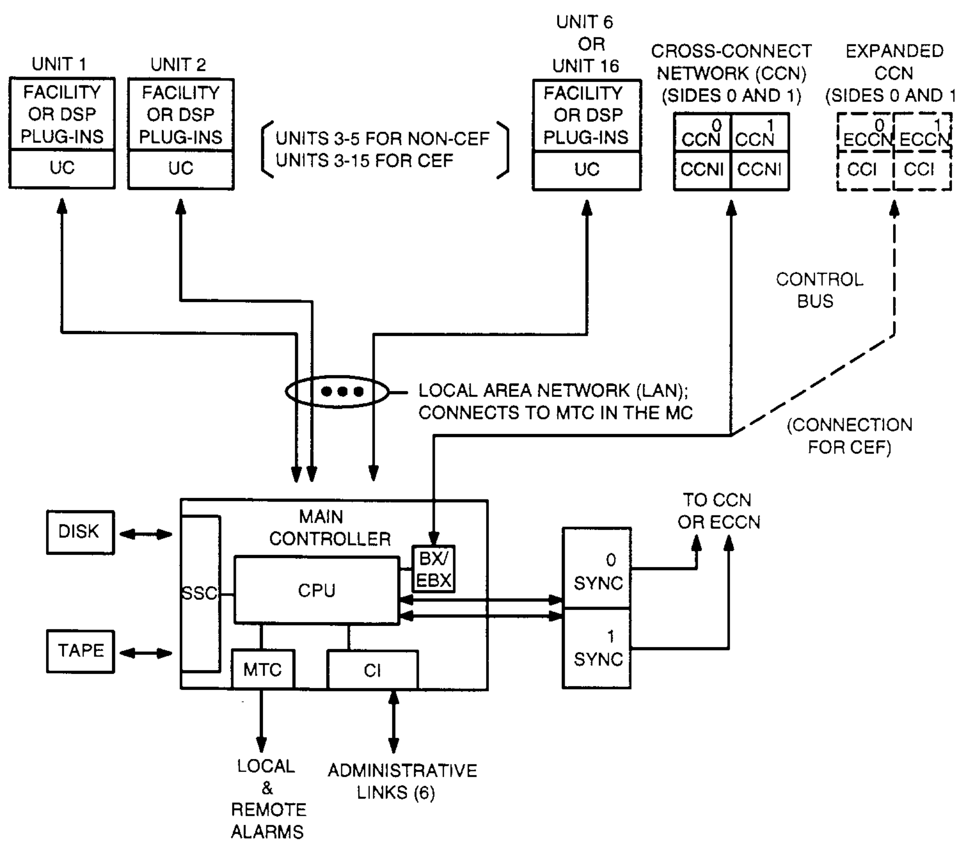

Figure 6-1. System Architecture Diagram

Communication between the UC (unit controller) for each unit and the MTC (maintenance circuit) of the main controller is by means of a LAN (local area network). Communication between the CCN or ECCN and the main controller is by means of a control bus. Connection of the SYNC, nonvolatile memory devices, and the alarms and administrative ports to the main controller is as follows: the SYNCs connect to the main processor, the nonvolatile memory (disk and tape) connects to the SSC (secondary storage controller), the local terminal and outside links connect to the CI (communications interface), ECI (enchanced CI), or HECI (high speed ECI) and the alarm connections go to the maintenance pack. These major blocks are the topics of discussion in the following paragraphs.

Main and Secondary Controllers

The heart of the DACS II microprocessor control system is the MC (main controller). The MC maintains the DACS II operating system, processes input commands and internal interrupt operations, and detects and responds to internal errors and alarms. It communicates with the other controllers to execute the time-slot cross-connections, and it monitors the health of the frame. One result of this monitoring is the selection of one duplicated SYNC to supply timing to the frame and the selection of the associated CCN to carry service. Other results are initiating recovery routines if an error is detected and reporting alarms if a failure has occurred.

The MC consists of the following circuit packs:

- CPU (central processing unit)
- SSC (secondary storage controller)
- CI/ECI/HECI (communications interface)
- MTC (maintenance circuit pack) or EMTC
- BX (bus extender) or EBX.

The CPU contains the microprocessor circuitry and the associated circuit memory. The SSC directs the information exchange with the nonvolatile, backup memory devices– the hard disk and the tape. Updating of the hard disk and recovery of lost information are done through the SSC. The CI, ECI, or HECI is the interface between DACS II and external administrative ports as well as a local terminal. The MTC or EMTC pack is the hub for the LAN and serves mainly as the alarm control point. The BX or EBX provides the dual bus control interface to the duplicated cross-connect network.

The unit controllers, which are the secondary controllers, manage the service provisioning information in the local unit memories. They also process commands from the main controller and send replies or requested information through the UBX (unit bus extender) to the main controller.

In the FTU/IFTUs, the FTMI (Facility Terminating Module Interface) provides communication between the UC and the facility processing circuits in the modules of the unit. In digital signal processing units, the DSPI (Digital Signal Processing Interface) serves as the interface between the processing circuit and its UC. In the cross-connect network for the non-CEF frame, the CCNI (Cross-Connect Network Interface) is the interface between the network and the control bus going to the main controller. For the CEF frame, the CCI (Clock and Control Interface) contains the main controller interface circuitry. The CI (Communications Interface) or ECI is the interface between DACS II and external administrative ports.

Nonvolatile Memories

The hard disk and the tape cartridge for DACS II are referred to as nonvolatile because they are magnetic devices and do not require continuous dc power as do the other memory devices in the DACS II. The hard disk contains a current copy of the cross-connect map and the functional status of the frame. These records are automatically updated by transfers through the SSC and are never more than one command transaction behind. Since this record is automatically updated, it can be corrupted if a failure occurs or if errors are transferred. This is one reason that the backup tape cartridge is provided.

The disk and tape for the CEF frames have expanded capacity so that only one of each is needed to provide the storage capabilities for the expanded MC and the 16 peripheral units. The capacities of these disk and tape units are 40 Mbyte and 24 Mbyte, respectively, compared to 20 Mbyte for these units for the non-CEF frame.

If troubleshooting shows that the hard disk record has been corrupted, the tape data base can be used to overwrite the disk which in turn can be used to boot the data into the frame. The tape must be manually updated; thus, the frame should be queried for out-of-service and failed packs before the data base information is copied to tape. Another use of the tape is to keep a copy of the DACS II internal operating system software. As such, it can be used to boot the frame memories from scratch if there is a catastrophic failure (a crash) and can be used to load new software (for example, maintenance releases or new generic software loads) into the machine.

Internal Synchronization

Figure 6-2 shows an expansion of the SYNCs into their component blocks. Two operating modes are available: (1) the master timing mode and (2) the timing extraction mode.

In the master timing mode, the oscillator circuitry in the TB (time base) pack is used to originate the signal used for timing. The DPLL (digital phase lock loop) circuits work to prevent variations in the frequency of the SYNC output. In the timing extraction mode, the timing is derived from incoming signals. These signals can be obtained through bridged connections to transmission lines connecting to a timing source at the other end of the facility or can be obtained from sinusoidal/square-wave sources wired to the frame. When timing is derived in this way, the SYNC is equipped with a TLI (timing link interface) which extracts the timing and supplies it to the DPLL. The DPLL uses this signal as a timing reference to produce the timing signals that drive the CCN. The DPLL has a 2-way communication link to the MP (main processor) for control and status messages and outputs a hardware error code status indicator to the CCN.

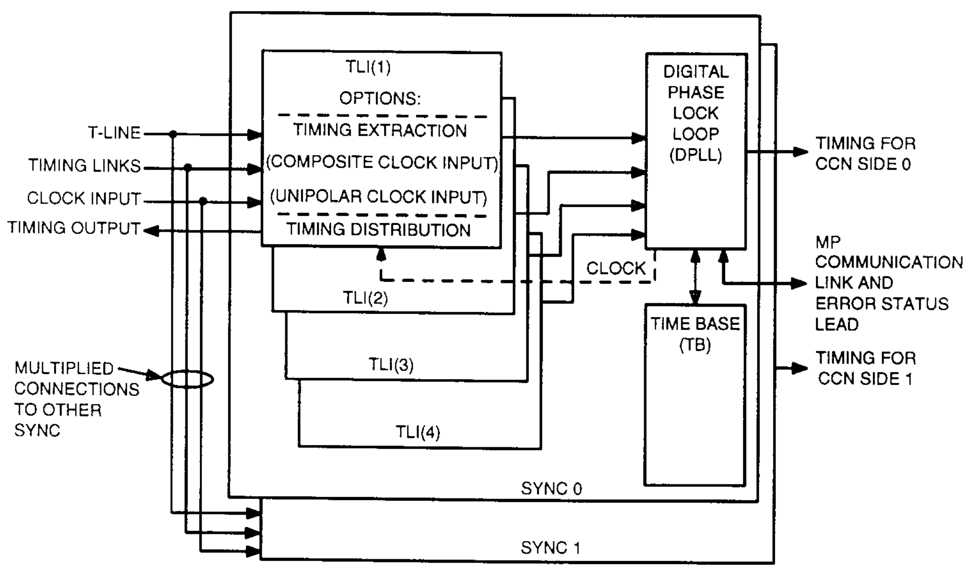

Figure 6-2. Synchronizer Block Diagram

In the timing extraction mode, different codes of TLIs are needed for the different types of incoming timing links. These TLIs are tailored to the line rate and signal format of the incoming line signal or external clock. Among the variations are 1.544-Mb/s transmission lines, 2.048-MHz BSRF (basic synchronization reference frequency), CCITT compatible timing links, sinusoidal/square wave clock signals, and the 64-kb/s composite clock for the Digital Data System. Furthermore, equipment codes of the TLI are available to output a clock signal for distribution to other equipment in the office. In this arrangement, the signal produced in the DPLL is connected to circuitry in the TD (timing distributor) type TLI that produces the output signal.

The TD accepts clocking and framing pulses from the DPLL and generates timing signals for distribution to other equipment within a central office. Each distributor provides four identical outputs. All distributors also provide an interface to the 5-MHz time base CRO (clock reference oscillator) when the SYNC is operating in the master timing mode. The two types of TLI distributors are a 64-kb/s composite clock for use in DDS and a CCITT compatible 2.048-MHz sine wave clock signal.

The entire SYNC function is duplicated so that if the selected active-side SYNC fails or is taken out of service, the other side will be automatically selected for use. During normal operation, one SYNC is active and its mate is cross-coupled to it so that both are running at the same frequency and phase. The active SYNC must be removed from service to cause a switch to the other SYNC. For higher reliability, multiple timing inputs connect to the DACS II by means of the TLI. Timing inputs to the TLI in SYNC 0 are multipled to the corresponding TLI in SYNC 1 so that the same sources are available to both.

DS1 or 2.048 Mb/s Facility Terminating Units

The FTU/IFTU is the peripheral unit type that is grown and equipped to terminate DS1 or 2.048 Mb/s lines. Common equipment in the FTU/IFTU provide the control functions and signal processing for connection to the CCN or ECCN. The NPCs (network processing circuits) provide the line interface and signal processing. The family of NPC codes, each with its own array of software selectable line options, provides all the required line formats and zero code suppression modes for compatibility with other transmission equipment at the other end. The functions of the circuit packs in an FTU/IFTU are described in the following paragraphs. A fully equipped FTU/IFTU consists of four FTMs (facility terminating modules). Figure 6-3 shows the signal rates and conversions that take place in the FTM.

Communication and control circuitry for the FTU/IFTU is contained in the UC (unit controller), the UBX (unit bus extender), and the FTMI (FTM interface). The UC connects to the DACS II main controller over the LANs. Within the FTU/IFTU, the FTMI serves as the interface between the UC and the packs in the FTM, distributing information from the UC and sending replies from the FTM packs. Distributing information from the UC involves decoding the address for the appropriate FTM. The UBX is needed with the UC to buffer and reclock the communications with the FTMI.

Timing and sync pulses from the synchronizer are delivered to the FC (format converter) packs in the FTM from the CCB (cross-connect buffer) or CCI (clock and control interface) packs of the cross-connect network. The FTMI is also timed from the FC packs.

The line interface of the NPC terminates the incoming line signals and provides the compatible framing and signaling format. Among these formats (for DS1) are: Fe (extended superframe), DDS data, D4 channel bank, *SLC®* carrier, and 64-kb/s clear-channel lines. Circuitry for two NPC positions resides on a dual circuit plug-in installed in the FTMs. The NPC also: (1) provides facility performance monitoring, (2) sends and receives facility alarms, and (3) sends carrier trunk conditioning to the other end.

In addition to the line interface circuitry, the DDC contains processing circuitry to change the signals to standard form for multiplexing into higher rate bit streams internal to the DACS II. A PCM (pulse code modulation) transceiver converts the two digroup signals to higher rate signals, and a multiplexer combines these into a single bit stream that is twice the rate of each input. The multiplexer also produces a duplicate output signal for protection if one output (side) fails. These outputs are applied along with the same outputs from the other DDCs in the module to the respective FCs (format converters) of the module. In the FC for each side, these signals are converted from serial to parallel data forms and read out on multiple rails to the respective CCN. The FC for a side goes to the like side of the duplicated CCN, and these same conversions and connections occur for the other (up to three) FTMs in the unit.

When the FTMI is grown in the software data base, the line interface equalizer (for DS1) or the line interface impedance (for 2.048 Mb/s) is specified for the FTM shelf. For DS1 lines, the equalization for the left and right halves of the FTM shelf is specified; this equalization is applied to the outgoing (transmit side) path going to the DSX-1 bay. For 2.048 Mb/s lines, the impedance of the outgoing path is set for either 75-ohm coax or 120-ohm twisted pair. The selection of either equalization or impedance controls whether NPCs for DS1 or PBCs (primary block circuits) for 2.048 Mb/s will be installed in the FTM.

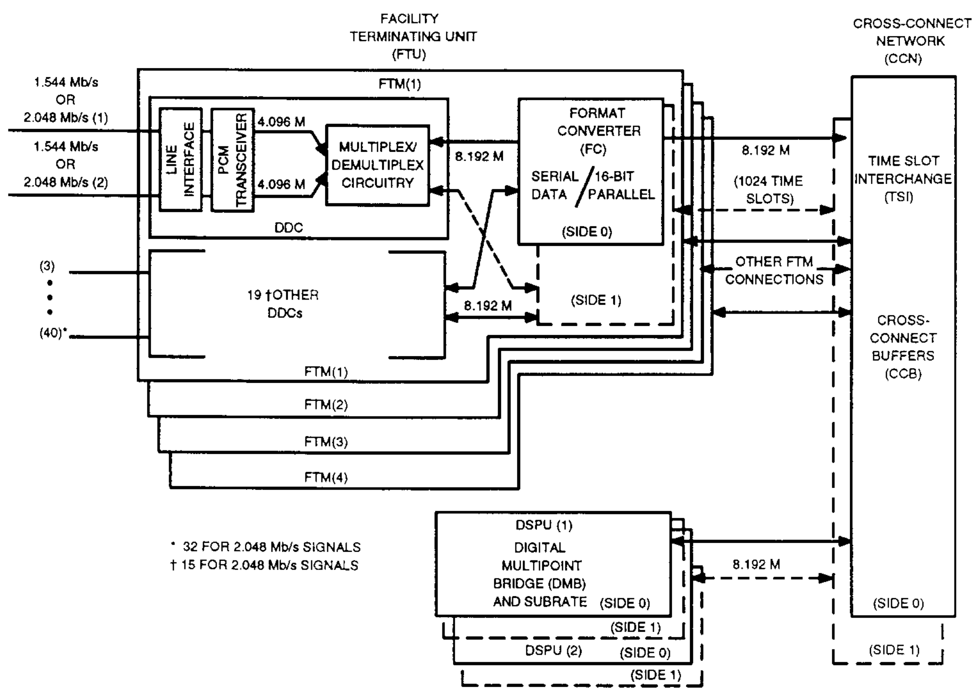

Figure 6-3. Unit and Cross-Connect Network Block Diagram

Cross-Connect Networks

Different cross-connect networks are used for the non-CEF and CEF frames, but the overall function of the network remains the same. That overall function is to accomplish channel cross-connections by the time-slot interchanging operations in the TSI (time slot interchange) packs. These packs are called ETSIs (expanded TSIs) in the ECCN for CEF frames. The TSI or ETSI operations are: connecting unit channel data to network buses, switching time slots out of the network data buses to the unit buses, and connecting the cross-connected data to the unit port. Each TSI or ETSI has access to the network data from all the peripheral units. The switching of time slots into the unit buses is enabled by buffers in the TSIs that store the data so that it can be written into the unit buses in the correct channel sequence. Each facility or digital processing unit connects to the CCN or ECCN over four network buses or ports. These ports have a 4096 time-slot capacity. Each port contains 1024 time-slot data buses, timing, status and error information.

Interconnection of information in the internal bit stream establishes a path through the DACS II that may be a 1- or 2-way cross-connection, a broadcast connection, or connections to the DSPUs for conference bridging. The type of connection is controlled by the input command. This path (or map) is determined by the main controller based on the record of used and available paths in the controller memory. The maps are autonomously transferred to the nonvolatile memory of the disk for backup protection. The CCN and ECCN are single-stage, nonblocking, time division switches.

The CCN or ECCN is duplicated so that cross-connections can be reproduced in the other network by the main controller without any loss of service should a failure occur on the active side. If the main controller is also out of service when a failure occurs in the CCN or ECCN or duplicated peripheral unit pack, other packs in the unit will cause the switchover to the other side of the cross-connect network. The switchover can also be manually forced to allow maintenance on the inactive side.

Three CCNs are available for the different size DACS II frames: the CCN for the original multibay frames (with up to six units), the CCN for the single-bay frame (with two units), and the expanded CCN (ECCN) for the capacity expansion frame (with up to 16 units). These versions of the CCN are described in the following paragraphs.

CCNs for Non-CEF Frames

When fully equipped, the CCN for the original multibay frame is a 24,576 X 24,576 time-slot switch because it handles 6 times the 4096 time slots (per unit). Each side of the CCN mounts up to 36 TSIs, one CCNI, and one CCB for each peripheral unit. In a fully equipped frame, six TSIs are required per unit to connect each unit from and to itself and the five other units. The CCNI (CCN interface) communicates between the CCN and the MC and contains the error summary register for the CCN. The CCB (cross-connect buffer) produces the timing and sync pulses from the synchronizer circuit block. The TSI switches time slots from the network data buses from all the peripheral units to the CCB for conversion to the port going to the associated unit. Power for the duplicated network is obtained from power units in a separate shelf.

The CCN for the single-bay frame is a scaled down version of the above; it is a 8192 X 8192 time-slot switch because it serves up to two units. This network is distinguished in the software as the CCN2. Fully equipped, it contains four TSIs per side, one CCNI per side, and two CCBs per side. Power is obtained from power units in a separate shelf.

ECCN for CEF Frame

The ECCN for the Release 5.0 CEF is a 65,536 X 65,536 time-slot switch because it handles 16 times the 4096 time slots (per unit). Each side of this duplicated network mounts one CCI (clock and control interface), one ETSI per unit (16 total), and two BT (bus terminators). The CCI regenerates clock and timing from the SYNC, communicates between the expanded MC and the ETSIs including master resets from the MC, and provides error detection for the ECCN. The ETSI switches time slots from the network data bases from all peripheral units to an associated peripheral unit.

There are no separate power units for the ECCN. All circuit packs are powered from –48v power feeds.

Digital Signal Processing Units

These are equipped with the appropriate duplicated DSP circuit packs to produce custom arrangements such as DS0 channel bridging or subrate data multiplexing. By being separate from the facility terminating units, the full time-slot capacity of a unit is available at the DSPUs to allow almost any size or type connection without sacrificing any termination capacity in the facility units.

DS0 channel bridging is enabled by installing DMB (digital multipoint bridge) circuit packs in the DSPU. Each DMB consists of a single circuit pack that serves both the input and output functions. Channels to be bridged are cross-connected in the CCN/ECCN, bridged in the DMB, and returned to the CCN/ECCN to be added to the data stream. This bridging is done digitally without decoding the channel information. Each DMB circuit pack is treated as two separate bridging NPCs that process a 512 time-slot bit stream. The DMBs are duplicated for protection against service loss and connected to the respective sides of the CCN.

Among the bridge configurations that can be supported are the symmetrical and data polling. The symmetrical configuration is a 2-way communications circuit between all bridge legs. The data polling network is a one-way broadcast from the backbone leg (BBL) to the broadcast legs (BRD). The broadcast legs are combined (added) in the DMB and transmitted to the backbone leg. The BRD to BBL direction can also be processed for gain, echo suppression, and noise guard through the DMBs. Broadcast connections are actually formed outside the DMB in the CCN.

Other DSP plug-ins provide subrate channel data processing and C-bit processing for the enhanced 2.048 Mb/s interface feature. Subrate processing includes those functions into the DACS II that are done by external DDS multijunction units and subrate multiplexers. These functions are described under the heading *FEATURE FUNCTIONS.* The CPR (C-bit processor) plug-in monitors and sources signaling C-bits on 2.048-Mb/s lines. This function is described further in Chapter 15.

Frame Alarm Indications

Extensive error detection and handling takes place in the DACS II. For example, for a hardware error, the DACS II evaluates all the error inputs including any from power units and reports the results in an ERR ANALYSIS message. These processes and those that check for software errors are not detailed in this manual. General descriptions of the following are provided here:

- Circuit pack failures
- Carrier failure alarms
- Facility performance alarms.

Circuit Pack Failures

Circuit pack communication and operations are continuously monitored by the main controller to check for errors. If errors are detected, the main controller institutes an error recovery routine which confirms that the error was not a transient and runs diagnostic tests on the suspect pack. The suspect pack is also removed from service, and service is switched to the other side if the circuit group is duplicated. If the tests fail, an office alarm is registered. If the tests pass, the CP (circuit pack) must be manually restored to service. In the DS3 unit, all the transmission packs are included in protection switching groups. This switching to a standby spare prevents the loss of service due to the failure of a single pack.

Carrier Failure Alarms

These show a loss of incoming signal, framing, or high transmission errors, or receipt of a remote alarm signal from the equipment at the other end of the line. Incoming failures are reported in an output message as a red alarm, and the receipt of the signal that indicates a local alarm at the other end is reported as a yellow alarm. Either condition also generates an office alarm. Facility protection switching is provided with the *SLC* carrier feature to switch service to the protection line and thereby avert a carrier failure situation. Whenever a red alarm exists, DACS II sends a yellow alarm signal to the other end. Additional carrier failure alarm conditions that are reported in output messages are:

- Simultaneous red and yellow DS1 alarms

- AIS (alarm indication signal), also referred to as the all 1s signal
- Local and remote alarms from a digital multiplex interface frame (DMI/BOS signaling format).

The AIS (all 1s signal) is a digital signal associated with a maintenance alarm detected on a defective maintenance span. DACS II transmits the AIS signal in the direction of the failure as a substitute for the normal signal. It is intended to show other equipment (downstream) that a failure has occurred elsewhere and to inhibit local alarms so that the defective section can be identified by the local alarm indication.

The programmable AIS alarm (Release 4.1) allows the user to select how the alarm indication signal from the far end will be reported. The DACS II user can select whether a major alarm, minor alarm, or no alarm is generated. Release 4.0 alarm escalation rules will be applied for the AIS alarm.

During a carrier failure, the affected NPCs send trunk conditioning and trouble insertion words out on the channels. Trunk conditioning is used on channels with signaling to cause office switching equipment to discontinue calls and stop charges. Trouble insertion words are sent in the message part of the channel and are necessary to signal trouble on data circuits. The codes for these trunk conditioning or insertion words are entered as part of the cross-connect commands.

Facility Performance Alarms

Microprocessor circuits in the NPCs detect and record various line error conditions. The results of this monitoring are used to provide status information on demand and to register office alarms when prescribed thresholds are exceeded. The monitored parameters vary depending on the type of NPC, but the following list for DS1 lines serves as an example: (1) line bit errors, (2) errored seconds, (3) severely errored seconds, (4) cyclic redundancy check errors, and (5) carrier reframing activity. Current counts are available on demand by requesting the NPC status, and accumulated counts are obtained by requesting the count for a particular facility parameter or as provided in the daily (midnight) report.

The alarm thresholds for the facility parameters are set initially when the NPCs are provisioned for service. Unless specific alarm thresholds are entered, default values apply. Up to three additional values for each alarm can be loaded into the DACS II to serve as options that can be selected initially or by means of a change command.

Status Panel Functions

The status panel conveys status and alarm information regarding the DACS II and provides an administrative port (TTY1) for connection of a console terminal. This is a multiple of administrative link 1 and allows connection of a roll-up terminal while the regular terminal is disconnected from the back. Figure 6-4 shows the status panel for the non-CEF frame. The one for the CEF has the same front panel features, but it is mounted on a plug-in.

There are five LED indicators on the status panel. The classification of the alarms and the color of the LEDs vary on panels used outside the U.S.A., but the following gives the domestic stampings:

- FRAME ALARM - CRITICAL: Indicates a service-affecting failure affecting more than 120 channels (red LED)
- FRAME ALARM - MAJOR: Indicates a service-affecting failure affecting equal to or less than 120 channels (red LED)
- FRAME ALARM - MINOR: Indicates a non-service-affecting failure (yellow LED)
- MAIN CONTROLLER - FAILURE: Indicates a failure of the main controller (red LED)
- FRAME ALARM ACO (ALARM CUTOFF): Indicator that is lighted when the alarm cutoff switch is operated (green LED).

There are four switches on the status panel that do the following functions:

- FRAME ALARM - ACO: Disables the audible alarm
- FRAME ALARM - LAMP TEST: Checks for failed lamps by lighting all lamps on the status panel
- MAIN CONTROLLER - RESET ENABLE: Switch that enables (ON position) or disables (OFF position) the main controller reset switch
- MAIN CONTROLLER - RESET: Resets the main controller provided the RESET ENABLE switch is in the ON position.

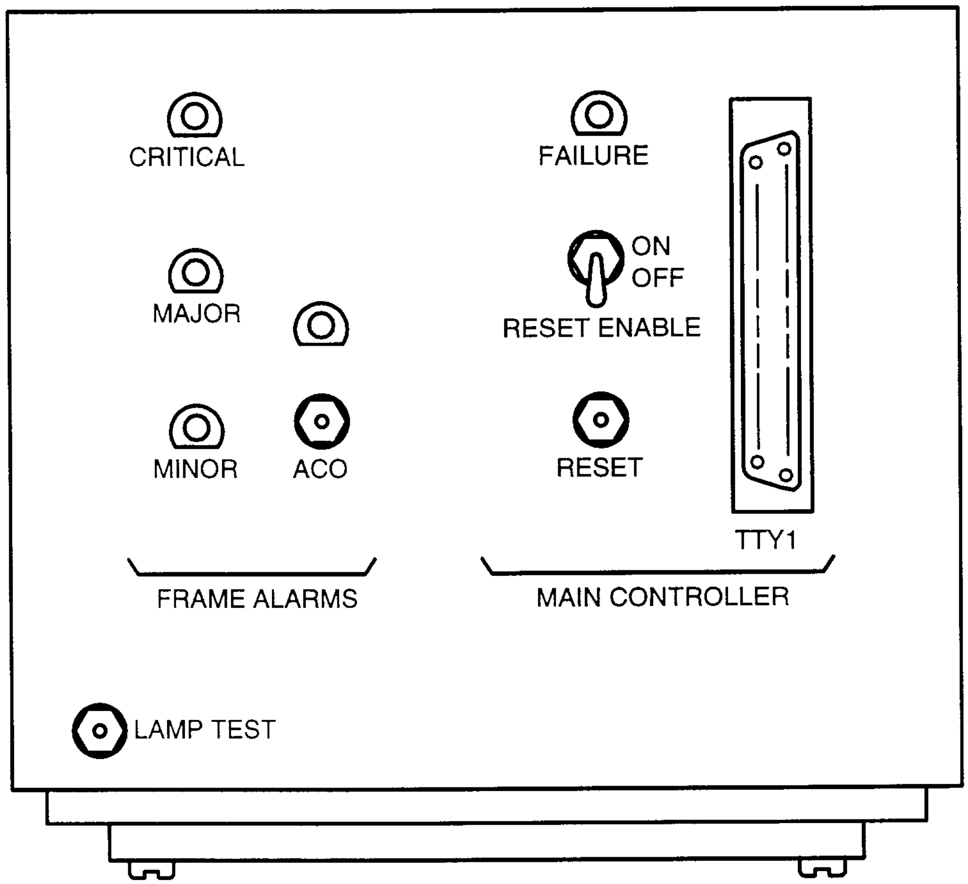

Figure 6-4. Status Panel (Non-CEF)

Powering

Power distribution and fusing for the frame are done on the main fuse and alarm panel and on shelf fuse blocks. Office battery is delivered over four feeders so that the loss of any input will not interrupt service. These feeders are fused at the fuse and alarm panel with 70-type fuses that provide a visual indication when blown and automatically activate office alarms.

Power units in the frame produce lower dc voltages derived from the –48 volt input (or –60 volt input for some export applications). Secondary feeders distribute power to groups of converters for the major circuit blocks in the frame (controllers, SYNCs, CCNs, DSPUs, FTU/IFTUs, and the hard disk). Each side of the SYNC and CCN has its own converter group. Different codes of converters are used for the various output voltages needed in each group, but each one has common protection mechanisms. These mechanisms are a power interlock to turn the converter off whenever the latch is opened for removal and power shutdown circuits to prevent overvoltage or overcurrent damage. A red LED on each converter lights when a shutdown circuit operates, when the output fails, or when the latch switch is turned off. A power converter failure causes an office alarm. The 563A converters for the DS3 unit also have a green LED that lights to show that the power is on.

The power protection philosophy for plug-in power units is based on the use of redundant power converters that supply the load in a converter group when a converter fails. For DS3 units, the number of power converters must grow from two to three when the number of service MXR pairs grows from three to four.

For the ECCN of the CEF frame, the CCI and ETSI circuit packs are powered directly from –48 volts.

Feature Functions

DACS II *SLC* Carrier Direct Interface

The *SLC* carrier direct interface eliminates costly external equipment required to terminate *SLC* carrier facilities and provides grooming functions for these interfaces. Special NPC plug-ins (S96D and SS5D) allow the DACS II to terminate lines from connecting RTs for the following: *SLC* carrier Modes I and III and *SLC* Series 5 carrier FPB (feature package B) and FPC. The *SLC* 96 carrier Mode III or *SLC* Series 5 carrier FPC configuration (Figure 6-5) multiplexes special service channels only on up to two or four (Series 5 FPC) bidirectional DS1 facilities. Each Mode III configuration uses a 2.2-kb/s Fs data link to carry alarm and protection switching information between the RT (remote terminal) and DACS II. The Series 5 FPC configuration uses the ESF framing format that has a 4-kb/s data link derived from the DS1 bit stream. The DACS II terminates the Mode III or Series 5 carrier lines, processes and terminates the *SLC* carrier data link, supports facility protection switching between the *SLC* carrier RT and

DACS II, and routes the associated DS0 channels onto intraoffice or interoffice facilities, depending on the application.

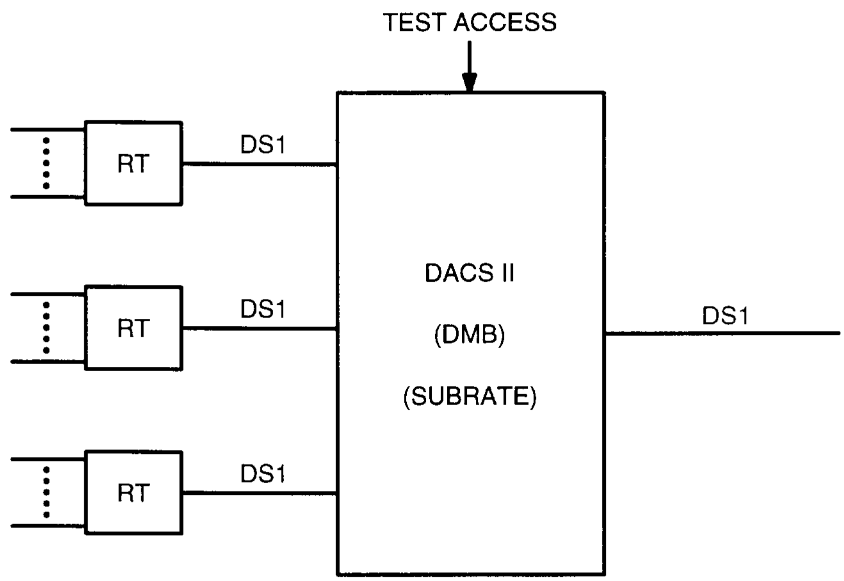

Figure 6-5. ***SLC*** **96 Carrier Mode III and** ***SLC*** **Series 5 FPC Carrier Interface**

The *SLC* 96 carrier Mode I or Series 5 FPB configuration (Figure 6-6) carries both locally switched and special service channels on up to four bidirectional DS1 facilities. The *SLC* carrier data link carries alarm, protection switching, and maintenance information between the RT, DACS II, and the digital switch. DACS II terminates the Mode I or Series 5 FPB interface, passes the switched DS0 channels and its associated data link maintenance information to a digital switch, supports facility protection switching between the *SLC* carrier RT and a digital switch, and grooms out the nonswitched channels onto intraoffice or interoffice facilities, depending on the application.

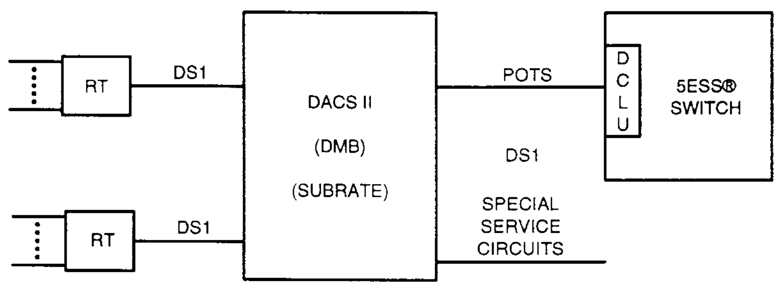

Figure 6-6. ***SLC*** **96 Carrier Mode I and** ***SLC*** **Series 5 Carrier FPB Interface**

Framing Format for *SLC* 96 Carrier Interface

The *SLC* 96 carrier RT uses the Fs framing format to communicate with the central office equipment. The Fs framing format is a 4-kb/s data link (on digroup A) with 2.2-kb/s carrying data and 1.8-kb/s sharing the bit position with the D4 signaling frame (Fs) format. The Fs framing format is derived from the standard D4 channel bank superframe format.

SLC 96 Mode I 5:4 Protection Feature

Beginning with Release 4.1 software, a 5:4 protection arrangement for the Mode I pass-through feature will replace the existing 5:5 arrangement. This architecture is described in Chapters 2 and 4. There is no protection line between DACS II and the digital switch with the 5:4 arrangement; all switching is done as Mode I stand alone with no end-to-end switching. Every digroup (including DGA) will only be protected between DACS II and the RT; no protection switching is performed on the DL digroups.

Framing Format for *SLC* Series 5 Carrier FPC Interface

The *SLC* Series 5 carrier RTs communicate with the central office equipment by means of a 4-kb/s data link derived from the DS1 bit stream of digroup A. The framing format for this data link is the ESF (extended superframe format) with the D4 channel counting sequence.

Circuit Pack Requirements for *SLC* Carrier Interface

The DACS II hardware required to achieve the *SLC* carrier direct interface consists of the TG183 *SLC* 96 carrier dual card (S96D) and the TG184 *SLC* Series 5 carrier dual card (SS5D). The TG183 pack is also used for *SLC* Series 5 carrier FPB with Specials which is the Series 5 equivalent of *SLC* 96 carrier Mode I. These circuit packs can be used in any of the DDC (dual digroup circuit) slots of the facility terminating units. The S96D and SS5D circuit packs can be grown in DACS II as either a DS-type or a DE-type NPC. When grown as a type DS NPC, these cards provide a line interface with the following characteristics:

- Fs or ESF format DS1 signal (as required) with data link for status and protection switching communications
- 9-state signaling for coin telephone circuits
- *SLC* carrier alarm handling and data link communications
- Facility performance monitoring
- Line signal loopback capability.

The TG80B circuit pack can be used for the *SLC* 96 carrier Mode I and Mode III non-data link carrying digroups; it can also be used for the *SLC* Series 5 carrier FPB w/S interface for non-data link carrying digroups. The TG184 is required for all digroups for the *SLC* Series 5 carrier FPC interface.

When grown as a DE type, the S96D and SS5D circuit packs perform all the functions of the DDC. The DACS II software enables the line protection switching and allows all 96 channels from the different *SLC* carrier digroups to be addressed on digroup A by means of the DACS II commands. The protection switching is done by automatically cross-connecting the failed line channels to the standby protection line.

To support the S96D circuit pack, the DACS II processor must be able to control the circuit pack to terminate or pass-through the individual fields of the data link. It must read stored data link data and generate data link data as required to allow the S96D to transmit over the data link.

Alarms in *SLC* 96 Carrier Mode III Interface

The alarm field of the data link specifies framing, major, minor, power/miscellaneous, and digroup alarms as well as FELP (far-end loopback) command messages for all shelves. DACS II recognizes, detects, and declares the associated alarm condition when an alarm message is received in the alarm field of the data link from the RT.

Alarms in *SLC* 96 Carrier Mode I or Series 5 Carrier FPB Interface

DACS II can recognize, detect, and declare alarm conditions from either the RT end or the local switch end. DACS II will always intercept and overwrite the alarm bits of the data link, regenerate other bits, and transmit out over the data link to the far end. Therefore, when a failure occurs between DACS II and the digital switch, instead of generating an alarm condition on the entire DS1, DACS II will trunk-condition each channel of the affected POTS circuits in the direction of the RT. In this way, the non-locally- switched channels between the RT and DACS II remain unaffected and their service is not impaired.

Alarms in *SLC* Carrier Series 5 FPC Interface

Three types of alarms are available from the *SLC* Series 5 carrier system:

- The AIS (alarm indication signal) on each digroup
- Yellow alarm on each digroup
- Alarm information on the digroup A data link for all digroups.

The alarm information carried on the data link includes major, minor, power/miscellaneous, and carrier line failure alarms for the near end and the far end. DACS II recognizes, detects, and declares all alarm conditions received from the *SLC* Series 5 carrier system.

Maintenance in Mode III or Series 5 FPC Interface

DS1 Facility Monitoring

DACS II monitors for and detects loss of data link data, OOF (out-of- frame) conditions, LOS (loss-of-signal) conditions, and BPVs (bipolar violations) for *SLC* 96 carrier, and CRC (cyclic redundancy checking) for Series 5 on the DS1 lines.

Line Loopbacks

There are two line loopbacks supported by DACS II in the *SLC* carrier interface. The first is the LILB (line interface loopback), where the DS1 signal is internally looped back to sectionalize a failure to the DS1 line interface. DACS II can do an LILB automatically after a protection switch is done. DACS II does this loopback the same way it is done in the *SLC* carrier systems. The second type of loopback is the LLB (line loopback). DACS II is capable of initiating or terminating an LLB in response to a manual request entered over one of the administrative links. If the LLB is initiated by DACS II, the FELP message is used to request that the channel bank loop the incoming DS1 signal to the output bitstream. If DACS II receives an FELP message from an RT or DCLU (digital carrier line unit), DACS II performs a full DS1 loopback towards the bank it received the message from. LLBs allow craft to do single-ended fault location of the looped digroup from the near end. The LILB and LLB are illustrated in Figure 6-7.

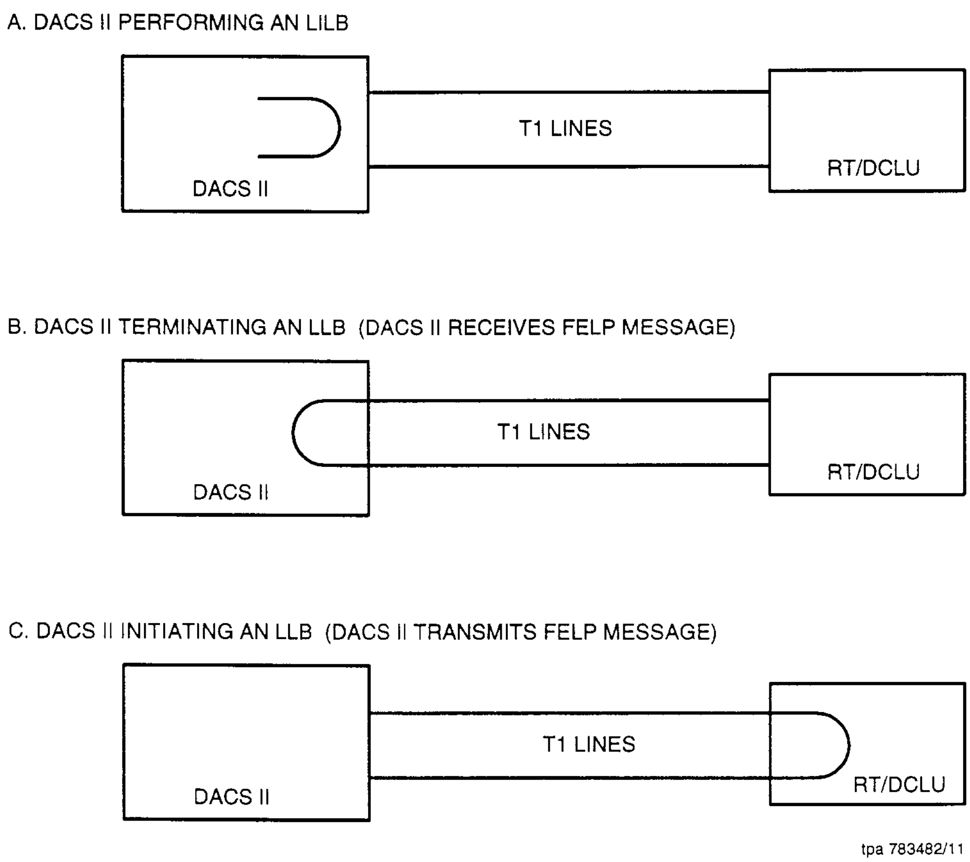

Figure 6-7. Line Interface and Line Loopbacks

Protection Line Switching

A protection line and the associated digroups at each end can be equipped to carry service if one of the primary lines fail. Switching of service onto the protection facility is accomplished by coordination of the equipment at each end of the facility over the *SLC* carrier data link. At the DACS II end, the facility switching is accomplished by automatically cross-connecting all the affected service channels to channels of the protection digroup. Protection switching can also be initiated manually by entry of a command. When not directly in use, the protection line is continuously powered and monitored and carries duplicate service for the RT A-shelf main line. Since the protection line must be able to carry DGA service, the DGP must be provisioned with a *SLC* carrier data link.

Maintenance in Mode I or Series 5 FPB Interface

DACS II performs the same maintenance procedures for both special service channels and POTS channels. For protection switching, there is a protection line on the RT side of DACS II. When the digroup with the data link needs to be protected, DACS II will ensure that the data link continues to be passed through to the switch. If non-locally-switched special service channels are involved on the failed line, DACS II reconfigures its cross-connect map and switches the special service channels to the protection digroup.

CIU for *SLC* Carrier Series 5 Carrier

The CIU (craft interface unit) can either be plugged into the CTU (channel test unit) of a Series 5 carrier RT, or it can be connected to a DACS II administrative port. All the transmission and signaling options for the channel units are entered from the CIU by commands sent to the BC (bank controller). The CIU transmits the information to the BC, which stores the information in nonvolatile system memory. Since the information is stored, the provisioning can be done before the channel units are installed; then when installed in the frame, the BC writes into the channel unit registers.

DACS II Subrate Feature

The DACS II Subrate feature is implemented in DACS II by adding two new circuit packs to the existing DSPU (digital signal processing unit). The SRM (subrate multiplexer) and the MJU (multipoint junction unit) circuit packs under the control of the software provide all the functions of a DDS hub including the following:

- Subrate multiplexing
- Dataport error correction
- DS0A and DS0B cross-connect capability

- Secondary channel capability
- Multipoint bridging
- Parity channel error correction.

Figure 6-8 shows that access to the Subrate feature is provided by cross-connecting an incoming channel from a facility digroup to a DSPU equipped with SRM and MJU circuit packs. The required digital data functions are performed, and the resulting signal is sent back to the CCN/ECCN (cross-connect network). Multiple circuit processing functions such as those for a circuit that requires both subrate multiplexing and multipoint bridging are performed by connecting the desired functions in tandem by means of the CCN/ECCN. Functions located on the same Subrate feature card can also be connected in tandem by means of the CCN. Subrate error correction can be associated with any multiplexer or MJU circuit, or it can exist as a separate stand-alone function. Once all required processing is performed, the signal is then cross-connected by means of the CCN/ECCN to the out going facility. The internal cross-connections are done automatically by the system.

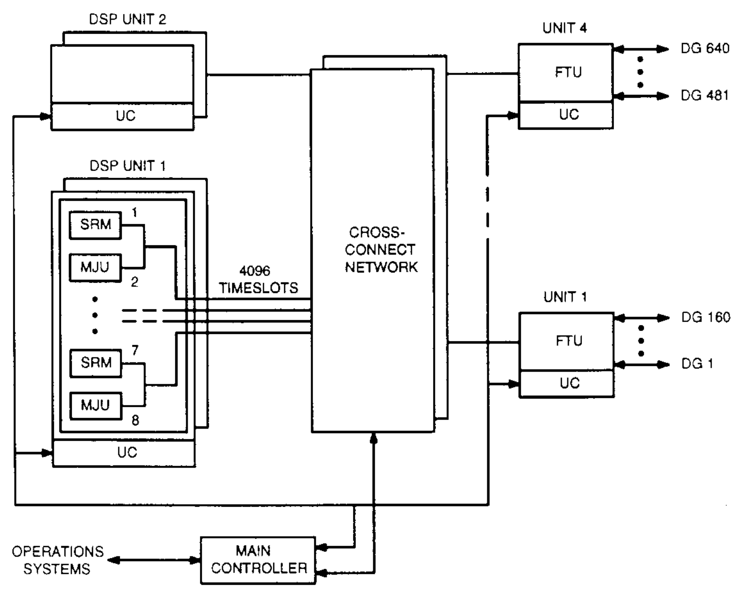

Figure 6-8. DACS II Subrate Feature—System Architecture

SRM Circuit Pack

The SRM circuit pack provides standard digital data subrate multiplexing of 2.4, 4.8, and 9.6-kb/s DS0A formatted signals and dataport error correction. The SRM functions are illustrated in Figure 6-9. The SRM circuit pack provides three types of subrate multiplexers that multiplex five, ten, or twenty subrate channels. Any subrate channel interfacing the SRM circuit pack can have dataport subrate error correction performed on it as an independent function, or in combination with multiplexer processing. Similarly, 56-kb/s DS0A channels can interface the circuit pack and have parity channel error correction performed as an independent function. This function can also be performed on the DS0B channel associated with any multiplexer.

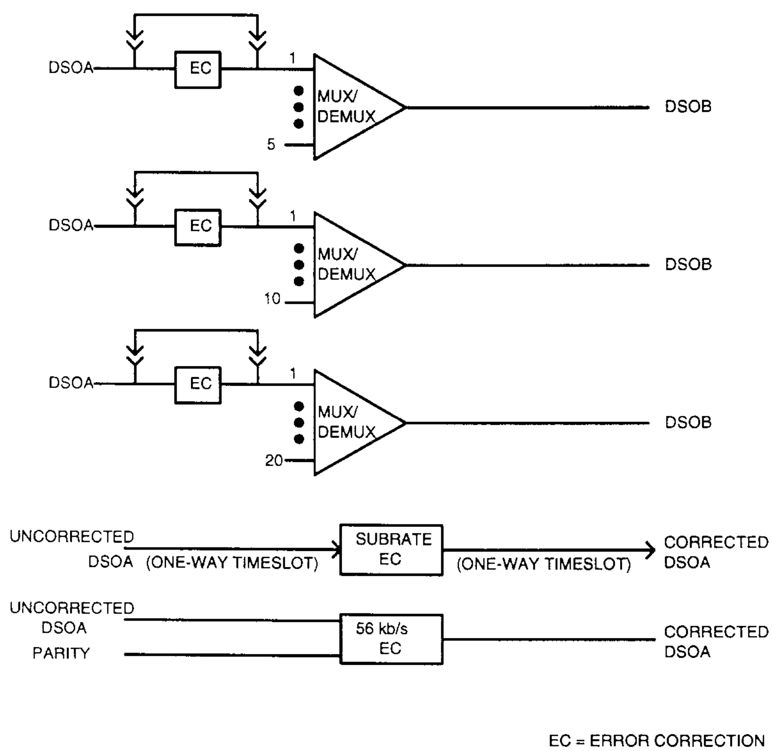

Figure 6-9. SRM Functions

MJU Circuit Pack

The MJU circuit pack provides multipoint bridging of subrate and 56-kb/s DS0A formatted signals and provides dataport error correction. These functions are illustrated in Figure 6-10. This bridging is equivalent to that done in external multipoint junction units. Each MJU provides one control leg and four branch circuits. Multipoint circuits requiring more than four branches are formed by cascading MJU branch circuits to the control leg of additional MJUs. The MJUs operate at 2.4, 4.8, 9.6 and 56 kb/s and do the signal processing necessary for the secondary channel capability. As with the SRM circuit pack, channels interfacing the MJU circuit pack can have subrate or parity channel dataport error correction done on them as an independent function, or as part of the MJU processing. The MJU circuit pack also provides DDS maintenance functions (blocking, branching, and loopback) in response to ABATS (automated bit access test system) commands. The HUBID (hub identifier) must be provisioned by software before the MJU can be grown.

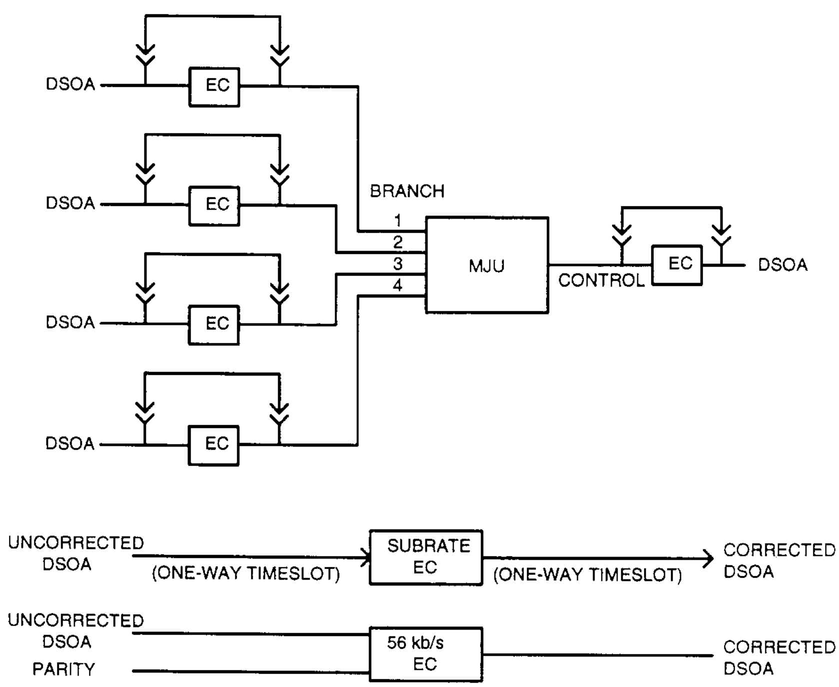

Figure 6-10. MJU Functions

DACS II Subrate Capacities

The DSPU supports up to eight circuit packs that are duplicated for protection. The DSPU can support any combination of SRM, MJU, and other circuit packs such as the DMB (digital multipoint bridge) that are designed for use in the DSPU. Each circuit pack position has a capacity of 512 time slots.

The MJU circuit pack supports up to 102 multipoint junction units with 1 control leg and 4 branch circuits per multipoint junction unit. The number of subrate multiplexers supported on the SRM circuit pack depends on the mix of 2.4, 4.8, or 9.6-kb/s channels. An SRM supports five 9.6-kb/s circuits, ten 4.8-kb/s circuits or twenty 2.4-kb/s circuits. The 5-circuit SRM uses 6 time slots per multiplexer. The 10-circuit SRM uses 11 time slots per multiplexer. The 20-circuit SRM uses 21 time slots per multiplexer. These capacities do not include error correction. Three time slots are required if parity channel error correction is included on a 56-kb/s DS0A channel. Additional time slots are required to do subrate DS0A error correction only when there is no multiplexer or MJU involved. The system reserves the total number of time slots needed for each function to ensure that access is always possible for every channel or port. This ensures that the system will be nonblocking for all cross-connections.

DACS II Subrate Memory Administration

The subrate data base and all operations are controlled by the main controller in the frame; there is not a separate controller for the subrate as with the original DACS. The software for subrate is downloaded from tape to the DACS II hard disk when the frame software is installed or updated. All equipment status and circuit maps associated with the Subrate feature are stored on the DACS II hard disk system as a backup for the volatile memory in the frame. Data on the disk is further backed up by storage on the DACS II tape system. If there is a loss of data in the volatile memories (RAM), DACS II can be rebooted from a cold boot. Cold boot is defined as a manual reset of the DACS II that results in all controllers being reset, the data base being downloaded from the hard disk, and all hardware assignments being reestablished from disk information.

DS3 Termination Feature

General

The DS3 feature allows the use of a DS3U (DS3 unit) in the frame. Each DS3U terminates up to six DS3 coaxial lines and contains the equipment to demultiplex the DS3 asynchronous signals into component DS1 signals and to DS0 channels for connection to the existing CCN/ECCN for cross-connection. DS0 channels from other facilities connected to the CCN/ECCN are assembled into DS3 signals for connection to the DS3 lines in the other direction. Once derived, the DS0 channels can be cross-connected to other DS0 channels, to the DSPU, or to test access equipment for transmission and signaling tests. The DS3U equipment also offers DS3 and DS1 signal performance monitoring.

Since one DS3 signal contains 28 DS1 signals, protection switching is provided in the DS3U to prevent the loss of service owing to the failure of any single circuit pack in the DS3U. This switching is for a failure of any DS3U circuit pack; there is no spare DS3 facility nor DS3 facility switching. This same approach to protection switching is used in the DACS III-2000 and DACS IV-2000 equipment.

The following subsections provide the functional description of the DS3U circuitry and the DS3U protection switching.

Transmission Paths

Figure 6-11 shows a simplified block diagram of the DS3U equipment. The FLI (facility line interface) pack forms the interface with the DS3 coaxial lines on the facility side of the unit, and the FMT (formatter) forms the interface with the CCN/ECCN on the DACS II side. At the heart of the MMFG is the MXR (multiplexer) which contains the muldems (multiplexer-demultiplexers) to make the signal conversions between the DS3 and DS1 (M13 muldem) and between the DS1 and DS0 (M10 muldem). The functions of these packs are detailed in the following subheadings for those packs.

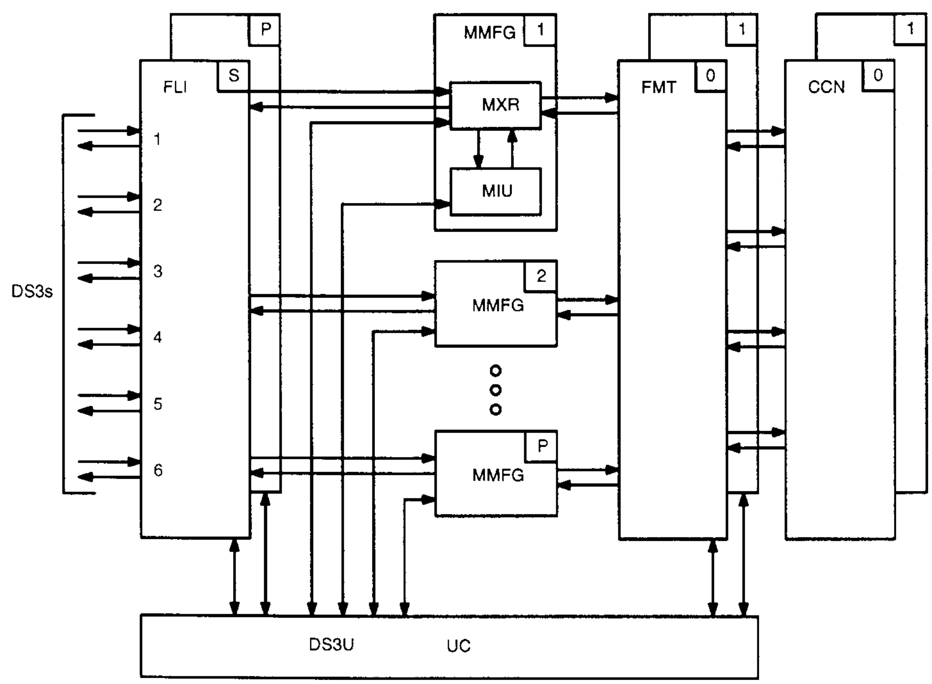

Figure 6-11. Simplified DS3U Block Diagram

FLI Pack

This pack terminates up to six DS3 coaxial lines for connection to the MXR positions in the DS3U. In addition to the signal termination that involves both impedance matching and signal level equalization, the FLI also: (1) performs bipolar/unipolar signal conversions, (2) recovers DS3 line clock signal for MXR demultiplexing functions, and (3) accomplishes DS3 signal loopback on an out-of-service MXR when the pack is diagnosed. Two FLI packs are provided in the DS3U for protection switching. The line signals pass through relay contacts for the service and protection FLI packs in the unit so that the DS3 signals can be connected around the service FLI to the protection FLI if the service pack fails. The FLIs (working with the FMT packs) also accomplish the MXR protection switching on the line side of the MMFG packs. If any of the six MMFGs fails, the FLIs and FMTs simultaneously switch DS3 data to the protection MMFG. Further details on the operation of the protection groups in the DS3U are covered under a separate heading. Circuitry in the two FLIs maintains 75-ohm line impedance whether one or both of the unit FLIs are present.

EMXR/MXR Pack

Figure 6-12 shows an expanded block diagram of the data flow through the M13 and M10 muldems in the MXR pack. At the FLI interface on the pack, the MXR selects either the service or protection FLI to accomplish protection switching of the FLI on the DACS II side. In the direction of transmission toward the CCN/ECCN, the M13 muldem demultiplexes the DS3 signal into 28 DS1s which are applied to the 28 PCM transceivers in the M10 muldem. Each transceiver (PCM blocks in Figure 6-12) reformats the 24-channel data and signaling and the FDL (facility data link) into a 32-channel 4.096 Mb/s serial signal that is combined with the signal from the other transceiver for the pair in the channel controller circuit. The channel controller multiplexes the two 4.096 Mb/s signals into a single 64-channel 8.192 Mb/s serial stream. The FMT (formatter) interface interleaves two pairs of these 8.192 Mb/s signals into a 16.384 Mb/s serial stream. Seven such signals are developed for the seven pairs of channel controller signals in this interface and are applied to both the 0 and 1 side FMT packs. The 28 PCM transceivers correspond to 28 NPC positions in the MXR that are provisioned by DACS II commands.

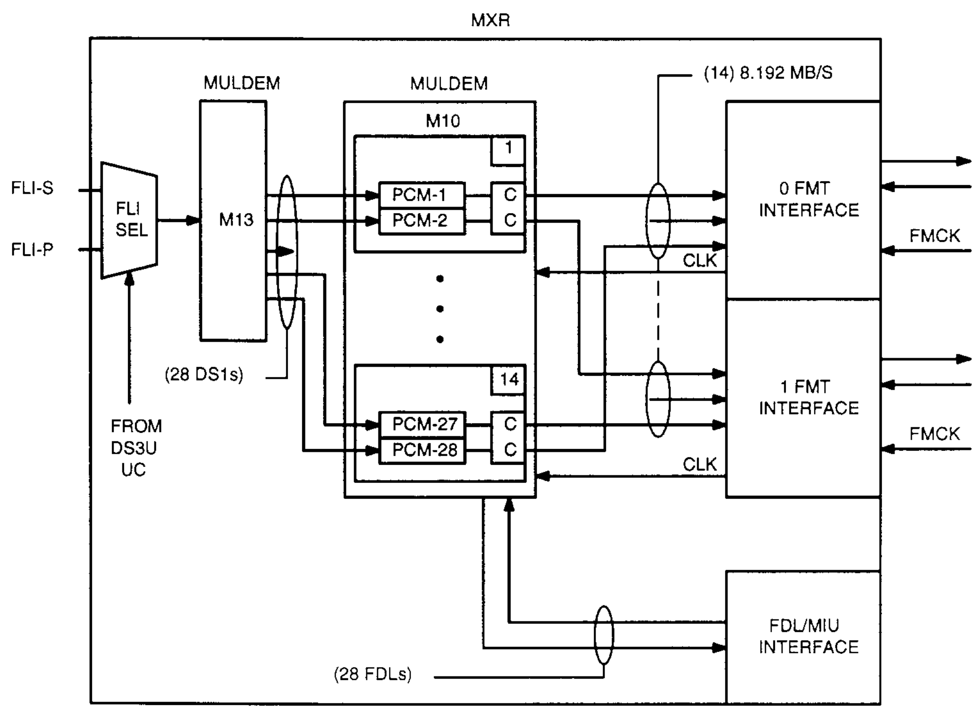

Figure 6-12. Simplified EMXR/MXR Block Diagram

In the direction of transmission from the CCN/ECCN, the MXR performs the reverse functions to produce one DS3 signal from the DS0 channels delivered by the CCN. The DS0 channels received from the FMT packs on the seven 16.384 Mb/s serial data streams are converted to fourteen 8.192 Mb/s signals that connect to the fourteen channel controllers. Signals are received from both FMT packs, and the channel controllers select the source based on the CCN status bus. The channel controllers further demultiplex those data signals into the 4.096 Mb/s signals and apply them to the respective PCM transceivers. The M13 muldem multiplexes the 28 DS1s from the PCM transceivers into the 44.736 Mb/s unipolar stream that is applied to both the service and protection FLI packs.

This M13 muldem contains the necessary DS1 buffers for storage and the circuitry for bit stuffing to accomplish the mux/demux functions.

FMT Pack

The formatter pack contains MXR interface circuitry, four receive formatters feeding the CCN/ECCN, four transmit formatters from the CCN/ECCN, a clock generator, and DS3U UC interface. In the direction of transmission toward the CCN/ECCN, the interface produces fourteen 8.192 Mb/s streams from the seven 16.384 Mb/s signals from the MXR pack. Circuitry for 2:1 selection of the 16.384 Mb/s signals from the service or protection MXR packs accomplish protection switching of the MXR pack on the CCN/ECCN side. Each of the four receive formatters takes signals from the MXR interface circuitry (of 1-1/2 MXR packs) and applies them to one of the four receive ports to the CCN/ECCN. Each of these CCN/ECCN ports is the standard interface provided for any of the FTU or DSPU units in the frame. The four CCN/ECCN ports are 1024 time-slot, 8.192 Mb/s ports. Only 1008 slots out of the 1024 slots contain DS0 channel information from the DS3 signal.

In the direction of transmission from the CCN/ECCN, each of the four transmit formatters receives a 1024 time-slot, 8.192 Mb/s signal from one of the four CCN/ECCN ports. Signals from these formatter circuits are split into six signals that are connected to 2:1 selection circuitry for protection switching of this direction of transmission to the MXRs. The selected signals are converted by the MXR interface circuitry that produces the seven 16.384 Mb/s signals for the MXR packs.

There are two FMTs in the DS3U, each one associated with one side of the CCN/ECCN. These form a protection group to protect against the loss of service owing to the failure of a single FMT pack. The FMT is switched with the CCN/ECCN side which means that its failure causes the CCN/ECCN side to switch and that the FMT switching follows the CCN/ECCN switching (initiated by other causes). The clock generator in the FMT produces a local frame SYNC and an 8.192 MHz clock. These signals are distributed from the FMT on each CCN/ECCN side to the six service MXRs and one protection MXR in the unit. The MXR selects the timing signals from the active FMT and in turn produces a 44.736 MHz clock that is used for timing the MXR's DS3 output signal.

Protection Switching

The standby packs in the DS3U protect against the loss of service owing to a failure of any single pack. The strategy is implemented by having the following protection groups: the FLIs (1:1 protection), the MMFG (MXR) group (1:6 protection), the FMTs (1:1 protection), and the power units. Subsequent paragraphs describe the first three failure groups, and Figure 6-13 shows how the protection circuitry is placed to accomplish switch around of service. The power protection is based on the availability of reserve power. Three power units in the DS3U are diode OR'd together to supply the DS3U although only two are required for the load.

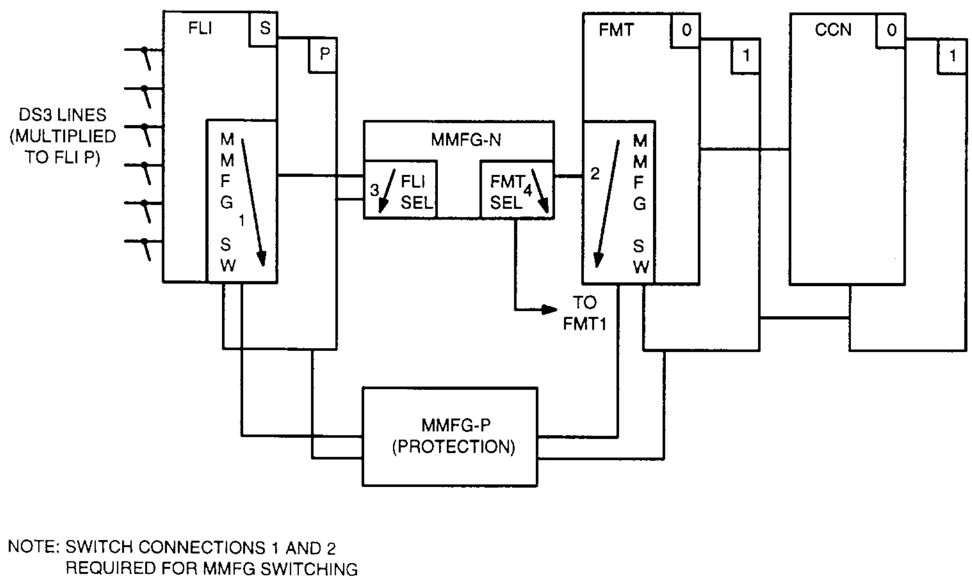

Figure 6-13. Protection Switching Circuitry

The FLI protection switching maintains service if one of the FLI packs fails in the DS3U. This switching is accomplished by relays in the FLI packs and switching circuitry in the MXR packs. The switching is so fast that the transmission may only perceive a framing error. This switching is under control of the DS3U UC, but if the UC is not present, the service FLI is automatically selected. If either FLI loses power or is physically disconnected, the select signal from the UC is overridden and the other FLI is automatically selected.

The MMFG protection switching maintains service if there is a failure of any single MMFG. There is one protection MMFG for the six service MMFGs. The MMFG includes the MXR packs and will be switched out as a group if any pack in the group fails. This switching is accomplished by circuitry on both sides of the MXR in the FLI and FMT packs. To accomplish this switching, the DS3U UC coordinates the switching operations on these packs and loads provisioning into the protection MXR to match that of the MXR to be switched out. The overall operation is managed by a fail-safe, lock-and-key mechanism administered by the DS3U UC. This mechanism is a step-by-step procedure in which the UC unlocks the involved packs and loads the provisioning information, but the switching can be locked again if any involved pack cannot be unlocked. Conversely, the UC can override locked conditions if one or more of the FLI and FMT packs are failed; however, the procedure also prevents a failed UC from falsely initiating a switch. The MXR switching is so fast that the transmission may only perceive a framing error.

The FMT protection switching maintains service if one of the FMT packs fails in the DS3U. The 0-side and 1-side FMT packs are part of the CCN/ECCN failure group and are switched with the CCN/ECCN side. The switching is controlled by the DACS II main controller that monitors the status of all CCN/ECCN packs on both sides. If the MC is failed or out-of-service, the switching is automatically controlled by the error status of the CCN/ECCN side (based on the status of all the packs on each side).

Equipment Description

7

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Equipment Description

7

Introduction

This chapter contains the physical description of the DACS II equipment. It is intended to acquaint the reader with the size and appearance of various DACS II frame configurations. Circuit pack codes are also listed in this chapter. Ordering is done from Equipment List Structure information maintained by the AT&T Account Executives. The basic items of the list structure are given in Chapter 8 (Equipment List Structure) to introduce the reader to the list structure.

The concentration of circuitry in DACS II placed demands on the physical design to contain all the circuitry in the same space as the previous generation of equipment without any adverse signal or heat effects. Established design techniques have also proved successful for the new circuit packaging and frame layout. In addition, standard frame construction has been maintained to be compatible with existing installations, and familiar equipment groupings have been preserved to make the appearance similar to other DACS II frames.

Three benefits arise from the resulting equipment design: low start-up costs, modular growth capability, and reduced floor space needs. These allow deploying the DACS II in small installations, in larger offices where growth potential exists, and in very large complexes.

Capacity Expansion Frame

The CEF (capacity expansion frame) is the most efficient and economical means to produce large DACS II installations. The CEF provides the control and cross-connect capacity for as many as 16 peripheral units with the start-up flexibility of only ordering 2 bays for 3 units. The 16-unit installation requires 7 equipment bays, which is the smallest arrangement possible with the existing plug-in equipment. New plug-in circuit packs have been designed for two of the main circuit blocks in the frame for the CEF. Since the CEF is intended for expansion, there is no single-bay version of the CEF.

General Frame Information

The basic framework for mounting equipment subassemblies is 2 feet 2 inches wide, 7 feet high, and 13 inches deep. The frames are the unequal flange-type which are commonly used for other transmission equipment. This framework which provides the opening to mount shelf assemblies is referred to as a bay. Equipment panels and shelf assemblies that mount the plug-ins are bolted to the bay openings; these panels are 20-1/2 inches wide. When more than one bay is needed to mount all the equipment panels for the installation, bays are bolted together to form multiple-bay frames.

Original interface bays refer to equipment that is ordered prior to Release 5 and is installed according to a fixed assignment of the six unit positions in the frame. **Flexible interface** bays refer to equipment that is ordered starting with Release 4 and is installed to allow user-defined assignment of the units in the frame. Along with defining the unit position assignments in the equipment order, the customer or installer also enters the unit assignments in the software configuration file. This file dictates how the unit equipment can be grown in the software inventory and determines the coordinate locations for the equipment location query command. The fully flexible assignment of unit positions in the bays to the side of the common equipment switch bay came in Release 4.1 and is the only way bays are ordered now. Original interface bays are no longer available.

The majority of the interconnections between the circuit pack positions are done via printed wiring backplanes on the equipment shelves. Connectors at the CP (circuit pack) positions that accept the plug-ins are pressed into the multilayer paths on the backplane. All other connections to the back connector pins are made by wire wrapping (on pre-Release 5 frames) or connectorized cable. Interconnections between the major subassemblies in the frame are made by ribbon cables.

Heat ramps or baffles are mounted in the frame to direct the rising heat away from the circuits located above. Placement of these baffles prevents the buildup of heat in the frame. The DACS II is cooled by natural convection only and does not require the use of cooling fans.

The single-bay frame is a special arrangement for small or temporary installations. The assignment of the two unit positions in the small frame is fixed; the List 2 version of the frame can be equipped with either a DSPU or a DS3U in the bottom unit position (unit 5). Release 5.0 of software cannot be loaded on the single-bay frame because it only supports the CEF. However, Release 5.1 software can be loaded because it supports both non-CEF and CEF frames.

Common Frame Subassemblies

Frame Subassemblies

These subassemblies mount the major circuit blocks of common equipment or peripheral unit equipment. The fuse and alarm panel, plug-in power units, and fuse distribution boards are also included here because these are associated with the subassemblies. These subassemblies are:

- Main Controller and Synchronizer
- Facility Terminating Unit (for DS1 and 2.048-Mb/s Signals)
- Integrated Facility Terminating Unit (for DS1 and 2.048-Mb/s Signals)
- Digital Signal Processing Unit
- DS3 Terminating Unit (for DS3 Signals)
- Cross-Connect Network or Expanded Cross-Connect Network (for CEF).

Main Controller and Synchronizer

This subassembly consists of CPs and power units for the DACS II main controller and the synchronizer. Associated with the controller are the frame status panel, the memory disk drive, and the memory tape cartridge, all of which are mounted near the controller. The main controller consists of the following circuit packs:

- CPU (central processing unit)
- CI (communications interface), ECI (enhanced communications interface), or HECI (high speed ECI)
- SSC (secondary storage controller)
- MTC (maintenance) or expanded MTC (for CEF)
- BX (bus extender) or expanded BX (for CEF).

Equipment codes for most of these plug-ins, as well as hard disk and tape drives, have been designed for the CEF frame. Table 7-1 is a summary of this equipment for ready reference.

Table 7-1. Expanded MC Equipment

Circuit Pack	Equipment
4-Mbyte CPU	TM657B
8-Mbyte EBX (Expanded Bus Extender)	UM71
EMTC (Expanded MTC)	UM56, UM75 *
8-Mbyte CI	TM658C
8-Mbyte ECI	TM736C
HECI	TM762
40-Mbyte Hard Disk	ED-9C015-30
24-Mbyte Tape	ED-9C016-30
SSC for 40-Mbyte Disk	TM659C

* UM75 is used with Release 6.0.

Facility Terminating Unit

The FTU (facility terminating unit) is the general name for the circuit block to terminate digital line facilities, and it is also the name for the facility unit hardware for the original interface bay. Within an FTU, the equipment is further divided into four FTMs (facility terminating modules). Each FTM occupies one shelf and contains one FTMI (facility terminating module interface), an FC (format converter) for each duplicated side, and up to 20 dual digroup plug-ins of the family for various NPC applications. Each dual plug-in contains the circuitry for two NPC positions. Figure 7-1 shows unit 1 hardware for the original interface bay equipped with all DDC (dual digroup circuits) for DS1 lines.

Common control plug-ins and power units for the FTU are mounted in a separate shelf assembly in the original interface bay. The control packs are the CPU (central processing unit) used as the unit controller and the unit bus extender. Up to three 411AA power units and associated fuse distribution boards are on the shelf assembly.

If FTM(s) of a unit are equipped for 2.048-Mb/s lines, only 16 of the 20 dual plug-in positions are used because of the additional channel capacity of each 2.048-Mb/s termination. The last four slots of the FTM are left vacant.

FTM 4	NPC (121-140)	0 F C (4)	F T M I (4)	1 F C (4)	NPC (141-160)
FTM 3	NPC (081-100)	0 F C (3)	F T M I (3)	1 F C (3)	NPC (101-120)
FTM 2	NPC (041-060)	0 F C (2)	F T M I (2)	1 F C (2)	NPC (061-080)
FTM 1	NPC (001-020)	0 F C (1)	F T M I (1)	1 F C (1)	NPC (021-040)

Figure 7-1. FTU Plug-In Positions

Integrated Facility Terminating Unit

The IFTU (integrated facility terminating unit) is the hardware used in flexible interface bays to mount the plug-ins for terminating DS1 and 2.048-Mb/s lines. This hardware integrates the unit common control, FTM signal processing packs, and associated power units and fuse boards into the same shelf assembly. This consolidated hardware is only slightly larger than the FTU alone for the original interface bay so that three IFTUs will fit in one flexible bay. This consolidation enables the flexible placement of the different unit equipment in the flexible interface frame. The same FTU plug-ins are used in the IFTU, and the IFTU is treated as an FTU in the configuration file.

Figure 7-2 shows unit 1 hardware for the flexible interface bay equipped with all DDC (dual digroup circuits) for DS1 lines. Because of the additional channel capacity of each 2.048-Mb/s line, four less dual circuit plug-ins are used in FTMs equipped for 2.048-Mb/s lines.

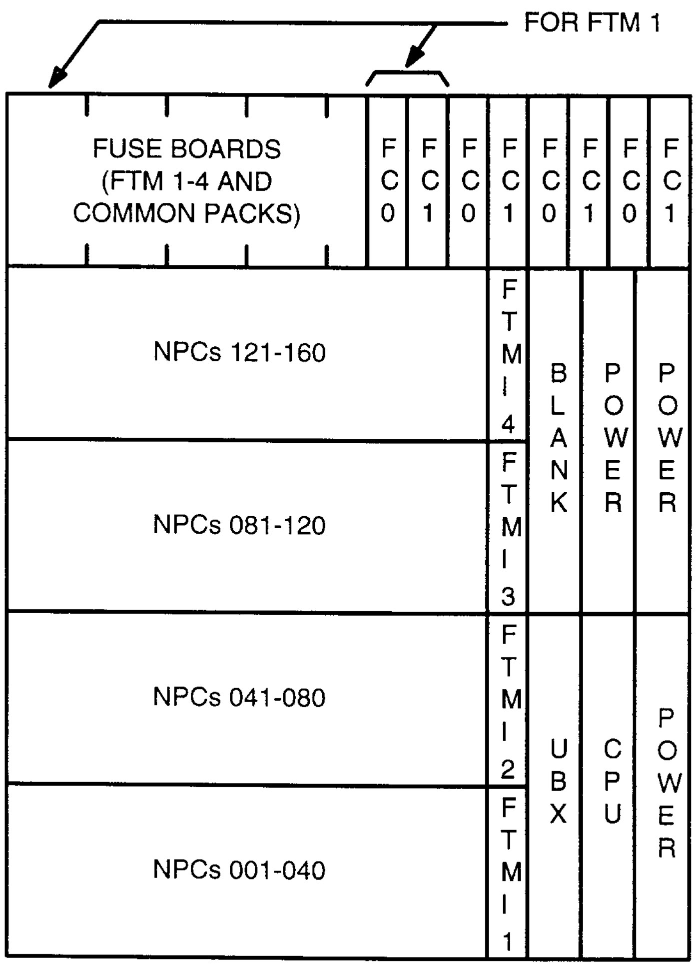


Figure 7-2. Integrated Facility Terminating Unit

Digital Signal Processing Unit

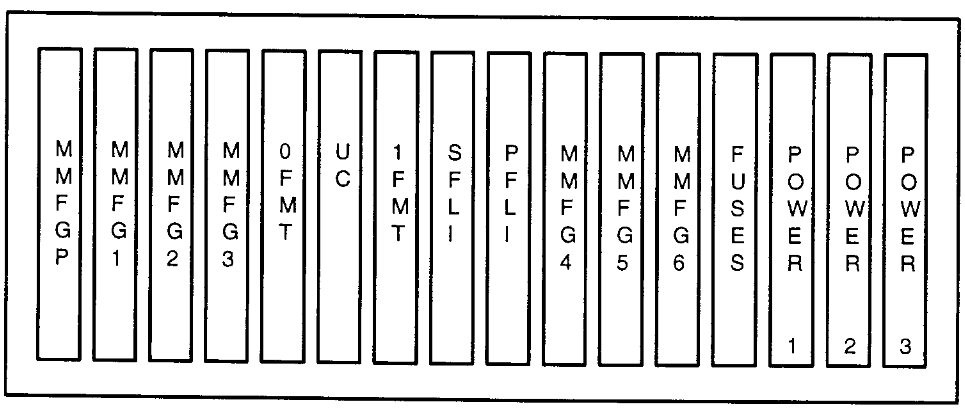
The DSPU occupies one DACS II shelf and is equipped as needed by the customer to provide digital channel processing functions such as channel bridging and subrate channel processing. This processing is done on internal channels; no facilities terminate on the DSPUs. Each DSPU consists of the common circuit packs, which are the DSPI (digital signal processor interface) and the unit controller, the specialized DSP circuit packs, and the power units for the DSPU. There are 8 DSP positions on the 0-side and 8 on the 1-side of the DSPU giving a total of 16 DSP positions. The DSP packs are duplicated on these two sides for redundancy to allow service switching in case a pack fails. The specialized DSP circuit packs for the DSPU are: DMB (digital multipoint bridge), SRM (subrate multiplexer), or MJU (multipoint junction unit), and CPR (C-bit processor) for export applications. Any combination of DMBs, SRMs, and MJUs can be used. The type (or combination of types) of signal processing depends on the customer's applications and services.

For export applications with only 2.048-Mb/s facilities, the DSPU can only be equipped with DMB circuit packs or CPR (C-bit processing) circuit packs, the subrate feature is not applicable.

DS3U Unit

The DS3U is the designation for the shelf of equipment that is used to terminate DS3 facilities on the frame. Figure 7-3 shows the fully equipped DS3U. The plug-in circuit packs for this unit are 12 inches high (which is taller than the packs for the FTU or DSPU), but the DS3U has a smaller heat ramp so that it will fit in the unit positions in the frames. Circuit packs in the unit provide the interfaces with the DS3 coaxial lines and the CCN/ECCN and MC on the DACS II side. Each MMFG (multiplexer-MIU function group) shown in the DS3U consists of mounting positions for the MXR (multiplexer) pack. The power units and the fuse board for the DS3U are also included in the unit. Two multicoaxial cable connectors are provided behind the unit to connect to the transmit and receive coaxial cables for up to six DS3 facilities. Connections to each CCN/ECCN side are through eight separate ribbon cables, and the connection with the MC is through twisted pair cables.

In the original interface bays which are ordered with assigned unit positions, the DS3U can only be used in units 5 and 6, which are also reserved for DSPU use. Along with mounting the DS3Us in these positions, the unit designations must be entered into the software configuration file. In a flexible bay, the DS3U can be placed in any unit position.



NOTE: EACH MMFG CONSISTS OF MXR AND MIU POSITIONS

Figure 7-3. DS3U Plug-In Positions

Cross-Connect Network

This network is duplicated (sides 0 and 1) to protect against loss of service, and both sides must be equipped exactly alike. Different networks are used in the

CEF (capacity expansion frame) and non-CEF frames. Furthermore, a small version of the non-CEF cross-connect network is used in the single-bay frame. All versions of cross-connect networks use a single stage of timeslot interchanging which results in fewer plug-ins and space savings. The following circuit packs are used in the network of the non-CEF frames: the TSI (time slot interchange), CCB (cross-connect buffer), and CCNI (cross-connect network interface). The circuit packs for the network in the CEF are: the expanded TSI, the CCI (clock and control interface), and the BT (bus terminator); the network for the CEF is called the ECCN (expanded cross-connect network). The equipage of the cross-connect network is determined by the number of peripheral units equipped. One ETSI per cross-connect side is required for each peripheral unit equipped (see Chapter 9). The required plug-ins and their identification and location are given in the Operation and Maintenance Manuals for DACS II.

For the single-bay frame, the cross-connect network is designated as CCN2 in the software and on the hardware. The hardware for the CCN2 consists of a single shelf of plug-ins for the two units of NPCs in a single-bay frame. For the non-CEF multibay frames, each side of the network (CCN0 and CCN1 in software) has two shelves on which to mount all the plug-ins for the units in the frame. For the CEF frames, a single shelf per side mounts all the ECCN plug-ins for the peripheral units of the large DACS II configuration. In the ECCN, one ETSI pack for each unit connects it to every other equipped unit ETSI. In non-CEF frames, separate TSI packs are required to connect each unit to itself and to every other unit in the frame in the non-CEF network.

Plug-In Power Units

Different codes of power units are available to produce the lower voltages required by the various DACS II subassemblies. All the power units that supply the same functional subassembly are mounted together in a group. The number of power units in a group always includes an extra unit to supply the load in case one of the power units in the group fails. Common equipment groups are usually fully equipped with power units to accommodate the ultimate load of all involved circuit packs. The number of power units required in the FTMs depends on the number of plug-ins installed for the facilities (see Chapter 9). In original interface bays, the power unit groups are generally located in the lower half of the frame.

All power units have test points for output voltage measurements and a red failure LED. The 563A power units also have a green LED to show that the power unit is operating. The latch operates the power switch to prevent arching when the power units are installed or disconnected.

No separate power units are used for the ECCN of the CEF frame. Instead, the ECCN plug-ins contain the power converter circuitry to produce the required lower DC voltages. The CCI produces the 5-volt and –5.2-volt power required by it and the ETSIs, and each ETSI produces its own 3-volt power.

Fuse and Alarm Panel

This ED-2C855-30 fuse and alarm panel is mounted at the top of the single-bay frame and at the bottom of the multibay frames and contains the heavy amperage 70-type fuses for the –48 volt primary power distribution. The four battery feeders are brought in at the top, run down the side of the bay, and are terminated on this panel. For some export frames, redundant feeders are connected to OR'ing diodes on the panel. The heavy fuses have lower amperage indicator fuses associated with them; these indicator fuses have a color bead that protrudes when the fuse blows. Alarm contacts in the fuse holders close when a fuse blows to light the lamp on the fuse panel. The ED-2C855-30, G3 panel is used on the CEF to provide the additional 48-volt power distribution for the large DACS II.

Fuse Distribution Boards

Plug-in fuse distribution boards are used in the frame subassemblies to distribute power from the power units and protect these packs should a short circuit occur on the load. Different amperage LED or indicator bead (for MC in CEF) fuses are used in these boards as required. The LED lights or the bead is extended when the fuse blows. The Operation and Maintenance Manuals for DACS II furnish listings of the packs fed by the fuses. Generally, the power distribution is such that a short on a circuit pack and the blown fuse will have a minimum effect on other circuit packs. Accordingly, the power to the NPCs in original bay FTUs is distributed as follows: each NPC fuse feeds eight consecutive NPCs. In duplicated entities such as CCN/ECCN, DSPU, and DS3U, the powering is distributed so that each fuse feeds one side of a protection group; that way a blown fuse will cause service to switch to the other side.

There are two fuse distribution boards for the IFTU fuses. With ED-9C012-30 board, each fuse board for the NPCs supplies 16 DDCs (4 DDCs/8 NPCs per fuse). With ED-9C011-30 boards, each fuse board for the NPCs supplies 4 DDCs (1 DDC/2 NPCs per fuse). A separate ED-9C011-30 fuse board supplies the unit common equipment plug-ins.

CEF Configurations

Like the previous equipment offerings for DACS II, the capacity expansion frame is modular and supports different size office installation. As a start, it can be ordered with only two bays and a minimum of circuit packs to serve as few as two DS1 terminations. At full capacity, it can have seven bays to serve 2560 DS1 terminations (using all dual digroup circuit plug-ins). The capacity is slightly larger (2688 DS1s) if all 16 units are equipped as DS3Us for DS3 line connections. Each peripheral unit which contains the plug-ins to either terminate facilities or provide digital channel processing (in the DSPU) is self-contained and can be added to a working frame without interrupting existing service. As a peripheral unit is added, one more ETSI plug-in is added to each side of the ECCN. The existing unit equipment for FTU/IFTU, DSPU, and DS3U types of units is used in the CEF frames. Those units are also modular and allow plug-ins to be added as additional terminations or signal processing is needed.

Figure 7-4 shows the placement of the side bays around the switch bay and the numbering of the peripheral unit positions. The numbering for the first six unit positions is the same as for non-CEF frames and the same numbering convention continues for the other units. The ETSI packs are placed in the ECCN shelf for units in a corresponding left-right sequence to match the addition of bays and units to the switch bay.

Side bays added to a CEF configuration can only be the flexible interface type which allow the use of any type unit (IFTU, DSPU, or DS3U) in any unit position. Variations in the CEF configurations can occur in bays 1 and 3 because non-CEF frames with original interface bays could have been retrofitted to the CEF frames. In those cases, bay 1 or bay 1 and bay 3 can be original interface bays in which different FTU hardware would be used and unit positions 5 and 6 would have restricted use.

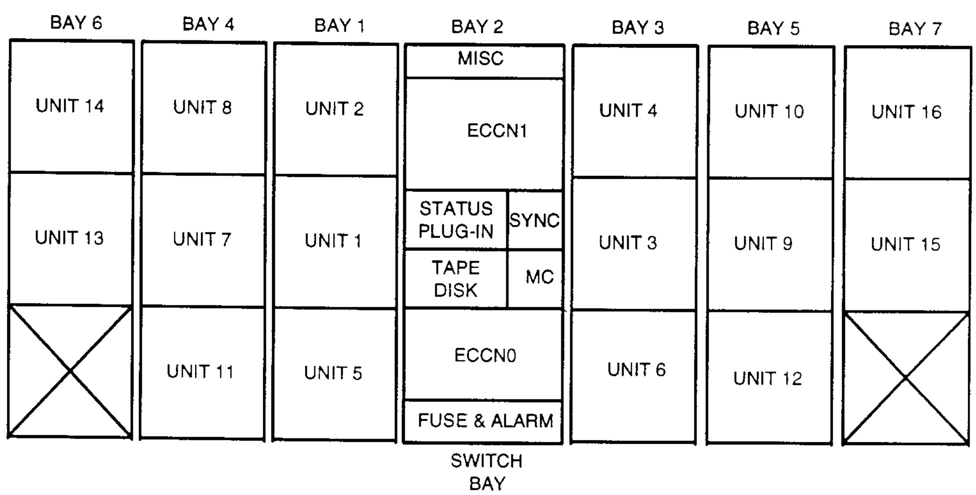


Figure 7-4. 7-Bay CEF Configuration

Enclosed Configurations

Beginning with Release 6.0, DACS II is offered in two additional frame configurations, an EMC compliant Enclosed Capacity Expansion Frame (ECEF) and an EMC compliant Enclosed Single Bay Frame (ESBF). These frames are cabinetized versions of the DACS II Capacity Expansion Frame (CEF) and Single Bay Frame (SBF) measuring 600mm X 600mm X 2200mm (23.6"x23.6"x86.6") per bay. Frame extensions will be available to increase the height of the frame to 2600mm (102.3").

In general, frame layout (i.e. Unit and Circuit Pack locations) in the ECEF is the same as for a similarly equipped CEF. Some differences exist, however, between the switch bay layouts of the ECEF and CEF.

Cabinet doors are provided on the front and rear of each bay to provide access to the circuit packs and cabling. Doors are removable without tools if open access is required. Since the Status and Alarm Panel on the Switch Bay is not visible when the cabinet doors are closed, visual indication of power and alarms is provided by a series of indicator lamps mounted at the top of the Switch Bay. These indicators include power, critical alarm, major alarm, minor alarm, and Main Controller major alarm.

The main controller for the ESBF will utilize the same Expanded Frame Controller as the CEF and ECEF. ECEFs and ESBFs will comply with the following standards:

1. FCC, Part 15 of Chapter 1 of Title 47 of the Code of Federal Regulations for Class B equipment.
2. International Electrotechnical Commission (IEC): Electromagnetics Compatibility for Industrial Process Measurement and control Equipment, Publication 801
3. IEC C.I.S.P.R.[1] Publication 22
4. European standard EN 55022
5. American National Standards Institute (ANSI) T1.308-1990
6. Bell Communications Research (Bellcore) EMC requirements, TA-NWT-001089

Where standards differ in allowable interference criteria, DACS II is designed to be compliant with the more stringent requirement, regardless of which standard they are derived from.

1 C.I.S.P.R. - International Special Committee on Radio Interference

Non-CEF Configurations

Original Interface Bay Configurations

Three configurations for non-CEF frames are available to meet the size requirements for different installations. The smallest arrangement is the single bay, next is a double-bay frame, and the largest is the 3-bay frame arrangement. These frame configurations are discussed in the following paragraphs. The descriptions of the common subassemblies used in the frames were given previously under separate subheadings.

Single-Bay Frame

The single-bay configuration (Figure 7-5) consists of a single 2 ft. 2 in. wide bay. It combines one FTU, one optional DSPU (or conditionally one DS3U), power converters, control and synchronization circuitry, a cross-connect network, and hard disk and tape storage devices all in the single bay. It has a special cross-connect network which is slimmed down to serve only two units of NPCs. This cross-connect network is designated CCN2 in the software configuration file and on the frame. An operational peculiarity of the single-bay frame is that the numbering of the unit positions in it is units 1 and 5 to match the designation of the units in the same relative locations in the other configurations. The single-bay frame offers an economical installation for smaller applications while offering all of the features of the software releases and the overall precision, quality, and reliability of DACS II. The one FTU in the single-bay frame terminates one hundred sixty 1.544-Mb/s or one hundred twenty eight 2.048-Mb/s signals. If more DS1 or 2.048-Mb/s terminations will be required at DACS II, then it would be advisable to order a 2-bay frame. A DS3U terminates six DS3 signals, each of which contains 28 DS1 signals, providing a unit capacity of up to 168 equivalent DS1s.

The use of the DS3U in the unit 5 position to terminate DS3 signals depends on the vintage of the equipment. The DS3U can be used in the J98774B-1, List 2 bay, but it cannot be used in the J98774B-1, List 1 bay.

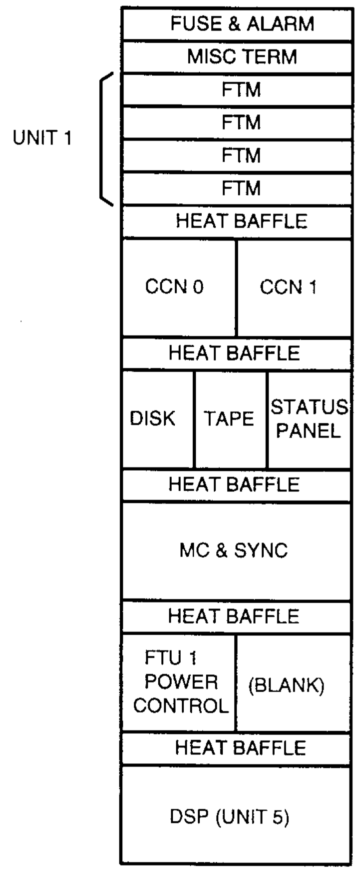


Figure 7-5. DACS II Single Bay

Double-Bay Frame

The double-bay configuration (Figure 7-6) produces a 4 ft. 4 in. wide frame. Bay 1 contains two FTUs, one DSPU or DS3U, and the power converters for these units. Bay 2 contains the control and synchronization circuitry, cross-connect network, hard disk drive, and power for this equipment. Bay 2 is referred to as the switch bay since it mounts the common equipment plug-ins. The use of the DSPU or DS3U in the frame depends on which equipment shelf is ordered or field installed. The two FTUs provide a total capacity for three hundred twenty 1.544-Mb/s or two hundred fifty-six 2.048-Mb/s terminations. The double-bay arrangement can be expanded to a triple bay as growth occurs.

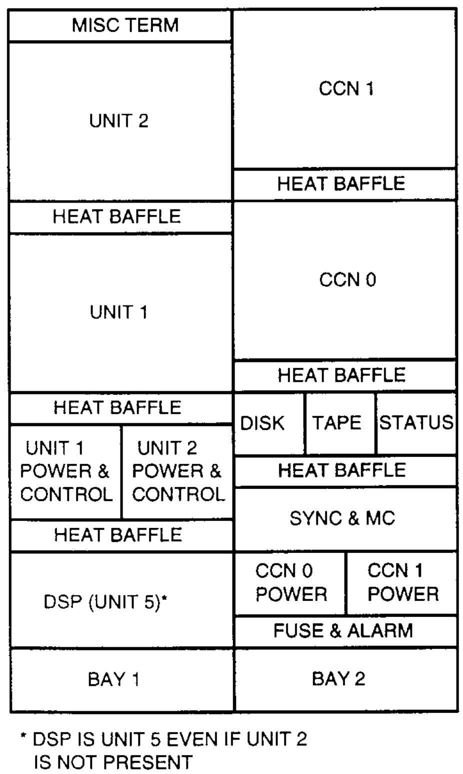
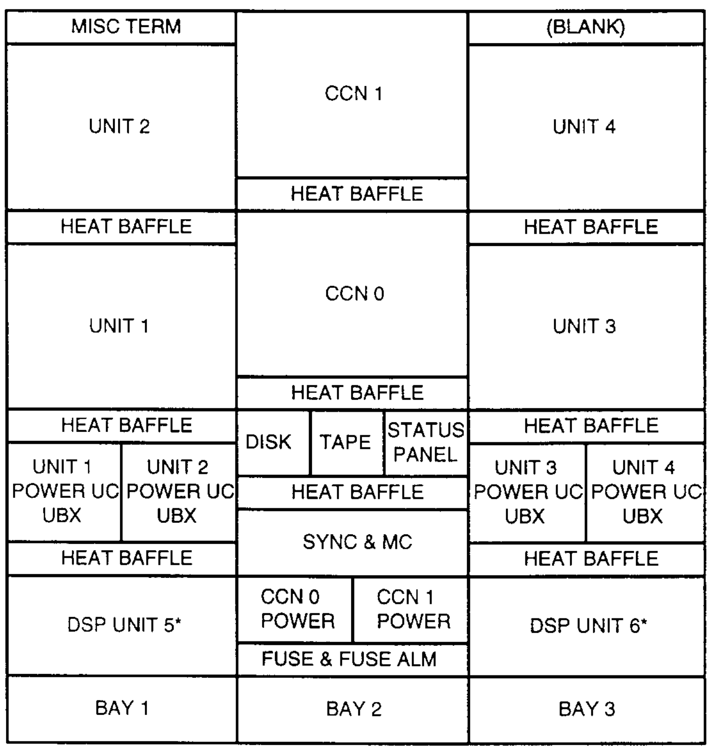


Figure 7-6. DACS II Double-Bay Frame

Triple-Bay Frame

The triple-bay configuration (Figure 7-7) produces a 6 ft. 6 in. wide frame. This arrangement mounts a total of four FTUs and two DSPUs or DS3Us. Two of the FTUs and one DSPU or DS3U are in bay 1 along with the power for these units. The MC and synchronization circuitry, cross-connect network, and the power units for this equipment are in bay 2. The use of the DSPU or DS3U in units 5 and 6 depends on which equipment shelves are ordered or field installed. The other two FTUs, the other DSPU or DS3U, and the associated powering are in bay 3. The triple-bay configuration is capable of supporting six hundred forty 1.544-Mb/s or five hundred twelve 2.048-Mb/s terminations and either a DSPU or a DS3U in units 5 and 6.



* DSP IN UNIT 5 AND 6 EVEN IF UNITS 2, 3 AND 4 ARE NOT PRESENT

Figure 7-7. DACS II Triple-Bay Frame

Flexible Interface Bay Configurations

The flexible interface bays are used in 2-bay and 3-bay configurations. The descriptions of the common subassemblies were given previously under separate headings.

The first phase of introduction of the flexible interface bay was in Release 4.0 with the use or addition of a right-side flexible interface bay to a 2-bay frame. With the common equipment already contained in the second bay, this side bay adds three units which are numbered 3, 4, and 6; units 1, 2, and 5 are always mounted in bay 1. In Release 4.0, the use of a flexible bay in bay 3 allowed mounting either DSPU or DS3U types in unit positions 3 and 4. If FTU types were required in bay 3, the original interface bay would be used. In either case, unit 6 can be a DSPU or DS3U type. Figure 7-8 illustrates the two phases of introduction of the flexible interface bay concept.

The second phase (Release 4.1) or fully flexible frame not only allows bay 3 to have flexible unit assignments but also allows bay 1 to have flexible unit assignments. In that arrangement, any type unit (IFTU, DSPU, or DS3U) can be placed in all the unit positions of the frame configuration. For example, all six units of a 3-bay configuration can be equipped for DS3 to produce a substantial DS3 terminating capacity. When the equipment is installed, the software configuration file is updated to designate the side bays as flexible after which the unit types are assigned as required.

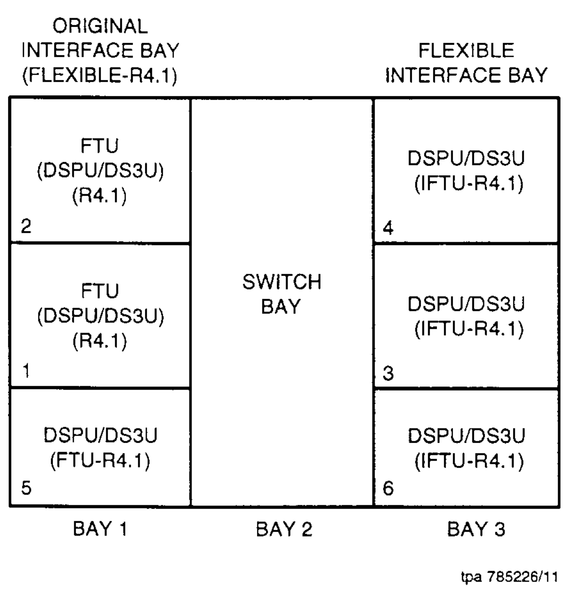


Figure 7-8. Flexible Interface Bay Configurations

Double-Bay Frame

The use of a flexible interface bay for bay 3 and the introduction of the IFTU in Release 4.1 produces possibilities different from the original interface 2-bay frame. For example, the frame could be equipped for: three IFTUs with each one terminating either one hundred sixty DS1s or one hundred twenty-eight 2.048-Mb/s, three DSPUs with each providing eight digital signal processing functions, or three DS3Us with each one terminating six DS3 signals. Alternatively, the frame could be equipped for any combination of units with no restrictions on the assignments of unit types.

Triple-Bay Frame

In Release 4.0, this frame differs from the original interface bay in the equipage of the right-side bay. Bay 1 retains the original interface bay designation as follows: two FTUs and one DSPU or one DS3U in unit position 5. The unit 5 assignment depends on which equipment shelf is installed. Each FTU provides either one hundred sixty DS1s or one hundred twenty-eight 2.048-Mb/s terminations. When equipped as a DS3U, unit 5 provides six DS3 terminations.

With the use of flexible bays in bays 1 and 3 and the introduction of the IFTU in Release 4.1, any type unit (IFTU, DSPU, or DS3U) can be placed in any of the six peripheral unit positions. This produces possibilities different from the original interface 3-bay frame. For example, the frame could be equipped for: six IFTUs with each one terminating either one hundred and sixty DS1s or one hundred and twenty-eight 2.048-Mb/s, more than two DSPUs with each providing eight digital signal processing functions, or six DS3Us with each one terminating six DS3 coaxial lines. This latter arrangement produces a DS3 termination capacity of 36 DS3 signals which makes it attractive for use as DS3 network equipment with add/drop capability and facility and channel test capabilities. Six DSPUs were not listed above because without any facility terminations to bring service channels to the frame, channel bridging could not be used.

Single Shelf Configuration

The DACS II ISX (Digital Access and Cross-Connect System II - Integral Shelf Cross-Connect) is a single shelf digital cross-connect system. The DACS II ISX system terminates up to 64 DS-1 or E-1 facilities and also provides DS-0 cross-connect and test access capability. The DACS II ISX is an enclosed shelf that supports the same environmental, ESD and EMC standards as DACS II Release 6.0 Enclosed Frames. Refer to Section 16 for detailed information regarding the DACS II ISX.

Circuit Packs

Circuit pack construction consists of a printed wiring board and a latch (two latches on the larger CPs for the DS3U and ECCN) on the front to draw the pack into the slot and to secure it. Four sizes of boards are used: those nominally 8 inches high, those nominally 4 inches high, those 12 inches high, and those 16 inches high. The smallest boards are used for the synchronizers, TLIs (timing link interfaces), TBs (time bases), and facility termination CPs. The 8-inch high boards are used for the controller and the DSPU. The 12-inch boards are used in the DS3U, and 16-inch boards are used in the ECCN; these packs have latches, top and bottom, to evenly draw the pack into the slot. A printed contact connector on the back of the CPs engages the protruding pins at the shelf position; the printed connector on the CP is keyed to prevent insertion of the wrong type CP. The CPs and plug-in power units have an identifying code printed on the front plate. Hinged designation strips over the shelf slots give the plug-in functional designations and the location coordinates of the plug-ins.

Table 7-2 describes whether the packs for the CEF that are backward compatible or not for use in previous release frames. Backward compatibility not only means use with previous software but also physical compatibility with non-CEF backplane connectors. The disk and tape drives are shown as not applicable because the additional storage is not needed for non-CEF frames. The backplane connectors for Release 5 are keyed to prevent the insertion of previous release circuit packs.

Table 7-2. Expanded Circuit Pack Compatability

Circuit Pack	Circuit Block	Equipment Code	Backward Compatible
4-Mbyte CPU		TM657B	YES
8-Mbyte EBX (Expanded Bus Extender)		UM71	NO
EMTC (Expanded MTC)		UM56	NO
		UM75	NO
8-Mbyte CI	EMC	TM658C	YES
8-Mbyte ECI		TM736C	YES
40-Mbyte Hard Disk		ED-9C015-30	N.A.
24-Mbyte Tape		ED-9C016-30	N.A.
SSC for 40-Mbyte Disk		TM659C	YES
Expanded TSI		BBS2	NO
Clock Control Interface	ECCN	BBS1	NO
Bus Terminator		BBR1	NO

Integrated circuits on the CPs can be damaged by static electricity that builds up on work surfaces and personnel. These charges are produced by physical movement and contact with other objects. Dry air allows greater charges to accumulate so that higher potentials occur in areas with low relative humidity. These potentials are not a safety hazard, but they can damage delicate integrated circuit components. Therefore, the necessary precautions, such as proper handling and use of grounding wrist straps on the frame, must be observed to prevent damage by ESD (electrostatic discharge).

Table 7-3 which is a complete listing of the equipment, is provided at the end of this chapter for reference.

Administrative Ports

There are six administrative ports on the DACS II frame that are associated with the main controller. These ports are used for connecting administrative terminals and external operations systems. Connectors for these ports are located on the back of the frame, behind the main controller with the TTY1 connector bridged to the front to allow easy connection of a different terminal to it. These connectors conform to the RS-449 standard that specifies the mechanical and functional characteristics of the RS-422, -423, and -485 interfaces. Adapters for an RS-232C interface are also available. The six ports are independently programmable for rates of 300-, 600-, 1200-, 2400-, 4800-, and 9600-bits per second, and either they will all be provisioned for asynchronous protocol or divided between 4 asynchronous and 2 synchronous links. The assignment of the links depends on the plug-in (CI, ECI, or HECI) that is installed in the main controller. The synchronous link on the HECI can operate at speeds up to 56 kb/s. Furthermore, up to two asynchronous links on either can be provisioned for use with TABS protocol. Asynchronous links can also be provisioned for Modified Snider protocol to allow connection of the CIU (craft interface unit) to DACS II to provision *SLC*® Series 5 carrier channel units over the data link.

The administrative terminal is the input/output device used to communicate with the frame. Complete specifications for compatible terminals are given in the terminal requirements portion of the J-SPEC equipment document, but the general requirements are given in Chapter 13, Engineering Considerations. Examples of the administrative terminals in general use are the *TELETYPE*® BSR4340 teleprinter with 16k buffer and the *TELETYPE* 4420-10FB display terminal.

Hard Disk and Tape Cartridge

These provide the nonvolatile backup memory for DACS II. Mounting space for both is provided above the MC (main controller) on the non-CEF frame and to the left of the MC on the CEF frame. The ED-9C015-30 disk drive and ED-9C016-30 tape drive are mounted vertically for better heat dissipation; previous drives are mounted horizontally. The entire disk drive and hard disk are installed/replaced as a unit, but the tape cartridge is separately replaceable. Power must be removed to stop the movement before disconnecting either one. The commands to remove the tape or disk from service cause the power to be removed, or the SSC pack can be disconnected according to maintenance instructions. Maintenance is required per maintenance instructions to clean the tape drive head and roller capstan. Whenever the tape drive is restored to service, the head is automatically realigned and the tape retensioned.

Drive Cleaning Kit

Since 1991 AT&T has offered one free AT&T Tape Drive Cleaning Kit with each purchased AT&T DACS II system. To receive the free kit, simply fill out and return the postage-paid card included in the packaging of the purchased system.

The AT&T Tape Drive Cleaning Kit cleans ultrasensitive tape drive read/write heads and capstans without leaving harmful residues or risking damage to the drive. The kit consists of:

- Cleaning cartridge
- Read/write head cleaner insert
- Capstan cleaner insert
- Detailed instructions, customized for AT&T DACS products
- Ultreen® cleaning solution *
- 12 head cleaning pads
- 6 capstan cleaning pads
- Tweezers
- Cleaning record card
- Storage case.

* Ultreen ® is a safe, AT&T approved solution especially formulated for cleaning delicate tape drive components. If you require a material safety data sheet regarding this chemical, please contact your AT&T account representative or call 1-800-225-RTAC. Use of a non-approved cleaning solution may damage the tape drive and void its warranty. Never use alchohol-based solutions for cleaning the DACS tape heads.

Under normal operating conditions and cleaning once per month, the kit will last one year and will ensure reliable operation of the tape drive. AT&T recommends one cleaning kit per DACS II system.

A refill kit is also available and consists of:

- 18 head cleaning pads
- 6 capstan cleaning pads
- cleaning solution
- tweezers
- cleaning record card.

For re-orders call:
1-800-962-0668 (United States)
or
1-206-343-7283 (Worldwide)

Table 7-3. Plug-In Equipment

Full (Abbreviation)	Circuit Pack	Used In	Number Required Per Frame(F) Unit (U)
Bus Terminator (BT)	BBR1	ECCN	4 (F)
Clock Control Interface (CCI)	BBS1	ECCN	2 (F)
Expanded TSI (ETSI)	BBS2	ECCN	Up to 32 (F)
DS3 Multiplexer (MXR)	KCR1	DS3U	Up to 7 (U)
DS3 Facility Line Interface (FLI)	KCR3 or KCR4	DS3U	2 (U)
Formatter (FMT)	KER1	DS3U	2 (U)
Unit Controller (UC)	KER2	DS3U	1 (U)
Synchronizer Power Unit (SPU)	TG58	SYNC	2 (F)
Time Bases-Stratum 3 (TBS3)	TG60	SYNC	2 or 3 (F)
CCITT Local (TBCL)	TG61		
CCITT Toll (TBCT)	TG62		
Stratum 2 (TBS2)	TG63		
Timing Link Interface (TLI)		SYNC	Up to 8 (F)
Timing Extractors-		SYNC	Choose 2 Of 1
Bipolar DS1 (TXB1)	TG64		or more codes.
2.048 Mb/s Wire Pairs (TXB2)	TG65		Selection based
Composite Clock 64 kb/s (TXCC)	TG66		on the sync
Unipolar Clock (TXUC)	TG67B		configuration (F).
BSRF (TXRF)	TG68		
2.048 Mb/s 75-ohm coax (TP75)	TG75		
Timing Distributors-		SYNC	2, Choose 1 (F)
Comp. Clock 64 kb/s out (TDCC)	TG70		
Sine Wave 2.048 MHz out (TDS2)	TG71B		
Format Converter	FC	TG79	FTU
Dual Digroup Card (DDC)	TG80B, TG191 *	FTU	Up to 80 (U)
Facility Terminating Module Interface	FTMI	TG81	FTU
Dual Primary Card (DPC) (120 ohm termination)	TG182, TG192 *	FTU	Up to 64 (U)
SLC 96 Carrier Direct (S96D) Interface	TG183B	FTU	Up to 80 (U)

* TG191 and TG192 are used with Release 6.0.

Table 7-3 Plug-In Equipment (Continued)

Full Name (Abbreviation)	Circuit Pack	Used In Unit (U)	Number Required Per Frame(F)
SLC 96 Carrier Direct (S96D) Interface	TG183	FTU	Up to 80 (U)
SLC Series 5 Carrier (SS5D) Direct Interface	TG184	FTU	Up to 80 (U)
Dual Primary Card (DPC) (75 ohm termination)	TG185, TG192 *	FTU	Up to 64 (U)
Special Zero Code (ZDC) Suppression - ZBTSI	TG186	FTU	Up to 80 (U)
Dual Primary Card (DPC) (Minor BER)	TG187, TG192 *	FTU	Up to 64 (U)
Main Controller Power (MCP)	SM565	MC	1 (U)
DSP Controller Power (DCP)	SM566	DSPU	1 (U)
Digital Phase-Locked Loop (DPLL)	TM590	SYNC	2 (U)
Central Processing Unit (CPU)	TM657	MC, UNITS	1 (F) 1 (U)
Central Processing Unit (CPU)	TM657B	EMC, UNITS	1 (F) 1 (U)
Communications Interface (CI)	TM658B	MC	1 (F)
Communications Interface (CI)	TM658C	MC	1 (F)
Secondary Storage (SSC) Controller	TM659B	MC	1 (F)
Secondary Storage (SSC) Controller	TM659C	MC	1 (F)
Time Slot Interchange (TSI)	TM660	CCN	Up to 72 (F)
Digital Multipoint Bridge (DMB)	TM665	DSPU	Up to 8 (U)
Enhanced Communications (ECI) Interface	TM736B	MC	1 (F)
Enhanced Communications (ECI) Interface	TM736C	MC	1 (F)
Subrate Multiplexer (SRM)	TM739	DSPU	Up to 8 (U)
Multipoint Junction Unit (MJU)	TM740	DSPU	Up to 8 (U)
C-bit Processor (CPR)	TM747	DSPU	Up to 8 (U)
High Speed Enhanced Communications Interface (HECI)	TM762	MC	1(F)
Maintenance Circuit (MTC)	UM24B	MC	1 (F)
Maintenance Circuit (EMTC)	UM56, UM75 *	MC	1 (F)
Cross-Connect Buffer (CCB)	UM26B	CCN	Up to 12 (F)

* UM75 and TG192 are used with Release 6.0.

Table 7-3 Plug-In Equipment (Continued)

Full Name (Abbreviation)	Circuit Pack	Used In	Number Required Per Frame(F) Unit (U)
Bus Extender (BX)	UM27	MC	1 (F)
Bus Extender (EBX)	UM71	MC	1 (F)
Unit Bus Extender (UBX)	UM28	FTU	1 (U)
DSP Interface (DSPI)	UM29	DSPU	1 (U)
Cross-Connect (CCNI)	UM30	ECCN	2 (F)
Network Interface			
24 Mbyte Disk (DISK)	ED-2C876-30	MC	1 (F)
24 Mbyte Tape (TAPE)	ED-2C877-30	MC	1 (F)
40 Mbyte Disk (DISK)	ED-9C015-30	MC	1 (F)
24 Mbyte Tape (TAPE)	ED-9C016-30	MC	1 (F)
Status Plug-In (STATUS)	ED-9C017-30	MC	1 (F)
Fuse Board (DSR FUSE BD)	ED-2C863-30 G1,A	FTU	2 (U)
Fuse Board (DSR FUSE BD)	ED-2C863-30 G2,A	FTU	1 (U)
Fuse Board (DSR FUSE BD)	ED-2C863-30 G3,A	CCN,	4 (F)
		DSPU	1 (U)
Fuse Board (DSR FUSE BD)	ED-2C863-30 G4,A	CCN2	2 (F)
Fuse Board (DSR FUSE BD)	ED-2C980-30	DS3U	1 (U)
Fuse Board (DSR FUSE BD)	ED-9C011-30	IFTU	5 (U)
Fuse Board (DSR FUSE BD)	ED-9C012-30	IFTU	17 (U)
Power Unit (PU)	411AA PWR UNIT	FTU	3 (U)
	(411AB, -60V)	DSPU	2 (U)
		MC	1 (F)
	485AB PWR UNIT	CCN	8 (F)
	484GA PWR UNIT	DISK,	1 (F)
		TAPE	
	563A PWR UNIT	DS3U	3 (U)

Related Equipment

DS1 Multipoint Junction Unit Shelf

DACS II currently supports subrate multiplexing, multipointing, error correction, and secondary channel for 2.4 kb/s, 4.8 kb/s, 9.6 kb/s, and 56 kb/s services. DACS II also supports on-board subrate multiplexing of 19.2 kb/s services by treating each 19.2 kb/s circuit as two adjacent 9.6 kb/s subrate channels. Until now, however, DACS II did not support 19.2 kb/s Multipoint Junction Unit (MJU) capabilities. This capability is now provided by the AT&T DS1-MJU Shelf. The DS1-MJU Shelf provides DACS II customers with the ability to support 19.2 kb/s MJU functions, including error correction and secondary channel capabilities. Once the DS1-MJU Shelf is installed and cabled to the DACS II, all circuit level operations (for example, provisioning, testing, etc.) are provided via standard DACS II administration.

Features and Benefits

The benefits for supporting 19.2 kb/s multiplexing and multipoint circuits include the following.

- The DS1-MJU Shelf allows DACS II customers to offer 19.2 kb/s MJU services today, minimizing initial investment as customers determine future service demands.
- The DS1-MJU Shelf supports DDS secondary channel and 19.2 kb/s error correction for full service compatibility and quality. This support is in compliance with the American National Standard for Telecommunications - Digital Hierarchy - Format Specifications, ANSI T1.107b, 199X and the Bell Communications Research Digital Data System (DDS) Multipoint Junction Unit Requirements TA-TSY-000192.
- The 19.2 kb/s subrate multiplexing is currently supported by DACS II's Subrate Feature. Each 19.2 kb/s circuit is treated as two adjacent 9.6 kb/s circuits. Therefore, only the multipointing (MJU function) capability requires the DS1-MJU Shelf.
- The DS1-MJU Shelf is modular and easily grows in capacity (from four to forty-eight 19.2 kb/s MJU functions) as customer demand increases.
- The DS1-MJU Shelf contains no DS0A wiring, thereby eliminating the risk of service interruption due to distributing frame activity.
- Once the DS1-MJU Shelf is installed, it no longer requires subsequent hands-on work for provisioning multipoint circuits. All circuit level administration is done remotely through the DACS II.
- The 19.2 kb/s MJU circuit design is modeled after the design procedures used by other DCS vendors which use Card Replacement (CR) for MJU support.
- Standard DACS II test access commands are used to gain DS0 test access for any leg in the multipoint circuit, providing remote testing and trouble isolation.
- The DACS II and the DS1-MJU Shelf provide alarms to isolate equipment and facility failures.

These key points all contribute to an administrative environment that is consistent with current DACS II networks and offers service providers with an efficient and effective method for providing 19.2 kb/s services to their customers.

Equipment Description

Each DS1-MJU Shelf supports from four to forty-eight 19.2 kb/s MJU functions on 1 to 12 DS1-MJU circuit packs. For economic startup, the DS1-MJU Shelf can be equipped with a single DS1-MJU circuit. Additional DS1-MJU circuit packs may then be added in-service to the DS1-MJU Shelf for future growth. Each DS1-MJU circuit pack provides four 19.2 kb/s MJU functions and supports both subrate error correction and full secondary channel capabilities.

The DS1-MJU Shelf is mounted in a separate equipment bay and is cabled to the DACS II at the DS1 level using T1DM framing. Although the DS1-MJU Shelf can be located anywhere (up to a maximum of 655 feet from DACS II, depending on the type of cable used), it is recommended that it be placed in the same lineup with the DACS II, leaving enough space for growth of standard DACS II Input/Output (I/O) bays. Standard DACS II Dual Digroup Circuit (DDC) packs provide the DS1 interfaces to the DS1-MJU Shelf. Up to 12 duplex DS1s (1 DS1 for each DS1-MJU circuit pack) are used to cable each DS1-MJU Shelf to the DACS II. Up to 6 DS1-MJU Shelves can be mounted in a 7-foot bay, providing a total of two hundred and eighty-eight 19.2 kb/s MJU functions per bay.

For maximum flexibility and utilization of DACS II DS1 ports, all DS1 connections between the DS1-MJU Shelf and the DACS II should be made via the DSX-1. Once the MJU Shelf is installed and cabled to the DACS II, all subsequent circuit provisioning is provided via DACS II administration.

Synchronization

To support digital data applications, all network elements must be synchronized to the same timing reference signal. Failure to do so can result in degraded or lost service. The DACS II receives network timing from either a DS1 source or a 64 kb/s Composite Clock. DACS II then distributes this synchronization timing to the DS1-MJU Shelf at the DS1 level. Each DS1-MJU circuit pack extracts timing from its corresponding incoming DS1 signal. If the network timing source to DACS II is lost, DACS II will enter a holdover mode and use its internal clock to provide timing to the DS1-MJU Shelf.

DS0 Channel Numbering

To simplify the circuit assignment process, MJU channel assignments on the DS1s between the DACS II and the DS1-MJU Shelf are all preassigned. That is, the 24 DS0 channels are all predesignated as either control legs or branch legs of the 19.2 kb/s MJU functions. Table 7-4 identifies channel assignments for each of the four 19.2 kb/s MJU functions supported on the DS1 between the DACS II and the DS1-MJU Shelf.

Table 7-4. Channel Assignments Between DACS II and DS1-MJU Shelf

DACS II Channel	MJU Function	DACS II Channel	MJU Function
1	MJU 1 Cntrl. Leg	13	MJU 3 Cntrl. Leg
2	MJU 1 Branch 1	14	MJU 3 Branch 1
3	MJU 1 Branch 2	15	MJU 3 Branch 2
4	MJU 1 Branch 3	16	MJU 3 Branch 3
5	MJU 1 Branch 4	17	MJU 3 Branch 4
6	Unused	18	Unused
7	MJU 2 Cntrl. Leg	19	MJU 4 Cntrl. Leg
8	MJU 2 Branch 1	20	MJU 4 Branch 1
9	MJU 2 Branch 2	21	MJU 4 Branch 2
10	MJU 2 Branch 3	22	MJU 4 Branch 3
11	MJU 2 Branch 4	23	MJU 4 Branch 4
12	Unused	24	T1DM Framing

The channel numbering scheme and MJU capacity (four per DS1 port) are identical to those of other vendors' CR implementations, with each additional DACS II DS1 corresponding to an MJU circuit pack of a CR system. 19.2 kb/s MJU inventory and forecasting with DACS II can be tracked in a manner similar to that used for CR systems. That is, the modularity of four MJUs per DS1 port can be used as a guide for determining new 19.2 kb/s MJU capacity requirements.

Circuit Provisioning

Once the DS1-MJU Shelf is installed and connected to DACS II, DACS II cross-connect commands are used to establish multipoint connections. The 19.2 kb/s DS0A signals are simply connected to the appropriate MJU channel as shown in Table A. No additional work at the DS1-MJU Shelf or DSX-1 is required for these connections. Large multipoint circuits are created by cascading MJUs (connecting a branch leg from one MJU to a control leg of another MJU) via DACS II cross-connect commands. To simplify craft activity and circuit tracking in the DACS II, a specified range of DACS II DS1 terminations can be dedicated to the DS1-MJU Shelf.

Because the channel assignments and MJU modularity are consistent with CR implementations, the same circuit design techniques may also be used on DACS II. That is, from a circuit design perspective, the DS1 termination on the DACS II can be viewed as a DACS II "Quad MJU" (QMJU) circuit pack, with the leg/branch time slot assignments for this QMJU as specified in Table A. The 19.2 kb/s MJU circuits for both CR systems and DACS II are created by connecting the customer channels to these QMJU circuit packs.

Test Access

All standard DACS II test access features (monitor, split, and terminate) are available for 19.2 kb/s multipoint circuits. The DACS II provides DS0A test access for any leg (control or branch) of a multipoint circuit and directs the leg under test to a DACS II Test Access Digroup (TAD). Test access sessions may be established and controlled remotely from an operations center, with subrate testing being provided via existing external test equipment. Isolating faulty branches is easily accomplished using standard DACS II test access features as well as the MJU branch select/block and loopback functions. The DS1-MJU Shelf fully supports these DDS standard functions.

The DS1-MJU Shelf also provides DS1 monitoring access for both the transmit and receive DS1 signals. This access is provided via access jacks on the DS1-MJU circuit pack faceplate. Each DS1-MJU circuit pack also provides a DS1 loopback feature which loops the incoming DS1 signal back to the DACS II. This feature can be used for installation connectivity testing as well as for trouble sectionalization.

Alarms and Trouble Sectionalization

Both the DACS II and the DS1-MJU Shelf provide a number of alarms to identify failed equipment and facilities. These maintenance features allow quick trouble isolation and fast service restoration.

DS1-MJU Shelf Alarms

Table 7-5 identifies various alarm conditions provided by LEDs on each DS1-MJU circuit pack.

Table 7-5. Alarm Condition LEDs on DS1-MJU Circuit Packs

LED	Function
HDW	This LED indicates a hardware malfunction with the DS1-MJU circuit pack.
LOS	This LED indicates that the DS1-MJU detects a loss of DS1 signal.
LOF	This LED indicates that the DS1-MJU detects a loss of DS1 framing.
RFA	This LED indicates that the DS1-MJU detects a Remote Frame Alarm from the DACS II.
LPBK	This LED indicates that the DS1 loopback feature is active.

In addition to the alarm indications, each DS1-MJU circuit pack provides the switches used for maintenance as shown in Table 7-6.

Table 7-6. Maintenance Switches on DS1-MJU Circuit Packs

Switch	Function
LPBK	This switch provides the DS1 signal loopback.
RESET	This switch causes a complete reset of the DS1-MJU circuit pack.
LED TST	This switch is used to test the circuit pack LEDs.

The DS1-MJU Shelf provides contact closures for power visual and audible alarms. These contact closures can be tied to the office alarm grid for quick detection and isolation of DS1-MJU alarms.

DACS II Alarms

The DACS II detects, identifies, and reports the following equipment and DS1 facility alarms over its administrative links (X.25 or Snider).

- Dual Digroup Circuit pack failure
- DS1 LOS/LOF (RED CGA)
- DS1 RFA detection (RFA CGA)
- DS1 AIS detection (AIS CGA)

Trouble Sectionalization

The intent of the DS1-MJU is to minimize maintenance. For this reason, service-affecting alarm conditions on the DS1-MJU will be passed to the DACS II system by creating a DS1 signal failure for the DS1-MJU to the DDC. The remote alarms from DACS II allow users to perform quick trouble isolation between the DACS II and the DS1-MJU Shelf. Table 7-7 summarizes how these alarms can help isolate trouble without first having to dispatch maintenance craft to the office.

Table 7-7. DS1-MJU Alarm States

Alarm	Action
HDW	Causes a Red CGA in DACS II.
LOS	Transceiver will send an all 1s pattern to DACS II (AIS CGA).
LOF	Transceiver will send an RFA (Yellow) Alarm towards the DACS II.
RFA	No action by the DS1-MJU when an RFA signal is received.
Single Fuse Blown (in a circuit)	Contact closures (PMJU, PMJUR) provided for connection to Office Alarm Systems.
Dual Fuse Blown (in a circuit)	Contact closures activated and the transceiver is disabled providing a CGA to DACS II.

ORDERING

Table 7-8 shows ordering information and lists descriptions for the DS1-MJU Bay/Shelf. For pricing and availability, consult your AT&T Account Executive.

Table 7-8. Equipment Ordering Information for DS1-MJU Bay/Shelf

List	Description
NJ00623A-1, List 1	Framework, assembly, wiring, and equipment for one flexible interface bay equipped with one NJ00623AA1, L-1 shelf in position 1.
NJ00623A-1, List 2	Assembly and equipment required in addition to List 1 for one NJ00623AA1, L-1 shelf assembly located in positions 2 through 6. Maximum of 5 List 2 per List 1.
NJ00623A-1, List 3	Assembly and equipment required for **field installation** of one NJ00623AA1, L-1 shelf assembly. To be mounted in the frame assembly ordered by List 1.
NJ00623A-1, List 4	Circuit pack required to equip one DS1-MJU termination in a DS1-MJU Shelf. Maximum of 12 List 4 per List 1, List 2, or List 3.

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Ordering

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Ordering Procedure

The following is a simplified procedure for ordering a DACS II system.

1. Consult extensively with an AT&T Account Executive to obtain configuration and pricing information.
2. The AT&T Account Executive or the customer's equipment engineer fills out a customer order for equipment and software. Assistance can be obtained from an AT&T Account Executive or an AT&T customer service representative.

   The information for your order must include the following:

   - Your order number
   - Your geographic location
   - Types of bays required
   - Number of DS1 and DS3 facilities required
   - Growth expectations
3. The order is sent to the AT&T Customer Service Organization
4. The AT&T Customer Service Organization uses your order to generate schedules for equipment engineering, manufacturing, shipment, and installation. The Customer Service Organization also generates an order number and coordinates the engineering, manufacturing, shipping, and installation of the system.
5. The DACS II is installed. The equipment can be installed by AT&T or the customer ordering the equipment. Detailed information concerning installation can be obtained from an AT&T Account Executive.

Equipment List Structure

Introduction

This chapter is intended to familiarize the reader with the DACS II equipment list structure. This list structure is a tabular listing specified in the reference J drawing. The items in this listing identify the equipment for the purposes of ordering and manufacturing. This listing starts with the minimum equipage and gives the assemblies, equipment groupings that are ordered as blocks, and circuit packs to build the installation to the required size. Individual pieces of equipment (circuit packs, equipment panels, etc.) are also ordered on an individual code basis.

The listings in this section are not provided as an ordering guide. Since this manual is not updated for every change on the J-drawing, the equipment listings may not be up-to-date. For the latest ordering information, see your local account executive.

This chapter is divided into listings for equipment and software specified by the following J drawings: J98774A-2, J98774B-1, J98774C-1, J9874D-1, J98774FA-1, J98774SD-5, J98774BE-4, J9877BD-5, and J98774SE-4. The J98774A-2 is for multibay (non-CEF) equipment with software Releases 4.0, 4.1, and 5.1. The J98774B-1 equipment is for single-bay (Non-CEF) software Releases 4.0, 4.1, and 5.1. The J98774C-1 is for CEF equipment for Releases 5.0 and 5.1. The introduction in the J98774C-1 Listing shows how the list items identify equipment in the frame. The figures in that introduction may be useful to the reader who is not acquainted with the list concept, provided the reader remembers that the specific items apply only to the one J number.

DACS II Equipment List Structure

Introduction

The equipment list structure identifies the equipment as list items in TABLE A of the J drawing for the purposes of ordering and manufacturing. This listing starts with the minimum equipage needed to operate the DACS II and allows for growth by the addition of circuit packs, subassemblies, and frames. The hardware architecture is modular and lends itself to organized growth.

Figure 8-1 shows some of the basic List items that cover the minimum frame equipage and the addition of bay 3 to the right of the common equipment switch bay. Notice that the starting 2-bay frame includes the customer defined FTU or DS3U.

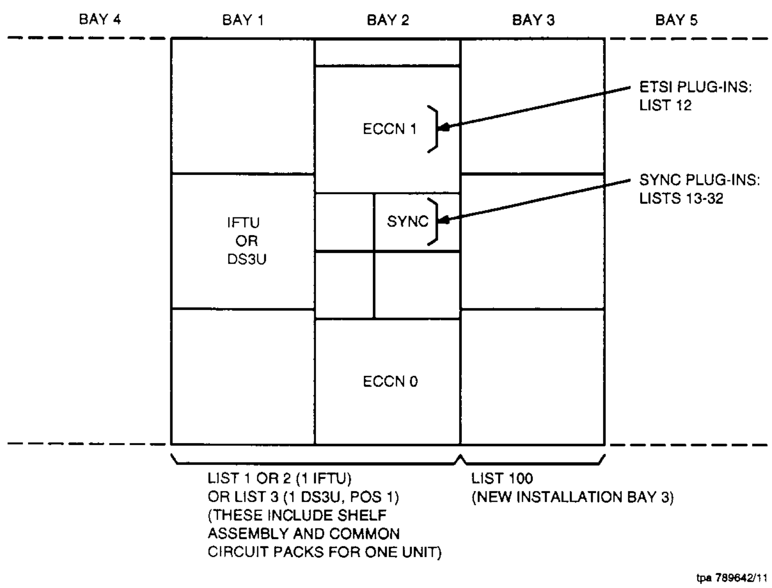

Figure 8-1. Basic CEF List Items

Figure 8-2 shows some of the List items to equip an IFTU (integrated facility terminating unit) and a DSPU (digital signal processing unit) in bay 3. These lists are for the field addition of unit subassemblies in added side bays. Other list items (not shown) specify the installation of shelf assemblies in the bay 1. Some of the options in list items are shown for the different circuit packs that go into the unit slots.

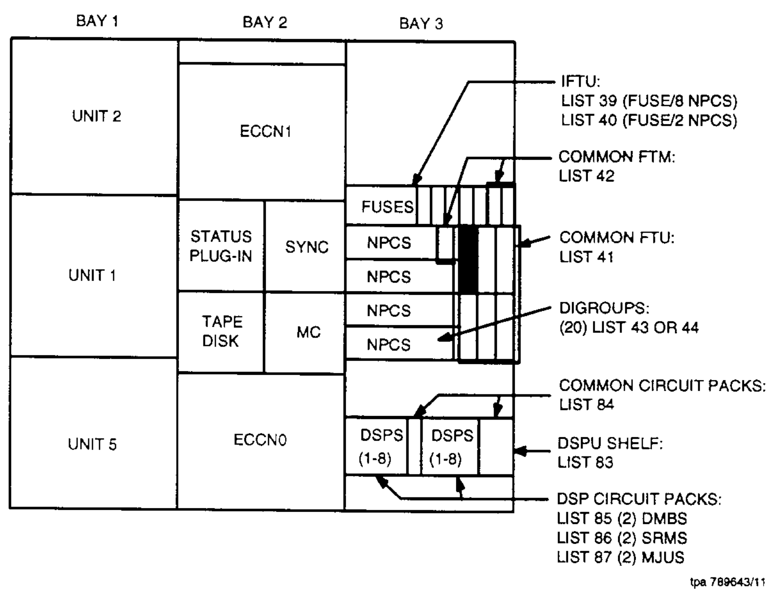

Figure 8-2. CEF Unit List Items

J98774C-1 CEF (Capacity Expansion Frame) List Structure

The listings in this section are not provided as an ordering guide. Since this manual is not updated for every change on the J-drawing, the equipment listings may not be up-to-date. For the latest ordering information, see your local account executive.

LIST # **DESCRIPTION**

1. Framework, assembly, wiring, equipment, and common circuit packs for one two-bay DACS II CEF (Capacity Expansion Frame) with a switch bay and a flexible interface bay equipped with one IFTU (integrated facility terminating unit) assembly (specify unit position number) fused on a eight NPC basis with common circuit packs required to support forty DS1 terminations.
   (1) ED9C025-30,G1
   (4) BBR1
   (2) BBS1
   (1) 484GA
   (1) 411AA
   (1) ED9C023-30,G1
   (1) SM565
   (2) TG58
   (2) TM590
   (2) TM657B
   (1) TM659C
   (1) UM56
   (1) UM71
   (1) ED9C015-30,G1
   (1) ED9C016-30,G1
   (1) ED9C017-30,G1
   (2) BBS2
   (2) TG79
   (1) TG81
   (1) ED9C025-30,G4
   (1) ED9C011-30,G1
2. Framework, assembly, wiring, equipment, and common circuit packs for one two-bay DACS II CEF with a switch bay and a flexible interface bay equipped with one IFTU assembly (specify unit position number) fused on a two NPC basis with common circuit packs required to support forty DS1 terminations.
   (1) ED9C025-30,G1
   (4) BBR1
   (2) BBS1
   (1) 484GA
   (4) 411AA
   (1) ED9C023-30,G1
   (1) SM565

(2) TG58
(2) TM590
(2) TM657B
(1) TM659C
(1) UM56
(1) UM71
(1) ED9C015-30,G1
(1) ED9C016-30,G1
(1) ED9C017-30,G1
(2) BBS2
(2) TG79
(1) TG81
(1) ED9C011-30,G2
(16) ED9C012-30,G1
(1) UM28

3. Framework, assembly, wiring, equipment and common circuit packs for one two-bay DACS II CEF with a switch bay and a flexible interface bay equipped with one DS3U shelf assembly in position 1 with common circuit packs required to support three DS3 terminations (does not include MXR circuit pack required for protection per List 66).
(1) ED9C025-30,G5
(4) BBR1
(2) BBS1
(1) 484GA
(1) 411AA
(1) SM565
(1) TG58
(2) TM590
(1) TM657B
(1) TM659C
(1) UM56
(1) UM71
(1) ED9C015-30,G1
(1) ED9C016-30,G1
(1) ED9C017-30,G1
(2) 563A
(2) BBS2
(2) KER1
(1) KER2
(2) KCR4
(1) ED-2C980-30,G2

4. Reserved.

5. Framework, assembly, wiring, equipment and common circuit packs for one DACS II CEF switch bay plus four List 12 for field replacement of a DACS II switch bay equipped in a network bay frame.
(1) ED9C008-30,G1
(4) BBR1

(8) BBS2
(2) BBS1
(1) TM657B
(1) TM659C
(1) UM56
(1) UM71
(1) ED9C015-30,G1
(1) ED9C016-30,G1
(1) ED9C017-30,G1
(1) ED9C023-30,G1

6. Assembly, wiring, equipment, common circuit packs, and drawings to rebuild one DACS II CEF switch bay into an existing installation equipped in an *ESS*™ switch framework (7'-0" high) plus four List 12.
(1) ED9C030-30,G1
(8) BBS2
(4) BBR1
(2) BBS1
(1) TM657B
(1) TM659C
(1) UM56
(1) UM71
(1) ED9C015-30,G1
(1) ED9C016-30,G1
(1) ED9C017-30,G1
(1) ED9C023-30,G1

7. Circuit Pack required to provide one high speed enhanced communication interface which has four asynchronous interfaces and two X.25 interfaces.
(1) TM762

8. Blank panel for one unequipped unit position.

9. Circuit pack required to provide one communication interface with six asynchronous administrative links (Note: Order one List 9 or 10).
(1) TM658C

10. Circuit pack required to provide one enhanced communication interface with four asynchronous interfaces and two synchronous administrative links. (Order one List 9 or 10).
(1) TM736C

11. Circuit pack required to replace the TM657 in each FTU, IFTU or DSPU shelf in the existing system.
(1) TM657B

12. Circuit packs required to provide expanded TSI in the 0 and 1 ECCN shelf for each FTU, IFTU, DSPU or DS3U assembly.
(2) BBS2

13. Circuit pack required to provide time base oscillator for Stratum-3 of the North American synchronization network.
(2) TG60

14. Circuit pack required to provide time base oscillator for local exchange of CCITT compliant synchronization networks.
    (2) TG61

15. Circuit pack required to provide time base oscillator for transit exchanges of CCITT synchronization networks.
    (2) TG62

16. Circuit pack required to provide time base oscillator for Stratum-2 of the North American synchronization network.
    (2) TG63

17. Circuit pack required in addition to List 13 when the DACS II is not timed by the network but supplies timing to an isolated Stratum-3 timing island, with four duplicated DDS composite clock timing distributions (optional order one List 17 or 18).
    (1) TG60
    (2) TG70

18. Circuit pack required in addition to List 13 when the DACS II is not timed by the network but supplies timing to an isolated Stratum-3 timing island, with four duplicated 2.048-MHz CCITT compliant timing distributions (optionally order one List 17 or 18).
    (1) TG60
    (2) TG71

19. Circuit pack required in addition to List 14 when the DACS II is not timed by the network but supplies timing to an isolated CCITT compliant local exchange timing island, with four duplicated DDS composite clock timing distributions (optionally order one List 19 or 20).
    (1) TG61
    (2) TG70

20. Circuit packs required in addition to List 14 when the DACS II is not timed by the network but supplies timing to an isolated CCITT compliant local exchange timing island, with four duplicated 2.048-MHz CCITT compliant timing distributions (optionally order one List 19 or 20).
    (1) TG61
    (2) TG71B

21. Circuit packs required in addition to List 15 when the DACS II is not timed by the network but supplies timing to an isolated CCITT compliant DDS composite clock timing distributions (optionally order one List 21 or 22).
    (1) TG62
    (2) TG70

22. Circuit packs required in addition to List 15 when the DACS II is not timed by the network but supplies timing to an isolated CCITT compliant transit exchange timing island, with four duplicated 2.048-MHz compliant timing distribution (optionally order one List 21 or 22).
    (1) TG62
    (2) TG71B

23. Circuit packs required in addition to List 16 when the DACS II is not timed by the network but supplies timing to an isolated Stratum-2 timing island, with four duplicated DDS composite clock timing distributions (optionally order one List 23 or 24).
(1) TG63
(2) TG70

24. Circuit pack required in addition to List 16 when the DACS II is not timed by the network but supplies timing to an isolated Stratum-2 timing island, with four duplicated 2.048-MHz CCITT compliant timing distributions (optionally order one List 23 or 24).
(1) TG63
(2) TG71B

25. Circuit pack required for timing extractor to provide two duplicated DS1 timing link inputs (1.544-Mb/s).
(2) TG64

26. Circuit pack required for timing extractor to provide two duplicated CCITT compliant primary block timing link inputs (2.048-Mb/s) with 120-ohm balanced termination.
(2) TG65

27. Circuit pack required to provide timing extractor to provide two duplicated DDS composite clock timing link inputs (64-kb/s).
(2) TG66

28. Circuit pack required to provide timing extractor to provide two duplicated unipolar clock (sine/square wave) timing link inputs (512-kHz, 1.0-MHz, 1.544-MHz, 2.048-MHz or 5.0-MHz) with 100-ohm balanced termination.
(2) TG67B

29. Circuit pack required to provide timing extractor to provide two duplicated BSRF 2.048-MHz at –20dBm timing link inputs with 75-ohm single-ended termination.
(2) TG68

30. Circuit pack required to provide timing distributor to provide four duplicated DDS composite clock timing link distributions (64-kb/s).
(2) TG70

31. Circuit pack required to provide timing distributor to provide four duplicated 2.048-MHz CCITT compliant sine wave timing link distributions.
(2) TG71B

32. Circuit pack required to provide timing extractor to provide two duplicated CCITT compliant primary block timing link inputs (2.048-Mb/s) with 75-ohm balanced termination.
(2) TG75

33. Reserved.

34. Reserved.
35. Reserved.
36. Reserved.
37. Assembly and equipment required in addition to List 1, 2 or 3 for one IFTU (intergrated facility terminating unit) assembly fused on an eight NPC basis (specify unit position number).
    (1) ED9C025-30,G4
38. Assembly and equipment required in addition to List 1, 2 or 3 for one IFTU (integrated facility terminating unit) assembly fused on a two NPC basis (specify unit position number).
    (1) ED9C025-30,G5
39. Assembly and equipment for field installation of or in addition to Lists 100 through 116 one IFTU assembly fused on an eight NPC basis (specify unit position number).
    (1) ED2C854-30,G33
40. Assembly and equipment for field installation of or in addition to Lists 100 through 116 one IFTU assembly fused on an two NPC basis (specify unit position number).
    (1) ED2C854-30,G34
41. Common circuit packs required when an IFTU is ordered. (One set of circuit packs equivalent to List 41 is embedded in Lists 1 and 2.)
    (3) 411AA
    (1) TM657B
    (1) UM28
42. Common circuit packs for each group of 40 digroup module equipped in an integrated facility terminating unit. (One set of circuit packs equivalent to List 42 is embedded in Lists 1 and 2.)
    (2) TG79
    (1) TG81
43. Circuit pack required to equip two digroups (max 80 List 43 per IFTU).
    (1) TG80B
44. Not applicable.
45. Circuit pack required to equip two primary blocks for 2.048-Mb/s.
    (1) TG182
46. Circuit pack required to equip two NPCs for *SLC*® 96 carrier interface.
    (1) TG183
47. Circuit pack required to equip two NPCs for *SLC* series 5 carrier interface.
    (1) TG184
48. Circuit pack required to equip two digroups with a 75-ohm interface for 2.048-Mb/s.
    (1) TG185

49. Circuit pack required to equip two NPCs for zero byte TSI for zero code suppression.
(1) TG186
50. Fuse boards always required when an IFTU assembly, fused on a (8) NPC basis is ordered. (one List 50 is included in List 1 and List 207.)
51. Fuse boards always required when an IFTU assembly, fused on a two (2) NPC basis is ordered. (one List 51 is included in List 2 and List 215.)
52. Reserved.
53. Reserved.
54. Reserved.
55. Reserved.
56. Reserved.
57. Reserved.
58. Reserved.
59. Reserved.
60. Reserved.
61. Reserved.
62. Reserved.
63. Assembly and equipment required in addition to List 1, 2 and 3 for one DS3U shelf assembly (specify unit position number).
(1) ED9C025-30,G3
64. Assembly and equipment required for field installation of or in addition to List 105 through 116 one DS3U shelf assembly (specify unit position number).
(1) ED2C854-30,G35
65. Common circuit packs for the DS3U. (One set of circuit packs equivalent to List 65 is embedded in list 3.)
(2) 563A
(2) KER1
(1) KER2
(2) KCR4
66. Circuit pack required to equip one DS3 termination in a DS3U shelf. (Minimum 2 List 66 always required, when the first KCR1 is ordered a second KCR1 for protection must also be ordered, maximum 7 List 66 per list 3, 63 or 64.)
(1) KCR1
67. Power unit for the DS3U shelf. (Required in addition to those provided in List 3 or 65 when there are more than 4 list 66.)
(1) 563A

68. Circuit pack to equip the interface unit capability for one DS3 termination (28 DS1) in a DS3U shelf (maximum 7 per List 3, 63 or 64 when the first KCR2 is ordered a second KCR2 for protection must also be ordered).
(1) KCR2
69. Reserved.
70. Reserved.
71. Reserved.
72. Reserved.
73. Reserved.
74. Reserved.
75. Reserved.
76. Reserved.
77. Reserved.
78. Reserved.
79. Reserved.
80. Reserved.
81. Reserved.
82. Assembly and equipment required in addition to List 1,2 or 3 for one DSPU (digital signal processing unit) shelf assembly. (Specify unit position number.)
(1) ED9C025-30,G2
83. Assembly and equipment required for the field installation of or in addition to List 100 through 116 a DSPU shelf assembly. (Specify unit position number.)
(1) ED2C854-30,G36
84. Common circuit packs for the DSPU. (Maximum 1 List 84 per list 82 or 83.)
(1) SM566
(1) TM657B
(2) 411AA
(1) UM29
(1) ED9C023-30,G2
85. Circuit packs required to equip one duplicated 512- channel digital multipoint bridge. (maximum 8 List 85 per List 82 or 83.)
(2) TM665
86. Circuit packs required to provide one duplicated subrate multiplexer. (Maximum 8 List 86 per list 82 or 83)
(2) TM739

87. Circuit pack required to provide one duplicate multipoint junction unit. (Maximum 8 List 87 per list 82 or 83.)
    (2) TM740
88. Circuit pack required to provide one duplicated C-BIT processor for 2.048-Mb/s.
    (2) TM747
89. Reserved.
90. Reserved.
91. Reserved.
92. Reserved.
93. Reserved.
94. Reserved.
95. Reserved.
96. Reserved.
97. Reserved.
98. Reserved.
99. Reserved.
100. Assembly, wiring and equipment for one flexible interface bay in bay position 3 in addition to List 1, 2, or 3.
    (1) ED2C854-30,G13
101. Assembly, wiring and equipment for one flexible interface bay in bay position 4 in addition to List 1, 2, or 3.
    (1) ED2C854-30,G14
102. Assembly, wiring and equipment for one flexible interface bay in bay position 5 in addition to List 1, 2 or 3.
    (1) ED2C854-30,G15
103. Assembly, wiring and equipment for one flexible interface bay in bay position 6 in addition to List 1, 2, or 3.
    (1) ED2C854-30,G16
104. Reserved
105. Reserved
106. Reserved
107. Reserved
108. Reserved
109. Reserved

110. Reserved
111. Reserved
112. Reserved
113. Reserved
114. Reserved
115. Reserved
116. Assembly required for field mounting of DACS II units per List 39, 40, 64, or 83.
117. Reserved.
118. Reserved.
119. Reserved.
205. Equipment required in addition to List 1,2,37,38,207 and 215 to provide an optional timing connection from the IFTU in position 1 to meet 2.048 Mb/s timing requirements.
(1) ED9C025-30,GB
206. Equipment required in addition to List 1,2,37,38,207 and 215 to provide an optional timing connection from the IFTU in position 2 to meet 2.048 Mb/s timing requirements.
(1) ED9C025-30,GC
207. Framework, assembly, wiring, equipment, and common circuit packs for one two-bay CEF with a switch bay and flexible interface bay equipped with one IFTU.
(1) ED9C025-30,G6
(1) ED9C017-30,G1
(1) ED9C011-30,G1,G2
(4) BBR1
(2) BBS1
(2) BBS2
(1) SM565
(2) TG58
(2) TG79
(1) TG81
(2) TM590
(2) TM657B
(1) TM659C
(1) UM28
(1) UM56
(1) UM71
(4) 411AA
(1) 484GA

208. Assembly, wiring, and equipment for one flexible bay in position 3.
(1) ED2C854-30,G101

209. Assembly, wiring, and equipment for one flexible bay in position 4.
(1) ED2C854-30,G102

210. Assembly, wiring, and equipment for one flexible bay in position 5.
(1) ED2C854-30,G103

211. Assembly, wiring, and equipment for one flexible bay in position 6.
(1) ED2C854-30,G104

212. Assembly, wiring, and equipment for one flexible bay in position 7.
(1) ED2C854-3-,G105

213. Equipment required in addition to List 207 or 215 to provide an adapter for a 75 ohm coax cable.
(1) ED9C025-30,G7

214. Equipment required in addition to List 207 or 215 to provide an adapter for a 75 ohm coax cable.
(1) ED9C025-30,G8

215. Framework, assembly, wiring, and equipment, and common circuit packs for one two bay CEF with switch bay and flexible bay with one IFTU.
(1) ED9C025-30,G5,G6
(1) ED9C017-30,G1
(1) ED9C023-30,G1
(1) ED9C011-30,G1
(1) ED9C012-30,G1
(4) BBR1
(2) BBS1
(2) BBS2
(1) SM565
(2) TG58
(2) TG79
(1) TG81
(2) TM590
(2) TM657B
(1) TM659C
(1) UM28
(1) UM56
(1) UM71
(4) 411AA
(1) 484GA

216. Equipment required in addition to List 208 through 212 to provide an adapter panel for 75 ohm coax cable.
(1) ED2C854-30,G106

217. Equipment required in addition to List 208 through 212 to provide an adapter panel for 75 ohm coax cable.
(1) ED2C854-30,G107

218. Equipment required in addition to List 208 through 212 to provide an adapter panel to terminate 120 ohm twisted pair cable.
(1) ED9C025-30,G9

219. Equipment required in addition to List 208 through 212 to provide an adapter panel to terminate 120 ohm twisted pair cable.
(1) ED2C854-30,G108

D. Equipment required in addition to Lists 1, 2, 37, 38, 39, and 40 when the IFTU shelf is mounted in position 1 (non-hierarchical designation strips).

E. Equipment required in addition to Lists 1, 2, 37, 38, 39, and 40 when the IFTU shelf is mounted in position 2 (non-hierarchical designation strips).

F. Equipment required in addition to Lists 1, 2, 37, 38, 39, and 40 when the IFTU shelf is mounted in position 3 (non-hierarchical designation strips).

G. Equipment required in addition to Lists 1, 2, 37, 38, 39, and 40 when the IFTU shelf is mounted in position 4 (non-hierarchical designation strips).

H. Equipment required in addition to Lists 1, 2, 37, 38, 39, and 40 when the IFTU shelf is mounted in position 5 (non-hierarchical designation strips).

J. Equipment required in addition to Lists 1, 2, 37, 38, 39, and 40 when the IFTU shelf is mounted in position 6 (non-hierarchical designation strips).

K. Equipment required in addition to Lists 1, 2, 37, 38, 39, and 40 when the IFTU shelf is mounted in position 7 (non-hierarchical designation strips).

L. Equipment required in addition to Lists 1, 2, 37, 38, 39, and 40 when the IFTU shelf is mounted in position 8 (non-hierarchical designation strips).

M. Equipment required in addition to Lists 1, 2, 37, 38, 39, and 40 when the IFTU shelf is mounted in position 9 (non-hierarchical designation strips).

N. Equipment required in addition to Lists 1, 2, 37, 38, 39, and 40 when the IFTU shelf is mounted in position 10 (non-hierarchical designation strips).

P. Equipment required in addition to Lists 1, 2, 37, 38, 39, and 40 when the IFTU shelf is mounted in position 11 (non-hierarchical designation strips).

Q. Equipment required in addition to Lists 1, 2, 37, 38, 39, and 40 when the IFTU shelf is mounted in position 12 (non-hierarchical designation strips).

R. Equipment required in addition to Lists 1, 2, 37, 38, 39, and 40 when the IFTU shelf is mounted in position 13 (non-hierarchical designation strips).

S. Equipment required in addition to Lists 1, 2, 37, 38, 39, and 40 when the IFTU shelf is mounted in position 14 (non-hierarchical designation strips).

T. Equipment required in addition to Lists 1, 2, 37, 38, 39, and 40 when the IFTU shelf is mounted in position 15 (non-hierarchical designation strips).

U. Equipment required in addition to Lists 1, 2, 37, 38, 39, and 40 when the IFTU shelf is mounted in position 16 (non-hierarchical designation strips).

V. Equipment required in addition to List 82 or 83 when DSPU shelf is mounted in position 1 (non-hierarchical designation strips).

W. Equipment required in addition to List 82 and 83 when DSPU shelf is mounted in position 2 (non-hierarchical designation strips).

X. Equipment required in addition to List 82 and 83 when DSPU shelf is mounted in position 3 (non-hierarchical designation strips).

Y. Equipment required in addition to List 82 and 83 when DSPU shelf is mounted in position 4 (non-hierarchical designation strips).

Z. Equipment required in addition to List 82 and 83 when DSPU shelf is mounted in position 5 (non-hierarchical designation strips).

AA. Equipment required in addition to List 82 and 83 when DSPU shelf is mounted in position 6 (non-hierarchical designation strips).

AB. Equipment required in addition to List 82 and 83 when DSPU shelf is mounted in position 7 (non-hierarchical designation strips).

AC. Equipment required in addition to List 82 and 83 when DSPU shelf is mounted in position 8 (non-hierarchical designation strips).

AD. Equipment required in addition to List 82 and 83 when DSPU shelf is mounted in position 9 (non-hierarchical designation strips).

AE. Equipment required in addition to List 82 and 83 when DSPU shelf is mounted in position 10 (non-hierarchical designation strips).

AF. Equipment required in addition to List 82 and 83 when DSPU shelf is mounted in position 11 (non-hierarchical designation strips).

AG. Equipment required in addition to List 82 and 83 when DSPU shelf is mounted in position 12 (non-hierarchical designation strips).

AH. Equipment required in addition to List 82 and 83 when DSPU shelf is mounted in position 13 (non-hierarchical designation strips).

AJ. Equipment required in addition to List 82 and 83 when DSPU shelf is mounted in position 14 (non-hierarchical designation strips).

AK. Equipment required in addition to List 82 and 83 when DSPU shelf is mounted in position 15 (non-hierarchical designation strips).

AL. Equipment required in addition to List 82 and 83 when DSPU shelf is mounted in position 16 (non-hierarchical designation strips).

AM. Equipment required in addition to List 82 or 83 when DSPU shelf is mounted in position 1 through 16 (hierarchical designation strips).

AN. Equipment required in addition to Lists 3, 63, or 64 when the DS3U shelf is mounted in position 1 through 16 (designation strips).

AP. Equipment required in addition to Lists 1, 2, 37, 38, 39, or 40 when the IFTU shelf is mounted in position 1 through 16 (export hierarchical designation strips).

AQ. Equipment required in addition to Lists 1, 2, 37, 38, 39, or 40 when the IFTU shelf is mounted in position 1 through 16 (DS1 hierarchical designation strips).

AR. Equipment required in addition to Lists 1,2,37,38,39, or 40 when the IFTU shelf is mounte.
(1) ED9C025-30,GA

AS. Wiring and equipment in addition to List 5 for a connectorized fuse and alarm panel.
(1) ED9C008-30,GB

AT. Wiring and equipment in addition to List 6 for a connectorized fuse and alarm panel.
(1) ED9C030-30,GB

AU. Wiring and equipment in addition to List 100, 105, or 117 for a connectorized fuse and alarm panel.
(1) ED2C854-30,GB

AV. Wiring and equipment in addition to List 101, 106, or 112 for a connectorized fuse and alarm panel.
(1) ED2C854-30,GC

AW. Wiring and equipment in addition to List 102, 107, 110, 113, or 118 for a connectorized fuse and alarm panel.
(1) ED2C854-30,GD

AX. Wiring and equipment in addition to List 103, 108, or 114 for a connectorized fuse and alarm panel.
(1) ED2C854-30,GE

AY. Wiring and equipment in addition to List 104, 109, 111, 115, or 118 for a connectorized fuse and alarm panel.
(1) ED2C854-30,GF

AZ. Equipment always required in addition to List 5.
(1) ED9C025-30,GD

BA. Equipment always required in addition to List 5.
(1) ED9C008-30,GD

BB. Equipment always required in addition to List 6.
(1) ED9C030-30,GC

BC. Equipment always required in addition to List 207 or 215.
(1) ED9C025-30,GD

BD. Wiring and equipment always required in addition to List 1, 2, 3, 207, 215.
(1) ED9C025-30,GD

BE. Wiring and equipment always required in addition to List 5.
(1) ED9C008-30,GE

BF. Wiring and equipment always required in addition to List 6.
(1) ED9C030-30,GD

BG. Wiring and equipment always required in addition to List 100, 102, 104, 105, 107, 109, 110, 111, 113, 115, 117, 118, 119, 208, 210.
(1) ED2C854-30,GM

BH. Wiring and equipment always required in addition to List 101, 103, 106, 108, 112, 114, 209, 211.
(1) ED2C854-30,GL

J98774A-2 Multibay (non-CEF) List Structure

The Listings in this section are not provided as an ordering guide. Since this manual is not updated for every change on the J-drawing, the equipment Listings may not be up-to-date. For the latest ordering information, see your local account executive.

LIST # **DESCRIPTION**

1. Not applicable
2. Framework, assembly, wiring, equipment, and common circuit packs for one 640 digroup DACS II. (This equipment is mounted on an assembly of 3 Network Systems unequal flange type frameworks. It may be cabled directly from underneath in those locations with raised floors where no cable duct exists between frames.) Consists of:
   (1) ED-2C853-30,G2
   (4) 411AA
   (1) 484GA
   (6) 485AB
   (1) SM565
   (2) TG58
   (2) TG79
   (1) TG81
   (2) TM657
   (1) TM659
   (2) TM660
   (2) TM590
   (1) UM24B
   (2) UM26B
   (1) UM27
   (1) UM28
   (2) UM30
   (1) ED-2C876-30,G1
   (1) ED-2C877-30,G1
   (2) ED-2C863-30,G1
   (2) ED-2C863-30,G2
   (4) ED-2C863-30,G3
3. Not applicable
4. Framework, assembly, wiring, equipment, and common circuit packs for one 320 digroup DACS II. Consists of: Same circuit packs as List 2.
5. Not applicable
6. Framework, assembly, wiring, and equipment to provide an additional 320 digroups to an existing List 4. Consists of:

   (1) ED-2C853-31,G6

7. Assembly and equipment required in addition to Lists 2, 4, 6, 80, 81, 102, 104, and 106 for one DSP (digital signal processor) shelf assembly. Consists of:

   (1) ED-2C853-31,G7

8. Circuit pack always required in addition to List 2, 4, 102, or 104 to provide one communication interface circuit pack with six asynchronous interfaces for Generic 3.1 or higher software. Consists of:

   (1) TM658B.

9. Circuit pack required to provide time base oscillator for Stratum 3 of the North American synchronization network. Consists of:

   (2) TG60.

10. Circuit pack required to provide time base oscillator for local exchange of CCITT compliant synchronization networks. Consists of:

    (2) TG61.

11. Circuit pack required to provide time base oscillator for transit exchanges of CCITT synchronization networks. Consists of:

    (2) TG62.

12. Circuit pack required to provide time base oscillator for Stratum 2 of the North American synchronization network. Consists of:

    (2) TG63.

13. Circuit pack required to provide timing extractor to provide two duplicated DS1 timing link inputs (1.544-Mb/s) with no distribution. Consists of:

    (2) TG64.

14. Circuit pack required to provide timing extractor for two duplicated CCITT compliant primary block timing link inputs (2.048-Mb/s) with 120-ohm terminating impedance. Consists of:

    (2) TG65.

15. Circuit pack required to provide timing extractor for two duplicated DDS composite clock timing link inputs (64-kb/s) with no distribution. Consists of:

    (2) TG66.

16. Circuit pack required to provide timing extractor for two duplicated unipolar clock (sine/square wave) timing link inputs in 512-kHz, 1.0-MHz, 1.544-MHz, 2.048-MHz, or 5.0-MHz with no distribution. Consists of:

    (2) TG67
    (2) TG67B.

17. Circuit pack required to provide timing extractor for two duplicated BSRF 2.048-MHz at -20 DBM timing link inputs with no distribution. Consists of:

    (2) TG68.

18. Circuit pack required to provide timing distributor for four duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG70.

19. Circuit pack required to provide timing distributor for four duplicated 2.048-MHz sine wave timing link distributions. Consists of:

    (2) TG71B.

20. Stratum 3 Timing extractor/DDS Timing Distributor Combination Circuit Packs.
    (3) TG60
    (2) TG70

21. Reserved.

22. Reserved.

23. Reserved.

24. Circuit packs required when the DACS II is not timed by the network but supplies timing to an isolated timing island and is required to provide four duplicated 2.048-MHz sine wave timing link distributions. Consists of:

    (2) TG71
    (3) TG60.

25. Reserved.

26. Reserved.

27. Reserved.

28. Common circuit packs for each additional group of 40 digroups equipped in an FTU or initial and each additional Group of 40 digroups equipped in an IFTU. (Maximum 15 List 28 per List 2 or 102) (maximum 7 List 28 per List 4 or 104) (maximum 8 List 28 per List 6 or 106) (maximum 4 List 28 per List 83, 84, 85, 86, 87, 88, 89 or 90 in addition to 7 List 28 for List 80 or 3 List 28 for Lists 81, 82, 100 or 101). Consists of:

    (2) TG79
    (1) TG81.

29. Common circuit packs for facility terminating unit 2, 3, or 4, or for each IFTU 1, 2, 3, 4, 5, or 6. (Maximum 3 List 29 per List 2 or 102) (maximum 1 List 29 per List 4 or 104) (maximum 2 List 29 per List 6 or 106). Consists of:

    (1) TM657
    (1) UM28
    (3) 411AA.

30. Discontinued Availability
31. Circuit packs required when the second unit is equipped. Consists of:

    (6) TM660
    (2) UM26B.
32. Circuit packs required when the third unit is equipped. Consists of:

    (10) TM660
    (2) UM26B.
33. Circuit packs required when the fourth unit is equipped. Consists of:

    (14) TM660
    (2) UM26B.
34. Circuit packs required when the fifth unit is equipped. Consists of:

    (18) TM660
    (2) UM26B.
35. Circuit packs required when the sixth unit is equipped. Consists of:

    (22) TM660
    (2) UM26B.
36. Power units required in addition to those provided in List 2, 4, 102, or 104 when equipping the frame with the first DSP shelf assembly (List 7 or 62). (Maximum 1 List 36 per List 2, 4, 102, or 104.) Consists of:

    (2) 485AB.
37. DSP (digital signal processor) common packs. (Maximum 1 List 37 per List 7, 62, 73 or 75). Consists of:

    (1) SM566
    (1) TM657
    (1) UM29
    (2) 411AA.
38. Circuit packs required to equip one duplicated 512-channel multipoint bridge. (Maximum 8 List 38 per List 7, 62, 73 or 75.) Consists of:

    (2) TM665.
39. Circuit pack required when the DACS is not timed by the network but supplies timing to an isolated timing island and is required to provide eight duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (4) TG70.
40. Timing extractor and timing distributor circuit packs required to provide two duplicated DS1 timing link inputs (1.544-Mb/s) with four duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG70
    (2) TG64.

41. Timing extractor and timing distributor circuit packs required to provide two duplicated DS1 timing link inputs (1.544-Mb/s) with eight duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (4) TG70
    (2) TG64.

42. Timing extractor and timing distributor circuit packs required to provide two duplicated DS1 timing link inputs (1.544-Mb/s) with twelve duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (6) TG70
    (2) TG64.

43. Timing extractor and timing distributor circuit packs required to provide two duplicated DS1 timing link inputs (64-Mb/s) with four duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG70
    (2) TG66.

44. Timing extractor and timing distributor circuit packs required to provide two duplicated DS1 timing link inputs (64-Mb/s) with eight duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (4) TG70
    (2) TG66.

45. Timing extractor and timing distributor circuit packs required to provide two duplicated DS1 timing link inputs (64-Mb/s) with twelve duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (6) TG70
    (2) TG66.

46. Timing extractor and timing distributor circuit packs required to provide two duplicated unipolar clock (sine/square wave) timing link inputs (512-kHz, 1.0-MHz, 1.544-MHz, 2.048-MHz, or 5.0-MHz) with four duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG70
    (2) TG67B.

47. Timing extractor and timing distributor circuit packs required to provide two duplicated unipolar clock (sine/square wave) timing link inputs (512-kHz, 1.0-MHz, 1.544-MHz, 2.048-MHz, or 5.0-MHz) with eight duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (4) TG70
    (2) TG67B.

48. Timing extractor and timing distributor circuit packs required to provide two duplicated unipolar clock (sine/square wave) timing link inputs (512-kHz, 1.0-MHz, 1.544-MHz, 2.048-MHz, or 5.0-MHz) with twelve duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

(6) TG70
(2) TG67B.

49. Timing extractor and timing distributor circuit packs required to provide two duplicated BSRF 2.048-MHz at –20 dBm timing link inputs with four duplicated DDS composite clock timing distributions (64-kb/s). Consists of:

    (2) TG70
    (2) TG68.

50. Timing extractor and timing distributor circuit packs required to provide two duplicated BSRF 2.048-MHz at –20 dBm timing link inputs with eight duplicated DDS composite clock timing distributions (64-kb/s). Consists of:

    (4) TG70
    (2) TG68.

51. Timing extractor and timing distributor circuit packs required to provide two duplicated BSRF 2.048-MHz at –20 dBm timing link inputs with twelve duplicated DDS composite clock timing distributions (64-kb/s). Consists of:

    (6) TG70
    (2) TG68.

52. Timing extractor circuit packs required to provide two duplicated BSRF 2.048-MHz at –20 dBm timing link inputs and two duplicated DS1 timing link inputs (1.544-Mb/s) with no distributions. Consists of:

    (2) TG68
    (2) TG64.

53. Timing extractor and timing distributor circuit packs required to provide two duplicated BSRF 2.048-MHz at –20 dBm timing link inputs and two duplicated DS1 timing link inputs (1.544-Mb/s) with four duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG64
    (2) TG68
    (2) TG70.

54. Timing extractor and timing distributor circuit packs required to provide two duplicated BSRF 1.048-MHz at –20 dBm timing link inputs and two duplicated DS1 timing link inputs (1.544-Mb/s) with eight duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG64
    (2) TG68
    (4) TG70.

55. Timing extractor and timing distributor circuit packs required to provide two duplicated DDS composite clock timing link inputs (64-kb/s) and two duplicated DS1 timing link inputs (1.544-Mb/s) with no distributions. Consists of:

    (2) TG64
    (2) TG66.

56. Timing extractor and timing distributor circuit packs required to provide two duplicated DDS composite clock timing link inputs (64-kb/s) and two duplicated DS1 timing link inputs (1.544-Mb/s) with four duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG64
    (2) TG66
    (2) TG70.

57. Timing extractor and timing distributor circuit packs required to provide two duplicated DDS composite clock timing link inputs (64-kb/s) and two duplicated DS1 timing link inputs (1.544-Mb/s) with eight duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG64
    (2) TG66
    (2) TG70.

58. Circuit pack required to provide one enhanced communications interface that has four asynchronous interfaces and two X.25 synchronous interfaces for Generic 3.1 or higher software. Consists of:

    (1) TM736B.

59. Not applicable.

60. Circuit packs required to provide one duplicated Subrate multiplexer. (Maximum of 8 List 60 per List 7, 62.) Consists of:

    (2) TM739.

61. Circuit packs required to provide one duplicated multipoint junction unit. (Maximum of 8 List 61 per List 7, 62.) Consists of:

    (2) TM740.

62. Assembly and equipment required for the field installation of a DSP (digital signal processor) shelf assembly. Requires List A or B when applied to List 2, 4, 6, 102, 104, or 106 frames. Consists of:
    (1) ED-2C853-31,G12

63. Discontinued Availability

64. Discontinued Availability

65. Discontinued Availability
66. Circuit packs required to equip one DS3 termination in DS3 shelf assembly that supports the KCR3 facility line interface circuit pack (734A cable length up to 700 feet). (Minimum 2, maximum 7 List 66 per List 63, 64, 74 or 76.) Consists of:

    (1) KCR1.
67. Power unit required in addition to Lists 65 and 96 for more than four of List 66. Consists of:

    (1) 563A.
68. Not applicable.
69. Circuit pack required to equip two digroups for *SLC* 96 carrier interface. Consists of:

    (1) TG183.
70. Circuit pack required to equip two digroups for *SLC* Series 5 carrier interface. (Minimum 1, maximum of 80 List 70 per List 1.) Consists of:

    (1) TG184.
71. Reserved.
72. Framework, assembly, wiring, and equipment for flexible growth bay (7-foot network frame) to equip up to three units to an existing List 4 frame. Consists of:

    (1) ED-2C854-30,G1
73. Equipment required in addition to List 72 for a digital signal processor shelf. Consists of:

    (1) ED-2C854-30,G3
74. Discontinued Availability
75. Equipment required for field installation of a digital processor shelf in an existing List 72 bay. Consists of:

    (1) ED-2C854-30,G6
76. Discontinued Availability
77. Circuit pack required to equip two enhanced digroups. Consists of:

    (1) TG80B.

78. Circuit pack required to equip two digroups when ZBTSI zero code suppression is required. Consists of:

    (1) TG186.

79. Equipment required in addition to List 72, 80, 81, 82, 91, 100, 101, 107, or 108 to provide a cover for unequipped positions.

80. Framework, assembly, wiring, equipment, and common circuit packs for one DACS II, three bay frame with bay 3 having FULLY flexible equipage. Consists of:

    (1) ED-2C853-31,G16

81. Framework, assembly, wiring, equipment, and common circuit packs for one DACS II, two bay frame with bay 1 flexible interface bay equipped with one intergrated facility terminating unit (IFTU) fused on an eight NPC basis into position 1 with common circuit pack required to support 40 DS1 terminations having FULLY flexible equipage. Consists of:

    (1) ED-2C853-31,G17,G20

82. Framework, assembly, wiring, equipment, and common circuit packs for one DACS II, three bay frame with bay 1 and bay 3 fully flexible interface bays, with bay 1 equipped with one intergrated facility terminating unit (IFTU) fused on an eight NPC basis into position 1 with common circuit pack required to support 40 DS1 terminations. Consists of:

    (1) ED-2C853-31,G18,G20

83. Equipment required in addition to List 72 or 91 to equip one integrated facility terminating unit (IFTU) fused on an eight NPC basis. (Specify unit position number.) Consists of:

    (1) ED-2C854-30,G18

84. Equipment required in addition to List 72 or 91 to equip one integrated facility terminating unit (IFTU) fused on a two NPC basis. (Specify unit position number.) Consists of:

    (1) ED-2C854-30,G9

85. Equipment required for a field addition to equip one integrated facility terminating unit (IFTU) fused on an eight NPC basis. (Specify unit position number.) (For List 72 or 91 flexible bay.) Consists of:

    (1) ED2C854-30,G10

86. Equipment required for a field addition to equip one integrated facility terminating unit (IFTU) fused on a two NPC basis. (Specify unit position number.) (For List 72 or 91 flexible bay.) Consists of:

    (1) ED-2C854-30,G11

87. Equipment required in addition to List 80, 81, 82, 100, 101, 107, or 108 to equip one integrated facility terminating unit (IFTU) fused on an eight NPC basis. (Specify unit position number.) Consists of:

    (1) ED-2C853-31,G20

88. Equipment required in addition to List 80, 81, 82, 100, 101, 107, or 108 to equip one integrated facility terminating unit (IFTU) fused on a two NPC basis. (Specify unit position number.) Consists of:

    (1) ED-2C853-31,G21

89. Equipment required for a field addition to equip one integrated facility terminating unit (IFTU) fused on an eight NPC basis. (Specify unit position number.) (For List 80, 81, 82, 100, 101, 107, or 108 bay arrangement.) Consists of:

    (1) ED-2C853-31,G22

90. Equipment required for a field addition to equip one integrated facility terminating unit (IFTU) fused on a two NPC basis. (Specify unit position number.) (For List 80, 81, 82, 100, 101, 107, or 108 bay arrangement.) Consists of:

    (1) ED-2C853-31,G23

91. Framework, assembly, and equipment required to provide a flexible growth frame (7 feet 0 inches network bay frame) and cables to be used with an existing *ESS* switch arrangement (ED-2C853-30,G3). Consists of:

    (1) ED-2C854-30,G2

92. Assembly and equipment required in addition to Lists 2, 4, 6, 80, 81 or 82 for one DS3 shelf assembly that supports the KCR4 facility line interface circuit pack (734A cable length up to 900 feet). Consists of:

    (1) ED-2C853-31,G25

93. Equipment required for field installation of one DS3 shelf assembly that supports the KCR4 facility line interface circuit pack (734A cable length up to 900 feet). Consists of:

    (1) ED-2C853-31,G26

94. Equipment required in addition to Lists 72 or 91 to provide a DS3 shelf assembly that supports the KCR4 facility line interface circuit pack (734A cable length up to 900 feet). Consists of:

    (1) ED-2C854-30,G31

95. Equipment required for field installation of one DS3 shelf assembly that supports the KCR4 facility line interface circuit pack (734A cable length up to 900 feet) in an existing List 72 or 91 bay). Consists of:

    (1) ED-2C854-30,G32

96. Common packs for one DS3 shelf assembly that supports the KCR4 facility line interface circuit pack (734A cable length up to 900 feet). Consists of:

    (2) 563A
    (2) KCR4
    (2) KER1
    (1) KER2

97. Common circuit packs required when an integrated facility terminating unit (IFTU) is ordered.
    (3) 411A
    (1) TM657
    (1) UM28

98. Fuse boards required when an integrated facility terminating unit fused on an eight NPC basis is ordered.

99. Fuse boards required when an integrated facility terminating unit fused on a two NPC basis is ordered.

100. Framework, assembly, wiring, equipment, and common circuit packs for one DACS II two bay frame with bay 1 flexible interface bay equipped with one integrated facility terminating unit (IFTU) fused on a two NPC basis in position 1 with common circuit packs required to support 40 DS1 terminations. Consists of:

    (1) ED-2C853-31,G17,G21

101. Framework, assembly, wiring, equipment, and common circuit packs for one DACS II three bay frame with bay 1 and bay 3 fully flexible interface bays with bay 1 equipped with one IFTU fused on a two NPC basis in position 1 with common circuit packs required to support 40 DS1 terminations. Consists of:

    (1) ED-2C853-31,G18,G21

102. Discontinued Availability.

103. Reserved.

104. Discontinued Availability.

105. Reserved.

106. Discontinued Availability.

107. Framework, assembly, wiring, equipment, and common circuit packs for one DACS II two bay frame with bay 1 flexible interface bay equipped with three DS3 shelf assembly in position 1 with common circuit packs to support 1 DS3 termination. Consists of:

    (1) ED-2C853-31,G17,G25,GK

108. Framework, assembly, wiring, equipment, and common circuit packs for one DACS II three bay frame with bay 1 and bay 3 fully flexible interface bays with bay 1 equipped with one DS3 shelf assembly in position 1 with

common circuit packs required to support three DS3 terminations. Consists of:

(1) ED-2C853-31,G18,G25,GK

109. Equipment and wiring required when DACS II is connected to the NJ office alarm system, 24 or 48 volts.
(1) ED2C853-30,G27

110-199. Reserved.

200. Circuit pack required to equip two primary blocks for 2.048-Mb/s service. Consists of:

(1) TG182.

201. Circuit pack required to provide one duplicated C-bit processor for 2.048-Mb/s service. Consists of:

(2) TM747.

202. Circuit pack required to equip two digroups with a 75-ohm interface for 2.048-Mb/s service. (Minimum 1, maximum 32 per FTU.) Consists of:

(1) TG185.

203. Equipment required in addition to List 2 or 4 to permit redundant –48V and –48V RTN power connections. Consists of:

(1) ED-2C853-31,G8

204. Reserved.

205. Equipment required in addition to List 2 or 4 to provide an optional timing connection from the FTU 1 and one to meet export timing requirements. Consists of:

(1) ED-2C853-31,G9

206. Equipment required to provide cable support for the external cabling to each FTU. (Export-France only.)

207. Adapters for 75-ohm coax cable input and output to the facility terminating unit for 2.048-Mb/s service. (Minimum 1, maximum 4 per FTU.)

208. Equipment required to support coax cable when List 207 is furnished.

209. Circuit pack required to provide timing extraction for two duplicated CCITT compliant primary block timing link inputs (2.048-Mb/s) with 75-ohm terminating impedance. Consists of:

(2) TG75.

210. Reserved.

211. Equipment required in addition to List 304 to provide frame cover assemblies for EMI protection. Consists of:

(1) ED-2C853-31,G15

212. Reserved.

213. Reserved.

214. Circuit pack to provide two primary rate interfaces (2.048 MHz) with 120-ohm terminating impedance. Consists of:

     (1) TG187.

215. Reserved.

216. Reserved.

217. Equipment required in addition to List 4 and 215.
     (1) ED2C853-31,G29

218. Equipment required in addition to List 2 and 215.
     (1) ED2C853-31,G30

219. Reserved.

220. Equipment required in addition to List 404.
     (1) ED2C853-31,G31

221. Equipment required in addition to List 404 and 220.
     (1)ED2C853-31,G32

222-303. Reserved.

304. Framework, assembly, wiring, equipment and common circuit packs for one 256 digroup DACS II for –60V input power. (Export-Germany only.) Consists of:

     (1) ED-2C853-31,G4,GE

305-309. Reserved.

310. Circuit pack required to provide time base oscillator for local exchange of CCITT compliant synchronization networks for –60V input power. Consists of:

     (2) TG90.

311. Circuit pack required in addition to List 302 or 304 to provide time base oscillator for transit exchanges of CCITT synchronization networks for –60V input power. Consists of:

     (2) TG91.

312-328. Reserved.

329. Common circuit packs required in addition to List 304 for facility terminating unit 2, 3 or 4 for –60V input power. (Maximum 1 List 329 per List 304) (maximum 2 List 329 per List 6.) Consists of:

     (1) TM657
     (1) UM28
     (3) 411AB
     (2) ED-2C863-30,G1,GA

330-403. Reserved.

404. Framework, assembly, wiring, equipment, and common circuit packs for one 320 Digroup DACS on 600MM wide framework.
(1) ED2C853-31,G19

A. Equipment required in addition to List 7, 62, 63 or 64 when the DSP or DS3 shelf is mounted in bay 1. Consists of:

   (1) ED-2C853-31,GA

B. Equipment required in addition to List 7, 62, 63 or 64 when the DSP or DS3 shelf is mounted in bay 3. Consists of:

   (1) ED-2C853-31,GB

C. Circuit pack required in addition to List 9 and 20 or 9 and 39 to provide a CRO (clock reference oscillator). Consists of:

   (1) TG60.

D. Circuit pack required in addition to List 12 and 20 or 12 and 39 to provide a CRO. Consists of:

   (1) TG63.

E. Equipment required in addition to List 2 or List 102 for DACS II DS1 application (designation strips).

F. Equipment required in addition to List 4 or 104 for DACS II DS1 application (designation strips).

G. Equipment required in addition to Lists 6 through 106 for DACS II DS1 application (designation strips).

H. Equipment required in addition to List 2 for DACS II CEPT application (designation strips). Consists of:

   (1) ED-2C853-31,GF

J. Equipment required in addition to List 4 for DACS II CEPT application (designation strips). Consists of:

   (1) ED-2C853-31,GG

K. Equipment required in addition to List 6 for DACS II CEPT application (designation strips).

L. Equipment required in addition to List 2 for DACS II GATEWAY application (designation strips).

M. Equipment required in addition to List 4 for DACS II GATEWAY application (designation strips).

N. Equipment required in addition to List 6 for DACS II GATEWAY application (designation strips).

P. Equipment required in addition to Lists 7 and A or 62 and A for DACS II DS1 application or for GATEWAY application requiring contiguous numbering (designation strips).

R. Equipment required in addition to Lists 7 and B or 62 and B for DACS II DS1 application or for GATEWAY application requiring contiguous numbering (designation strips).

S. Equipment required in addition to Lists 7 and A or 62 and A for DACS II CEPT application or for GATEWAY application requiring hierarchical numbering (designation strips).

T. Equipment required in addition to Lists 7 and B or 62 and B for DACS II CEPT application or for GATEWAY application requiring hierarchical numbering (designation strips).

U. Equipment required in addition to List 73 when the digital signal processor shelf is mounted in position 3 (for DS1 application or for GATEWAY application requiring contiguous numbering). (Designation strips).

V. Equipment required in addition to List 73 when the digital signal processor shelf is mounted in position 4 (for DS1 application or for GATEWAY application requiring contiguous numbering). (Designation strips).

W. Equipment required in addition to List 73 when the digital signal processor shelf is mounted in position 6 (for DS1 application or for GATEWAY application requiring contiguous numbering). (Designation strips).

X. Equipment required in addition to List 73 when the digital signal processor shelf is mounted in position 3 (for CEPT application or for GATEWAY application requiring hierarchical numbering). (Designation strips).

Y. Equipment required in addition to List 73 when the digital signal processor shelf is mounted in position 4 (for CEPT application or for GATEWAY application requiring hierarchical numbering). (Designation strips).

Z. Equipment required in addition to List 73 when the digital signal processor shelf is mounted in position 6 (for CEPT application or for GATEWAY application requiring hierarchical numbering). (Designation strips).

AA. Equipment required in addition to List 74 when the DS3 shelf is mounted in position 3 (designation strip).

AB. Equipment required in addition to List 74 or 94 when the DS3 shelf is mounted in position 4 (designation strip).

AC. Equipment required in addition to List 74 or 94 when the DS3 shelf is mounted in position 6 (designation strip.)

AD. Equipment required in addition to List 63, 64, 92 or 93 when the DS3 shelf is mounted in position 5 (designation strip).

AE. Equipment required in addition to List 63, 64, 92 or 93 when the DS3 shelf is mounted in position 6 (designation strip).

AF. Reserved.

AG. Equipment required in addition to List 304 (designation strips).

AH. Equipment and wiring required in addition to List 80, 81 or 82 when DSP shelf per List 7 is specified (one for each List 7).

(1) ED-2C853-31,GJ

AJ. Equipment and wiring required in addition to List 80, 81 or 82 when DS3 shelf per List 63 or 92 is specified (one for each List 63 or 92).

(1) ED-2C853-31,GK

AK. Equipment required in addition to Lists 80 or 82 and AH when DSP shelf is mounted in unit 3 of bay 3.

AL. Equipment required in addition to Lists 80 or 82 and AH when DSP shelf is mounted in unit 4 of bay 3.

AM. Equipment required in addition to Lists 80 or 82 and AH when DSP shelf is mounted in unit 6 of bay 3.

AN. Equipment required in addition to Lists 80 or 82 and AJ when DS3 shelf is mounted in unit 3 of bay 3.

AP. Equipment required in addition to Lists 80 or 82 and AJ when DS3 shelf is mounted in unit 4 of bay 3.

AQ. Equipment required in addition to Lists 80 or 82 and AJ when DS3 shelf is mounted in unit 6 of bay 3.

AR. Equipment required in addition to Lists 81 or 82 and AH when DSP shelf is mounted in unit 1 of bay 1.

AS. Equipment required in addition to Lists 81 or 82 and AH when DSP shelf is mounted in unit 2 of bay 1.

AT. Equipment required in addition to Lists 81 or 82 and AH when DSP shelf is mounted in unit 5 of bay 1.

AU. Equipment required in addition to Lists 81 or 82 and AJ when DS3 shelf is mounted in unit 1 of bay 1.

AV. Equipment required in addition to Lists 81 or 82 and AJ when DS3 shelf is mounted in unit 2 of bay 1.

AW. Equipment required in addition to Lists 81 or 82 and AJ when DS3 shelf is mounted in unit 5 of bay 1.

AX. Equipment required in addition to List 83, 84, 85, 86, 87, 88, 89, 90, 101 or 102 when the IFTU shelf is mounted in position 1 (nonhierarchical designation strips).

AY. Equipment required in addition to List 83, 84, 85, 86, 87, 88, 89 or 90 when the IFTU shelf is mounted in position 2 (nonhierarchical designation strips).

AZ. Equipment required in addition to List 83, 84, 85, 86, 87, 88, 89 or 90 when the IFTU shelf is mounted in position 3 (nonhierarchical designation strips).

BA. Equipment required in addition to List 83, 84, 85, 86, 87, 88, 89 or 90 when the IFTU shelf is mounted in position 4 (nonhierarchical designation strips).

BB. Equipment required in addition to List 83, 84, 85, 86, 87, 88, 89 or 90 when the IFTU shelf is mounted in position 5 (nonhierarchical designation strips).

BC. Equipment required in addition to List 83, 84, 85, 86, 87, 88, 89 or 90 when the IFTU shelf is mounted in position 6 (nonhierarchical designation strips).

BD. Equipment required in addition to List 81, 82, 83, 84, 85, 86, 87, 88, 89 or 90 when the IFTU shelf is mounted in position 1, 2, 3, 4, 5, or in addition to Lists 107 or 108 when the IFTU is mounted in position 2, 3, 4, 5, or 6 (export hierarchical designation strips).

BE. Equipment required in addition to List 81, 82, 83, 84, 85, 86, 87, 88, 89 or 90 when the IFTU shelf is mounted in position 1, 2, 3, 4, 5, or in addition to Lists 107 or 108 when the IFTU is mounted in position 2, 3, 4, 5, or 6 (DS1 hierarchical designation strips).

BF. Reserved.

BG. Reserved.

BH. Reserved.

BJ. Reserved.

BK. Reserved.

BL. Reserved.

BM. Reserved.

BN. Reserved.

BP. Reserved.

BQ. Reserved.

BR. Equipment always required in addition to List 2. Consists of:

(1) ED-2C853-31,GL

BS. Equipment always required in addition to List 4 or 80. Consists of:

(1) ED-2C853-31,GM

BT. Equipment always required in addition to List 6. Consists of:

(1) ED-2C853-31,GN

BU. Equipment always required in addition to List 2, 4, 80, 81, 82, or 304. Consists of:

(1) ED-2C853-31,GP

BV. Circuit pack always required in addition to List 2, 4, 80, 81, 82 or 304. Consists of:
(1) TM659B

BW. Equipment required in addition to List 2,4,6,80 and 207 to provide a cover that protects the 75 ohm adapters.

BX. Equipment always required in addition to List 7.
(1) ED2C853-31,GR

BY. Equipment always required in addition to List 62.
(1) ED2C853-31,GS

BZ. Equipment always required in addition to List 73.
(1) ED2C854-30,GG

CA. Equipment always required in addition to List 75.
(1) ED2C854-30,GH

CB. Equipment always required in addition to List 37.
(1) ED9C023-30,G2

CC. Equipment always required in addition to List 2, 4, 80, or 404.
(1) ED9C023-30,G2

J98774B-1 160 Single-Bay (non-CEF) List Structure

The Listings in this section are not provided as an ordering guide. Since this manual is not updated for every change on the J-drawing, the equipment Listings may not be up-to-date. For the latest ordering information, see your local account executive.

LIST # **DESCRIPTION**

1. Discontinued Availability.
2. Framework, assembly, wiring, equipment, and common circuit packs for one 160 digroup DACS II. Equipment is mounted in a network bay type framework. Consists of:
   (1) ED-2C952-30,G1
   (1) 484GA
   (6) 411AA
   (1) SM565
   (1) UM24B
   (1) UM27
   (1) ED-2C876-30,G1
   (1) ED-2C877-30,G1
   (2) TM657
   (1) TM659
   (2) TG58
   (2) TM590
   (2) ED-2C863-30,G1
   (1) ED-2C863-30,G2
   (1) UM28
   (2) TG79
   (1) TG81
   (2) TM660
   (2) UM26B
   (2) ED-2C863-30,G4
   (2) UM30
3. Assembly and equipment required in addition to List 1, 2, 102 or 300 for one digital signal processor (DSP) shelf assembly. Consists of:

   (1) ED-2C952-30,G3
4. Communications interface circuit pack. Always required in addition to List 1, 2, 102 or 300. Consists of:

   (1) TM658.
5. Time base oscillator circuit packs required for Stratum 3 of the North American synchronization network. Consists of:

   (2) TG60.

6. Time base oscillator circuit packs required for local exchanges of CCITT. Consists of:

   (2) TG61.

7. Time base oscillator circuit packs required for local exchanges of CCITT compliant synchronization networks. Consists of:

   (2) TG62.

8. Time base oscillator circuit packs required for Stratum 2 of the North American synchronization networks. Consists of:

   (2) TG63.

9. Timing extractor circuit packs required to provide two duplicated DS1 timing link inputs (1.544-Mb/s) with no distributions. Consists of:

   (2) TG64.

10. Timing extractor circuit packs required to provide two duplicated CCITT compliant primary block timing link inputs at 2.048-Mb/s with 120-ohm terminating impedance. Consists of:

    (2) TG65.

11. Timing extractor circuit packs required to provide two duplicated DDS composite clock timing link inputs (64-kb/s) with no distributions. Consists of:

    (2) TG66.

12. Timing extractor circuit packs required to provide two duplicated unipolar clock (sine/square wave) timing link inputs (512-kHz, 1.0-MHz, 1.544-MHz, 2.048-MHz, 5.0-MHz) with no distributions. Consists of:

    (2) TG67B.

13. Timing extractor circuit packs required to provide two duplicated BSRF 2.048-MHz at –20 dBm timing link inputs with no distributions. Consists of:

    (2) TG68.

14. Timing distributor circuit packs to provide four duplicated DDS composite clock timing link input (64-kb/s) distributions. Consists of:

    (2) TG70.

15. Timing distributor circuit packs to provide four duplicated 2.048-MHz sine wave timing link distributions. Consists of:

    (2) TG71B.

16. Circuit packs required when the DACS II is not timed by the network but supplies timing to an isolated timing island and is required to provide four duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:
    (2) TG70

17. Reserved.
18. Reserved.
19. Reserved.
20. Circuit packs required when the DACS II is not timed by the network but supplies timing to an isolated timing island and is required to provide four duplicated 2.048-MHz sine wave timing link distributions. Consists of:

    (3) TG60
    (2) TG71B.
21. Reserved.
22. Reserved.
23. Reserved.
24. Common circuit packs for each additional group of 40 digroups (20 dual digroups) equipped. Maximum of three List 24 per List 1, 2, 102 or 300. Consists of:

    (2) TG79
    (1) TG81.
25. Reserved.
26. Circuit packs required to equip two enhanced digroups. Minimum one with maximum 80 List 26 per List 1 or 2. (Discontinued Availability). Consists of:

    (1) TG80.
27. Circuit packs required when the second operational unit is equipped. Consists of:

    (6) TM660
    (2) UM26B.
28. Reserved.
29. DSP (digital signal processor) common packs. Maximum of one List 29 per List 3 or 56. Consists of:

    (1) SM566
    (1) TM657
    (1) UM29
    (2) 411AA
30. Circuit packs required to equip one duplicated 512 channel multipoint bridge. Maximum of 80 List 30 per List 3 or 56. Consists of:

    (2) TM665.

31. Circuit packs required when the DACS II is not timed by the network but supplies timing to an isolated timing island and is required to provide eight duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (4) TG70.

32. Timing extractor and timing distributor circuit packs required to provide two duplicated DS1 timing link inputs (1.544-Mb/s) with four duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG64
    (2) TG70.

33. Timing extractor and timing distributor circuit packs required to provide two duplicated DS1 timing link inputs (1.544-Mb/s) with eight duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG64
    (4) TG70.

34. Timing extractor and timing distributor circuit packs required to provide two duplicated DS1 timing link inputs (1.544-Mb/s) with 12 duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG64
    (6) TG70.

35. Timing extractor and timing distributor circuit packs required to provide two duplicated DS1 timing link inputs (64-Mb/s) with four duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG66
    (2) TG70.

36. Timing extractor and timing distributor circuit packs required to provide two duplicated DS1 timing link inputs (64-Mb/s) with eight duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG66
    (4) TG70.

37. Timing extractor and timing distributor circuit packs required to provide two duplicated DS1 timing link inputs (64-Mb/s) with 12 duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG66
    (6) TG70.

38. Timing extractor and timing distributor circuit packs required to provide two duplicated unipolar clock (sine/square wave) timing link inputs (512-kHz, 1.0-MHz, 1.544-MHz, 2.048-MHz, 5.0-MHz) with four duplicated DDS composite clock timing link distributions. Consists of:

    (2) TG67B
    (2) TG70.

39. Timing extractor and timing distributor circuit packs required to provide two duplicated unipolar clock (sine/square wave) timing link inputs (512-kHz, 1.0-MHz, 1.544-MHz, 2.048-MHz, 5.0-MHz) with eight duplicated DDS composite clock timing link distributions. Consists of:

    (2) TG67B
    (4) TG70.

40. Timing extractor and timing distributor circuit packs required to provide two duplicated unipolar clock (sine/square wave) timing link inputs (512-kHz, 1.0-MHz, 1.544-MHz, 2.048-MHz, 5.0-MHz) with 12 duplicated DDS composite clock timing link distributions. Consists of:

    (2) TG67B
    (6) TG70.

41. Timing extractor and timing distributor circuit packs required to provide two duplicated BSRF 2.048-MHz at –20 dBm timing link inputs with four duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG68
    (2) TG70.

42. Timing extractor and timing distributor circuit packs required to provide two duplicated BSRF 2.048-MHz at –20 dBm timing link inputs with eight duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG68
    (4) TG70.

43. Timing extractor and timing distributor circuit packs required to provide two duplicated BSRF 2.048-MHz at –20 dBm timing link inputs with 12 duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG68
    (6) TG70.

44. Timing extractor circuit packs required to provide two duplicated BSRF 2.048-MHz at –20 dBm timing link inputs and two duplicated DS1 timing link inputs (1.544-Mb/s) with no distributions. Consists of:

    (2) TG64
    (2) TG68.

45. Timing extractor and timing distributor circuit packs required to provide two duplicated BSRF 2.048-MHz at –20 dBm timing link inputs and two duplicated DS1 timing link inputs (1.544-Mb/s) with four duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG64
    (2) TG68
    (2) TG70.

46. Timing extractor and timing distributor circuit packs required to provide two duplicated BSRF 2.048-MHz at –20 dBm timing link inputs and two duplicated DS1 timing link inputs (1.544-Mb/s) with eight duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG64
    (2) TG68
    (4) TG70.

47. Timing extractor and timing distributor circuit packs required to provide two duplicated DDS composite clock timing link inputs (64-kb/s) and two duplicated DS1 timing link inputs (1.544-Mb/s) with no distributions. Consists of:

    (2) TG64
    (2) TG66.

48. Timing extractor and timing distributor circuit packs required to provide two duplicated DDS composite clock timing link inputs (64-kb/s) and two duplicated DS1 timing link inputs (1.544-Mb/s) with four duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG64
    (2) TG66
    (2) TG70.

49. Timing extractor and timing distributor circuit packs required to provide two duplicated DDS composite clock timing link inputs (64-kb/s) and two duplicated DS1 timing link inputs (1.544-Mb/s) with eight duplicated DDS composite clock timing link distributions (64-kb/s). Consists of:

    (2) TG64
    (2) TG66
    (2) TG70.

50. Circuit pack required to provide one enhanced communications interface that has four asynchronous interfaces and two X.25 synchronous interfaces. Consists of:

    (1) TM736B.

51. Not applicable.

52. Circuit pack required to provide one duplicated Subrate multiplexer (maximum of 8 per List 3). Consists of:

    (2) TM739.

53. Circuit pack required to provide one duplicated multipoint junction unit (maximum of 8 per List 3). Consists of:

    (2) TM740.

54. *SLC*® 96 interface card.
    (1) TG183

55. *SLC*® Series 5 interface card.
    (1) TG184

56. Equipment and cabling required for field installation of one digital signal processor. Consists of:

    (1) ED-2C853-31,G12

57. Assembly and equipment required in addition to List 2 or 102 or 300 for one DS3 shelf assembly that supports the KCR3 facility line interface circuit pack (734A cable length up to 700 feet). (Discontinued Availability). Consists of:

    (1) ED-2C952-30,G8

58. Equipment and wiring required for field installation of one DS3 shelf assembly that supports the KCR3 facility line interface circuit pack (734A cable length up to 700 feet). (Discontinued Availability). Consists of:

    (1) ED-2C952-30,G9

59. DS3 shelf assembly that supports the KCR3 facility line interface circuit pack (734A cable length up to 700 feet). (Discontinued Availability). Consists of:

    (2) KER1
    (1) KER2
    (2) KCR3
    (2) 563A
    (1) ED-2C980-30,G1

60. Circuit pack required to equip one DS3 termination in a DS3 shelf. Consists of:

    (1) KCR1.

61. Power unit for the DS3 shelf assembly. Consists of:

    (1) 563A.

62. Circuit pack to provide the interface unit capability for one DS3 termination (28 DS1) in a DS3 shelf. Consists of:

    (1) KCR2.

63. Circuit pack required to equip two enhanced digroups (minimum 1, maximum 80 List 63 per List 1 or 2). Consists of:

    (1) TG80B.

64. Circuit pack required to equip two digroups when ZBTSI zero code suppression is required. Minimum 1, maximum 80 List 64 per List 1 or 2. Consists of:

    (1) TG186.

65. Assembly and equipment required in addition to List 2 for one DS3 shelf assembly that supports the KCR4 facility line interface circuit pack (734A cable length up to 900 feet). Consists of:

    (1) ED-2C853-31,G25

66. Equipment required for field installation of one DS3 shelf assembly that supports the KCR4 facility line interface circuit pack (734A cable length up to 900 feet). Consists of:

    (1) ED-2C853-31,G26

67. Common packs for one DS3 shelf assembly that supports the KCR4 facility line interface circuit pack (734A cable length up to 900 feet). Consists of:

    (2) 563A
    (2) KCR4
    (1) KER1
    (2) KER2

68. Unassigned.

69. Unassigned.

70. Equipment and wiring required when DACS II is connected to NJ office alarm system, 24 or 48 volts.
    (1) ED2C952-30,G13

71-101. Unassigned.

102. Discontinued Availability.

103-199. Reserved.

200. Circuit packs required to equip two primary blocks for 2.048 Mb/s service (minimum of 1, maximum of 64 List 200 per List 1, 2 or 102). Consists of:

    (1) TG182.

201. Circuit packs required to provide one duplicated C-bit processing circuit for 2.048-Mb/s service (maximum of 2 List 201s per List 3 or List 56). Consists of:

(2) TM747.

202. Circuit pack required to provide a 75-ohm interface for 2.048 Mb/s service. Consists of:

(1) TG185.

203-204. Reserved.

205. Equipment required in addition to List 1, 2 or 300 to provide an optional timing connection from the FTU to meet export timing requirements. Consists of:

(1) ED-2C952-30,G7

206. Reserved.

207. Adapters for 75-ohm coax cable input and output to the facility terminating unit for 2.048-Mb/s service. (minimum 1, maximum 8). Consists of:

(1) ED-2C997-30,G1
(1) ED-2C997-30,G2

208. Equipment required to support 75-ohm coax cable when List 207 is ordered.

209. Circuit pack required to provide timing extractor for two duplicated CCITT compliant primary block timing link inputs (2.048-Mb/s) with 75-ohm terminating impedance.

(2) TG75.

210. Equipment required to provide frame cover assemblies for EMI protection.

211. Equipment required in addition to List 400 to provide an adapter for 75 ohm coax cable.
(1) ED2C952-30,G15

212. Equipment required to provide one diode assembly.
(1) ED9C019-30,G1

213. Equipment required in addition to Lists 400 and 211 to provide unit adapters and covers.
(1) ED2C952-30,G16

214. Circuit pack required to provide two primary rate (2.048-Mb/s) line 120-ohm terminating impedance (minimum 1, maximum 64 List 214 per List 1 or 2). Consists of:

(1) TG187.

215-299. Unassigned.

300. Framework, assembly, wiring, equipment, and common circuit packs for one 160 NPC DACS II for 60-volt input power. Consists of:

(1) ED-2C953-30 Group 4.

301. Circuit packs required to provide time base oscillator for local exchange of CCITT compliant synchronization networks for –60V input power. Consists of:

(2) TG90.

302. Circuit packs required to provide time base oscillator for transit exchange of CCITT synchronization networks for –60V input power. Consists of:

(2) TG91.

400. Framework, assembly, wiring, equipment, and common circuit packs for one 160 Digroup DACS on 600MM wide framework.
(1) ED2C952-30,G14

A. Circuit pack required in addition to Lists 5 and 16 or 5 and 31 to provide clock reference oscillator. Consists of:

(1) TG60.

B. Circuit pack required in addition to Lists 8 and 16 or 8 and 31 to provide clock reference oscillator. Consists of:

(1) TG63.

C. Circuit pack always required in addition to List 1. Consists of:

(1) UM24B.

D. Equipment and wiring required in addition to Lists 2 and 3, 102 and 3, or 300 and 3 when a DSP shelf is required or in addition to Lists 2 and 57 or Lists 102 and 57 or Lists 300 and 57. Consists of:

(1) ED-2C952-30,GA

E. Equipment and wiring required to equip a List 2 or 102 frame with a DSP shelf per List 56 or a DS3 shelf per List 58. Consists of:

(1) ED-2C952-30,GB

F. Circuit pack always required in addition to List 4 to provide a communication interface for Release 3.1 or higher software. Consists of:

(1) TM658B.

G. Equipment required in addition to List 1, 2 or 300 when the frame is to be cabled with 75-ohm coaxial cables. Consists of:

(1) ED-2C952-30,GD

H. Equipment required in addition to List 1, 2 or 300 for DACS II export application.

J. Equipment always required in addition to List 2. Consists of:

(1) ED-2C952-30,GG

K. Circuit pack always required in addition to List 1, 2, 102, or 300. Consists of:

(1) TM659B.

L. Equipment always required in addition to List 3.
(1) ED2C952-30,GH

M. Equipment always required in addition to List 56.
(1) ED2C952-30,GJ

N. Equipment always required in addition to List 2, 300, or 400.
(2) ED9C023-30,G3
(3) ED9C023-30,G2

O. Equipment always required in addition to List 29.
(1) ED9C023-30,G2

P. Equipment always required in addition to List 67.
(1) ED2C980-30,G2

Q. Equipment always required in addition to List 66 and List E when the DS3 shelf is to be mounted in a J98774B-1 frame.
(1) ED2C952030,GK

J98774D-1 Enclosed CEF (Enclosed Capacity Expansion Frame) List Structure

The Listings in this section are not provided as an ordering guide. Since this manual is not updated for every change on the J-drawing, the equipment Listings may not be up-to-date. For the latest ordering information, see your local account executive.

LIST # **DESCRIPTION**

1. Cabinet, assembly, wiring, equipment and common circuit packs for one DACS II Enclosed CEF Switch Bay.
   (1) ED9C058-30
   (1) T96699-41
   (2) T96699-41
   (4) T96699-41
2. Cabinet, assembly, wiring, and equipment for one DACS II Enclosed CEF Flexible Interface Bay in position 1 in addition to list 1.
   (1) ED9C059-30 G1
3. Cabinet, assembly, wiring, and equipment for one DACS II Enclosed CEF Flexible Interface Bay in position 3 in addition to list 1.
   (1) ED9C059-30 G3
4. Cabint, assembly, wiring, and equipment for one DACS II Enclosed CEF Flexible Interface Bay in position 4 in addition to list 1.
   (1) ED9C059-30 G4
5. Cabinet, assembly, wiring, and equipment for one DACS II Enclosed CEF Flexible Interfafe Bay in position 5 in addition to list 1.
   (1) ED9C059-30 G5
6. Cabinet, assembly, wiring, and equipment for one DACS II Enclosed CEF Flexible Interface BAy in position 6 in addition to list 1.
   (1) ED9C059-30 G6
7. Framework, assembly, wiring, and equipment for one DACS II Enclosed CEF Flexible Interface Bay in position 7 in addition to list 1 and list 5.
   (1) ED9C059-30 G7
8. Blank panel for one unequipped unit position in addition to list 2 through 7.
   (1) ED9C059-30 G12
9. Circuit pack required to provide one communication interface with six asynchronous administrative links.
   (1) TM658C
10. Circuit pack required to provide one enhanced communication interface with four asynchronous interfaces and two synchronous administrative links (9600 Baud or lower).
    (1) TM736C

11. Circuit pack required to provide one high speed enhanced communication interface with four asynchronous interfaces and two X.25 synchronous administrative links (greater than 9600 Baud).
(1) TM762
12. Circuit pack required to provide expanded TSI in the 0 and 1 ECCN shelf for each IFTU, DSPU, or DS3U assembly.
(2) BBS2
13. Circuit pack required to provide time base oscillator for stratum-3 of the North American Synchronization network. (2) TG60
14. Circuit pack required to provide time base oscillator for local exchange of CCITT compliant synchronization networks.
(2) TG61
15. Circuit pack required to provide time-base oscillator for transit exchanges of CCITT synchronization networks.
(2) TG62
16. Circuit pack required to provide time base oscillator for stratum-2 of the North American Synchronization network.
(2) TG63
17. Circuit pack required in addition to list 13 when the DACS II is not timed by the network but supplies timing to an isolated stratum-3 timing island, with four duplicated DDS composite clock timing distributions.
(2) TG70
18. Circuit pack required in addition to list 13 when the DACS II is not timed by the network but supplies timing to an isolated stratum 3 timing island, with four duplicated 2.048 MHz CCITT compliant timing distributions.
(2) TG60
19. Circuit pack required in addition to list 14 when the DACS II is not timed by the network but supplies timing to an isolated CCITT compliant local exchange timing island, with four duplicated DDS composite clock timing distributions.
(2) TG61
20. Circuit pack required in addition to list 14 when the DACS II is not timed by the network but supplies timing to an isolated CCITT compliant local exchange timing island with four duplicated 2.048 MHz CCITT compliant timing distributions.
(2) TG61
21. Circuit packs required in addition to list 15 when the DACS II is not timed by the network but supplies timing to an isolated CCITT compliant DDS compliant clock timing distributions.
(2) TG62
22. Circuit packs required in addition to list 15 when the DACS II is not timed by the network but supplies timing to an isolated CCITT compliant transit exchange timing island, with four duplicated 2.048 MHz compliant timing

distribution.
(2) TG62

23. Circuit pack required in addition to list 16 when the DACS II is not timed by the network but supplies timing to an isolated stratum 2 timing island, with four duplicated DDS composite clock timing distributions.
(2) TG63

24. Circuit pack required in addition to list 16 when the DACS II is not timed by the network but supplies timing to an isolated stratum 2 timing island with four duplicated 2.048 MHz CCITT compliant timing distributions.
(2) TG63

25. Circuit pack required for timing extractor to provide two duplicated DS-1 timing link inputs.
(2) TG64

26. Circuit pack required for timing extractor to provide two duplicated CCITT compliant primary block timing link inputs with 120 ohm balanced termination.
(2) TG65

27. Circuit pack required to provide timing extractor to provide two duplicated DDS composite timing link inputs.
(2) TG66

28. Circuit pack required to provide timing extractor to provide two duplicated unipolar clock timing link inputs with 100 ohm balanced termination.
(2) TG67B

29. Circuit pack required to provide timing extractor to provide two duplicated BSRF 2.048 MHz at -20dbm timing link inputs with 75 ohm single-ended termination.
(2) TG68

30. Circuit pack required to provide timing distributor to provide four duplicated DDS composite clock timing link distributions.
(2) TG70

31. Circuit pack required to provide timing distributor to provide four duplicated 2.048 MHz CCITT compliant sine wave timing link distributions.
(2) TG71B

32. Circuit pack required to provide timing extractor to provide two duplicated CCITT compliant primary block timing link inputs.
(2) TG75

33. Equipment required in addition to list 1 to provide optional traffic carrying timing connections from bay 2 IFTU in position 1 and/or for 2.048 Mb/s interface.
(1) ED9C058-30 GA

34. Reserved.

35. Circuit pack required to provide timing extractor for two CCITT "A" spec 64 Kb/s composite clock timing inputs.
(1) T96699-41
36. Reserved.
37. Reserved.
38. Assembly and equipment required in addition to list 2 thru 7 for one integrated facility terminating unit (IFTU) assembly fused on a two NPC basis.
(1) ED9C059-30 G11
39. Reserved.
40. Assembly and equipment for field installation of one integrated facility terminating unit (IFTU) assembly fused on a two NPC basis.
(1) ED9C059-30 G14
41. Common circuit packs required when an IFTU is ordered.
(3) 411A
42. Common circuit packs for each group of 40 digroup module equipped in an IFTU.
(2) TG79
43. Circuit pack required to equip two digroups.
(1) TG80B
(1) TG81
44. Reserved.
45. Circuit pack required to equip two primary blocks for 2.048 Mb/s.
(1) TG182
46. Circuit pack required to equip two NPCs for SLC 96 interface.
(1) TG183
47. Circuit pack required to equip two NPCs for SLC 5 interface.
(1) TG184
48. Circuit pack required to equip two digroups with a 75 ohm interface for 2.048 Mb/s.
(1) TG185
49. Circuit pack required to equip two NPCs for zero byte TSI for zero code supression.
(1) TG186
50. Reserved.
51. Fuse boards always requyired when an IFTU assembly, fused on a two NPC basis is ordered.
(1) T96699-41

52. Circuit pack to equip two enhanced digroups.
(1) TG191

53. Circuit pack to equip two enhanced primary blocks for 2.048 Mb/s.
(1) TG192

54-62. Reserved.

63. Assembly and equipment required in addition to list 2 thru 7 for one DS3U shelf assembly.
(1) ED9C059-30 G9

64. Assembly and equipment required for field installation for one DS3U shelf assembly.
(1) ED9C059-30 G15

65. Circuit packs required when a DS3U unit is ordered.
(2) 563A

66. Circuit pack to equip one DS3 termination in a DS3U shelf assembly. (Minimum 2 list 66 always required.
(1) KCR1

67. Power unit for the DS3U shelf.
(1) 563A

68. Reserved.

69. Circuit pack required to equip one enhanced multiplexer for one DS3 termination in a DS3U shelf.
(1) KCR5

70. Circuit pack to equip one enhanced multiplexer interface unit for one DS3 termination in a DS3U shelf.
(1) KCR6

71-81. Reserved.

82. Assembly and equipment required in addition to list 2 thru 7 for one digital signal processor unit (DSPU) shelf assembly.
(1) ED9C059-30 G8

83. Assembly and equipment required for the field installation of one digital signal processing (DSPU) shelf assembly.
(1) ED9C059-30 G16

84. Common circuit pack required when a DSPU is ordered.
(1) TM657B

85. Circuit pack required to equip one duplicated 512 channel digital multipoint bridge.
(2) TM655

86. Circuit pack required to provide one duplicated subrate multiplexer.
(2) TM739

87. Circuit pack required to provide one duplicate multipoint junction unit.
    (2) TM740

88. Circuit pack required to provide one duplicated C-Bit processor for 2.048 Mb/s.
    (2) TM747

89-99. Reserved.

100. Wiring and equipment in addition to list 1 to provide alarm indication for international applications.
    (1) ED9C058-30 G5

101. Wiring and equipment in addition to list 1 to provide alarm indication for domestic applications.
    (1) ED9C058-30 G4

102. Equipment required in addition to list 1 to provide -48V input power for international.
    (1) ED9C058-30 G3

103. Equipment required in addition to list 1 to provide -48V input power for domestic applications.
    (1) ED9C058-30 G2

104. Equipment required in addition to list 1 to permit duplicated -48V and -48V RTN power input feeders.
    (1) ED9C058-30 G6

105-212. Reserved.

213. Equipment required in addition to list 2 through 7 to provide an adapter for 75 ohm coax cable equipped with BT43 series posi-lock cable sockets for inputs and outputs to an IFTU for 2.048 Mb/s.
    (1) ED9C059-30 G18

214. Equipment required in addition to list 2 through 7 to provide an adapter for 75 ohm coax cable equipped with radial 75 ohm bulkhead jack receptacles for inputs and outputs to an IFTU for 2.048 Mb/s.
    (1) ED9C059-30 G19

215-217. Reserved.

218. Equipment required in addition to list 2 thru 7 to provide an adapter to terminate 120 ohm twisted pair cable on ribbon type connectors for inputs and outputs to an IFTU for 1.544 of for 2.048 Mb/s.
    (1) ED9C059-30 G20

219. Reserved.

400. Software operating system right to use fee always required in addition to IFTU list 38 or 40.

401. software operating system right to use fee always required in addition to DS3U list 63 or 64.

402. Software operating system right to use fee always required in addition to DSPU list 82 or 83.

A-C. Reserved.

D. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 1.
(1) 846513398
(1) 846513406
(1) 846514347

E. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 2.
(1) 846513414
(1) 846513422
(1) 846513430
(1) 846513448
(1) 846514347

F. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 3.
(1) 846513455
(1) 846513463
(1) 846513471
(1) 846513480
(1) 846514347

G. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 4.
(1) 846513497
(1) 846513505
(1) 846513513
(1) 846513521
(1) 846514347

H. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 5.
(1) 846513539
(1) 846513547
(1) 846513554
(1) 846513552
(1) 846514347

J. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 6.
(1) 846513570
(1) 846513588
(1) 846513596
(1) 846513604

(1) 846514347

K. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 7.
(1) 846513612
(1) 846513620
(1) 846513636
(1) 846513646
(1) 846514347

L. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 8.
(1) 846513653
(1) 846513661
(1) 846513679
(1) 846513687
(1) 846514347

M. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 9.
(1) 846513695
(1) 846513711
(1) 846513729
(1) 846513737
(1) 846514347

N. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 10.
(1) 846513752
(1) 846513760
(1) 846513756
(1) 846513794
(1) 846514347

P. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 11.
(1) 846513810
(1) 846513828
(1) 846513844
(1) 846513851
(1) 846514347

Q. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 12.
(1) 846513869
(1) 846513877
(1) 846513901
(1) 846513919
(1) 846514347

R. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 13.
(1) 846513927
(1) 846513935
(1) 846513943
(1) 846513950
(1) 846514347

S. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 14.
(1) 846513968
(1) 846513976
(1) 846513984
(1) 846513992
(1) 846514347

T. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 15.
(1) 846514008
(1) 846514016
(1) 846514024
(1) 846514032
(1) 846514347

U. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 16.
(1) 846514040
(1) 846514057
(1) 846514065
(1) 846514073
(1) 846514347

V. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 1.
(1) 846612760
(1) 846612828
(1) 846453108

W. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 2.
(1) 846612778
(1) 846612836
(1) 846543108

X. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 3.
(1) 846612786
(1) 846612844
(1) 846453108

Y. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 4.
(1) 846612794
(1) 846612851
(1) 846453108

Z. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 5.
(1) 846612802
(1) 846612869
(1) 846453108

AA. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 6.
(1) 846612810
(1) 846612877
(1) 846453108

AB. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 7.
(1) 846452589
(1) 846452712
(1) 846453108

AC. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 8.
(1) 846452597
(1) 846452720
(1) 846453108

AD. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 9.
(1) 846452613
(1) 846452746
(1) 846543108

AE. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 10.
(1) 846452621
(1) 846452753
(1) 846453108

AF. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 11.
(1) 846452571
(1) 846452704
(1) 846453108

AG. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 12.
(1) 846452605
(1) 846452738
(1) 846453108

AH. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 13.
(1) 846452639
(1) 846452761
(1) 846453108

AJ. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 14.
(1) 846452647
(1) 846452779
(1) 846453108

AK. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 15.
(1) 846452654
(1) 846452787
(1) 846453108

AL. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 16.
(1) 846452662
(1) 846452795
(1) 846453108

AM. Equipment required in addition to list 82 or 83 when the DSPU shelf is mounted in position 1 thru 16.
(1) 846452845
(1) 846452977
(1) 846453108

AN. Equipment required in addition to list 63 or 64 when the DSPU shelf is mounted in position 1 thru 16.
(1) 846450104

AP. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 1 thru 16.
(1) 846533206
(1) 846533196
(1) 846533164

AQ. Equipment required in addition to list 38 or 40 when the IFTU shelf is mounted in position 1 thru 16.
(1) 846538809
(1) 846538817
(1) 846538825
(1) 846538833

J98774FA-1 DACS II ISX List Structure

The listings in this section are not provided as an ordering guide. Since this manual is not updated for every change on the J-drawing, the equipment listings may not be up-to-date. For the latest ordering information, see your local account executive.

LIST # **DESCRIPTION**

1. Assembly, wiring, and equipment required to provide one Integral Shelf Cross-Connect (ISX) unit for 24 channel applications.
   (1) ED9C189-30 G1
   (3) 424AA
   (2) KER3
   (1) KER4
2. Assembly, wiring, and equipment required to provide one Integral Shelf Cross-Connect (ISX) unit for 30 channel applications.
   (1) ED9C189-30 G2
   (3) 424AA
   (2) KER3
   (1) KER4
3. Circuit pack required to equip two DS-1 terminations.
   (1) TG191
4. Circuit pack required to equip two E1 terminations.
   (1) TG192
5. Equipment required in addition to list 4 to provide an adapter for 75 ohm coax cable equipped with BT43 series posilock cable sockets.
   (1) ED9C199-30 G1
6. Equipment required in addition to list 4 to provide an adapter for 75 ohm coax cable equipped with DIN 1.6/5.6 cable sockets.
   (1) ED9C199-30 G2

A. Mounting kit required in addition to list 1 or 2 when the unit is to be mounted in a network bay frame.

B. Mounting kit required in addition to list 1 or 2 when the unit is to be mounted in a European Telecommunications Standard International (ETSI) rack.

C. Mounting kit required in addition to list 1 or 2 when the unit is to be mounted in a EIA/ANSI rack.

DACS II Software List Structure

J98774SD-5

The Listings in this section are not provided as an ordering guide. Since this manual is not updated for every change on the J-drawing, the equipment Listings may not be up-to-date. For the latest ordering information, see your local account executive.

LIST #	DESCRIPTION
1.	Assembly and equipment for Release 6.0.1 core software for initial orders and retrofits from gerneric 2, generic 3, generic 4, or release 5 software. Software includes the DS1 and Nx64 kb/s test access features. List includes three tapes (2 copies of the software and one formatted only tape) and the Software Release Description.
2.	Assembly and equipment for Release 6.0.1 core (List 1) software for adding features to the existing 6.0.1, or for providing a CN. List includes three tapes (2 copies of the software and one formatted only tape) and the Software Release Description.
3.	Assembly and equipment for one spare tape of Release 6.0.1 core (List 1) software.
4.	One tape formatted for Release 6 software.
C.	System start-up tape always required in addition to Lists M1R and P1R for new DACS II systems that are installed with release 6.0.1. Warning: List C should never be used on in-service frames.
A1.	Documentation required in addition to list 1 or 2 to provide PDS versions of the Operation and Maintenance Manual, the Command and Message Manual, and the Quick Reference Guide. These documents cover Release 6.0 and include DS1, SRDC, SLC, DS3, enhanced DS1 performance monitoring, roll, and Nx64 kb/s test access.
A2.	Gateway documentation provided in addition to list F2R or F2T to provide PDS versions of the 2.048 Mb/s Interface Operations and Maintnenance Manual, the Command and Message Manual, and the Quick Reference Guide. These manuals cover Release 6.0 and include 2.048 Mb/s Interface and Clear 2.048 Mb/s Interface.
B1.	Documentation required in addition to list 1 or 2 to provide MML versions of theOperation and Maintenance Manual, the Command and Message Manual, and the Quick Reference Guide. These documents cover Release 6.0 and include DS1, SRDC, SLC, DS3, enhanced DS1 performance monitoring, roll, and Nx64 kb/s test access.
B2.	Documentation provided in addition to List F2R or F2T to provide MML versions of the 2.048 Mb/s Interface Operations and Maintenance Manual, Command and Message Manual, and Quick Reference Guide. These manuals cover Release 6.0 and include 2.048 Mb/s Interface and Clear

2.048 Mb/s Interface.

F1R. SRDC and SLC application software and right-to-use fee required in addition to List 1 or 2 on initial orders of these features.

F1T. SRDC and SLC application software required in addition to List 1, 2, or 3 to provide these features when List F1R has been previously purchased.

F2R. Gateway and Clear 2 Mb/s Interface application software and right-to-use fee required in addition to List 1 or 2 on initial orders of this feature.

F2T. Gateway and Clear 2 Mb/s Interface application software required in addition to List 1, 2, or 3 to provide this feature when List F2R has previously been purchased.

F3R. DS3 termination application software and right-to-use fee required in addition List 1 or 2 on initial orders for this feature.

F3T. DS3 termination application software required in addition to List 1, 2, or 3 to provide this feature when List F3R has been previously purchased.

F4R. Enhanced DS1 performance monitoring application software and right-to-use fee required in addition to List 1 or 2 on initial orders of this feature.

F4T. Enhanced Ds1 performance monitoring application software required in addition to List 1, 2, or 3 to provide this feature when List F4R has been previously purchased.

F5R. Roll application software and right-to-use fee required in addition to List 1 or 2 on initial orders for this feature.

F5T. Roll application software required in addition to List 1, 2, or 3 to provide this feature when List F5R has been previously purchased.

M1R. Application software and right-to-use fee always required in addition to List 1 on initial orders for Release 6 Software.

M1S. Application software right-to-use fee always required in addition to List 1 for retrofits from generic 2, generic 3, generic 4, a Release 5 320/640 frame or a Release 6.0 320/640 frame to a Release 6 Capacity Expansion Frame.

M2S. Application software right-to-use fee always required in addition to List 1 for retrofits from generic 2, generic 3, generic 4, or generic 5 320/640 frame to Release 6 on a frame that will remain a 320/640 size frame.

P1R. Operating system software right-to-use fee always required in addition to List 1 on intial orders for Release 6 software.

P1S. Operating system software right-to-use fee always required in addition to List 1 for retrofits from generic 2, generic 3, generic 4, a Release 5 320/640 frame or a Release 6 320/640 frame to a Release 6.0.1 Capacity Expansion frame.

P2S. Operating system software right-to-use fee always required in addition to List 1 for retrofits from generic 2, generic 3, generic 4, or a Release 5 320/640 frame to Release 6.0.1 on a frame that will remain a 320/640 size frame.

J98774BE-4

The Listings in this section are not provided as an ordering guide. Since this manual is not updated for every change on the J-drawing, the equipment Listings may not be up-to-date. For the latest ordering information, see your local account executive.

LIST #	DESCRIPTION
1.	Assembly and equipment for Release 6.0.1 core software for initial orders and retrofits from gerneric 2, generic 3, generic 4, or release 5 software. Software includes the 2.048 Mb/s Interface, enhanced 2.048 Mb/s performance monitoring, and the Nx64 kb/s test access features. List includes three tapes (2 copies of the software and one formatted only tape) and the Software Release Description.
2.	Assembly and equipment for Release 6.0.1 core (List 1) software for adding features to the existing 6.0.1, or for providing a CN. List includes three tapes (2 copies of the software and one formatted only tape) and the Software Release Description.
3.	Assembly and equipment for one spare tape of Release 6.0.1 core (List 1) software.
4.	One tape formatted for Release 6 software.
C.	System start-up tape always required in addition to Lists M1R and P1R for new DACS II systems that are installed with release 6.0.1. Warning: List C should never be used on in-service frames.
A1.	2.048 Mb/s Interface documentation required in addition to list 1 or 2 to provide PDS versions of the Operation and Maintenance Manual, the Command and Message Manual, and the Quick Reference Guide. These documents cover Release 6.0 and include DS1, SRDC, SLC, DS3, enhanced DS1 performance monitoring, roll, and Nx64 kb/s test access.
A2.	DS1 documentation available in addition to List F1R or F1T to provide PDS versions of the Release Operation and Maintnenance Manual, Command and Message Manual, and Quick Reference Guide. These manuals cover DS1, gateway, DS3, and enhanced DS1 performance monitoring.
B1.	2.048 Mb/s Interface documentation required in addition to list 1 or 2 to provide MML versions of theOperation and Maintenance Manual, the Command and Message Manual, and the Quick Reference Guide. These documents cover 2.048 Mb/s Interface, Enhanced 2.048 Mb/s Interface, Clear 2.048 Mb/s Interface, and TS0 to non-TS0 XCON, and Nx64 kb/s test access.

B2. DS1 documentation in addition to List F1R or F1T to provide MML versions of the Release 6 Operation and Maintnenance Manual, Command and Message Manual, and Quick Reference Guide. These manuals cover DS1, gateway, DS3, and enhanced DS1 performance monitoring.

F1R. Gateway application software and right-to-use fee required in addition to List 1 or 2 on initial orders of these features.

F1T. Gateway application software required in addition to List 1, 2, or 3 to provide these features when List F1R has been previously purchased.

F2R. Enhanced 2 Mb/s Interface application software and right-to-use fee required in addition to List 1 or 2 on initial orders of this feature.

F2T. Enhanced 2 Mb/s Interface application software required in addition to List 1, 2, or 3 to provide this feature when List F2R has previously been purchased.

F3R. DS3 termination application software and right-to-use fee required in addition List 1 or 2 on initial orders for this feature.

F3T. DS3 termination application software required in addition to List 1, 2, or 3 to provide this feature when List F3R has been previously purchased.

F4R. Enhanced DS1 performance monitoring application software and right-to-use fee required in addition to List 1 or 2 on initial orders of this feature.

F4T. Enhanced Ds1 performance monitoring application software required in addition to List 1, 2, or 3 to provide this feature when List F4R has been previously purchased.

F5R. Clear 2.048 Mb/s Interface and TS0 to non-TS0 XCON application software and right-to-use fee required in addition to List 1 or 2 on initial orders for this feature.

F5T. Clear 2.048 Mb/s Interface and TS0 to non-TS0 XCON application software required in addition to List 1, 2, or 3 to provide this feature when List F5R has been previously purchased.

M1R. Application software and right-to-use fee always required in addition to List 1 on initial orders for Release 6 Software.

M2S. Application software right-to-use fee always required in addition to List 1 for retrofits from generic 2, generic 3, generic 4, or Release 5 to Release 6 on a 128 size frame.

P1R. Operating system software right-to-use fee always required in addition to List 1 on intial orders for Release 6 software.

P2S. Operating system software right-to-use fee always required in addition to List 1 for retrofits from generic 2, generic 3, generic 4, or a Release 5 to Release 6 on a 128 size frame.

J98774BD-5

The Listings in this section are not provided as an ordering guide. Since this manual is not updated for every change on the J-drawing, the equipment Listings may not be up-to-date. For the latest ordering information, see your local account executive.

LIST #	DESCRIPTION
1.	Assembly and equipment for Release 6.0.1 core software for initial orders and retrofits from gerneric 2, generic 3, generic 4, or release 5 software. Software includes the DS1 and Nx64 kb/s test access features. List includes three tapes (2 copies of the software and one formatted only tape) and the Software Release Description.
2.	Assembly and equipment for Release 6.0.1 core (List 1) software for adding features to the existing 6.0.1, or for providing a CN. List includes three tapes (2 copies of the software and one formatted only tape) and the Software Release Description.
3.	Assembly and equipment for one spare tape of Release 6.0.1 core (List 1) software.
4.	One tape formatted for Release 6 software.
C.	System start-up tape always required in addition to Lists M1R and P1R for new DACS II systems that are installed with release 6.0.1. Warning: List C should never be used on in-service frames.
A1.	Documentation required in addition to list 1 or 2 to provide PDS versions of the Operation and Maintenance Manual, the Command and Message Manual, and the Quick Reference Guide. These documents cover Release 6.0 and include DS1, SRDC, SLC, DS3, enhanced DS1 performance monitoring, roll, and Nx64 kb/s test access.
A2.	Gateway documentation provided in addition to list F2R or F2T to provide PDS versions of the 2.048 Mb/s Interface Operations and Maintnenance Manual, the Command and Message Manual, and the Quick Reference Guide. These manuals cover Release 6.0 and include 2.048 Mb/s Interface and Clear 2.048 Mb/s Interface.
B1.	Documentation required in addition to list 1 or 2 to provide MML versions of theOperation and Maintenance Manual, the Command and Message Manual, and the Quick Reference Guide. These documents cover Release 6.0 and include DS1, SRDC, SLC, DS3, enhanced DS1 performance monitoring, roll, and Nx64 kb/s test access.
B2.	Gateway documentation provided in addition to List F2R or F2T to provide MML versions of the 2.048 Mb/s Interface Operations and Maintenance Manual, Command and Message Manual, and Quick Reference Guide. These manuals cover Release 6.0 and include 2.048 Mb/s Interface and Clear 2.048 Mb/s Interface.

F1R. SRDC and SLC application software and right-to-use fee required in addition to List 1 or 2 on initial orders of these features.

F1T. SRDC and SLC application software required in addition to List 1, 2, or 3 to provide these features when List F1R has been previously purchased.

F2R. Gateway and Clear 2 Mb/s Interface application software and right-to-use fee required in addition to List 1 or 2 on initial orders of this feature.

F2T. Gateway and Clear 2 Mb/s Interface application software required in addition to List 1, 2, or 3 to provide this feature when List F2R has previously been purchased.

F3R. DS3 termination application software and right-to-use fee required in addition List 1 or 2 on initial orders for this feature.

F3T. DS3 termination application software required in addition to List 1, 2, or 3 to provide this feature when List F3R has been previously purchased.

F4R. Enhanced DS1 performance monitoring application software and right-to-use fee required in addition to List 1 or 2 on initial orders of this feature.

F4T. Enhanced Ds1 performance monitoring application software required in addition to List 1, 2, or 3 to provide this feature when List F4R has been previously purchased.

F5R. Roll application software and right-to-use fee required in addition to List 1 or 2 on initial orders for this feature.

F5T. Roll application software required in addition to List 1, 2, or 3 to provide this feature when List F5R has been previously purchased.

M1R. Application software and right-to-use fee always required in addition to List 1 on initial orders for Release 6 Software.

M2S. Application software right-to-use fee always required in addition to List 1 for retrofits from generic 2, generic 3, generic 4, or generic 5 to Release 6 on a 160 size frame.

P1R. Operating system software right-to-use fee always required in addition to List 1 on intial orders for Release 6 software.

P2S. Operating system software right-to-use fee always required in addition to List 1 for retrofits from generic 2, generic 3, generic 4, or a Release 5 to Release 6.0.1 on a 160 size frame.

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The Listings in this section are not provided as an ordering guide. Since this manual is not updated for every change on the J-drawing, the equipment Listings may not be up-to-date. For the latest ordering information, see your local account executive.

LIST #	DESCRIPTION
1.	Assembly and equipment for Release 6.0.1 core software for initial orders and retrofits from gerneric 2, generic 3, generic 4, or release 5 software. Software includes the 2.048 Mb/s Interface, Enhanced 2.048 Mb/s performance monitoring, and the Nx64 test access features. List includes three tapes (2 copies of the software and one formatted only tape) and the Software Release Description.
2.	Assembly and equipment for Release 6.0.1 core (List 1) software for adding features to the existing 6.0.1, or for providing a CN. List includes three tapes (2 copies of the software and one formatted only tape) and the Software Release Description.
3.	Assembly and equipment for one spare tape of Release 6.0.1 core (List 1) software.
4.	One tape formatted for Release 6 software.
C.	System start-up tape always required in addition to Lists M1R and P1R for new DACS II systems that are installed with release 6.0.1. Warning: List C should never be used on in-service frames.
A1.	2.048 Mb/s Interface documentation required in addition to list 1 or 2 to provide PDS versions of the Operation and Maintenance Manual, the Command and Message Manual, and the Quick Reference Guide. These documents cover Release 6.0 and include DS1, SRDC, SLC, DS3, enhanced DS1 performance monitoring, roll, and Nx64 kb/s test access.
A2.	DS1 documentation available in addition to List F1R or F1T to provide PDS versions of the Release Operation and Maintnenance Manual, Command and Message Manual, and Quick Reference Guide. These manuals cover DS1, gateway, DS3, and enhanced DS1 performance monitoring.
B1.	2.048 Mb/s Interface documentation required in addition to list 1 or 2 to provide MML versions of theOperation and Maintenance Manual, the Command and Message Manual, and the Quick Reference Guide. These documents cover 2.048 Mb/s Interface, Enhanced 2.048 Mb/s Interface, Clear 2.048 Mb/s Interface, and TS0 to non-TS0 XCON, and Nx64 kb/s test access.
B2.	DS1 documentation in addition to List F1R or F1T to provide MML versions of the Release 6 Operation and Maintnenance Manual, Command and Message Manual, and Quick Reference Guide. These manuals cover DS1, gateway, DS3, and enhanced DS1 performance monitoring.

F1R. Gateway application software and right-to-use fee required in addition to List 1 or 2 on initial orders of these features.

F1T. Gateway application software required in addition to List 1, 2, or 3 to provide these features when List F1R has been previously purchased.

F2R. Enhanced 2 Mb/s Interface application software and right-to-use fee required in addition to List 1 or 2 on initial orders of this feature.

F2T. Enhanced 2 Mb/s Interface application software required in addition to List 1, 2, or 3 to provide this feature when List F2R has previously been purchased.

F3R. DS3 termination application software and right-to-use fee required in addition List 1 or 2 on initial orders for this feature.

F3T. DS3 termination application software required in addition to List 1, 2, or 3 to provide this feature when List F3R has been previously purchased.

F4R. Enhanced DS1 performance monitoring application software and right-to-use fee required in addition to List 1 or 2 on initial orders of this feature.

F4T. Enhanced Ds1 performance monitoring application software required in addition to List 1, 2, or 3 to provide this feature when List F4R has been previously purchased.

F5R. Clear 2.048 Mb/s Interface and TS0 to non-TS0 XCON application software and right-to-use fee required in addition to List 1 or 2 on initial orders for this feature.

F5T. Clear 2.048 Mb/s Interface and TS0 to non-TS0 XCON application software required in addition to List 1, 2, or 3 to provide this feature when List F5R has been previously purchased.

M1R. Application software and right-to-use fee always required in addition to List 1 on initial orders for Release 6 Software.

M2S. Application software right-to-use fee always required in addition to List 1 for retrofits from generic 2, generic 3, generic 4, or Release 5 to Release 6 on a 128 size frame.

P1R. Operating system software right-to-use fee always required in addition to List 1 on intial orders for Release 6 software.

P2S. Operating system software right-to-use fee always required in addition to List 1 for retrofits from generic 2, generic 3, generic 4, or a Release 5 to Release 6 on a 128 size frame.

Growth and Capacity

9

Contents

Growth and Capacity

9

Introduction

This chapter gives the minimum equipage of mounting hardware and circuit packs for the DACS II and describes how the DACS II can be grown to accommodate additional facility terminations and services. The facility and DS0 channel capacities of the fully equipped frames and the NPC numbering methods are also discussed.

Chapter 6 gave a detailed description of the frame mountings and equipment subassemblies. With that background, we can go on to develop a description of how the DACS II is equipped.

General

Non-CEF equipment is available in three frame configurations: single-bay, double-bay, and triple-bay. For growth, the 2-bay can be expanded to a 3-bay to arrive at the maximum frame configuration. The single-bay frame provides two peripheral unit positions for small installations; side bays cannot be added. The CEF (capacity expansion frame) provides the capacity to serve 16 peripheral units that are mounted in a 7-bay configuration. The CEF is designed to satisfy the needs of large installations, but the architecture allows for low startup cost by installing fewer bays. For growth, additional side bays can be installed to arrive at the maximum configuration.

DACS II Minimum Equipage

Minimum equipage identifies the least amount of equipment that is needed to operate the DACS II. This equipage is not very practical for installation in the field, but it can be used for comparison and demonstrates that the ordering list structure supports growth from this minimum arrangement.

Non-CEF Frame

Figure 9-1 shows minimum equipage for a multibay frame. There is the switch bay and one side bay. Beginning with Release 4.1, the side bay 1 can also be a flexible interface bay in which case the peripheral unit types could be different from what is shown. The minimum equipage of shelf subassemblies in the bays is as follows:

- Main controller equipment (MC circuit packs, status panel, tape and disk drive, etc.).
- Power and fusing equipment for DACS II frame.
- One facility terminating unit with one FTM (facility terminating module) equipped for two digroup terminations. With the original interface bay, the FTU would be placed in unit 1.
- Duplicated CCN (cross-connect network) consisting of one CCNI (cross-connect network interface), one TSI (time-slot interchange), and one CCB (cross-connect buffer) pack for each side of the cross-connect network to support unit 1.
- Optional DSPU shelf assembly with power units equipped.

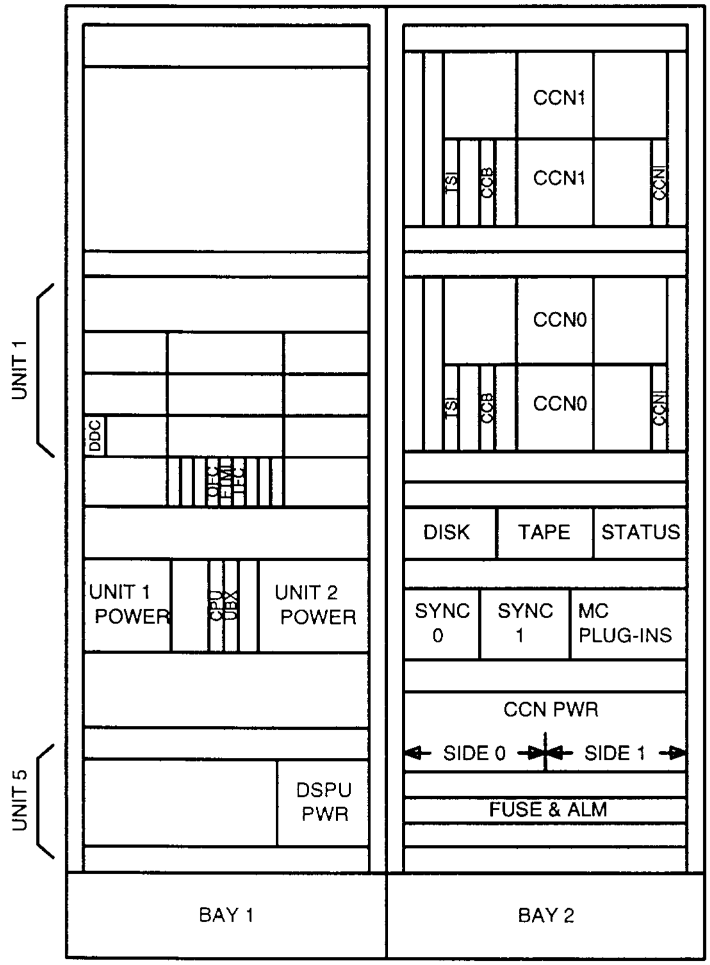

Figure 9-1. Minimum Equipage for non-CEF Frame

CEF Frame

Figure 9-2 shows minimum equipage for a CEF. The smallest frame configuration is the switch bay and one flexible interface bay. The minimum equipage of shelf subassemblies in the bays is as follows:

- Main controller equipment (MC circuit packs, status panel, tape and disk drive, etc.)
- Power and fusing equipment for DACS II frame
- One IFTU or DS3U (depending on customer order). The basic frame list includes the common equipment plug-ins for the ordered unit. For the minimum equipage, a single DDC position of an IFTU or a single MMFG position of the DS3U is obtained.
- Duplicated ECCN (expanded CCN) consisting of common equipment ECCN plug-ins and one ETSI for the single peripheral unit.

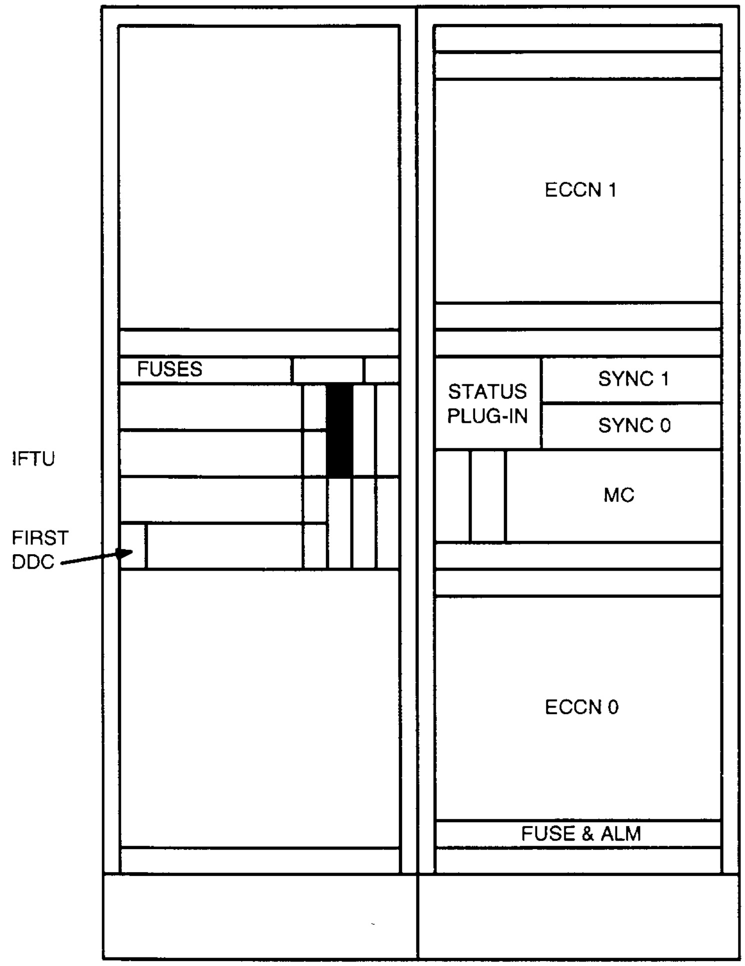

Figure 9-2. Minimum Equipage for CEF Frame

DACS II Growth

The sequence of DACS II growth is generally as follows:

- Circuit packs are added to fill units. For an IFTU, this occurs as each shelf module of 20 dual card slots is filled.
- More peripheral units are added to accommodate more terminations or services.
- When all the unit positions of the bay are filled, another bay is installed and the sequence repeated.

Details of adding unit equipment are given under the following headings for the various type units.

FTU (Facility Terminating Unit) Growth

The FTM (facility terminating module) within the unit is equipped by adding dual circuit cards. Each dual card contains two NPCs (network processing circuits) for two 1.544-Mb/s or 2.048-Mb/s line terminations. Examples of circuit packs are: DDC (dual digroup circuit), DPCs (dual primary circuits), and S96D (dual *SLC* 96 circuit).

After the module is filled to capacity (20 DDCs or 16 DPCs), another FTM in the unit is started. When commands are entered to grow the packs, the transmit line equalizer value (for DS1s) or the impedance value (for 2.048-Mb/s signals) for the FTM is entered. There is no mixing of DS1 and 2.048-Mb/s line signals within a FTM.

Following is the listing of the circuit packs for the FTM:

- One FTMI (facility terminating module interface)
- Two FCs (format converters), one for 0-Side and one for 1-Side
- Dual circuit cards for NPCs.

When all four modules of a unit are filled, another unit is added and at least one FTM is made available for service. Following is the listing of circuit packs for adding the unit:

- Power units - three required for whole unit, at least two required with first FTM
- One UC (unit controller)
- One UBX (unit bus extender)
- Circuit packs added to both sides of the CCN or ECCN to connect the FTU/IFTU to every other equipped unit. See the separate heading for CCN or ECCN growth for the plug-in additions.

DSPU (Digital Signal Processing Unit) Growth

The DSPU mounts up to eight DSP (digital signal processor) circuit packs to provide the required functions. Among the types that are available are: DMBs (digital multipoint bridges), SRMs (subrate multiplexers), MJUs (multipoint junction units) or CPRs (C-bit processors). There can be a mix of DMBs, SRMs, and MJUs in a DS1 environment or a mix of DMBs and CPRs in a 2.048-Mb/s environment. Before software Release 5, only 4 CPRs were allowed per side, but that restriction is removed with Release 5.0.

The DSPU is equipped in the following manner:

- Three power units
- One UC
- One DSPI (Digital Signal Processing Interface)
- DSP packs as required to provide both the required functions; whatever is installed on the 0-side of the DSPU must be duplicated on the 1-side.
- Circuit packs added to both sides of the CCN or ECCN to connect the DSPU to every other equipped unit. See the separate heading for CCN or ECCN growth for the circuit pack additions.

DS3U (DS3 Unit) Growth

The DS3U mounts packs for up to six DS3 multiplexers and required signal interface packs and power units.

The DS3U is equipped in the following manner:

- Three power units (one redundant backup)
- One unit UC
- Two FMT packs, one for 0-Side and one for 1-Side
- Two FLI packs, one service and one protection
- One MXR for service protection
- Other six MXRs as required for DS3 lines
- Circuit packs added to both sides of the CCN or ECCN to connect the DSPU to every other equipped unit. See the separate heading for CCN or ECCN growth for the plug-in additions.

CCN or ECCN Growth

Circuit packs must be added to the cross-connect network when a unit is to be added to enable the unit to be connected to every other equipped unit in the frame. The same circuit packs are added to both sides of the duplicated network.

For the non-CEF frame, the connectivity of a unit can be restricted in the software in which case circuit packs will not be required to connect to all other units. The following paragraphs for the CCN and ECCN summarize the equipage considerations.

CCN Type

When the CCN is installed, the required power units and CCNI interface pack per side will be installed. As each peripheral unit is added to the frame, a CCB for each side and several TSI packs are equipped. For full connectivity, the number of TSIs required on each side of the network is given by the number of equipped units squared. These circuit packs are identified in the Operation and Maintenance Manual and are listed in the completion message for growing the unit which also grows the required TSIs.

ECCN Type

When the ECCN is installed, the required CCI interface pack and two BTs will be installed for both sides. As each peripheral unit is added to the frame, an ETSI pack is added to each side. This single ETSI pack connects the added unit to every other equipped unit in the frame. No power units are required for the ECCN because the CCI and the ETSIs contain power converters.

DACS II Frame Growth

Non-CEF Configurations

The ordering list structure supports two methods of frame growth: (1) growth by adding only circuit packs (unit shelf assemblies already installed), and (2) growth by adding shelf assemblies and circuit packs. In the first method, all unit shelf assemblies are installed initially, and in the second, only those units shelf assemblies needed in the foreseeable future are installed initially. The second method is referred to as unit growth and only applies to the 2-bay and 3-bay versions. The single-bay version is growable by circuit packs but not by units beyond the FTU and the DSPU (or conditionally a DS3U). With either method, after a 2-bay frame is filled and more service capacity is needed, bay 3 must be added. Again, this side bay could be ordered either with all unit shelf assemblies equipped or only those needed soon equipped.

Starting with software Release 4, frame configurations could be ordered with flexible interface bays. Instead of the fixed assignment of unit types with original interface bays, the hardware and software allows unit assignment flexibility in the flexible interface bay. With Release 4.0, only bay 3 could be a flexible bay and the assignment flexibility only allowed variations in the DSPU and DS3U mounting compared to an original interface bay. With Release 4.1, flexible interface bays could be used in bays 1 and 3, and with the IFTU, full assignment flexibility was achieved.

CEF Configurations

The capacity expansion frame is designed to be expandable up to 7 bays for 16 peripheral units to meet the needs of large DACS II installations. In some cases the full capacity of the CEF may be needed initially to replace existing DACS installations with interframe ties. However, growth of the CEF to full capacity is more likely. The ordering list structure supports growth by the addition of circuit packs, unit shelf assemblies, and side bays.

The minimum frame equipage for the CEF is a 2-bay frame. Additional bays are added adjacent to the existing line up, with a maximum of three flexible interface bays on either side of the switch bay. Different list bays are available for connecting to new installation CEF frames. Figure 9-3, shows the way bay 3 would be equipped with an IFTU and a DSPU in a new installation side bay.

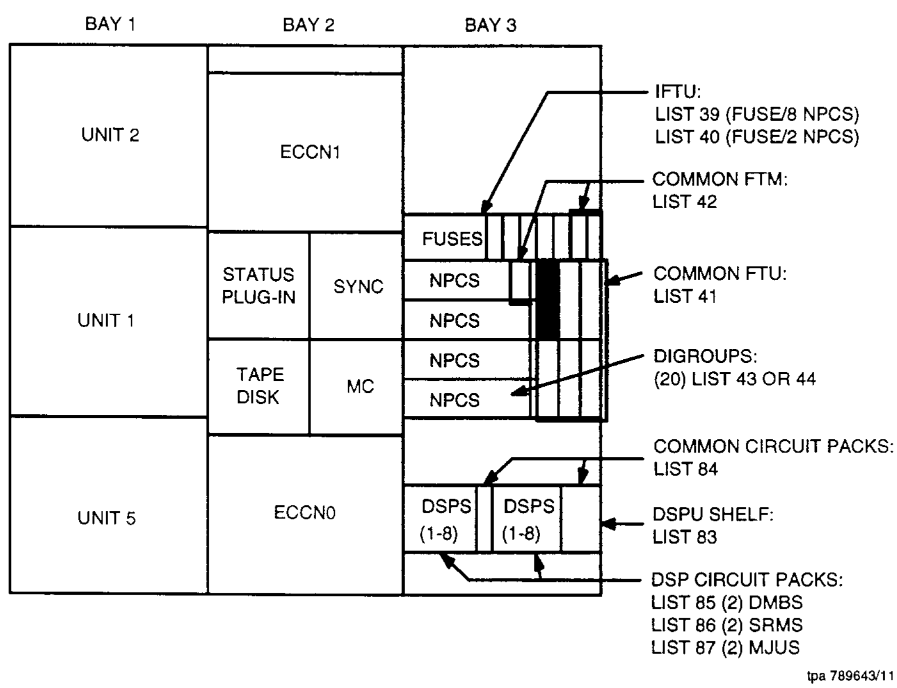

Figure 9-3. Peripheral Unit Growth

Additional unit shelf assemblies are easily added to the configuration with connectorized cables. Enhanced diagnostic tests for unit circuit packs include cabling tests to preserve the integrity of the configuration. Also, enhanced diagnostics for ECCN circuit packs test time-slot interchange capabilities and memory of added ETSI packs.

DACS II Capacity

Facility Terminating Unit Capacity

Each FTM shelf will hold 20 dual circuit cards that contain the circuitry for 2 NPCs (network processing circuits) to connect to 2 digital lines. With DS1 circuit packs, all 20 slots are used for a capacity of 40 NPCs. With 2.048-Mb/s circuit packs, only 16 slots are used for a capacity of 32 NPCs. Only 16 are used to remain within the unit time-slot capacity of 4096 because each 2.048-Mb/s line supplies 32 time slots compared to 24 for DS1 lines.

There are 4 FTMs for every FTU/IFTU so the NPC capacity for a unit equipped for DS1 terminations is 160 NPCs for 160 DS1s. With 8 less NPCs per shelf, the NPC capacity for a unit with 2.048-Mb/s terminations is 128 NPCs for that same number of lines.

DS3 Unit Capacity

Each DS3 termination brings 28 DS1 signals to the DACS II cross-connect network. With all 6 DS3 positions in the unit equipped, the total number of DS1 signals delivered is 168 which is eight more than delivered from each FTU/IFTU. The circuitry for these embedded DS1s is addressed in DACS II commands as NPCs although there are no NPC plug-ins as in other units. Only DS1 signals are delivered by DS3 signals, 2.048 Mb/s signals are not.

DSP (Digital Signal Processor) Capacity

Each DSP circuit pack has a time-slot capacity of 512. Bridging or subrate multiplexing or another DSP function is done using this 512 time-slot bitstream. The customer signals are supplied by DS0 channels connected to the DSP. For the DMB function, this capacity allows 256 channels to be bridged together either in one circuit or in 85 different circuits. For the multipoint junction unit function, this capacity allows up to four subrate customer signals to be bridged; furthermore, one multijunction unit can be connected to another for almost unlimited bridging. With 8 DSP circuit packs in the DSPU, a total of 4096 (8 x 512) time slots is available.

DS0 Termination Capacity

Each DS1 signal contains 24 DS0 channels, and each 2.048 Mb/s signal contains 32 time slots although only 30 are available for DS0 telephone channels with the CAS (channel associated signaling) format.

With all DS1 terminations, the 16 IFTUs of a fully equipped CEF configuration yield a maximum of 2,560 DS1s which contain 61,440 DS0 channels. The frame complex could also be equipped with a mix of unit types (IFTU, DSPU, and DS3U) to provide a balance of DS3 and DS1 terminations for hubbing and grooming and internal digital signal processing (in DSPUs). The DS1 or DS0 capacity of these various combinations on the frame would be determined using the foregoing unit capacities.

When DS3Us are equipped, each DS3 signal consists of 28 DS1s. With all 6 DS3 positions filled, there are 168 DS1s. This gives a DS0 channel capacity of 4032 for a fully equipped DS3U, each of which consists of 28 DS1s.

Four DS1 or 2.048 Mb/s terminations in any frame configuration can be designated for DS0 channel test access. This capability allows channels to be brought out to external test positions or equipment for transmission and signaling tests. Furthermore, any number of clear-channel DS1s can also be used for test access of other clear-channel DS1s. Designated test facilities cannot be used for terminating service line signals.

NPC Numbering

The numbering of the NPCs (network processing circuits) is important for locating the circuit packs by shelf position and for inputting and reading I/O messages. Two addressing methods are used: hierarchical and non hierarchical, which is also called extended. A provisioning command for the administrative link allows the user to specify the desired NPC addressing method. The equipment is ordered with shelf designation strips for one of the NPC addressing methods.

Hierarchical numbers are 3-part numbers that consist of the unit number, the module or DSP group, and the NPC number in the module or group. Extended numbers are consecutive numbers that result from counting the NPCs from unit 1 through 16. The large capacity of the CEF necessitated the use of 4-digit extended NPC numbers.

The large capacity of the CEF and the assignment flexibility with flexible interface bays have made it difficult to remember the extended numbers in all units. For reference, TABLE 9-1 START HERE lists this numbering for various type units. From Table 9-1, the characteristics of the DSPU and DS3U NPC numbering can be derived. For the DSPU, there are eight DSPs per unit and each one has two NPC numbers; each DSP starts with an NPC number 20 higher than the previous one. For the DS3U, there are eight more virtual NPCs than in the DS1 IFTUs; these additional NPCs are given a letter suffix (A through H) to count the NPCs. All DS3U NPCs are virtual ones because they are part of the DS3 circuitry and do not have separate circuit packs.

Table 9-1. Extended NPC Numbering

Unit	Unit Type	NPC Range
1	DS1 IFTU	0001-0160
	2.048 Mb/s IFTU	0001-0128
	DS3U	0001-0160,016A-016H
	DSPU	0001-0002, 0021-0022, 0041-0042, 0061-0062 0081-0082, 0101-0102, 0121-0122, 0141-0142
2	DS1 IFTU	0161-0320
	2.048 Mb/s IFTU	0161-0288
	DS3U	0161-0320,032A-032H
	DSPU	0161-0162, 0181-0182, 0201-0202, 0221-0222 0241-0242, 0261-0262, 0281-0282, 0301-0302
3	DS1 IFTU	0321-0480
	2.048 Mb/s IFTU	0321-0448
	DS3U	0321-0480,048A-048H
	DSPU	0321-0322, 0341-0342, 0361-0362, 0381-0382 0401-0402, 0421-0422, 0441-0442, 0461-0462
4	DS1 IFTU	0481-0640
	2.048 Mb/s IFTU	0481-0608
	DS3U	0481-0640,064A-064H
	DSPU	0481-0482, 0501-0502, 0521-0522, 0541-0542 0561-0562, 0581-0582, 0601-0602, 0621-0622
5	DS1 IFTU	0641-0800
	2.048 Mb/s IFTU	0800-0768
	DS3U	0641-0800,080A-080H
	DSPU	0641-0642, 0661-0662, 0681-0682, 0701-0702 0721-0722, 0741-0742, 0761-0762, 0781-0782
6	DS1 IFTU	0801-0960
	2.048 Mb/s IFTU	0801-0928
	DS3U	0801-0960,096A-096H
	DSPU	0801-0802, 0821-0822, 0841-0842, 0861-0862 0881-0882, 0901-0902, 0921-0922, 0941-0942
7	DS1 IFTU	0961-1120
	2.048 Mb/s IFTU	0961-1088
	DS3U	0961-1120,112A-112H
	DSPU	0961-0962, 0981-0982, 1001-1002, 1021-1022 1041-1042, 1061-1062, 1081-1082, 1101-1102
8	DS1 IFTU	1121-1280
	2.048 Mb/s IFTU	1121-1248
	DS3U	1121-1280,128A-128H
	DSPU	1121-1122, 1141-1142, 1161-1162, 1181-1182 1201-1202, 1221-1222, 1241-1242, 1261-1262

Table 9-1. Extended NPC Numbering (Continued)

Unit	Unit Type	NPC Range
9	DS1 IFTU 2.048 Mb/s IFTU DS3U DSPU	1281-1440 1281-1408 1281-1440,144A-144H 1281-1282, 1301-1302, 1321-1322, 1341-1342 1361-1362, 1381-1382, 1401-1402, 1421-1422
10	DS1 IFTU 2.048 Mb/s IFTU DS3U DSPU	1441-1600 1441-1568 1441-1600,160A-160H 1441-1442, 1461-1462, 1481-1482, 1501-1502 1521-1522, 1541-1542, 1561-1562, 1581-1582
11	DS1 IFTU 2.048 Mb/s IFTU DS3U DSPU	1601-1760 1601-1728 1601-1760,176A-176H 1601-1602, 1621-1622, 1641-1642, 1661-1662 1681-1682, 1701-1702, 1721-1722, 1741-1742
12	DS1 IFTU 2.048 Mb/s IFTU DS3U DSPU	1761-1920 1761-1888 1761-1920,192A-192H 1761-1762, 1781-1782, 1801-1802, 1821-1822 1841-1842, 1861-1862, 1881-1882, 1901-1902
13	DS1 IFTU 2.048 Mb/s IFTU DS3U DSPU	1921-2080 1921-2048 1921-2080,208A-208H 1921-1922, 1941-1942, 1961-1962, 1981-1982 2001-2002, 2021-2022, 2041-2042, 2061-2062
14	DS1 IFTU 2.048 Mb/s IFTU DS3U DSPU	2081-2240 2081-2208 2081-2240,224A-224H 2081-2082, 2101-2102, 2121-2122, 2141-2142 2161-2162, 2181-2182, 2201-2202, 2221-2222
15	DS1 IFTU 2.048 Mb/s IFTU DS3U DSPU	2241-2400 2241-2368 2241-2400,240A-240H 2241-2242, 2261-2262, 2281-2282, 2301-2302 2321-2322, 2341-2342, 2361-2362, 2381-2382
16	DS1 IFTU 2.048 Mb/s IFTU DS3U DSPU	2401-2560 2401-2528 2401-2560,256A-256H 2401-2402, 2421-2422, 2441-2442, 2461-2462 2481-2482, 2501-2502, 2521-2522, 2541-2542

Administrative Links and Operations Systems

10

Contents

Administrative Links and Operations Systems

10

Introduction

This chapter describes the administrative links that allow communication with and control of the DACS II and names the typical OSs (Operations Systems) that connect to DACS II. The Operations Systems portion of the chapter describes the most commonly used OSs.

Administrative Links

General

The DACS II (Figure 10-1) can be administered from a local terminal or from an OS (Operations System) connected to the administrative links. Following is a listing of many of the operations done at the administrative links:

- DS0 channel and clear DS1 signal cross-connections and test access
- Subrate data feature cross-connections
- Common equipment and feature equipment provisioning and maintenance
- Equipment and channel status information
- DS1 and DS3 facility provisioning and maintenance
- DS1 and DS3 facility performance readings
- DS3 facility AS&C (Alarm Surveillance and Control) and DS3 performance monitoring via TABS (Telemetry Asynchronous Block Serial) protocol link.

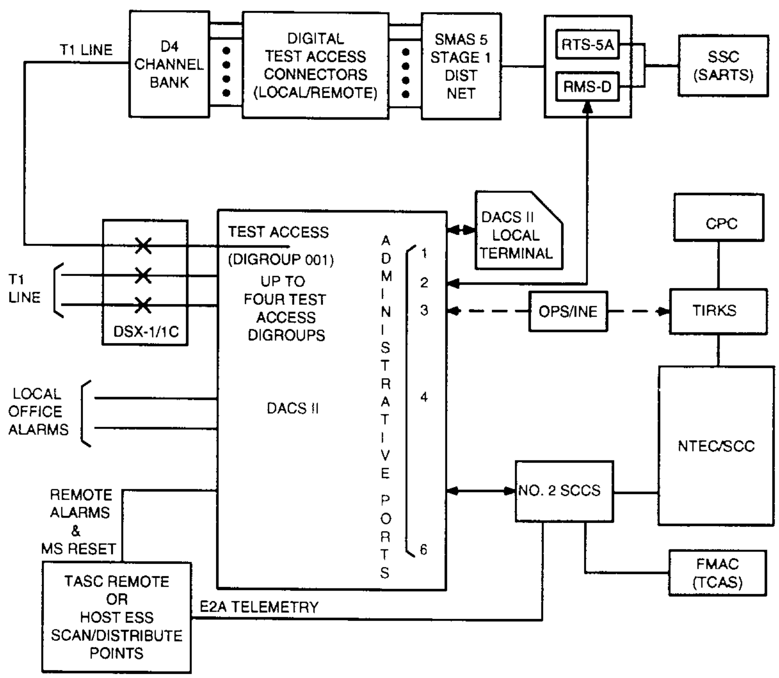

Figure 10-1. DACS II Operations Centers/Systems

Link Hardware Considerations

The CI (communications interface), ECI (enhanced version), or HECI circuit pack of the DACS II main controller provides six links to communicate with the OS or local terminal. These packs have separate equipment codes and are further distinguished as follows: the CI provides 6 asynchronous links and the ECI and HECI provide 4 asynchronous links and 2 synchronous X.25 protocol links. A synchronous X.25 link can have up to 16 virtual circuits, depending on the external communications equipment. The ECI and HECI can support up to 36 users simultaneously on six links. Different suffix codes of CI and ECI packs have been introduced since the ECI was first offered for Release 2 to incorporate additional memory circuitry and functional capabilities for the later software.

The TM736C ECI pack for Release 5.0 detects a clear-to-send change of state even when transmit clock is absent on a synchronous link. Figure 10-2 shows the administrative link configurations with the Release 3 and 4 ECI. These same configurations apply for the ECI pack for later software as well as the HECI in Release 5.1.

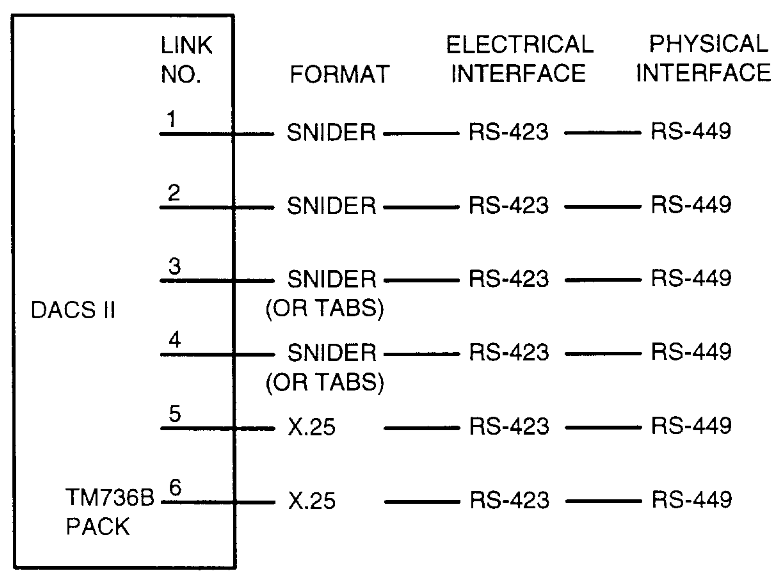

Figure 10-2. DACS II Administrative Link Configurations

The DACS II frame has seven TTY connectors for data link or terminal access to the MC (main controller). Six of these are behind the MC on the back of the frame and one is located on the front on the status panel. However, the front and rear connectors for link 1 must not be used at the same time or the equipment connected in parallel may be damaged. Activities such as changing the software configuration file and loading the software must be performed on link 1. The front access to link 1 is intended for easy connection of a terminal rolled up to the frame.

The synchronous and asynchronous serial links conform to EIA RS-449 which specifies the mechanical and functional characteristics of the RS-422, RS-423, and RS-485 interfaces. The RS-449 format is extendible with adaptation to RS-232C. Local terminals can be located up to 2000 feet (RS-449 format) or 50 feet (RS-232C format) from the DACS II. The 202T data set with 829A auxiliary sets are used to connect remote locations to the DACS II. Asynchronous links are independently programmable to rates of 300, 600, 1200, 4800, and 9600 baud. The synchronous links require an ED-2C646-30 adapter and are programmable for rates from 1200 to 9600 baud.

The synchronous links on the ECI and HECI circuit packs use X.25 protocol, and the asynchronous links can be provisioned for Snider protocol, modified Snider, or TABS (telemetry asynchronous block serial). The Snider protocol is compatible with OSs such as SCCS which were associated with the original DACS. Modified Snider protocol allows connection of the CIU (craft interface unit) for remote provisioning of *SLC*® Series 5 channel units. The TABS protocol allows the extraction of performance data from DACS II facility plug-ins and control of facility interface unit plug-ins.

Figure 10-3 shows the arrangements with three of the adapters for the RS-232C format. The listing of other applicable ED-2C646-30 adapters is as follows:

- G1 (group 1) for a TTY or CRT terminal via data sets
- G2 for a TTY or CRT terminal with NO data sets
- G3 for an OS with or without data sets
- G7 for DTE (data terminal equipment) and X.25 synchronous
- G8 for TABS (Telemetry Asynchronous Block Serial) protocol
- G9 for CIU (craft interface unit) connection.

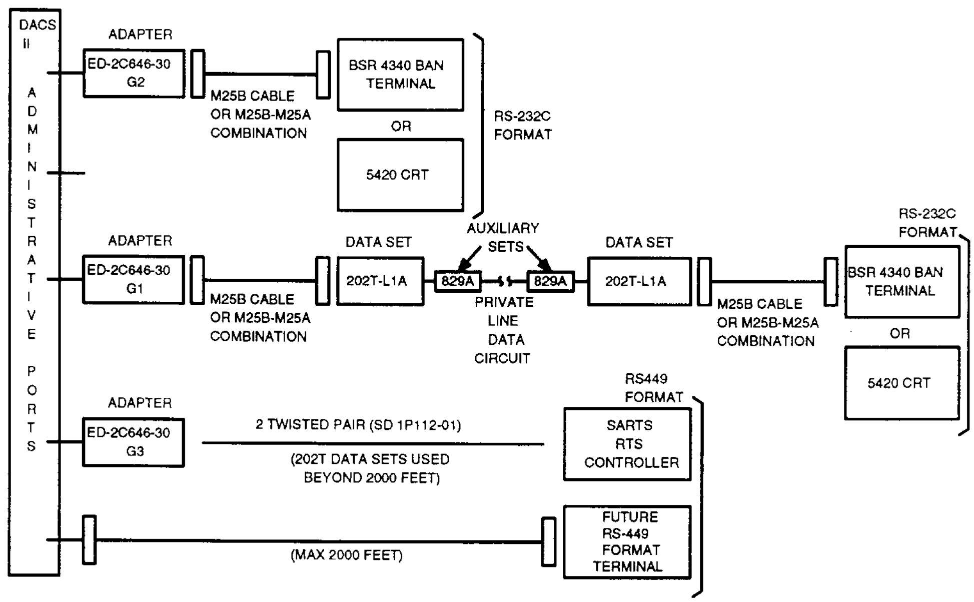

Figure 10-3. DACS II Adapters and Cabling for Administrative Ports

Link Provisioning

Link provisioning commands set many of the characteristics of the links and how input commands and output responses are handled. Among the characteristics that can be set are: baud rate, link protocol, message language, the command set available at the link (or to a login user), and the output message set that will appear at a link. The method used to address (number) the facility NPCs can also be set. All these characteristics take on default values when the software is loaded and whenever the links are restored to service if no other characteristics have been set. These default values represent commonly used combinations with the operating software feature package; for example, 1200 baud, PDS language, extended NPC addressing, and the majority of commands and outputs at the link for domestic features.

The NPC addressing options include an additional choice for software Release 5.0 and the capacity expansion frame. With a frame capacity for 2560 NPCs, the link provisioning allows selecting 4-digit extended NPC addressing. This selection must have been previously enabled by making the appropriate menu selection in the configure software routine to indicate that there would be 4-digit NPC numbers. The 4-digit NPC numbering is detailed in Chapter 9.

CIU Interface Characteristics

The CIU for *SLC* Series 5 carrier requires a modified RS-422 administrative link interface. The DACS II provides this interface by means of an ED-2C646-30, G9 adapter which converts a 37-pin connector on the DACS II side into a 25-pin connector on the CIU side. The data transmission is asynchronous at a rate of 1200 b/s; the DACS II administrative link must also be provisioned for Modified Snider protocol. Only one link can be set for CIU use at any time. The maximum cable length allowed between the CIU and DACS II is 13 feet.

The communication protocol between the CIU and DACS II is a master/slave relationship. For each CIU command, DACS II provides a response indicating whether the message was received correctly before executing the command. When DACS II is polled by the CIU, DACS II will send a reply indicating completion of the command. Only one provisioning session can be active between DACS II and the CIU at any one time.

If the DACS II does not receive a command from the CIU for a period of 2 minutes and it is not already executing a command, DACS II will time out and drop the session. If executing a command and the 2-minute time out occurs, DACS II will complete the command and then end the session if no other command has been received. If the CIU is disconnected during a session or if the DACS II resets the link, the CIU connection must be reestablished which sometimes involves removing and restoring the administrative link.

Protocol Description

Asynchronous (Snider) Interface

Each character transmitted or received by DACS II is in the ASCII format with a start bit, seven data bits, an even parity bit, and one stop bit. Input commands are limited to 120 characters. The DACS II echos characters on a character-by-character basis. There are three special input characters as follows: the ! (exclamation point) (or alternatively, a carriage return), the & (ampersand), and the ? (question mark). The exclamation point or carriage return terminates a command, the ampersand is used to abandon a command line (link remains in input state), and the question mark initiates the help dialogue.

There is an intercharacter timer and an output message timer. If there is a lapse of more than 60 seconds between input characters, the link sends the ?T sequence and goes to the idle state. If a link is inactive for more than 60 seconds, the link sends the ?T sequence and goes to the output-2 state and performs the inquire-acknowledge (ENQ-ACK) exchange.

When the DACS II sends the ENQ (Hex 05) to the link, it checks for the ACK (Hex 06) response. If the ACK is not received within 2 seconds, the ENQ is sent again; if ENQ is still not received within 20 seconds, the third ENQ is sent. If ACK is not received in 2 seconds, the link is placed in the protocol out-of-service state. If the ACK is received, the link goes from the output-2 state to the output-1 state and sends waiting output messages or goes to the idle state.

Two output states have been mentioned. The link is in the output-1 state during output message generation. At that time, the only input character that is recognized is the break. On completion of serving all output messages, the link goes to the idle state; 10 milliseconds are required before the link can go to the input state. The link goes to the output-2 state to perform the ENQ-ACK exchange. On completion of the ENQ-ACK exchange, the link goes to either the idle state or to the output-1 state. Release 5.1 provides a provisionable ENQ/ACK feature which allows a user to disable the ENQ/ACK protocol on such links to avoid the resulting performance degradation.

Release 5.1 supports the use of the XON/XOFF flow control protocol on DACS II asynchronous Snider administration links as a means of temporarily suspending DACS II output messages to allow easy viewing of lengthy output messages. To prevent inadvertent transmission or the erroneous receipt of an XOFF control character from locking out DACS II messages indefinitely, an internal timer is provided to automatically re-enable output if an XON or XOFF is not received within 60 seconds of receiving an XOFF. This timer is reset each time an XOFF is received.

X.25 Synchronous Interface

The DACS II X.25 interface conforms to the CCITT X.25 standard 1984 version. The DACS II always acts as DTE (data terminal equipment), and connecting operations systems act as DTE if they are connected through an X.25 packet switching network or they act as DCE (data circuit equipment) if they are connected directly. The X.25 protocol comprises the lower three layers (physical, data, and packet/network) of the seven layers of the protocol stack. DACS II does not use layers 4 through 7, but pseudo upper-layer processing occurs between the DACS II message generator or parser and the packet layer. The PDS and MML languages are supported on an X.25 link or virtual circuit.

The data link layer provides the link initialization, error control, and flow control for the data transport over the link. This layer is compatible with CCITT LAPB (link access procedure balanced). Only single link operation is supported, not multiple link. For frame exchange procedures, each data unit (or frame) is transmitted with an order bit first and a frame check sequence with the highest coefficient first. The occurrence of 7 consecutive 1s is interpreted as an abort with 15 or more indicating an abort plus an idle channel state. The modulo 8 frame sequencing is supported by DACS II. The DACS II link can be provisioned for frame address A or B to communicate with the connecting OS equipment. Table 10-1 lists the data link layer parameters.

The packet layer provides the interface procedures to establish, maintain, and terminate connections. The packet layer also multiplexes the virtual circuits on the link. The 16 virtual circuits which are allowed per link can be divided between permanent and switched types. Virtual call setup and call request timer are not supported by DACS II since it does not originate calls for switched virtual circuits.

Each data packet consists of the following octet (byte) fields: the general format ID, logical channel ID, packet type ID, and any additional field which contains an integral number of octets. Bits of an octet are numbered from 8 to 1, where 8 is the low-order bit transmitted first. Octets are numbered in ascending order and transmitted likewise. Table 10-1 lists the packet link layer parameters.

Table 10-1. Synchronous Link Level Parameters

Parameter Designation	Meaning	Value Range	Default
Data Layer Value			
N1	Max. Bits Per I-Frame	not selectable	1080
N2	Frame Transmission Attempts	2 through 16	7
K	Window Size	1 through 7	7
T1	Acknowledgement Timer	2 through 20 seconds	3
T2	Response Delay Timer	not selectable	0.3
T3	Idle Channel Timer	4 through 120 seconds	26
Packet Layer Value			
W	Window Size	1 through 7	2
P	Packet Size	128 through 512 octets	128
R20	Restart Retries	1 through 10	1
R22	Reset Retries	1 through 3	1
R23	Clear Retries	1 through 10	1
R25	Data Retransmissions	0 through 3	0
T20	Restart Timer	10 through 180 seconds	180
T22	Reset Timer	10 through 180 seconds	180
T23	Clear Timer	10 through 180 seconds	180
T25	Data Acknowledgement Timer	10 through 200 seconds	200
T26	Interrupt Confirmation Timer	10 through 180 seconds	180

OSs (Operations Systems)

Telephone Company Arrangements

Figure 10-4 shows typical OSs and maintenance and administrative centers associated with DACS II in the telephone company environment. The OSs can provide the following DACS II operations: provisioning, equipment maintenance, facility maintenance, and circuit maintenance. The DACS II CEF is compatible with the original DACS II interfaces except where changes in the messages are necessary because of differences in capacity or architecture.

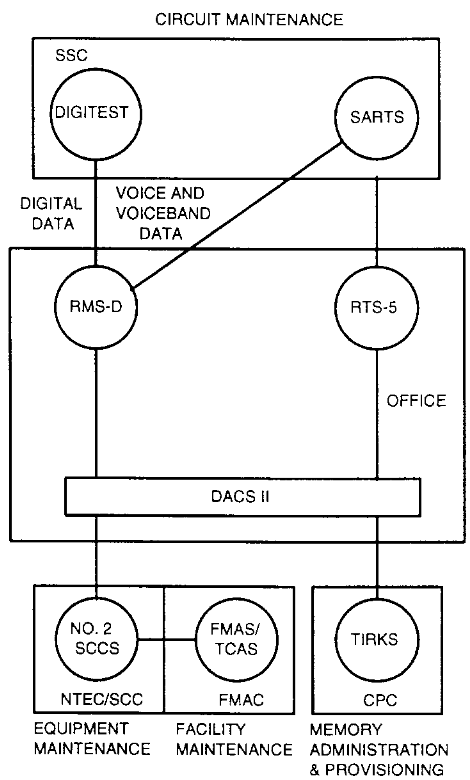

Figure 10-4. DACS II Operations Support

DS3 Alarm Surveillance and Control

One DACS II link is used for DS3 AS&C to connect scan point information to the OSs. This link is an asynchronous link using TABS protocol and can either be used exclusively for AS&C or shared for DS3 path performance monitoring to connect scan point information to the OS. The DACS II also responds to control signals received over this TABS link to initiate manual operation or to release the DS3 equipment protection switching or inhibiting.

The TABS link can be provisioned for a summary AS&C application or a detailed AS&C application. The summary AS&C scan points are shown in Table 10-2. The detailed AS&C scan points include a display for the DACS II frame itself, and two displays for each DS3 unit, one for alarms and one for protection switching status. In addition to these serial telemetry capabilities, the DACS II communicates to the GTP OS via a set of discrete status and control relay closures. Separate relay closures are provided for minor, major, critical, and main processor alarms, along with a remote frame reset control point.

DS3 Path Performance Monitoring

This monitoring is only applicable to DS3 signals using the C-Bit parity line format. The GTP (General Telemetry Processor) is the OS used for this performance analysis and it is connected to the DACS II over a separate asynchronous link using TABS protocol. Transmission errors and out-of-frames in both directions and at both ends of the facility are the types of parameters that are monitored.

Table 10-2. DS3 Scan Points

Point No.	Description*
1	Autonomous Frame Maintenance Condition
2	Manually Caused Frame Maintenance Condition
3	Disk or SSC Failure NSA
4	Tape or SSC Failure NSA
5	Main Controller Power Failure
6	SYNC Failure(s) SA
7	SYNC Failure(s) NSA
8	CCN Side Failure(s) SA
9	CCN Side Failure(s) NSA
10	CCN Power Failure(s) SA
11	CCN Power Failure(s) NSA
12	Unit Power Failure(s) SA
13	UC(s) Fail or Out-Of-Service
14	FLI Failure(s) SA
15	FLI Failure(s) NSA
16	FMT Failure(s) SA
17	FMT Failure(s) NSA
18	MXR Failure(s) SA
19	MXR Failure(s) NSA
20	MIU Failure(s) SA
21	MIU Failure(s) NSA
22	Exactly One Incoming DS3 Failure SA
23	Multiple Incoming DS3 Failures SA
24	Exactly One Incoming DS3 AIS SA
25	Multiple Incoming DS3 AIS SA
26	Exactly One IDLE Signals on Incoming DS3 (future)
27	Multiple One IDLE Signals on Incoming DS3 (future)
28-32	Unassigned
33	FLI Protection Switch(es) Active Manually
34	FLI Protection Switch(es) Active Automatically
35	Automatic Protection Switch Not Available for Active FLI(s)

Table 10-2. DS3 Scan Points (Continued)

Point No.	Description*
36	MMFG Protection Switch(es) Active Manually
37	MMFG Protection Switch(es) Active Automatically
38	MMFG Protection Switch(es) Inhibited Manually
39	Automatic Protection Switch Not Available for MMFG(s)
40	MMFG Protection Switch Release(s) Inhibited Manually
41-63	Unassigned
64	Telemetry Link Failure (Not Set By DACS II)

* SA means service affecting and NSA means not service affecting.

I-2000 Controller

The I-2000 Controller enables users to efficiently manage DACS II frames. Through enhanced centralized maintenance and administrative functions, the I-2000 Controller reduces operational expenses, creates customer satisfaction, and increases revenues.

The I-2000 Controller is a personal computer based system that enables users to remotely provision, control, and monitor a network of DACS II frames from a centralized location. The I-2000 Controller provides the following enhanced network management capabilities:

- Centralized control and administration of up to 6 diversely located DACS II frames.
- Centralized administration of DACS II equipment records to allow network providers to more efficiently utilize their equipment and facilities.
- Centralized control of the DACS II circuit provisioning implementation process.
- Centralized and continuous alarm surveilance of DACS II frames for increased availability.
- Support for circuit and facility restoration to reduce the time the customer is out of service in the event of equipment or facility failures.
- Test access setup.

Commands and Messages

11

Contents

Commands and Messages

11

Introduction

DACS II is an interactive system controlled by software commands. There are two message languages that can be used to communicate with DACS II. These are the PDS (Program Documentation Standards) language and the MML (Man-Machine Language). Each language has a set of input commands and output messages that are used to communicate with DACS II. An *input command* is a communication between a user* and DACS II. Output messages are originated by DACS II and sent to the user. This section gives an introduction to the format of the input commands and output messages as follows:

- Identifies the component parts of the messages
- Gives examples of command keywords and command verbs
- Describes the organization of DACS II messages
- Shows and explains some message examples.

Comprehensive discussions of input commands and output messages can be found in the PDS and MML versions of the DACS II Command and Message Manual. This section does not replace those documents, but rather provides an overview to their information. See Chapter 5 for information on ordering the DACS II Command and Message Manual.

* A *user* can be a person using DACS II or an OS (Operations System), such as TIRKS† system, SARTS, etc.

† Trademark of Bell Communications Research, Inc.

PDS Language

This part discusses the input commands and output messages associated with the PDS language for DACS II.

PDS Command Keywords

Commands consist of *keywords* combined with equipment and circuit identification. A *keyword* is an alphanumeric string of characters representing:

- Command verb*
- Entity identification
- Address specification
- Command result.

Command verbs, consisting of alphabetic characters, are action verbs that tell the system to do something. Table 11-1 lists some of the command verbs and their meanings.

Entity identification is a keyword that identifies a specific system or circuit pack within the system. For example, the keyword **NPC** refers to a network processing circuit pack.

Address specification is a keyword that refers to a specific address. **TP 03**, for example, refers to a specific test port.

Keywords sometimes report the results of a command. To a diagnostic command, DACS II might return the keyword **ATP** to indicate All Tests Passed. Table 11-2 lists a small sampling of keywords and their meanings.

* Command verbs are also called action verbs.

Table 11-1. DACS II PDS Command Verb Sampling

Verb	Meaning
TCON	Two-Way Cross-Connect
TCNT	Two-Way Terminated Cross-Connect
TDIS	Two-Way Disconnect
TTST	Two-Way Test Access
BCON	Broadcast Cross-Connect
BDIS	Broadcast Disconnect
OCON	One-Way Cross-Connect
ODIS	One-Way Disconnect
OCNT	One-Way Terminated Cross-Connect
CFR	Configure
RMV	Remove
RST	Restore
GRTH	Growth
DGRTH	Degrowth
DGN	Diagnostics
UTL	Utilities
BOOT	Boot
AUD	Audits
CHG	Change
ADD	Add
DLT	Delete

Table 11-2. DACS II PDS Keyword Sampling

Keyword	Meaning
ABT	Abort
ACO	Alarm Cutoff
AIS	Alarm Indication Signal
ATP	All Tests Passed
BBL	Backbone Leg
BCAST	Broadcast Keyword
BER	Bit Error Rate
BMTR	Backup Memory Transfer
BPV	Bipolar Violation
CATP	Conditional All Tests Passed
CCN	Cross-Connect Network
CFA	Carrier Failure Alarm
CFT	Craft
CFR	Configure
CGA	Carrier Group Alarm
CMAP	Channel Map
COMPL	Complete
COND	Condition
CONN	Connectivity
CONV	Convert Keyword
CUS	Customer Control Flag
DCC	Disconnect Code
DLT	Delete

Table 11-2. DACS II PDS Keyword Sampling (Continued).

Keyword	Meaning
DMAP	Digroup Map
DNY	Deny
EQD	Equipped
EQL	Equalization
ESR	Error Source Register
FRADTS	Frame Audit
FRM	Frame

PDS Command and Message List

Table 11-3 lists some of the command messages in the cross-connect and test access categories with the message numbers and keywords.

Table 11-3. DACS II PDS Message List

Category	Number	Message
Two-Way and One-Way Cross-Connect	11000	TCON,OCON
Two-Way and One-Way Terminated Cross-Connection	12000	TCNT,OCNT
Broadcast Cross-Connect	13000	BCON
Two-Way and One-Way Disconnect	15000	TDIS,ODIS
Broadcast Disconnect	15200	BDIS
Change Circuit Parameters	17000	CHG,TCON,OCON
Change Circuit Parameters	18000	CHG,BCON
Two-Way Monitor Test Access	21000	TTST,MON,TP
Two-Way Split Test Access	23000	TTST,SPL

Table 11-3. DACS II PDS Message List (Continued).

Category	Number	Message
Two-Way Hub Test Access	24000	TTST,HUB
Two-Way Terminate and Leave Activate/Release Test Access	25000	TTST,TLA,TLR
Two-Way Test Port Release Test Access	27000	TTST,TPR
Two-Way Looped Test Access	29000	TTST,LPD

PDS Dialogue Description

On-line help is available from the DACS II to guide the user through the entire construction of a command or just the completion of an unfamiliar portion of a command. This help is called by the entry of a question mark at any point on the command line or even within a macro or alternate map session. The dialogue is a menu-driven routine. At each point in the menu where an entry decision must be made, the dialogue lists all the keyword choices that the user has.

The following two keyboard characters control entry into, selection during, and exit from the dialogue:

1. **QUESTION MARK (?)**
   - Starts dialogue from command line
   - Requests second level of help within dialogue
   - When entered along with a valid dialogue response, it continues the dialogue.
2. **CARRIAGE RETURN (CR)** -- '\r' or ASCII 015
   - Terminates command line if not in dialogue mode.
   - From the *Menu* mode, it exits the dialogue and returns the user to the command line.
   - From the *Prompt* mode, it displays alternative prompt(s).
   - When entered along with a valid dialogue response, it exits the dialogue and returns the user to the command line.

These control characters allow DACS II to provide a wide spectrum of dialogue uses such as:

- Help with completing an entire command
- Help with only a single parameter or keyword
- No help at all.

Menu Mode

Use the Menu mode if all dialogue alternatives are literal strings. The system will present a menu of legal strings and an indexing number as follows:

1. "*string a*"
2. "*string b*"
3. "*string c*"

The user then responds by either selecting the indexing number (1, 2, or 3) or by typing the literal string itself.

Note: The software includes a **HELP** feature that is described in Section 11.

Prompt Mode

Use the Prompt mode if some dialogue alternatives require direct user interaction (a numeric field, a string, etc.).

Note: The software includes a **HELP** feature that is described in Chapter 12.

MML Language

This part discusses the commands and messages associated with the MML language for DACS II.

MML Command Keywords

Table 11-4 lists some MML keywords and their meanings.

Table 11-4. DACS II MML Keyword Sampling

Keyword	Meaning
ABT	Abort
ACO	Alarm Cutoff
ALM	Alarm
ASGN	Assigned
ATP	All Tests Passed
AUD	Audit
BDCST	Broadcast
BER	Bit Error Rate
CATP	Conditional All Tests Passed
CFA	Carrier Failure Alarm
CLR	Clear
CMAP	Channel Map
COMPLD	Completed
COND	Condition
CRS	Cross-Connection
CRS1	One-Way Cross-Connection
CUS	Customer Control Flag
DCC	Disconnect Code

MML Command and Message List

Table 11-5 lists a small sample of the MML commands and messages and shows how they are grouped.

Table 11-5. DACS II MML Message List

Group	Number	Message
Two-Way and One-Way Cross-Connect	11000	CONN CSR/CSR1
Broadcast Cross-Connect	13000	CONN BDCST
Two-Way and One-Way Disconnect	15000	DISC CSR/CSR1 BDCST
Change Circuit Parameters	17000	ED PRMTR
Change Circuit Parameters	18000	CHG RPATH
Edit Macros or Map Parameters	19000	ED PRMTR ENT MACRO MAP
Two-Way Monitor Test Access	21000	CONN TACC CHG
Two-Way Split Test Access	23000	CONN TACC SPLT
Two-Way Hub Test Access	24000	CONN HUB
Two-Way Terminate and Leave Activate/Release Test Access	25000	CHG TL TERM DISC TACC
Two-Way Test Port Release Test Access	27000	DISC TACC
Operator Loopback Test Access	29000	OPR LPBK

Description of MML Input Command (Message)

The user has two basic modes to input commands using the MML language. These are the command mode and the menu/prompt mode.

Command Mode

The command mode is for the experienced user or machine-machine operation. A command must be selected and parameters entered within a single line.

The user types in a single-line command without breaks in the command line, the only carriage return occurring at the end. A long single-line command may be continued on a second line by entering a backslash at the end of the first line. Single-line refers to the *command*, not the display of the command. A backslash (\) followed by a carriage return (<cr>) will still be a single line because the backslash negates the special meaning of the carriage return.

The general format for an input message, or command, is:

VERB[-modifier][-modifier]:[xy]:[zz]:[ww]:[d][,e]...[,z];

Menu/Prompt Mode

On-line help is available from the DACS II to guide the user through the entire construction of a command or just the completion of an unfamiliar portion of a command. This help is called by the entry of a question mark at any point on the command line or even within a macro or alternate map session. The dialogue is a menu-driven routine. At each point in the menu where an entry decision must be made, the dialogue lists all the keyword choices that the user has.

The user starts the menu/prompt mode by entering **?** (question mark). In response, DACS II initiates a dialogue search and then retrieves the list of parameters. This list is presented to the user in menu or prompt form. At this point, the user may continue or return to the command line.

The input command requests an action to be performed; this command contains necessary information for DACS II to accomplish the requested action.

Operation and Maintenance

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Operation and Maintenance

12

Introduction

This section relates some of the operation and maintenance activities at the DACS II. Operation refers to the activities done from the administrative links to control and operate the equipment. Maintenance refers to activities done at the equipment in response to trouble conditions or messages. The only routine maintenance on the equipment itself is cleaning the heads on the backup tape drive. Complete operation and maintenance instructions are covered in the appropriate Operation and Maintenance Manual for the release and feature. Each of these manuals contains a Maintenance Considerations Tab that presents the detailed maintenance philosophy.

DACS II Operation

General

When operation is mentioned, it refers to the activities that are performed at an administrative terminal. Circuit packs still must be installed to add service and status panel indicators and controls are used, but most of the interaction is from administrative terminals and OSs (Operations Systems).

Complete operating instructions are provided in the DACS II Operation and Maintenance Manuals (see Section 5). The Operation and Maintenance Manuals cover all types of operations including Acceptance, Company Order, and Maintenance (Trouble-Clearing) tasks. The tasks in the Operation and Maintenance Manuals are normally performed in response to some stimulus such as a work order (for example, new circuit), an alarm message at the terminal, or just the need to check the status of the equipment.

Operations may be performed locally or by an OS. The output message from DACS II identifies the original command and gives the requested information. The output message may be delayed if DACS II is processing other commands or if a printout of autonomous DACS II activity is taking place. Unless screening options have been set for the links, output messages resulting from work on other links will appear on all links.

The operations that are described here are:

- Equipment Provisioning
- Facility Provisioning
- Circuit Provisioning
- Querying the Data Base
- Using the Help Dialogue
- Using Macro Command Packages
- Using Alternate Maps.

DACS II Equipment Provisioning

Equipment provisioning refers to entering commands to add (or delete) circuit packs in the data base with any option information needed to define how the packs will operate when placed in-service. Once the packs are installed in their positions (as grown), commands must be entered to change the state of the packs to in-service. At this point, any provisioning options are downloaded to the circuits to produce the required operating characteristics and the pack is opened to error and alarm monitoring. Diagnostics are run on the pack as part of the restore sequence to ensure the pack is operational before going in-service. All the provisioning options and service and alarm status are stored on the hard disk and are transferred to tape to restore the data base should it be inadvertently cleared. The status of the equipment can be queried using commands.

The provisioning is hierarchical; the higher order entities must be equipped before the dependent entities. This is fundamental and is enforced by command denials to ensure that timing signals are delivered and that communication paths are established. Figure 12-1 depicts the frame hierarchy and shows the provisioning commands (in PDS language) associated with the entities. This figure illustrates the basic hierarchy, but the operation and maintenance manual should be used for the exact sequence and any operational considerations. A location command is available that gives the physical location of each pack in terms of its horizontal and vertical coordinates.

Along with the observance of the hierarchy, two general rules apply to provisioning or removing equipment. These are: (1) packs must be grown before being restored, and (2) packs that are not duplicated (duplex) must be removed before being degrown. For NPC packs, all cross-connections or test access must be disconnected before degrowth. In many cases, particularly with later software, the DACS II automatically grows or degrows supporting packs when a whole unit (for example, IFTU) is grown or degrown. These maintenance considerations are also detailed in the procedures to grow additional modules/units and to remove and degrow equipment.

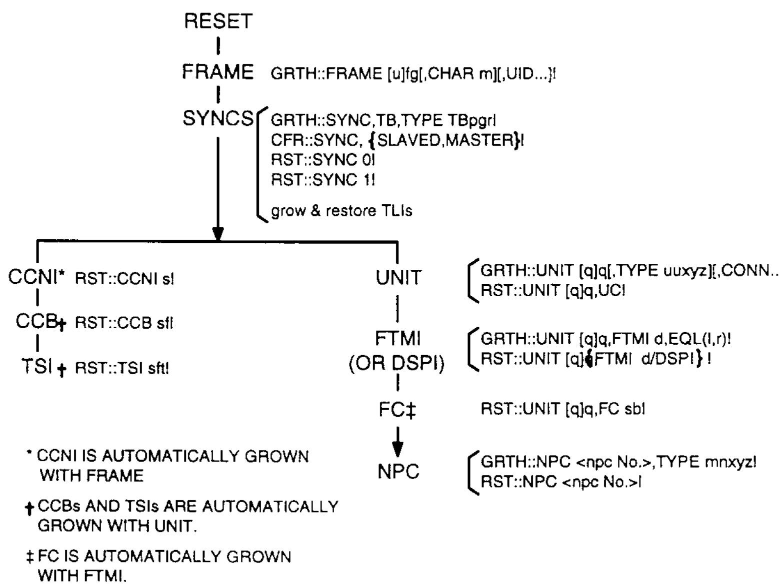

Figure 12-1. Frame Hierarchy (non-CEF)

DACS II Facility Provisioning

DS1 and 2.048 Mb/s facilities connect to NPCs (network processing circuit) in the frame, and DS3 facilities connect to MXR (multiplexer) packs (through a line interface). These NPCs and MXR packs must be provisioned in the data base to function and be compatible with the connecting facilities. In addition, virtual NPCs associated with the embedded DS1s in a DS3 signal must also be provisioned for the DS1 signal format carried in the DS3. The family of NPC packs that terminate DS1 facilities requires selecting various DS1 formats including D4 channel bank, ESF, T1DM, and *SLC*® carrier. Table 12-1 shows the family codes and growth types used in provisioning.

The forementioned DS1 formats that are applicable to embedded NPCs can also be provisioned in the virtual NPCs of the DS3U. Line format provisioning is also entered for the NPCs that terminate primary block circuits on 2.048 Mb/s facilities as described in Chapter 14. Zero code suppression functions such as D4 ZCS (D4 zero-code suppression), NZCS (no zero-code suppression), and B8ZS (bipolar with 8-zero substitution) are also selectable, as applicable. The command for provisioning or growing the NPC packs includes a field to specify an IW (insertion word) if other than the default unassigned channel code (X'7F) is required. This word defines the pattern that is sent out on all the channels while the NPC is out-of-service or before the channels are assigned.

Table 12-1. Equipment Codes

Hardware	Designation	Growth Types
TG-80	DDC	DE
TG-182	DPC	PB
TG-183	S96D	DS or DE
TG-184	SS5D	DS or DE
TG-185	DPC75	PC
TG-186	ZDC	DE
TG-187	DPC	PB
TM-665	DMB	MB
TM-739	SRM	SR
TM-740	MJU	MJ
TM-747	CPR	CP
DS3 Virtuals	None	TE or TI

Different facility performance alarm thresholds can also be entered in the command to grow the NPC packs. These thresholds control when alarm messages and alarms will be issued for the facility performance parameters monitored by the NPCs. If threshold options other than the default values are required, they must be entered in the data base by another command before they can be selected in the growth command. Threshold options may be changed with a change command after the facility is in service without affecting service. This feature could be useful when using the DACS II to monitor a facility that exhibits intermittent troubles.

DACS II System Boot Operation

Booting refers to downloading information from the main controller to the separate UNIT controllers and into circuit pack memories. There are different levels of booting: the warm boot and the cold boot. The warm boot loads provisioning information into packs and is initiated when the circuit pack or the UNIT controller is restored to service. The cold boot is a more extensive action that is brought about when loading software or data bases from tape, when operating the frame RESET, or when restoring the MC to service. The cold boot includes reloading programs into the MC and UNIT controller memories, and it includes diagnosing and restoring circuit packs. Service outage is minimized by booting circuit pack memories as soon as possible, but still the frame reset and boot can take over half an hour for a fully equipped frame carrying cross-connections.

DACS II Circuit Provisioning

In the past, the provisioning of special service circuits required sorting through bundles of wires to find two connections. One wire pair linked the customer to a central office and another connected to a high-speed digital channel. Until the two were brought together by a physical cross-connection, there could be no circuit. Through its remote cross-connect capability, DACS II eliminates this manual process. Physical activities are greatly reduced, and provisioning of special service circuits is automated.

General circuit provisioning applies to the cross-connect, disconnect, and change features. All these features are available both as single DS0 channel functions and as range-of-channel (N x DS0) functions. Part of the circuit provisioning is the entry of the signaling trunk conditioning or the transparent circuit insertion word. This information tells the NPC what trouble pattern to send on the connecting channel if a carrier failure occurs. This trouble pattern causes the far-end switching or data equipment to disconnect and stop charges.

In addition to 2-point cross-connections, the following other circuit capabilities exist:

- Multipoint circuits
- General use N x DS0 broadcast
- Subrate data cross-connections
- *SLC* carrier system channel cross-connections
- DS1 and 2.048 Mb/s Gateway cross-connections.

Two special keywords are used in provisioning commands to flag red special service or customer controlled circuits. The red circuit flag prevents the circuit from being disconnected or changed without using the INCL (include) keyword in the input message. The customer-controlled flag specifies that the circuit is connected under the control of a customer with restrictions similar to those for red circuits.

The terminate and leave capabilities are often used in the course of circuit provisioning and troubleshooting. For provisioning, the TLA (terminate and leave active) state can be used to establish the circuit but prevent use of it until it is tested. After using the test access to test the circuit, the testport will be released which will also release the terminate and leave status. The TLA state is brought up in both directions for the 2-way cross-connection and in the testport direction for the 1-way cross-connection. The change termination state command that was used to initiate the TLA state can also be used to release the condition if the test access command is not used.

Terminate and leave options for multipoint connections are the same as those for the 2-point connections; however, the "TLA/TLR on all legs" and the "TLA/TLR on all legs but one" features are added for broadcast circuits. In addition, if the connection is passing through the DMB, the TLA function can send a silent code insertion word onto the DMB channels.

Querying the Data Base

Query commands are associated with almost all different categories of DACS II commands to allow the user to read the status of the frame and connecting facilities and to list cross-connected circuits and user information. Some of these commands are used daily to check the equipage and service status of the equipment and to provide comparison information to interpret daily alarm audit messages. These commands and the NPC STATE command are used extensively in the operation and maintenance manuals to obtain as much information as possible while performing the tasks. The NPC STATE command is invaluable for provisioning facilities and troubleshooting. It shows the service state, the NPC provisioning options, and any facility errors that have been detected.

Examples of On-Line Help

The DACS II provides on-line help to the user in constructing commands at the terminal. This help is in the form of a menu-driven help routine. Different menus are displayed during the routine to provide the user with information on all the command fields. The menu items include command verbs, applicable keywords for a command, definitions of keywords, and the possible choices or number range for a variable field. Inappropriate selections bring error messages.

The help routine can be used to the degree needed to complete the command: either through the entire command in every field or only for a particular part of the command. Using help to construct the entire command will probably not be applicable after some experience is gained at entering commands since all the commands are documented and the direct entry of commands is so much faster.

Two operators or keyboard controls are used to invoke the different levels of the help routine. These operators are [SHIFT] [?] and [RETURN]. Shift is shown here to enter the question mark on commonly used terminals, but shift is not needed if there is a separate key for a question mark. The [SHIFT] [?] is used to initiate the routine or to go into a deeper level (more explanation), and the [RETURN] is used to see the alternative choices at a given point. The dialogue can be terminated either by entering an "&" symbol or by completing the current command line when it is displayed. These functions are shown in the following paragraphs.

Example 1 — Constructing Entire Command Using Help

The following sequence shows the use of the menus in the help routine to build a simple PDS UTL (utility) command. Only portions of long menu lists are shown here, but these examples still serve to show how selections are made.

(1) To invoke the help routine at the start level, enter [SHIFT] [?]. The DACS II will respond with **OK** and the following menu:

Select from:

1. ABT
2. ADD
3. AUD

.
.
.

34. UTL

Selection?

(2) To obtain more explanation, enter [SHIFT] [?]. The DACS II will respond with **OK** and the following list:

Select from:

1. ABT (abort the current command)
2. ACT (activate map)
3. ADD (adjust link parameters)
3. AUD (query facility alarm data)

.
.
.

34. UTL (perform a general utility)

Selection (1-34 or the actual literal)?

(3) Here you can enter either "**34**" or "**UTL**" followed by [SHIFT] [?]. The DACS II responds with this menu:

Select from:

1. ,
2. :
3. FRM
4. SEQ

Selection?

(4) To bypass the frame and sequence number, which is normally done unless that information is needed for records or to direct the command to a different location, enter either a "**2**" or a "**:**" followed by [SHIFT] [?]. The DACS II responds with a long list; you will be instructed to enter [RETURN] keys to page through it.

Select from:

1. ACO
2. ALL
3. ALMS

.
.
.

134. USERS
135. WHO
136. XC

(5) If you enter "**WHO**" and [SHIFT] [?], for example, the DACS II responds with **OK** and supplies the only appropriate keyword to complete the command as seen in the resulting output.

/*UTL::WHO,QRY!*/
Execute (YES/NO)?

(6) Now you simply answer "**Y**" followed by [RETURN] and the command will be run.

Example 2 — Obtaining Help at a Particular Point on a Command Line

The following sequence shows just one situation where the on-line help can be used to obtain information on particular fields of a command. In this case, the correct command format is known, but something is wrong with one of the variable entries. It must be recognized that if the command format is not known or if the keywords or variables are not clear, the help dialogue can be initiated at any point on the command line by entering [SHIFT] [?]. Try it for yourself!

(1) Assume the following multipoint circuit TCON command was entered and denied because one of the NPCs named in the command must be an MB-type.

```
TCON::FROM 0011,TO 0023,MPM(SYM,LEG),TRSP! PF

M 08:1906 01,00 2 TCON INERR BAD SYNTAX  2 LN MSG:
TCON::FROM 0011, TO 0023, =MPM=(SYM,LEG),TRSP! DNY
```

(2) The equal signs around the word **MPM** indicate a problem because it is a multipoint bridge circuit.

(3) You can start over using the help routine to obtain information. For example, enter **TCON::FROM** and [SHIFT] [?]. The DACS II responds with

```
ds3u npc number (160+8 npc on a ds3u unit) =
ftu npc number (160 npcs on a ftu unit) =.
```

Since you are working with a DMB which is in a DSPU, if you enter only [RETURN] you will see the next option which turns out to be **dspu npc number (first 2 npcs in every group of 20 on a dspu unit) =**.

(4) To get more information at this point, enter [SHIFT] [?]. The DACS II responds with:

```
/* 3 digit decimal integer, range 001-942 */ /* 4
digit decimal integer, range 0001-2542 */
```

Note 1: 3 digit is for E NPC addressing scheme (NPCAD), 4 digit is for X NPC addressing scheme. There will be different prompts (not shown here) for H NPC addressing.

Note 2: A pure 2.048 Mb/s frame will default to hierarchical numbering; for example 641, would be 05101.

(5) This is where the trouble occurred; one of the NPCs must be an MB-type in a DSPU unit.

(6) Enter an NPC equipped as a dmb conference and SHIFT ? after the equal sign.

(7) In response to **dmb conference number =**, enter SHIFT ? to get more information. The DACS II responds with:

dmb conference number (decimal integer, range 1 -85) =

(8) Enter your conference number (2 for example), and SHIFT ?. The DACS II responds with:

Select from:

1. CUS

.

.

.

8. **TO**

9. **TRB**

10. **TRSP**

Selection?

(9) Enter 8 and SHIFT ?.

(10) In response to **ftu npc number =** , enter SHIFT ? to get more information. The DACS II responds with:

/* ds3u NPC number (160+8 npc on a ds3u unit) = */
RETURN
ftu npc number (160 npcs on a ftu unit) =

(11) Now that the difference between the NPC numbers for the DSPU and IFTU sides of the circuit is clear, you can terminate the dialogue by entering the required **ftu npc** number followed by a RETURN . This will cause the command line developed through the dialogue to be displayed; at this point, you can enter the remaining information from the original command to complete the command.

Example 2 has demonstrated how to initiate the help routine at a point on the command line. Once you are in the help routine, you use the familiar keyboard operators, SHIFT ? and RETURN, to get more information. When looking at a menu of choices for a command field, as in Example 2, Step (8), you can select an item and then either continue the process or return to the current place on the command line. To continue the process, use SHIFT ? and the next menu will appear. To return to the command line, use the RETURN key. When looking at a prompt to enter a value, as in Example 2, Step (10), you can enter a value, look at the next choice, or request more information. To look at the next choice or to repeat the choices, use the RETURN key. To obtain more information to enter a value, use SHIFT ?. You can continue this process using SHIFT ? after each entry to complete and submit the command via the dialogue. Alternatively, you can use the RETURN key after an entry to obtain the current command line. Then you can directly enter the remainder of the command line just as you would any DACS II command.

Macros

A macro is a file that contains a package of component commands that are issued in sequence when the macro is executed. Any user that has login access to the frame can create a macro that is referred to by a file name. The user must use login access because the macro will be associated with the user's login ID. Macros are useful for entering the sequence of commands that are required to accomplish functions that are repeated regularly such as the entry of commands to query the data base. The use of macros saves typing, reduces the probability of error, and speeds up processing since the commands are submitted one after another.

Figure 12-2 shows a very elementary example of a macro to disconnect one circuit, connect some others, and look at the results. Two forms of the macro are shown. The second one uses positional variables in the macro, and the values for these variables are assigned in the execute macro command. This method results in a universal macro that can be used for different circuits.

There are two types of macros:

PRIVATE — Created and executed only by its owner, but can be deleted and queried by both its owner and the frame administrator.

PUBLIC — Created by the frame administrator and accessible to all users. However, this macro can be deleted only by the frame administrator.

```
A. ALL VALUES IN MACRO

APPEND::0!
TDIS::FROM 00101,TO 00301,STOP!
TCON::FROM 00101,TO 00501,TRSP!
TCON::FROM 00102,TO 00502,TRSP!
TCON::FROM 00103,TO 00503,TRSP!
UTL::QRY,CMAP 001!
END!

B. VALUES DEFINED IN EXC COMMAND

APPEND::0!
TDIS::FROM #0101,TO 00301,STOP!
TCON::FROM #0101,TO #0201,#03!
TCON::FROM #0102,TO #0202,#03!
TCON::FROM #0103,TO #0203,#03!
UTL::QRY,CMAP #01!
END!

(ASSOCIATED EXC COMMAND FOR MACRO B.)

EXC::MACRO QWKCON,(001,005,TRSP)!
```

Figure 12-2. Example of Macro

Alternate Maps

The alternate map capability provides a means of rapidly making predefined simultaneous changes to the cross-connect configuration of a large number of circuits. The major difference between this feature and a macro (with cross-connect commands) is its *larger size* (number of cross-connects to be changed), its *faster execution*, and its *overwrite capability*. The higher speed is achieved by greatly reducing I/O and computation time associated with individual cross-connections.

The alternate map capability supports customer applications such as rapid service restoration following facility failure, reference configurations, and day/night reconfigurations. It may also have applications in load balance provisioning and circuit rearrangement activities.

Figure 12-3 is a very elementary example of the creation of an alternate map to produce 2-way cross-connections. The ADD command in the example identifies the terminations of cross-connections (on NPCs 007 through 012) that are already on the frame and are to be included in an alternate map by means of the PIC (picture) operation. The map produced in this example (NEWMAP) becomes a reference map to be used in a second MAP command with the PIC keyword to create the desired map.

```
ED::MAP,NEWMAP!
TCON::FROM 00101,TO 00201,TRSP,IW X'7F!
TCON::FROM 00301,TO 00401,TRSP,TRB!
TCON::FROM 00501-24,TO 00601-24,TRSP,TRB!
ADD::NPC 007-012!
END!
```

Figure 12-3. Example of Alternate Map

Maintenance

General

This section describes the maintenance activities at DACS II, but is not intended to be a complete statement of the maintenance philosophy. Maintenance in this section means trouble clearing. Since the DACS II automatically runs periodic check routines and diagnostics, there is no need for the technician to run routine maintenance checks. The following is a brief overview of the maintenance activities provided by DACS II:

- Circuit Maintenance (Test Access)
- Facility Performance Monitoring
- Equipment Maintenance
- Memory Administration.

DACS II Maintenance (Trouble-Clearing) Operations

The DACS II maintenance operation involves interpreting alarms and teletypewriter printouts, replacement of implicated CPs (circuit packs), and restoration of CPs to service. When an error is detected in DACS II, the error recovery routine (identified by ERR on printouts) is run to interrogate the error registers to determine whether a hard fault has occurred. If error recovery declares a fault, DACS II attempts to configure around it by means of duplicated circuits, removes the failed CPs from service, and runs diagnostics. The results of the diagnostics and the CP removals appear at the administrative terminals. Trouble numbers in the diagnostics specify which tests failed and identify the defective CP. The trouble numbers are identified in the DACS II Operation and Maintenance Manuals troubleshooting procedures. Maintenance is also required in response to FRADTS (frame audits) printouts. These show that DACS II has detected an internal discrepancy.

When the DACS II Operation and Maintenance Manual is used for trouble clearing, there are two ways the Operation and Maintenance Manual directs the technician to trouble-clearing procedures. If, while performing some test procedure in the Operation and Maintenance Manual, the equipment fails to respond as specified, the Operation and Maintenance Manual will direct the technician to a trouble-clearing procedure. The other way the technician gets to trouble-clearing procedures is if there is an alarm, error message, or written trouble report. In this case, the technician finds the trouble indication in the Operation and Maintenance Manual and uses the procedures specified to clear the trouble.

DACS II Circuit Maintenance (Test Access)

Test access with the DACS II offers full testing functionality of monitoring and splitting modes and the use and release of the circuit terminations. Any 4 digroups can be dedicated for test access, with each digroup providing 12 static or dynamic TPs (test ports). These digroups however must be direct facility terminations; DS1s embedded in a DS3 signal can not be used for test access digroups. Complete test access is provided for all circuits cross-connected through the system, and facility and equipment status is provided for the circuits undergoing test access. If a failure to the test equipment or to the test port occurs, DACS II will automatically release the test port and restore the circuit under test to its original, pretest state.

DACS II Facility Maintenance and Performance Monitoring

The NPC circuitry monitors various facility performance parameters and reports the readings on demand and autonomously when alarm thresholds are reached. These performance readings and alarm information are provided via the administrative links, and alarms are registered at the frame and on the links. Table 12-2 lists the parameters that are monitored on DS1 facilities terminated on the frame.

Table 12-2. DACS II Facility Alarms and Performance Indicators

Alarm/Indicator	Definition
OOF	Out of Frame Count and Alarms
COFA	Change of Frame Alignment Count and Alarms
SLIP	Slip Count and Alarms
BER	Bit Error Rate Count and Alarms
ERS	Errored Second Counts
SERS	Severely Errored Second Counts
CRC	Cyclic Redundancy Code Counts
BPV	Bipolar Violation Counts
FRER	Framing Error Counts
RED CFA	Local Carrier Failure Alarm Indication
YELLOW CFA	Remote Local Carrier Failure Alarm Indication
AIS	Alarm Indication Signal

DACS II Equipment Maintenance

Tape Cartridge

The only routine maintenance that is actually required for the equipment is cleaning the head in the frame tape drive. Routine cleaning of the tape drive head and capstan ensures accurate read and write operations, but other factors control the life of the tape cartridge itself. Like all data cartridges with moving parts, the DACS II tape cartridge experiences wear as it is used. This wear, referred to as tape aging, is caused by the stresses that the tape undergoes when it starts moving and when it changes direction. Furthermore, tape aging is accelerated when these stresses occur with the tape at higher temperatures (brought on by performing repeated tape operations without allowing the tape to cool).

Design measures were taken starting with Release 4 to reduce the number of start/stop operations that occur during data base transfer. This has significantly increased the tape life expectancy for Release 4 over Release 3, even though the size of the data base is greater with Release 4. Since performing repeated tape operations shortens the life expectancy, instructions have been added in the O & M manuals to direct the user to disconnect the tape and allow it to cool during heavy use. The average life expectancies of the tape cartridges for DACS II is given in Table 12-3. These numbers are in terms of the number of tape operations (transfers or diagnostics) and assume single isolated operations on the same backup tape. Back-to-back operations cause more aging because of the heat buildup; consequently, the numbers in the table do not apply to back-to-back operations. With only one data base transfer per day, the numbers in the table can be doubled by alternating between two backup tapes in an odd day/even day manner.

Table 12-3. Tape Cartridge Life Expectancy

Software/Vintage	Average Life
Release 3	90
Release 4	270
Releases 5 and 6	200*

* This life is shorter than with Release 4 because of the larger capacity of the CEF.

The ED-9C016-30 tape unit for the capacity expansion frame is mounted vertically in the frame to reduce heat buildup. Consequently, the life expectancy is improved as required to handle the usage with the larger data base of a fully equipped CEF.

Hardware Error Detection

The DACS II is self-monitoring; it checks communications between packs and checks for errors (for example, parity errors) and runs diagnostic and frame comparison tests in the background. These diagnostics and comparisons and any resulting FRADTS messages are part of a frame audit program that is similar to that in the original DACS. Since this testing is done automatically, no manual diagnostic commands need to be entered as routine maintenance.

DACS II responds to hardware errors with a prescribed error recovery routine. As part of this error recovery, the DACS II evaluates all error inputs including any power unit conditions and reports the results in an ERR ANALYSIS message. This message lists the pack (or packs) that can be causing the fault. From this listing, the technician knows which packs can cause the trouble in order of likelihood. Printed out with this message will be the results of diagnostics that were run automatically and any service switching that occurred.

Diagnostic features supported by DACS II are similar to those supported in the original DACS with allowances for hardware architectural differences. Two types of diagnostics are provided:

- In-service — These are performed on the pack in an in-service state; these do not include all the possible tests because the pack is still in use.
- Out-of-service — Those done with the pack in an out-of-service state; these include all the tests prescribed for the pack.

A diagnostic command is provided for every major hardware entity in the frame. Output messages are generated in response to manual diagnostic commands, when the diagnostic function is invoked by the restore function, or autonomously under error recovery for removal, and in certain cases for frame audits.

DACS II Technical Support

AT&T provides its customers with dial-up, on-line technical support through COACH (Customized On-Line Aid for Customer Help). Following is a list of some of the tools this easy-to-use system provides:

- Diagnostic Dictionary — This is a history of symptoms, problems, temporary fixes, cautions, and solutions that could be of use in diagnosing, correcting, and avoiding present and future problems.
- Compatibility Data — This feature provides hardware compatibility information for each software generic.
- News and Bulletin — News provides the latest general information. Bulletins are information of more urgent nature. Bulletins are displayed immediately after login.
- COACH User's Guide — This feature provides instructions that explain how to use COACH. It also explains the differences between issues of COACH.

Anyone interested in gaining access to COACH should contact his/her technical coordinator. If a coordinator is not available, call AT&T Customer Service.

After regional work centers have been involved, troubles can be escalated to an RTAC (Regional Technical Assistance Center). Like the work centers, the RTAC is staffed with trained personnel, but it also has additional circuit information and contact with equipment design locations. The RTAC can be reached by calling 1-800-225-RTAC in the U.S.A. This will put you in touch with either the assigned RTAC or a centralized one (after business hours) which will in turn refer the problem to your local RTAC. RTAC can be called 24 hours a day, 7 days a week.

Engineering Considerations

13

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Engineering Considerations

13

Introduction

This chapter discusses considerations involved in engineering DACS II and its associated equipment. It is intended to provide the user with information concerning engineering philosophies, equipment requirements, and any problem areas that could arise as the result of improper engineering procedures.

DS1 Environment Synchronization Plan

General

The synchronization of clocks within a digital network can be divided into two parts: intrabuilding and interbuilding. For intrabuilding synchronization, a single clock or a clock with an extension within the building is designated as the BITS (building integrated timing supply). The BITS provides all the DS1 and DS0 synchronization references required by clocks in the building. Interbuilding synchronization refers to the synchronization of BITS between buildings.

Digital network synchronization is based on a hierarchical method consisting of four stratum levels: strata 1, 2, 3, and 4. The standard for the network known as the BSRF (basic synchronization reference frequency) uses the Cesium Beam standard. This is currently the only stratum 1 clock. It is the primary frequency reference for all clocks in the synchronization network. All clocks in strata 2, 3, and 4 are synchronized with a reference traceable to BSRF. A traceable reference is one that can be traced back through some number of clocks to the BSRF and is therefore locked in frequency with the BSRF.

For intrabuilding synchronization, the highest stratum clock within the building is designated as the BITS for that building. All other clocks in the building receive timing from the BITS at the DS1 and/or DS0 rates. The BITS in turn receives synchronization reference from the BITS in other buildings following a hierarchical plan. In this plan, a receiving BITS cannot have a stratum level higher than the sending BITS. The receiving BITS in turn supplies the reference frequency to other BITS at lower or equal hierarchical levels. In this manner, an interbuilding synchronization network is formed in which the flow of reference frequency is always from the highest to the lowest in the hierarchical structure, thus avoiding the formation of a closed loop in the structure. As shown in Figure 13-1, the intrabuilding network is a star network while the interbuilding network is a hierarchical tree-like network. In general, interbuilding BITS are synchronized at the DS1 rate, while intrabuilding synchronization is at the DS1 or DS0 rate.

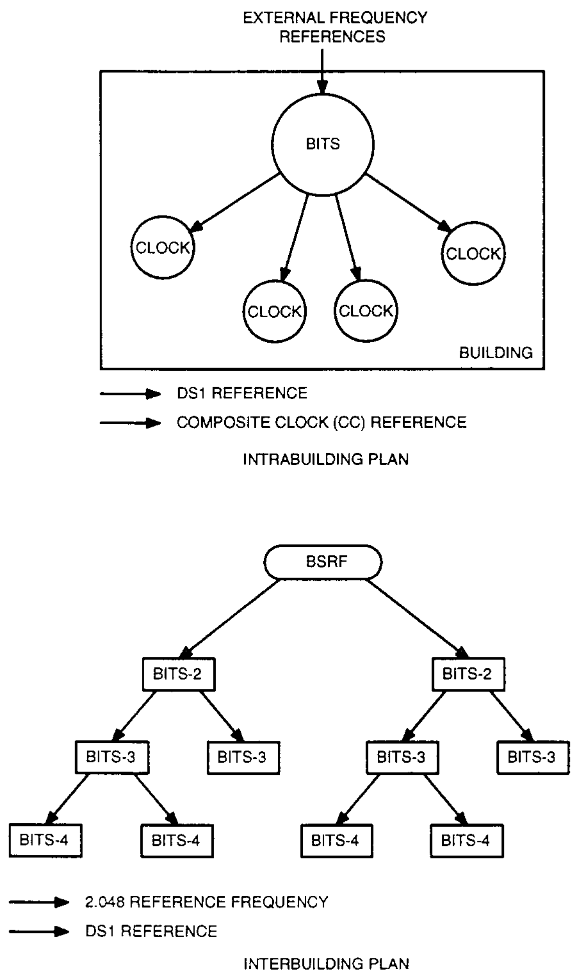


Figure 13-1. Intrabuilding and Interbuilding Network Plans

Engineering a Digital Synchronization Network

The engineering of the digital network is based on a hierarchy of clocks. As previously discussed, four strata are used with stratum 1 as the highest quality clock and stratum 4 as the lowest quality clock. Examples of digital synchronization network entities and their stratum levels are shown in Figure 13-2. Figure 13-3 shows an example of a digital synchronization network and it shows that: (1) only DS1 links are used to carry timing between buildings (equipment requiring DS0 synchronization does not have adequate buffer storage to accommodate phase variations among different equipment and therefore should not be used to carry timing between buildings); (2) within a building, both DS1 and CC (composite clock) (DS0) timing are generated by the BITS; and (3) all clocks other than BITS in a building are supplied both primary and secondary timing by the BITS in the building. Also, examples of BITS at the various structure levels are given. When engineering a digital synchronization network, the following engineering rules should be observed.

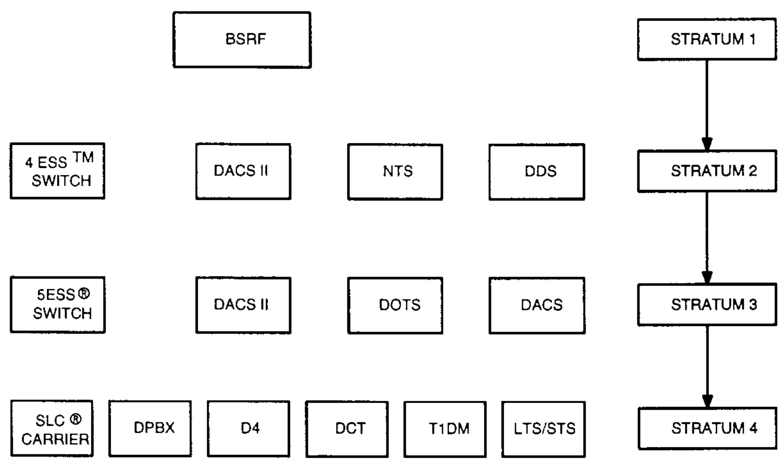
- Rule 1 — No timing loops may be formed in the synchronization network, in either the primary or secondary networks, or in any combination of primary and secondary facilities.
- Rule 2 — A building can only receive its synchronization reference from another building of the same or higher stratum. Clearly, if all buildings in a given stratum are placed in the same horizontal level and the strata are placed in the same vertical order with stratum 1 (the BSRF) at the top, then the flow of synchronization reference is mainly downwards with perhaps a few horizontal excursions, but never upwards.
- Rule 3 — The facilities with the greatest availability (that is, the least outage) should be selected for primary and secondary synchronization facilities.
- Rule 4 — When a timing supply is used as a sync expander (that is, timed from another clock within the same office), the unit provides outputs at the stratum level of the driving or master clock. For example, if a DACS II is used as a sync expander and is timed with a DS1 signal that originates from a 4 *ESS™* switch in the same office, the DACS II clock supplies outputs at a stratum 2 level which is the level of the 4 *ESS* switch clock, rather than at stratum 3, the level of the DACS II clock.

- Rule 5 — When a timing supply is used as an office master; that is, it is synchronized from another office, the unit provides outputs at the stratum level determined by the class of its own oscillator. For example:

  Stratum 2 — NTS, 4 *ESS* switch, or DACS II optionally equipped for a stratum 2 clock

  Stratum 3 — DOTS (digital office timing supply), DACS II, 5*ESS*® switch, or DACS

  Stratum 4 — D Banks or SDE (synchronization distribution expander).



LEGEND:

BSRF - BASIC SYNCHRONIZATION REFERENCE FREQUENCY
NTS - NODAL TIMING SUPPLY
DACS II - DIGITAL ACCESS AND CROSS-CONNECT SYSTEM II
DACS - ORIGINAL DACS
DDS - DIGITAL DATA SYSTEM
DOTS - DIGITAL OFFICE TIMING SUPPLY
DPBX - DIGITAL PRIVATE BRANCH EXCHANGE
DCT - DIGITAL CARRIER TRUNK
T1DM - T1 DATA MULTIPLEXER
LTS - LOCAL TIMING SUPPLY
STS - SECONDARY TIMING SUPPLY

Figure 13-2. Stratum Levels of Digital Network Synchronization Entities

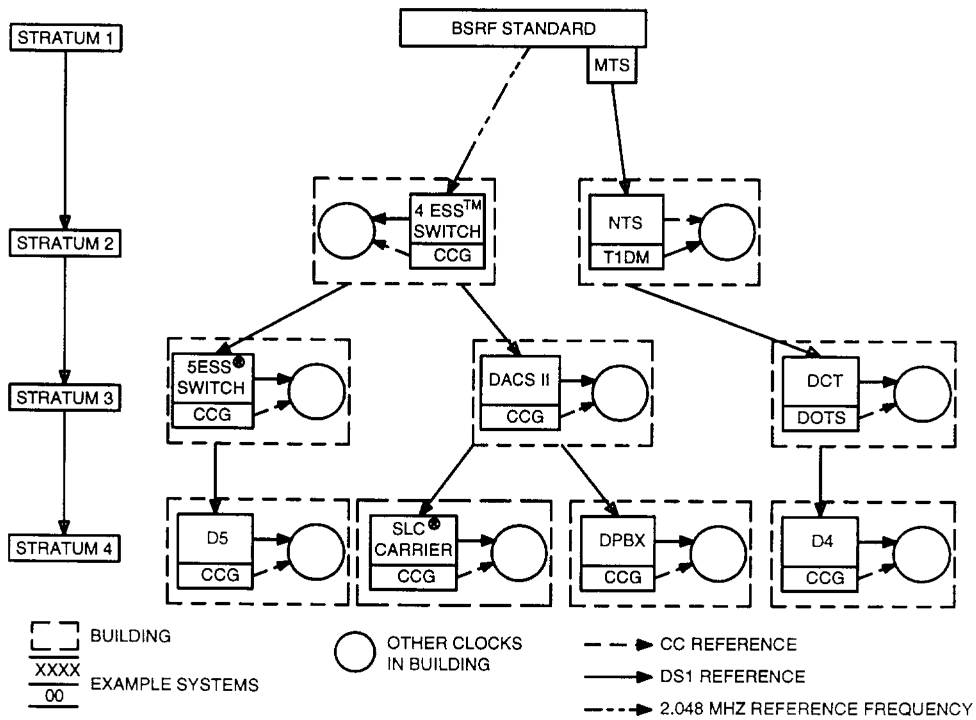


Figure 13-3. Digital Synchronization Network Architecture Example

DACS II in the DS1 Synchronization Network

The DACS II clock is normally a stratum 3 clock but can be optionally equipped as a stratum 2 clock and is fully duplicated in the system. Its use as a stratum 3 clock in the digital synchronization network requires that it be synchronized to a signal timed from a stratum 3 or higher source which has timing traceable to a stratum 1 frequency standard. Two sources are generally preferred to provide a timing reference for the DACS II clock. These are the 4 *ESS* switch and the DDS NTS (nodal timing supply), which are at stratum 2 in the hierarchy. In any case, the reference must be traceable to a stratum 1 clock. If more than one reference is available in an office, the single, most reliable timing reference should be used.

As DACS II is deployed in the network, situations will arise where the frame is timed to a 4 *ESS* switching equipment clock and a distant dataport channel bank is timed to the nodal timing supply composite clock. Figure 13-4 depicts this arrangement. Synchronization for end office channel banks equipped with only OCU dataports can be achieved by means of loop timing these banks to DACS II. Any distant channel banks which are equipped with DS0 dataports interconnected either to other dataports or to DDS equipment at the DS0 level must be timed to the DDS composite clock. The composite clock can only be provided by equipping the channel banks with OIU-2 or OIU-4 office interface units. In this case, both DACS II and the distant channel banks run independently. Since both are timed to references traceable to a stratum 1 clock, they will have sufficient accuracy to meet end-to-end slip rate objectives for quality transmission of data.

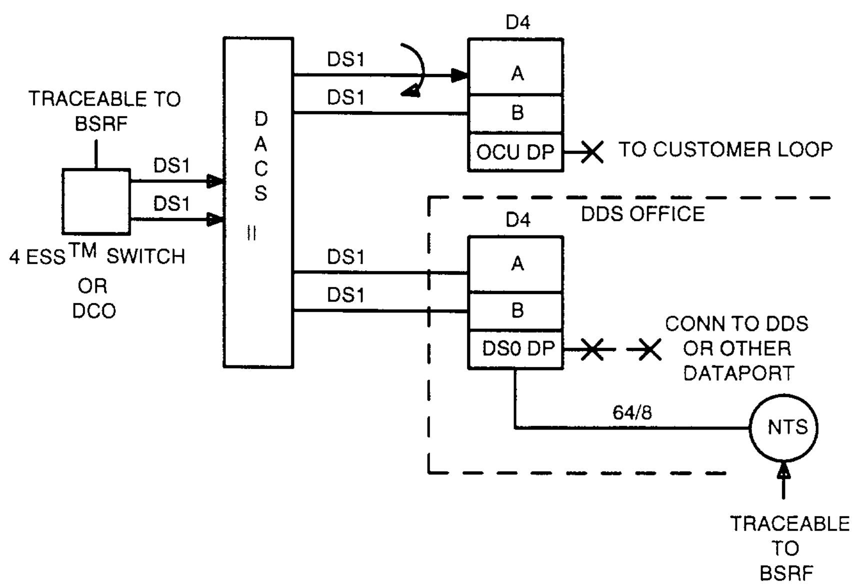


Figure 13-4. Frame Timed to a 4 *ESS* Switching Equipment Clock and Channel Bank to NTS Composite Clock

DACS II as a Stratum 2 BITS

Figure 13-5 illustrates DACS II as a stratum 2 BITS. In this arrangement, DACS II is used as a single master timing supply to all other equipment in the office including the 4 *ESS* switching equipment. The use of DACS II as a stratum 2 clock in the digital synchronization network requires that it be synchronized to a signal timed from a stratum 2 or stratum 1 source. Since the DACS II stratum 2 clock is considered better than the existing stratum 2 clocks, the sources preferred to provide a timing reference to the DACS II in a given building would be from another DACS II stratum 2 clock in a different building that is traceable to BSRF or from the primary BSRF itself. Timing extractors are used to extract timing from the external references. DACS II has two external timing links. One is the primary link and the other is the secondary link. These two links should be from different facilities if possible. The two links are provisionable as primary and secondary. If the primary link fails, the DACS II SYNC automatically switches to the secondary link. In addition, if there is a failure in the circuit packs of one SYNC, DACS II automatically switches to the other SYNC. These features make DACS II a very reliable stratum 2 source in the network.

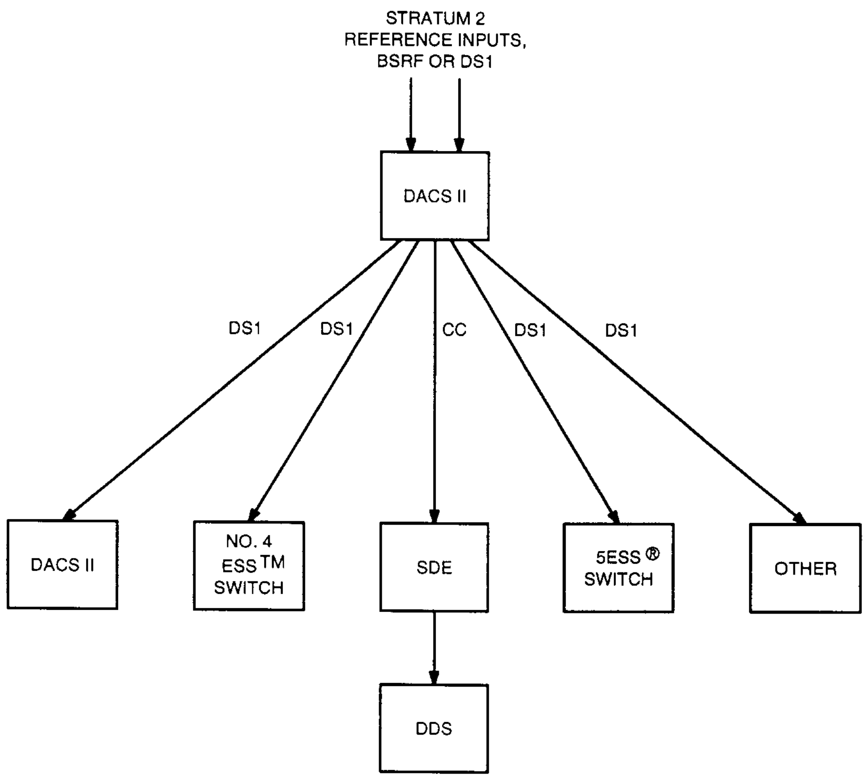


Figure 13-5. DACS II as a Stratum 2 Building Integrated Timing Supply

DACS II Timing Island

If a timing reference is unavailable for an isolated network, a timing island can be formed by equipping a DACS II frame for the master timing mode. In this mode, the other DACS frames and equipment are slaved to the master DACS II. The timing for the slaved equipment is obtained through the synchronizer circuitry from DS1 signals from the master DACS II. In this arrangement, digital channel banks connected to DACS II will be loop-timed for synchronization. Figure 13-6 illustrates DACS II as a timing island.

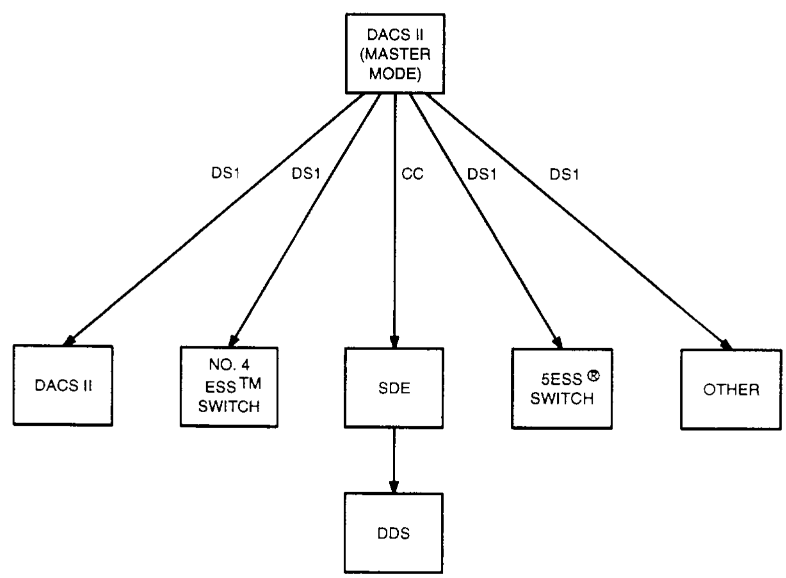
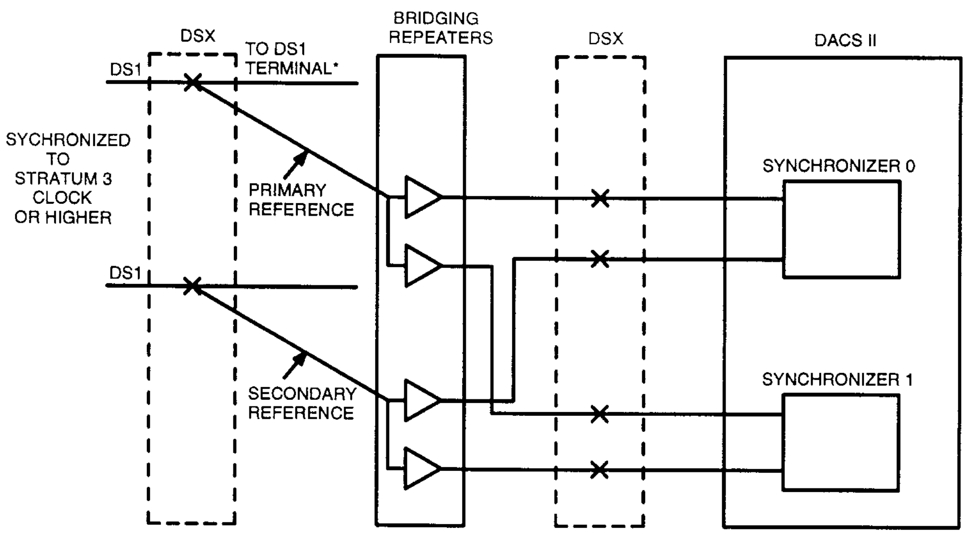


Figure 13-6. DACS II as a Timing Island

Interconnecting Timing References by Bridging Repeaters

Figure 13-7 shows the method of interconnecting timing references to DACS II by means of bridging repeaters. Four repeaters are required to provide duplicated primary and secondary timing references. Neither the primary reference DS1 nor the secondary reference DS1 need terminate on the DACS II frame; both need only appear at the DSX where they are connected to bridging repeaters as shown.



* IT IS NOT NECESSARY THAT EITHER REFERENCE DS1 TERMINATE ON A DACS II

Figure 13-7. Interconnecting Timing References by Bridging Repeaters

DACS II Synchronizer Circuit Packs

There are four types of circuit packs used in the DACS II synchronizer. These are the TB (time base), TLI (timing link interface), DPLL (digital phase-locked loop), and SPU (synchronizer power unit). These circuit packs are discussed in the following paragraphs.

TB (Time Base)

Time bases generate a high stability clock signal that is used by the DPLL pack to generate its system clocks. The stability of the TB determines the holdover stability of the SYNC when it is timed from a network reference and all timing links fail. In addition, when the SYNC is in the master mode, the stability of the TB determines the stability of the SYNC system clocks. There are four TB circuit packs:

- TG60 - Stratum 3 (North American Standard)
- TG61 - CCITT Local (CCITT Standard)
- TG62 - CCITT Toll (CCITT Standard)
- TG63 - Stratum 2 (North American Standard).

TLI (Timing Link Interface)

Timing link interfaces can either extract timing from a network source or distribute timing to other equipment. There are two types of TLIs each with packs available for different modes of operation.

TX (Timing Extractor)

Timing extractors accept synchronization signals from network synchronization sources and direct them to the DPLL circuit pack located in the SYNC. There are six types of timing extractors:

- TG64 - Accepts 2 bipolar DS1 (1.544-Mb/s) signals (North American standard) from bridging repeaters. It has a 100-ohm impedance and a sensitivity of 500mV peak-to-peak.
- TG65 - Accepts 2 (2.048-Mb/s) signals from twisted pair lines at 120 ohms.
- TG66 - Accepts 2 bipolar composite clocks (64-kb/s, from DDS clock) from twisted pair lines at 135 ohms; only frequency is extracted.
- TG67 - Accepts 2 sinusoidal/square wave signals (512-kHz, 1-MHz, 1.544-MHz, 2.048-MHz, or 5-MHz) from a twisted pair at 100 ohms.

- TG68 - Accepts 1 signal from a basic synchronization reference frequency (North American standard; 2.048-MHz from BSRF frame) over a 75-ohm coaxial cable.
- TG75 - Accepts 2 (2.048 Mb/s) signals from 75-ohm coaxial cable.

TD (Timing Distributor)

Timing distributors accept signals from the DPLL circuit pack, convert these signals to the appropriate formats, and distribute them. Each TD has four identical outputs. There are two types of TDs:

- TG70 - Outputs composite clock (64-kb/s, DDS timing signal) at 135 ohms and 4.8 V peak-to-peak.
- TG71 - Outputs 2.048-MHz sine wave (North American format) at either 75 ohms and 2 V peak-to-peak or at 120 ohms at 3 V peak-to-peak.

DPLL (Digital Phase-Locked Loop)

The DPLL circuit pack (TM590) outputs 16.384 MHz clock and frame SYNC signals to the cross-connect network. These signals are phase-locked to the signals from the timing extractors when the SYNC is supplied with a network reference. When the SYNC is in the master mode, the output clocks are free-running but monitored for frequency accuracy.

SPU (Synchronizer Power Unit)

The SPU circuit pack (TG58) provides +5 V dc and –5 V dc to the plug-ins located in the SYNC.

Equipping the DACS II Synchronizer

The DACS II SYNC is fully duplicated. It is made up of side 0 and side 1. Both sides of the SYNC will be identically equipped.

Circuit Packs That Are Always Required

Certain circuit packs are always required regardless of timing mode. These required circuit packs are discussed below.:

1. DPLL (TM590)

   Two are required. One in side 0, and one in side 1.

2. SPU (TG58)

   Two are required. One in side 0, and one in side 1.

3. TB (TG60, TG61, TG62, or TG63)

   Timing extraction (slaved mode) is the most common configuration for which two TBs are required, one on each sync side. One TB is installed in side 0 and one is installed in side 1. If the master timing mode is required, one additional time base is installed. This additional time base is referred to as the CRO (clock reference oscillator) and is shared by both side 0 and side 1.

Circuit Packs Required for Timing Extraction

When the DACS II is synchronized to a network source, a minimum of two timing extractors is required for the SYNC. The type of timing extractor used is determined by the type of network synchronization source signal being terminated. The two timing extractors should be installed in SYNC position 032 for side 0 and position 040 for side 1.

1. Extracting Timing From a DS1 Source

   To extract timing from a DS1 signal, TG64s are installed in SYNC sides 0 and 1 in the positions for TLI 4. The DS1 signals are routed from the DSX-1 through a special jack arrangement to T1 bridging repeaters. The output of the bridging repeaters is carried by shielded cable to terminal strip B.

2. Extracting Timing From a Composite Clock Source

   To extract timing from a CC (composite clock) source, TG66s are installed in the same locations as mentioned for the DS1 timing extraction. Composite clock signals are run directly from a DDS clock to the timing extractors. The distance from the DDS clock to the TLI is 1500 feet maximum. No bridging repeaters or other devices are required when using CC as a synchronization signal, though an SDE (synchronization distribution expander) could be used in offices that have exhausted their DDS clock outputs. The wiring to terminal strip B is the same as DS1 timing extraction.

3. Extracting Timing From a Sine/Square Wave Signal

   TG67s are used to extract timing signals from sine or square wave signals. These signals originate from a PFS (primary frequency supply) which is receiving its synchronization from an analog signal traceable to a stratum 1 clock source. The output from the PFS would be wired to the TLIs just as with the other timing signals. The TG67 can sync on a signal of 512-kHz, 1-MHz, 1.544-MHz, 2.048-MHz, or 5-MHz.

4. Extracting Timing From a BSRF Frame

   Some digital switches are synchronized from a BSRF frame. The output of this frame is a 2.048-MHz, 75-ohm impedance signal (requires coax cable) at a level of -20 dBm. Coax cables from this frame can be run to the DACS II SYNC. If the BSRF signal is to be used, then the TLI 2 position in both sides is equipped with TG68s. (TLI 2 is the only slot wired for coax cable. The coax cable inputs are to the 440 jacks on the terminal strip).

Normally, only one type of timing extractor will be used in a DACS II frame. The TXs must be installed symmetrically on the two sides; e.g., if a TG64 is installed in TLI 4 side 0, then a TG64 must be installed in TLI 4 side 1. If more than one type is equipped, the additional packs for each side can be installed in any of the other TLI mate positions and the wiring from the source is wired to those TLI positions.

Plug-in Circuit Packs Required for Timing Distribution

Timing distribution packs are always required when the DACS II frame is used as a master timing source (stand-alone timing for a timing island). Timing distribution circuit packs can be installed when timed from a network synchronization source to time other devices in the office. TDs are installed in TLI 1. Each TD outputs four identical timing signals. TDs are always installed in pairs, one in side 0 and one in side 1. If more than four pairs of timing taps are required, additional TDs can be installed in TLI 2, side 0 and side 1.

Engineering Multiple DACS II Arrangements

Due to the large cross-connect capacity of the DACS II frame, multiple complexes like those conceived for the original DACS should not be required in most installations. Even in large offices, the DS0 cross-connect requirements should be handled by, at most, two DACS II frames.

Cabling Types for DACS II and Associated Equipment

Office wiring to the DACS II includes signal connections and power, alarm, and control wiring. These different office wiring needs are outlined below:

- DS1, 2.048 Mb/s, or DS3 signal cabling to line interface such as DSX-1 for DS1
- Wiring of local alarms to office alarm circuit
- Wiring of remote alarm status and microprocessor reset closures to host local SPCS (stored program control system) scan points or possibly remote telemetry
- Wiring of local and remote administrative links (TTY channels)
- Wiring of dc power feeds from –48 V battery.

Restrictions on the length of these office connections are given in Table 13-1 along with the approved types of cabling. For local DACS II administration and test access via an LTP (local test port), the LTP and DACS II TTY should be located together for convenience. The local TTY may be located within 2000 feet of the DACS II complex if the RS-449 format is used or 50 feet if the RS-232C format is used without using data sets. Beyond these distances, 202T data sets are required in the DACS II.

Table 13-1. Cabling Requirements

Interbay Cable From DACS Frame To	Type Cable	Maximum Distance (Feet)
" " DSX-1	609C	655
DSX-3	728A	450
Test Access DS1s (to DSX-1)	609C	655
Remote Microprocessor Reset	Resistance not to exceed 300 ohms	
Office Alarm Circuit	Specified by CDDS (Circuit Development Documentation Standard)	

<table>
<tr><th>Interbay Cable From DACS Frame To</th><th>Type Cable</th><th>Format</th><th>Feet</th></tr>
<tr><td>Local Administrative Links</td><td>M25B</td><td rowspan="2">RS-232C</td><td rowspan="2">50</td></tr>
<tr><td rowspan="2">Remote Administrative Links</td><td>M25B*</td></tr>
<tr><td>M37B</td><td rowspan="2">RS-449</td><td rowspan="2">2000</td></tr>
<tr><td>Local TTY</td><td>M37B</td></tr>
</table>

*M25A cable can be used in series with M25B to provide lengths from 25 to 50 feet.

Line Signal Equalization or Impedance Matching

For connections between the DACS II and the DSX-1, 26-gauge cable is available to replace the 609C cable for distances less than 450 feet. This 26-gauge cable is coded 1249-020/R4320. Since it has a higher loss than the 609C cable, it should always be specified when the distance to the DSX-1 cross-connection is less than 450 feet. If the distance is over 450 feet, the 609C cable must be specified.

As part of provisioning a facility module, a value of equalization is entered in the command for growing the FTMI. Equalization is specified separately for the halves of the module; 20 DS1s per each equalizer group. This equalization is inserted in the outgoing path (toward the DSX-1) by the DACS II to produce a standard level signal at the DSX-1. The breakpoints for the DS1 equalizer values are shown in Table 13-2 for both the 609C and 1249 cables. For 1249 cable, the shield must be run to the terminating connector on the DACS II end instead of being cut short like the 609C cable.

Table 13-2. Cable Length (Feet) Equalizer Breakpoints

609C Cable	1249 Cable
0-133	0-90
133-267	90-180
267-400	180-270
400-533	270-360
533-655	360-450

Modules equipped for 2.048 Mb/s signals are provisioned to match the line impedance instead of inserting equalization. Values of either 75 or 120 ohms are available to match coaxial or twisted wire pairs, respectively. These and the other fundamental differences between the DS1 and 2.048 Mb/s signals make the two incompatible in the same module. Furthermore, for consistency of assignment and operation, DS1s and 2.048 Mb/s signals will probably not be used together in the same unit.

The line terminations for the 2.048-Mb/s signals require special adapters that are connected to the existing 50-pin cable connectors behind the FTUs. The line terminating cables fitted with 963P1-4 connectors plug into these adapters. For coaxial line terminations, a connector adapter per J98774B-1 is placed at the FTUs to accept the miniature coax cables equipped with 963P plugs. There are two coax adapter codes: the ED-2C997-30, G1 for direct shield ground, and the ED-2C997-30, G2 for grounding through a capacitor. Timing interfaces use the standard DACS II terminating assemblies located at the top of the DACS II frame. These interfaces are then cross-connected to DPCs designated as timing sources.

Eight NPCs that receive 2.048 Mb/s signals on a frame can be designated in the data base as sources for timing extraction. These NPCs are mounted in the first 2 FTMs of units 1 and 2; only the second NPC on each of the involved DPC cards is used to prevent the loss of two sources if one DPC fails. Signals from these sources are wired to top-bay terminal strip A where they are cross wired to TSB which is wired to the sync ports on the TLI packs.

As part of provisioning a multiplexer in the DS3U, the LBO (line buildout) setting (on/off) is entered in the grow MXR command. When selected, the LBO is inserted in the outgoing path to ensure that all signals are delivered to the connecting equipment at the same level. This is accomplished by building out the loss of shorter cabling. The default setting is LBO off. The cable breakpoints for LBO selection are given in Table 13-3. The cable combination shown in this table is produced using a 219N splice. The total cable length is calculated as follows: 734A length plus three times the KS-19224,L2 length. In other words, the proportion of the KS-19224,L2 cable is controlled by having three times the actual length entered in the total calculation.

Table 13-3. DS3 LBO Selection

Connecting Equipment	KS-19224,L2 Cable Alone	734A/KS-19224,L2 Cable Combination	LBO Setting
DSX-3	0-75 feet 75-150 feet	0-225 feet 225-450 feet	ON OFF
DS3 NTE and FT Series G per Note 1	0-150 feet 150-300 feet	0-450 feet 450-900 feet	ON OFF
FT Series G per Note 2	0-150 feet 150-283 feet	0-450 feet 450-850 feet	ON OFF
FT Series G per Note 3	75-200 feet 200-300 feet	225-600 feet 600-900 feet	ON OFF

Notes
1. Service 1-5 DOA, service 1-7 TMA, service 6-7 DOA with protection and service TMA; also for protection TMA without RA or protection DOA without RA.
2. Protection TMA or DOA with RA.
3. Service 6-7 DOA with protection and service 1 DOA.

DOA = dual quadrant assembly, RA = restoration access, TMA = terminating muldem assembly.

Blocking in DACS II

DACS II uses a single-stage TSI (time-slot interchange) architecture in the cross-connect networks. With this architecture, DACS II is fully nonblocking for any number or type of cross-connections up to its full terminating capacity. In the 3-bay installation with 640 DS1s, the DACS II permits the assignment and redistribution of up to 15,360 individual DS0 channels. In a 7-bay CEF with 2,560 DS1s, the DACS II permits cross-connecting all 61,440 DS0 channels. The design also ensures rapid execution times for cross-connect and test access commands. For the CEF frame for Release 5.0, the execution times are on the order of 330 ms for cross-connection of two DS0s and 675 ms for cross-connection of a 24-channel range. The multiple DS0 channel cross-connections and rapid execution times enable services such as the LBRV (low bit rate voice) bundle routing and video teleconferencing. Multipoint cross-connect capabilities enable N x DS0 broadcast services.

Switching Machine Requirements and Trunk Conditioning for DACS II

This part explains how trunk circuit requirements are translated into trunk conditioning specifications of cross-connect commands entered into the DACS II. These requirements are based on switching equipment found in the U.S.A. and on the use of 4-state signaling (ab bits) for circuits with signaling. Channels in the 2.048 Mb/s signal using CAS (channel associated signaling) provide 16-state signaling (abcd bits). This 16-state capability also exists with DS1 signals using the ESF format, and starting with Release 3, the DACS II supports this capability in the TC (trunk conditioning) field of the cross-connect messages. This is supported by the direct entry in binary form (efghijkl,mnopqrst) or shortened entry in hexadecimal form (X'rs,X'tu). These trunk conditioning formats correspond to the first 2.5 seconds and thereafter for the FROM and TO sides. In Gateway applications between DS1 and 2.048 Mb/s signals, there are requirements on what can be entered for the cd bits, and the DACS II will accept the the 4-state format and affix the required cb settings. See Chapter 15 for more information on Gateway.

During a carrier failure, DACS II sends a programmed bitstream on each channel of the facility cross-connected to the failed facility to signal the far-end switching machine or terminal. The bitstream causes the far-end switching machine to disconnect customers, stop billing, and make circuits busy to new calls. Different trunk conditioning options are available for the cross-connect commands to meet the trunk conditioning requirements of various circuits. These options are: the selection of signaling or no signaling (transparent - TRSP), the selection of a standard insertion word (for example, TRB, MUX) or user defined insertion word for the message bits, and for signaling, the specification of the signaling bits to achieve the required disconnect and make-busy conditions. Setting the variables (ijkl,mnop) in the <tc> field of the cross-connect command controls the pattern of the A and B signaling bits sent during a carrier failure.

Table 13-4 lists examples of the trunk conditioning required for various switching machines and trunk circuits in terms of the required on-hook, off-hook conditions. Table 13-5 lists the typical trunk conditioning (including nonswitched services) in the <tc> field format used in the the cross-connect commands. Table 13-6 shows customer and channel states and the associated signaling bits for various SLC® 96 carrier channel types. The variables for the <tc> of the TCON command (PDS language) are described in Table 13-7. Variables ijkl define the signaling bits sent on the FROM facility when the TO facility has alarmed, and variables mnop define the signaling bits sent on the TO facility when the FROM facility has alarmed. Within these blocks, variables ij and mn pertain to the signaling bit state for the first 2.5 seconds after a carrier failure and kl and op are for the remaining time. Variables i,m,k,o are for the A signaling channel and j,n,l,p are for the B signaling channel needed for 4-state signaling.

Table 13-4. Trunk Conditioning For Switched Services

Service	Trunk Types	Requirements (Notes 1 and 2) SXS, 1XB, 5XB, 1 *ESS* 2 *ESS*, 3 *ESS*, 5*ESS* Switches	4XB, 4AXB XBT, 4 *ESS* Switches
Message Telephone	2-Way	A0/1+B0/1	A0/1+B0/1
	1-Way Incoming	A0+B0	A0+B0
	1-Way Outgoing:		
	Loop, E&M	A0/1+B0/1	A0/1+B0/1
	Interoffice, Local (Extended Area)	A0/1+B0/1	NA
	CAMA, AIS	A0/1+B0	NA
	TSPS*	A0/B0	NA
		A0/1+B0/1	NA
	LAMA Loop	A0/1+B0/1	NA
	Joint-Hold	A0+B0	NA
	CCIS†	None (1 *ESS*, 2 *ESS* switch)	None (4A-ETS, 4 *ESS* switch)
Special (Foreign Exchange)	Off-Premises Extension — Loop Start Only		
	FXO	A0+B0	NA
	FXS	A0+B1	NA
	PBX-CO Trunk — Ground Start		
	FXO	A0+B1	NA
	FXS	A1/0+B1	NA
Private Line	Tandem Tie Trunks	A0/1+B0/1	NA

Notes:

1. A0, B0=Steady on-hook
   A0/1, B0/1=2.5 seconds on-hook followed by steady off-hook
   B1=Steady no-ring
   A0=Loop open
   A1=No tip ground.
2. NA=Not applicable.

* A0+B0 toward local office; A0/1+B0/1 toward TSPS trunk circuit from DACS II on toll office side of facility.

† No signaling insertion on CCIS trunks.

Table 13-5. Trunk Conditioning Specifications

Type Trunk	Specification
2W & 4W Code Select 2W & 4W Ringdown	TC(0000,0000),TRB TC(0000,0000),TRB
2W & 4W Dial Tie Trunk 4 E&M Tandem	TC(0011,0011),TRB TC(0011,0011),TRB
2W & 4W FX Station End, Ground Start	TC(0101,1101),TRB
2W & 4W FX Station End, Loop Start	TC(0000,0101),TRB
2W & 4W FX Office End, Ground Start	TC(1101,0101),TRB
2W & 4W FX Office End, Loop Start	TC(0101,0000),TRB
4FLT (Intermediate Tandem) 4HGT (Intermediate Tandem)	TC(0101,0101),TRB TC(0101,1101),TRB
2W & 4W Dial Tie Line 4W Tandem Tie Trunk	TC(0011,0011),TRB TC(0011,0011),TRB
2W & 4W Transmission Only	TRSP,TRB
2NS, 4NS, 4N12, 4N15 (No Signaling)	TRSP
Dataport CCIS	TRSP,MUX TRSP,TRB
TSPS -Local Office End TSPS -TSPS Office End	TC(0000,0000),TRB TC(0011,0011),TRB
1-Way Incoming Trunk 1-Way Outgoing Trunk (Loop, E&M, Interoffice)	TC(0000,0000),TRB TC(0011,0011),TRB
2-Way Message Trunk	TC(0011,0011),TRB
SLC Series 5 Carrier DCLU End	TC(0000,0101),TRB

Table 13-6. SLC® 96 Carrier Signaling States

Channel Type	Customer State	Signaling Bits* To CO A	To CO B	To RT A	To RT B	Channel State
Single party	On-Hook	0	0	0	1	Channel test
	Off-hook	1	0	1	0	Forward disconnect
	Unequipped	1	1	1	1	Idle
				1	1/0	-R Ringing
Superimposed Ringing Multiparty	On-hook	0	0	0	1	Channel test
	tip-party ground	0	1	1	0	Tip-party test
	Off-hook	1	0	1	1	Idle
	Unequipped	1	1	1	1/0	-R Ringing
				1/0	0	+T Ringing
				1/0	1	-T Ringing
				1/0	1/0	+R Ringing
Frequency Selective Ringing	On-hook	0	0	0	1	Channel test
	Off-Hook	1	0	1	1	Idle
	Unequipped	1	1	1	1/0	Frequency band 1 ringing
				1/0	1/0	Frequency band 2 ringing
				1/0	1	Frequency band 3 ringing
				1/0	0	Frequency band 4 ringing
Coin	On-hook	0	0	0	0	Negative loop mode
	Coin ground	0	1	0	1	Channel test
	Off-hook	1	0	1	0	Positive loop mode
	Unequipped	1	1	1	1	Ground star
				0	0/1	Positive coin check
				1	1/0	-R Ringing
				1/0	0	Positive coin control
				1/0	1	Negative coin control
				1/0	1/0	Negative coin check
Universal Voice Grade	On-hook	0	0	0	0	Ground start
	Ring ground	0	1	0	1	Channel test
	Off-hook	1	0	1	1/0	-R Ringing
	Unequipped	1	1	0	1/0	Idle
Direct inward DP term	Normal battery	0	0	0	0	Loop open
	reverse battery	1	1	1	1	Loop closure

* The 1/0 notation means alternating ones and zeros.

Table 13-7. Trunk Conditioning Variations

Command	Explanation
TCON:FRM xy,SEQ wz:FROM abcdd,TO ghijj,TC(ijkl,mnop)*, TRB[,NTR m][,RDC]!	where: TC is trunk conditioning information with standard trouble code X´E4
TCON:FRM xy,SEQ wz:FROM abcdd,TO ghijj,TRSP [,NTR m][,RDC]!	where: TRSP is fully transparent channel with no signaling or trouble code
TCON:FRM xy,SEQ wz:FROM abcdd,TO ghijj,TRSP,TRB [,NTR m][,RDC]!	where: TRSP, TRB is transparent with standard trouble insertion code X´E4
TCON:FRM xy,SEQ wz:FROM abcdd,TO ghijj,TRSP,MUX [,NTR m][,RDC]!	where: TRSP, MUX is transparent with MUX out of sync code (X´1A or X´18 on TLA)†
TCON:FRM xy,SEQ wz:FROM abcdd,TO ghijj,TC(ijkl,mnop), IW X'nn[,NTR m][,RDC]!	where: X´nn is specific insertion word "nn" in place of trouble word
TCON:FRM xy,SEQ wz:FROM abcdd,TO ghijj,TRSP,IW X'nn [,NTR m][,RDC]!	where: TRSP,IW X´nn is transparent with specific insertion word

* The keyword TC(ijkl,mnop) indicates to DACS II that the circuit being formed will use A/B signaling and require A/B conditioning during a carrier failure. The letters take on a value of "0" or "1" to indicate an off-hook (1) or on-hook (0) condition to be sent during a carrier failure. The "ijkl" field defines the bits transmitted on the FROM facility when the TO facility is in CGA, and the "mnop"field defines the bits transmitted on the TO facility when the FROM facility is in CGA.

† A circuit connected using the MUX keyword is conditioned with the 1A (mux out of sync) code. When the circuit is brought up in the TLA (terminate and leave activate) state, the 18 (unassigned mux code) is automatically transmitted in the TLA direction instead of the 1A code.

Loss of service due to a DMB failure is minimized because the DMB circuit group is duplicated so that the MC can remap service through the duplicate DMB in case of a failure. If the MC is out of service when a DMB failure occurs, service is automatically switched to the duplicate DMB.

The TRSP code word is used in the trunk-conditioning field of the cross-connect command for a DMB since the DMB does not pass signaling. When only one end of the cross-connection is on the DMB, the usual trunk-conditioning specification for a multipoint circuit is TRSP, IW X'E4 (no signaling, silent code). If both ends are on DMBs (interframe or intraframe), TRSP alone is used. A failure of an incoming facility or removal of a digroup will cause the unassigned channel code (silent code) to be sent on all affected DMB legs. The removal of DMBs which affect service (removal of both DMBs) causes the per-channel trunk conditioning specified in the cross-connect command to be inserted on all legs in the outgoing direction.

The paragraphs that follow give the switching machine considerations for implementing the CGA (carrier group alarm). Considerations for CCIS (common channel interoffice signaling) are also given.

For installation of a DACS II frame, evaluation of requirements for software updates in SPCS (stored program control system) and trunk circuit modifications in electromechanical switches should be made as indicated in Tables 13-8 and 13-9. The DACS II per-channel TC is compatible with switched and nonswitched special service circuit requirements. The response of SPC (stored program control) or an EM (electromechanical) switch to per-channel TC depends on its ability to recognize the supervisory signals and its ability to respond in the desired manner by terminating calls and making the trunk busy. It must also be capable of automatically restoring the trunk to service when the affected upstream carrier CGA is retired.

The *ESS* switches have the hardware required to recognize per-channel TC supervisory signals. All machines are programmed to respond to the signals on 2-way trunks and on 1-way incoming trunks. For the 1A *ESS* switch without a DCT (direct carrier trunk), the required software changes needed for 1-way outgoing trunks are contained in the 1AE8 generic carrier trunk-conditioning recognition feature. For 1-way outgoing trunks, software changes are required in the non-DCT 1 *ESS* switch and in the 2/2B *ESS* switch to provide the reverse-make-busy capability. Software changes are required in the software CGA algorithms to provide per-channel rather than per-digroup treatment. On the basis of the TC information, the *ESS* switch determines to take the trunk out of service and to restore it on an individual basis rather than infer the status of a digroup from the behavior of several channels.

For CCIS trunks, there is no signaling in the trunk. The per-channel TC technique reduces the software interpretation of a VPA (voice path assurance) failure on the trunk. Nongroup treatment is also required for the software CGA algorithms to properly handle upstream facility failures on DACS II CCIS trunks. No changes are needed for trunks in a DCT, since it monitors signals on all trunks. No changes are needed for trunks in a 3 *ESS* switch, since all the trunks are 2-way trunks.

Table 13-8. Switch Feature Feature Requirements

SPC Switches	Trunk Signaling Type NON-CCIS	CCIS
1/1A *ESS* (non-DCT)	1AE8 Generic CTCR Feature	1AE8 Generic CTCR Feature
2B *ESS*	Hardware and Software Modification* †	Software Modification*
3 *ESS*	Existing	Not Applicable
4 *ESS*	4E6 Generic	4E6 Generic
4AXBT-ETS	Same as 4AXBT non-ETS (Per Table 13-9)	Existing
5*ESS*	Existing	Existing
DMS‡-10	Existing	Not Applicable

* Schedules for 2/2B *ESS* switch software modifications are being negotiated and will be announced when commitments have been made.

† For RMB on outgoing trunks, replace SD-2H103 with SD-2H144 trunk circuit. In addition, software modification is required to recognize RMB feature.

‡ Registered trademark of Northern Telecom.

In EM switches, the associated trunk circuits must be able to provide the RMB (reverse make-busy) capability. No trunk circuit changes are needed for 2-way and 1-way incoming trunks. However, trunk circuit changes are needed to implement the RMB feature for certain cases of 1-way outgoing trunks as shown in Table 13-8. In all cases except toll switchboard trunks and extended area service trunks (such as SD-31779-01), circuits are currently available with the RMB feature for the step-by-step switches listed in Table 13-9. Likewise, other electromechanical switches also feature OGT (outgoing trunk circuits) with RMB (such as SD-26209-01 in 1XB switch). The OGT circuits without RMB can be supplemented with a single trunk make-busy circuit (SD-96541-01) as indicated in Table 13-8.

Table 13-9. Reverse Make-Busy Requirements

E-M Switch	OGT	Trunk Circuit SD Drawing	Trunk Circuit J Drawing
SXS	Loop, Loop/E&M, or E&M (Includes ONI ANI-B, C, & D types only; but not LAMA Loop or EAS Loop types	SD-32199-01 SD-32240-01 SD-32241-01 SD-32244-01 SD-32245-01 SD-32342-01 SD-32344-01 SD-32367-01 SD-32542-01 SD-32543-01 SD-32551-01 SD-35020-01 SD-35021-01 SD-35022-01 SD-35023-01 SD-35024-01	J33013-AL J33013-AN J33013-AP J38943-M J38943-N J38943-R J38943-P J38923-C J38943-S J38943-V J38923-J J38950-BA J38950-BB J38950-BC J38950-BD J38950-BE
1XB	Loop	SD-26209-01 (typical) OR SD-96541-01 with OGTs without RMB	J95108-F J99206-BC
4XB	Loop	SD-96541-01	J99206-BC
4AXB (non-ETS)	Loop	SD-96541-01	J99206-BC
XBT	Loop	SD-96541-01	J99206-BC
XBT	E&M	SD-95060-01	J98605-AB4
5XB	LAMA, CAMA, or EAS Loop	SD-26116-01	J23055-W50
5XB	E&M	SD-25847-01* SD-26174-01†	J23055-J J23055-CW/CX

* Trunk circuit has RMB capability if option ZK is added and option ZJ is removed.
† Trunk circuit has RMB capability.

Administrative Terminals, Links, and Modem Requirements

The administrative links are covered in Chapter 10 of this document, but the connecting terminal requirements are summarized here.

- Terminal Characteristics: RS-449 or RS-232-C interface, Full Duplex, 1200-9600 baud asynchronous, ASCII characters (10 bits -1 start, 1 stop, 7 data, 1 parity) with even parity, responds with answerback ACK when ENQ is received.
- Display Terminal: Must meet the terminal characteristics. Among the various vendors' equipment that meet the specifications, two AT&T Teletype® teletypewriter terminals for comparison are: 4425 and 5425.
- Printers: Must meet the terminal characteristics and include flow control to prevent receive buffer overflow.
- Modems: 1200 baud asynchronous, full duplex RS-232-C.
- Adapters: The application schematic for the DACS II frame shows the wiring of the adapter pins:
  ED-2C646-30, G1:DACS II to RS-232-C Modem
  ED-2C646-30, G2:DACS II to RS-232-C Terminal
  ED-2C646-30, G2:RTS 5 Interconnection.
- Link Cable: M25B Cord (50-foot maximum cable length): for RS-232-C format.

Software Release Updates

The current software releases for DACS II are: Release 4.1 for the non-CEF applications and Releases 5.0 for the CEF and Releases 5.1 and 6.0 for both the CEF and non-CEF. As subsequent enhancements are made to DACS II, new releases of the DACS II software will be available with any new hardware to implement these enhancements. The new software releases will be available on tape which can be loaded into DACS II using the frame reset and backup memory transfers. The procedures for installing new software loads are covered in the Software Release Description which is sent out with the software tapes. The SRD document provides the proven technique for installation and includes any circuit pack unit replacements that are required. Chapter 2 provides information regarding the DACS II software releases.

Recommended Spares

The number of spare circuit packs and power converters required is a function of the failure rate, the repair interval, and the total number of working packs for each code in the office. Table 13-10 shows the number of spares required based on the number of circuit packs used in the office; numbers based on experience with actual failure rates and repair intervals supersede this basic listing. Table 13-11 serves as a guide for the number of spare fuses. The quantities listed in this table will suffice for fuse failures due to aging; however, many more could be needed for trouble-clearing to find a shorted CP or backplane wiring short.

Table 13-10. Recommended Spare Circuit Packs

Number In Frame(s)	Spares
1-4	1
5-10	2
11-20	3
21-40	4
41-80	5
81-160	6
161-320	7
321-640	8
641-1280	9
1281-2560	10
2561-5120	11

Table 13-11. Recommended Fuse Spares List

Quantity	Fuse	Amp
5	70B	3
5	77C	5
5	77H	4
5	77J	7.5
5	74J	7.5
5	70B	2
5	70G	0.5
5	70D	5
5	80A	.5
5	80C	3
5	80D	5

2.048 Mb/s Environment

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Introduction

This chapter provides a description of the 2.048-Mb/s transmission facility interface capabilities of DACS II. The information given in this chapter is unique to the 2.048 Mb/s interface.

For general information about DACS II, refer to the other sections of this document.

For information on input commands and output messages, refer to the Command and Message Reference Manual (see Chapter 5). For procedures using the input commands and output messages, refer to the Operations and Maintenance Manual (see Chapter 5).

2.048 Mb/s Environment

General

In a 2.048 Mb/s environment, a DACS II system utilizes almost all the same basic frame circuit packs. The DACS II Main Controller configuration remains unchanged from its North American counterpart. The DACS II Synchronizer requires a new TB (time base) and TLI (timing link interface) extractor circuit packs; these new circuit packs are required since international timing reference rates differ from their North American counterpart. The entire DACS II Cross-Connect Network remains unchanged. The only circuit pack changes required for an FTU (facility terminating unit) to process 2.048 Mb/s facilities are in the facility terminating circuit packs. The common FTU circuit packs — FTMI (facility terminating module interface), FC (format converter), facility terminating unit bus extender and FTU controller — remain unchanged. The new circuit packs required are digroup terminating packs, called DPC (dual primary circuits). Each DPC fully terminates two 2.048-Mb/s facilities for DACS II processing and administration.

The DACS II Interface System supports all of the cross-connection, digital signal processing (with the exception of Subrate), operations, and administrative capabilities that are currently provided by all of the DACS II generics as they apply to a 2.048-Mb/s environment. The basic 2.048 Mb/s frame structure is described by CCITT Recommendation G.704. This structure consists of 32 time slots with each time slot containing 8 bits. A frame repetition rate of 8 kHz corresponds to a digital frame transmission rate of 2.048-Mb/s.

The 32 time slots of a 2.048 Mb/s frame are consecutively numbered from 0 to 31, with time slot zero dedicated to frame alignment, optional CRC (cyclic redundancy checking), and alarm transmission. Time slot 16 of a 32-time-slot-frame may be used for CAS (channel associated signaling) or as a general purpose channel. Channel associated signaling refers to the signaling bits associated with the remaining 30 time slots of a frame. These time slots (1 through 15 and 17 through 31) may be used to support any 64-kb/s digital signal such as PCM voice or digital data. 2.048 Mb/s frames are transmitted in a multiframe arrangement consisting of 16 consecutive frames numbered 0 through 15.

Starting with Release 3, the DACS II supports the 32-channel format of the 2.048-Mb/s transmission facilities. All DACS II cross-connect and administrative commands fully support the 32-channel format in the PDS (Program Documentation Standards) and MML (Man-Machine Language) command languages.

DACS II derives timing for the 2.048-Mb/s interfaces from sources such as traffic-carrying and non-traffic-carrying 2.048-Mb/s digital signals and from 2.048-MHz or 5-MHz analog references from clock distribution systems. An internal DACS II clock that satisfies CCITT Recommendation G.735 can also be used to derive timing.

DACS II monitors each incoming 2.048-Mb/s facility for degraded minutes, severely errored seconds, errored seconds, unavailable seconds, slip events, CRC 4 check block error events, framing error events, loss of frame alignment events, and multiframe alignment error events. The alarm thresholds for most of these facility parameters can be set to other than default values by establishing the values in the data base and selecting them with commands. When thresholds are exceeded, alarm messages will be issued.

DACS II recognizes four classifications of alarms in a 2.048 Mb/s environment: PMA (prompt maintenance alarm) Critical, PMA Major, DMA (deferred maintenance alarm), and MI (maintenance information). LEDs are provided on the DACS II status panel to display the first three alarm categories and a main controller failure.

Test access is obtained using a test access facility going to an external test position or system. Monitor, split, and released modes are used to control the test access. Up to four 2.048-Mb/s DACS II facility interfaces can be provisioned for test access.

Primary Interface

Basic 2.048-Mb/s Frame Structure

The basic frame structure corresponds to the 2.048-Mb/s frame structure which is described in CCITT Recommendation G.704. There are 256 bits per frame. They are numbered 1 through 256 with a repetition rate of 8 kHz.

There are 32 time slots per frame, referred to as channel time slot numbers 0 through 31. Each channel time slot has 8 bits numbered 1 through 8. Channel TS0 (time slot 0) is allocated for framing and other special use. Time slots 1 through 15 and 17 through 31 are allocated for any 64-kb/s digital signal including PCM voice and digital data. TS16 is provisional for CAS (channel associated signaling) or for NSA (nonsignaling associated). For CAS, TS16 is used to carry channel associated signaling. For NSA, TS16 is used the same as TS1 through TS15 and TS17 through TS31.

Applications of TS0

TS0 consists of bits 1 through 8 which are allocated as shown in Table 14-1.

TS0 Output Signal Specifications: The output signal for TS0 consists of an alternating framing pattern containing FWs (frame words) and NFWs (not frame words). For the FW, the frame alignment signal is transmitted as shown in Table 14-1. Bit 1 is the Si (spare international) bit and bits 2 through 8 of the FW constitute the frame alignment signal. The NFW does not contain a frame alignment signal but consists of an Si in bit 1; bit 2 is always set to 1; bit 3 is for an RAI (remote alarm indication) bit; and bits 4 through 8 are Sn (spare national) bits. The notes at the end of Table 14-1 provide the output signal specifications for the bits in TS0.

Table 14-1. Allocation of Bits 1 Through 8 in TS0

Alternate Frames	Bit Number 1	2	3	4	5	6	7	8
Frame containing frame alignment signal — FW (Frame Word)	Si	0	0	1	1	0	1	1
	Note 1	Note 2						
Frame not containing the frame alignment signal — NFW (Not Frame Word)	Si	1	RAI	Sn	Sn	Sn	Sn	Sn
	Note 1	Note 3	Note 4	Note 5				

Notes:

1. A primary interface is provisioned for CRC (Cyclic Redundancy Check-4) or non-CRC.

   When the primary interface is provisioned for CRC, the Si bit positions contain the encoded CRC word, a CRC multiframe alignment signal, and international bits, as described in CCITT G.704. These international bits located in frames 13 and 14 of the 16-frame multiframe are set to a 0 or 1, defaulted to a 1, or not set if they have been provisioned for cross-connection.

   When provisioned for non-CRC, each Si bit is set to a 0 or 1, defaulted to a 1, or not set if they have been provisioned for cross-connection.

2. Bits 2 through 8 of the FW are the frame alignment signal (0011011).

3. Bit 2 of the NFW is always set to 1.

4. Bit 3 of the NFW is designated as an RAI (remote alarm indication) bit only and is set to 0 or 1 with a 1 representing the alarm condition.

5. Bits 4 through 8 of the NFW are the spare national bits and are explicitly set to a 0 or 1, defaulted to a 1, or not set if they have been provisioned for cross-connection.

TS0 Input Signal Specifications: Referring to Table 14-1, when the Si bit is provisioned for CRC-4, the incoming Si bit positions contain the encoded CRC-4 word, a CRC-4 multiframe alignment signal, and international bits. The CRC-4 bits are used for performance monitoring. The international bits are located in frames 13 and 14 of the multiframe and are provisioned for cross-connection. The Si bit can be displayed on request and the frame alignment signal is monitored for loss-of-frame alignment. For the NFW, if three consecutive zeros are detected in bit 2, a loss of frame is indicated. Bit 3 of the NFW is monitored for RAI (remote alarm indication). The status of bit 3 can be displayed on request (0 indicates no alarm at the upstream location and 1 indicates an alarm condition at the upstream location). Bits 4 through 8 are ignored on the incoming signal, but the status of these bits can be displayed on request.

Cross-Connections Involving TS0: There are certain rules and restrictions involved when cross-connections involve TS0. A discussion of these rules and restrictions follows:

- *TS0-to-TS0 Cross-Connection —* If CRC-4 is not utilized in the outgoing direction of TS0, then only bit 1 (Si bit) and bits 4 through 8 (Sn bits) of the NFW and bit 1 (Si bit) of the FW can be cross-connected. The other bits in TS0 are sourced as indicated in Table 14-1. The integrity of the Si bits of the FW and NFW is maintained so that these two Si bits are treated independently.

  If CRC-4 is utilized in the outgoing direction of TS0, then only bits 4 through 8 (Sn bits) of the NFW and bit 1 (Si bit) of frames 13 and 15 of the CRC-4 multiframe can be cross-connected. The other bits in TS0 are sourced as indicated in Table 14-A. Again, the integrity of the Si bits in the FW and NFW is maintained. There is no requirement for cross-connecting the Si bits of TS0 between a primary with CRC and one without CRC-4.
- *Cross-connection of TS0 to other than TS0 —* not allowed.
- *Cross-connection of other than TS0 to TS0 —* not allowed.

Setting the Spare National and International Bits in TS0: The Sn and Si bits in TS0 may be individually set to 0 or 1 via the CHG::TS0 command. These bits are represented by "abcdefgh" in the command. If the NPC is provisioned for the CRC-4 multiframe format, variables a and b represent the Si bits in the FW (frame word) and NFW (not frame word), respectively. If the NPC is provisioned for the CRC-4 multiframe format, variables a and b represent the Si bits in frames 13 and 15 of the CRC multiframe, respectively. Each of the bit positions ab and defgh may be set to 0 or 1, or may be marked with a dash (-) to indicate that the bit is unaffected, or they may be set to p indicating that this bit is passed through transparently if it is cross-connected. Bit c, the RAI (remote alarm indication) signal, is not settable. These parameters can also be used in the GRTH::NPC command to set these bits when the NPC is grown initially.

Reading the Spare National and International Bits in TS0: The Si and Sn bits in TS0 for both the transmit and receive directions are readable via the UTL::QRY,NPC command. All transmit or receive bits are displayed with this single command and the format for displaying the bits is the same as the format for setting the bits as shown above. If the NPC is not provisioned for the CRC multiframe format, variables a and b represent the Si bits in the FW and NFW, respectively. If the NPC is provisioned for the CRC multiframe format, variables a and b represent the Si bits in frames 13 and 15 of the CRC multiframe, respectively. Bit c is the RAI signal. Each of the letters a, b, c and d through h is a 1 or 0 indicating the value of the spare and RAI received bits.

Priorities for Setting Output Bits in TS0: As indicated previously, some of the bits in TS0 may have more than one use, depending on how the primary and the cross-connection are provisioned. The following is a summary of how all the bits in TS0 are sourced:

- *Framing Bits* — Bits 2 through 8 of the FW are not settable and are fixed at a pattern of 0011011. Bit 2 of the NFW is not settable and is fixed at 1.
- *RAI (Remote Alarm Indication)* — Bit 3 of the NFW is used as an RAI.
- *CRC-4 Framing* — Bit 1 of the FW and bit 1 of the NFW can be provisioned for CRC-4 framing.
- *Insertion Word Under a Failure Condition* — It is recommended that, if TS0 is cross-connected and a failure occurs on the incoming primary, AIS (alarm indication signal) be applied to all cross-connected bits in TS0 of the outgoing primary.
- *Cross-Connection* — Sn (spare national) and Si (spare international) bits can be cross-connected to a TS0 from any other TS0.
- *Bit Setting* — For information on setting the spare national and international bits when they are not cross-connected, see Table 14-1 and the paragraph on setting the spare national and international bits in TS0.
- *Defaults* — If none of the above uses for the output bits in TS0 are specified or are applicable, the spare national and spare international bits with the exception of bit 3 are defaulted to 1. Bit 3 is set to 0.

Applications of TS16

TS16 consists of bits 1 through 8 and can be used either for CAS (channel associated signaling) or for use as a telephone channel when it is provisioned for the NSA (non-signaling associated) mode. Table 14-2 shows how the bits in TS16 are allocated.

When TS16 is provisioned for CAS as specified in CCITT Recommendation G.704, the X bits shown in Table 14-2 are the spare bits and are either set to 1 or cross-connected. When cross-connecting the X bits, no setting of the X bits is required. Bit Y indicates the status of the TS16 multiframe alignment signal. A zero in this bit position indicates proper alignment of the multiframe and a one indicates a loss-of-frame alignment.

Table 14-2. Allocation of Bits 1 Through 8 of TS16

Channel Time Slot 16 Of Frame 0	Channel Time Slot 16 Of Frame 1		Channel Time Slot 16 Of Frame 2		Channel Time Slot 16 Of Frame 15	
0000 xyxx	abcd channel 1	abcd channel 16	abcd channel 2	abcd channel 17	abcd channel 15	abcd channel 30

CAS can be activated on a per-channel (per-time-slot) basis. When CAS is activated on a circuit, all four signaling bits are cross-connected. When the signaling bits are cross-connected from a circuit provisioned without signaling or from one that is idle (disconnected), then the signaling pattern will be the no-signaling code 1101. An all-zeros signaling bit code can be provisioned to be replaced with the all 1s code (1111) or passed through the network transparently (see the Provisioning section of this chapter).

When not provisioned for CAS, TS16 is treated the same as any TS1 to TS15 or TS17 through TS31 channel.

Cross-Connections Involving TS16: There are certain rules and restrictions involved when cross-connecting TS16. The restrictions apply only if the primary interface associated with TS16 is provisioned for CAS. If it is not provisioned for CAS, then TS16 is treated like any other TS1 through TS15 or TS17 through TS31. It is important to note that TS16 here refers to channel timeslot 16 and not telephone channel 16. The following are the rules and restrictions for cross-connections involving TS16.

- *CAS TS16 to Any Time Slot Other Than TS0 or Another CAS TS16* — The cross-connection is allowed, but it can only be in one direction since a 2-way cross-connection in this case is disallowed.

- *Time Slot Other Than a CAS TS16 to a CAS TS16* — This cross-connection is not allowed.
- *CAS TS16 to a CAS TS16* — Only bits 5, 7, and 8 (the "X" spare bits of TS16) of frame 0 of the 16-frame TS16 multiframe can be cross-connected. The other bits (a,b,c,d channel signaling bits) are overwritten at the transmit side of the TO direction TS16.

Provisioning

Provisioning in DACS II consists of both equipment provisioning and circuit provisioning. Equipment provisioning involves the growth (equipage) of the necessary circuit packs and their association with logical NPCs (network processing circuits). Circuit provisioning is the process of assigning certain parameters to a connection to make it compatible with the network and to pass the intended intelligence.

Equipment Provisioning

NPC and DPC: Each DPC terminates two 2.048-Mb/s transmission facilities. When each 2.048-Mb/s transmission facility is provisioned, it is assigned an NPC number. In Release 3.0, a 3-tuple hierarchical NPC numbering system was introduced as an alternative to the consecutive numbering of extended numbering. With hierarchical numbering, the NPC number is represented by uvmnp which identifies the unit number and allows counting the NPC number within the unit. Letters uv represent the 2-digit unit number (01-06), m is the single-digit module number (for example, 1 through 4 for IFTUs), and np is the 2-digit NPC number (01 through 32) in the unit.

Channel Numbering: The term telephone channels refers to the channels on the digital lines which carry the customer message information. The numbers given to these channels are the ones that are used in the DACS II commands to address these channels. For NPCs operating in the NSA (nonsignaling associated) mode, 31 channel time slots corresponding to telephone channels 01 through 31 are available for message transmission. Time slot 0 contains signal framing bits and assignable bits which can be cross-connected, and it is addressed in commands as channel 00. For NPCs operating with CAS signaling, both TS0 and TS16 have designated usage and are not considered telephone channels. Consequently, 30 telephone channels (01 through 30) are available with CAS and do not include time slot 0 or 16. Channel TS0 is addressed as channel 0 in DACS II commands, and TS16 of CAS circuits is addressed as channel 31. Refer to Table 14-3 for the correlation between channel time slots and telephone channel numbers.

Table 14-3. Correlation Between Time Slots and Telephone Channel Numbers

Time Slots	Telephone Channel Numbering (Default)	Time Slot Channel Numbering (Optional)*
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9
10	10	10
11	11	11
12	12	12
13	13	13
14	14	14
15	15	15
16	31	16
17	16	17
18	17	18
19	18	19
20	19	20
21	20	21
22	21	22
23	22	23
24	23	24
25	24	25
26	25	26
27	26	27
28	27	28
29	28	29
30	29	30
31	30	31

*Restricted to NSA primary applications.

Addressing of Timeslot Ranges: Any contiguous time slot range within a primary is permitted with the modifications as noted below. The timeslot addresses specified refer to the DACS II representation as specified in Table 14-3. In a range of channels for a CAS primary, channel time slot 16 is addressed as time slot 31. The following restrictions apply:

- A time-slot range must be contiguous and entirely within a primary.
- CAS TS16 is not allowed in range commands.
- TS0 is not allowed in range commands.
- A framed, synchronous 2.048-Mb/s cross-connection may be performed by specifying a range 00-31. For a primary provisioned for CAS, the range may also be specified as 00-30, in which case the spare "X" bits of TS16 are not cross-connected. The range may start at 01 if the Sn and Si bits in TS0 are not to be cross-connected.

NPC-Type and Options: The FTU NPC type PBxyz (120 ohms) and the type PCxyz (75 ohms) provide the 2.048-Mb/s primary terminations. If the NPC-type is not specified, then the default of PB100 applies. The argument xyz is a 3-digit hexadecimal number represented by 12 binary bits (abcdefghjklm). These 12 bits are shown in Table 14-4. Note that bits gh and jklm are not shown in Table 14-4 and are reserved for use in the enhanced 2.048 Mb/s feature package.

Table 14-4. NPC Provisioning Options xyz (abcd efgh jklm

Bit	Value	Meaning
a	0 1	CRC-4 multiframe in TS0. Non-CRC-4 framing in TS0.
b	0 1	NPC is not used as a synchronization source. NPC is used as a synchronization source.
c	0 1	CCITT G.732 consequent AIS (<tc> not used). Other alarm timing (Note 1).
d	0 1	Nonsignaling associated (NSA). Channel associated signaling (CAS). (Note 2).
e	0 1	Telephone channel numbering (default). (Note 2). Time-slot channel numbering (NSA).
f (Note 3)	0 1	Substitute signaling bits 1111 for 0000. Pass signaling bits through unchanged.

NOTES:

1. Reserved for use in enhanced 2.048 Mb/s feature package only.
2. If bit d is set to 1 then bit e must be set to 0.
3. Bit f can be set independently of all other options in this table.

NPC Growth: The GRTH::NPC command is used to equip the NPC, and the RST::NPC command places the NPC in service. The NPC type must be specified as either PBxyz or PCxyz. When the NPC is grown with the DCC (disconnected code), the DCC is either a 2-digit or a 3-digit code depending on whether the primary is provisioned for CAS or NSA. If provisioned for CAS, the DCC code must be three digits to accommodate the cross-connected time slot and its associated portion of TS16 used for signaling. The first two digits represent the cross-connected time slot and digit three represents signaling. For NSA primaries, the DCC code is two digits to represent the cross-connected time slot only. The default code is X'D5D (11010101) (1101).

Changing of NPC Options: The CHG::NPC TYPE command is used to change the xyz provisioning options of Table 14-4 after the NPC has been grown. Bits b and f can be changed without affecting service on the NPC. Bit a can be changed without degrowing the NPC. Bits d and e can be changed without degrowing the NPC if the NPC doesn't have any cross-connections on it. The Sn and Si bits are changeable on an in-service NPC without affecting service.

Circuit Provisioning

When performing cross-connect, disconnect, and change commands, there are certain parameters that are unique to 2.048 Mb/s applications. These are discussed in the following paragraphs.

Specifications of Signaling, Trunk Conditioning, and Insertion Words: The tc field is used to specify signaling type, signaling consequence action, and cross-connect consequence action. In addition, it is required that signaling bits be controlled/modified on a bit-by-bit basis by using the sc option discussed below. Within tc, TC(X;X') indicates signaling type and signaling consequence action and IW(X') indicates cross-connected time-slot consequence action. The application of tc is discussed in the following paragraphs and is shown in Table 14-5 and Table 14-6.

Table 14-5. Signaling Type and Signaling Consequence Action (Not Applicapble for TS0 or CAS TS16

Primary Type In Cross-Connection	Allowable <tc>, Signaling Type and Signaling Consequence Action Keyword	Resulting Signaling	Resulting Signaling Consequence Action (From,To)
CAS<-->CAS	TRSP	Fixed at 1101,X'D	Fixed at 1101,X'D
	TC(X'rs,X'tu)*	CAS	X'F
	Omitted	CAS	X'F
NSA<-->CAS	TRSP/Omitted	None (fixed at 1101,X'D in CAS direction)	1101,X'D in CAS direction
NSA<-->NSA	TRSP/Omitted	None	Not applicable

* Only used to provide per-time-slot DCC Codes.

Table 14-6. Time-Slot Consequence Action (Not Applicable for TS0 or CAS TS16

Allowable IW Keyword	Resulting Cross-Connected Time-Slot Consequence Action (From,To)
Omitted	X'FF, X'FF
IW X'pq*	X'FF, X'FF

* Only used to provide per-time-slot DCC codes.

- *Signaling Type* — Signaling may be either CAS (TC default on CAS primaries) or *none* (TRSP). In the TRSP case, a signaling state of 1101 is forced on the corresponding signaling bits in time slot 16 on any CAS primary. On an NSA primary, *none* is the only possibility, and no special action is taken for signaling. Keywords are TC, TRSP, or omitted, and a special application of TC as noted in the next paragraph.
- *Signaling Consequence Action (Trunk Conditioning)* — The only consequent action is 1111. This is provisionable by the keyword TC or omitting the keyword as follows:

  Trunk-conditioning parameters are specifiable and are X'FF,XFF as a default. These parameters are only used as a means of setting per-time-slot DCC (disconnect codes). The form of TC is TC(efghijkl,mnopqrst) or TC(X'rs,X'tu). The first is the binary form, and the second is the hexadecimal form. During the first time period after a failure, the TC specified in the efgh (or X'v) and mnop (or X't) fields is sent on the FROM and TO sides of the circuit, respectively. The tc specified in the ijkl (X's) and qrst (X'u) fields is sent on the FROM and TO sides, respectively, for the rest of the failure condition. (The FROM and TO sides are designated as they were specified in the cross-connect command; trunk conditioning is done on the incoming time slots of a failed primary.)
- *Signaling Conversion (sc)* — The mapping of signaling bits through DACS II on CAS primaries is controlled on a bit-by-bit basis by the option sc. Each bit in each direction is controlled directly by abcd of the SC(abcd,abcd) option. The first set of abcd bits represents the FROM direction and the second set represents the TO direction of the signaling bit.

The options are:

p - Pass bits through unchanged if cross-connected.

v - Pass bits through inverted if cross-connected.

0 - Set the bit to 0 at the output.

1 - Set the bit to 1 at the output.

The bits that are controlled with a 0 or 1 are not influenced by the TC signaling consequence action or cross-connect command and will maintain the 0 or 1 output state.

- *Cross-Connection Time Slot Consequence Action (Insertion Word)* — The only consequent action is 11111111. Insertion word parameters are specifiable and are X'FF as a default, but they are only used as a means of setting per time slot disconnect codes DCC only. The form is specified explicitly as IW(X'pq), where X'pq is sent in both the FROM and TO directions on the incoming time slots of a failed primary. Other standard keywords, such as TRB, may also be provided but are not required.
- *One-Way Circuits* — With the restriction noted above, the trunk conditioning and insertion word positions for the FROM direction of a one-way circuit are replaced by dashes; for example, TC(-------- ,11111111), IW(X'FF).
- *Multipoint Circuits* — Only broadcast multipoint circuit cross-connections using BCON support signaling as an option.

Cross-Connections Involving Time Slot 0 and CAS Time Slot 16: The following rules apply for cross-connections involving TS0 and TS16.

- *Disallowed Cross-Connections* — If a disallowed cross-connection involving time slot 0 or 16 is attempted, the command will be denied and a DNY message will be printed that is appropriate to the command.
- *Signaling/Trunk Conditioning* — For a cross-connection between two TS0s or two CAS TS16s on CAS primaries, TRSP is the only possibility and the allowable signaling/trunk conditioning options are restricted accordingly. A one-way cross-connection from CAS time slot 16 to a time slot other than 0 or 16 is treated like any other one-way cross-connection involving time slots 1 through 15 and 17 through 31.
- *Insertion Word* — Insertion words for cross-connections between two TS0s or two CAS TS16s only apply to the cross-connected spare bits in these time slots (that is, Si/Sn and x bits). The other insertion word bits have no effect. (A one-way cross-connection from CAS TS16 to a time slot other than 0 or 16 is treated like any other one-way cross-connection involving time slots 1-15 and 17-31).

Cross-Connections Involving DMB: Cross-connections involving the μ law DMB (digital multipoint bridge) are specified in Table 14-7 for analog applications and digital bidirectional point-to-multipoint polling data applications. Included in Table 14-7 is the non-DMB cross-connection because the concept of A→μ and μ→A-law conversions has been introduced. It should be noted that all legs of a bridge circuit must use the same type of code conversion and that the type will be set by the option selected in connecting the first leg.

Table 14-7. A→μ Code Conversions

Cross-Connect Type From/To	Name Keyword	Conversion Type
PB/PC → PB/PC	NAM/Omitted	none
PB/PC → DMB	NAM	none
	Omitted	A→μ

Provisioning of Cross-Connect DCCs: The per-cross-connect DCC (disconnect code) option can be used in the TDIS,ODIS and BDIS commands. If DCC is specified, the "tc" value specified during TCON, OCON, or BCON will be the value inserted into the disconnected channel and its associated signaling byte (when provisioned for CAS). Normally, this will be the X'FF and X'F codes, respectively. If DCC is not specified, the GRTH::NPC DCC code is used as the disconnect code. For user provisionable DCC codes, the TC and IW are specified in the paragraph above.

Note: The GRTH NPC disconnect code DCC is used in the normal way as specified in the part on equipment provisioning.

When channels formed using the TCNT and OCNT commands are disconnected using the DCC keyword, channels will be terminated using the final tc state as specified when the cross-connection was formed. If DCC is not specified, the GRTH::NPC disconnect code is used.

Timing and Synchronization

Timing Sources

In a 2.048 Mb/s environment, DACS II can be synchronized from any of the following time sources:

1. A nontraffic 2.048-MHz synchronization signal with a frame structure in accordance with CCITT Recommendation G.704 and electrical characteristics in accordance with CCITT Recommendation G.703 for 2.048-Mb/s signals. (Note that both 75- and 120-ohm interfaces are required.)
2. Unframed sources: 2.048-MHz, 1-MHz, and 5-MHz, timing signals from clock distribution systems.
3. A designated incoming 2.048-Mb/s traffic signal. Either software or hardware methods may be used to select a traffic signal. Software selection is preferred.
4. An internal clock having the accuracy and stability to provide service with a frame slip rate not to exceed 3.5 slips per hour for a 24-hour period.

Normal operation is any combination of type 1, type 2, and type 3, with type 4 used primarily for emergency conditions.

It is possible for any combination of at least three sources of types 1, 2, and 3 to be active at a time.

The type 3 signal can be obtained from any of eight designated NPC slots in the first two modules of unit positions 1 and 2. With this number of possible sources, NPCs in different modules and units can be selected as sources to prevent the possibility of losing all inputs because of a hardware failure affecting a circuit group. For example, four primaries from FTU 1 (two each from FTMs 1 and 2) and four from FTU 2 (two each from FTMs 1 and 2) could be used for diversity. It is further recommended that high numbered slots be chosen for the synchronizing primaries to allow standard primaries to be grown in order, while synchronizing primaries could be isolated to the ends of the shelves.

Source Selection

The selection of a timing source is both provisionable and automatic and has the capability of being set up in a priority fashion. When a failure occurs to a source, a second source of equal or lesser priority will automatically be switched in. When the failure clears, timing will be derived from the highest priority source. Manual source selection is also provided by changing synchronizer priorities with the CHG SYNC command.

Test Access

Test Access NPCs

There can be up to four test access NPCs (NPCTP) numbered 1 through 4 that are designated as test access NPCs by using the GRTH: NPC NPCTP command. Only NPCs provisioned to support CAS may be designated for test access. There can be up to 12 test access ports per test access NPC, for a total of 48 possible ports.

The mapping of test access ports to channel time slots in a test access NPC is shown in Table 14-8.

Table 14-8. Timeslot Mapping for Test Access Ports

Test Access Port	From Time Slot	To Time Slot
01,13,25,37	5	6
02,14,26,38	7	8
03,15,27,39	9	10
04,16,28,40	11	12
05,17,29,41	13	14
06,18,30,42	17	18
07,19,31,43	19	20
08,20,32,44	21	22
09,21,33,45	23	24
10,22,34,46	25	26
11,23,35,47	27	28
12,24,36,48	29	30

Note: Time slots 0 and 16 have special use and are assigned for testports.

Cross-Connection of Unused Time Slots

Time slots 5 through 14 and 17 through 30 can be cross-connected if they are not in use as test access ports.

Restrictions or Blockage on Test Access Port Growth

- Test access ports must be grown consecutively.
- If time slots 0 through 4, 16 and 31 in a test access primary are cross-connected, these cross-connections will not cause blockage of test access port growth.
- If time slots 5 through 14 and 17 through 30 in a test access primary are cross-connected, these cross-connections will not cause blockage of growth of test access ports that do not involve the cross-connected time slots.

Configurations

The following exceptions for test access configurations apply to 2.048 Mb/s interfaces.

- Monitor test access of CAS time slot 16 is provided. Split test access is not permitted.
- The HUB test access command can only be used on NPCs and NPCTPs that are provisioned as CAS primaries.

Trunk Conditioning - Test Port Type

Trunk conditioning (tc) can be specified either when the test port is grown or in the TTST command line. The following rules are used to determine which tc to apply in the TTST::MON command:

- *For mapped circuits* — The tc takes on the mapped XCON tc value and overrides any other tc specified at test port growth or in the TTST command line.
- *For unmapped circuits* —
  1. If tc is specified in the command line, then apply it as specified.
  2. If tc was specified in the test port growth command, then apply it as specified.
  3. Otherwise, if no tc was specified in the TTST or GRTH command line, deny the command.

Test Access of Unmapped Circuits: In test access of a mapped circuit, the test port takes on the characteristics (tc, sc A—>μ) of the tested circuit. When an unmapped NPC is tested, the tc and A—>μ conversions are set according to the rules specified above.

The sc is not specifiable in the test command; the test access circuit will always have the sc defaulted to PPPP.

Automatic Test Release

Upon a frame reset, all test access is disconnected and the circuits revert to their prior states.

If the administrative port over which a test access was initiated fails, then the test access in question is disconnected and the circuit is restored to its prior state.

Monitoring Jacks on Primaries

Each 2.048-Mb/s traffic output signal can be monitored at a miniature jack on the DPC pack. This jack on the front of the pack provides bridging access to the signal in the transmit direction for both NPCs on the pack; the bottom jack is for the odd numbered NPC and the top jack is for the other NPC. These monitor points are in the form of a connector that is accessible from the front of the frame. The monitor point signal level for the 75- and 120-ohms interfaces is 30 dB ± 20 percent below the input signal level when the monitor point is terminated in 75- and 120-ohms, respectively. Transmission of the monitored signal will continue to comply with the appropriate mask provided in CCITT G.703 when a short circuit is applied across the monitor point.

Maintenance and Alarms

Alarm Classification

DACS II alarm classification is consistent with CCITT Recommendation M20. Five main categories of alarms are provided:

- *Critical Prompt Maintenance Alarm (PMA Critical)* — The PMA critical alarm is declared for a failure or a combination of failures affecting six or more primary block interfaces. Examples include duplex failure of the cross-connect network or six 2.048-Mb/s primary signals in a loss-of-frame alignment condition.

- *Major Prompt Maintenance Alarm (PMA Major)* — The PMA major alarm is declared for:
  1. Failure of only one side of a duplex entity that would result in a PMA critical if the duplicated side also failed.
  2. Any failure or combination of failures affecting five or less primary block interfaces.
  3. Any power failure.
- *Deferred Maintenance Alarm (DMA Minor)* — A DMA minor alarm is declared for any non-service-affecting failure not included in a PMA major or a minor state 2.048-Mb/s failure.
- *Main Controller Alarm* — The failure of a DACS II main controller (main controller failure does not affect service on DACS II; it affects only the ability to change existing service).
- *Maintenance Information (MI)* — Conditions that do not warrant alarm classification but require message(s) to be sent over the DACS II administrative links.

External Alarm Indication

DACS II offers an alarm status panel and contact relay closures for a summary of the frame alarm status. DACS II provides PMA critical, PMA major, DMA minor, and main controller failure summary alarms on the frame status panel via the illumination of LEDs. The DACS II alarm philosophy relies upon the intelligence built into the equipment to indicate the nature of any equipment failures and to indicate what corrective actions need to be taken. Except for LEDs on power converter units, indicator fuses, and power alarm lamps, there are no alarm indicators on the frames besides the summary alarm LEDs on the status panel. Local or remote terminal operation is used to determine corrective action.

There are two sets of external alarm indicators, one local and one remote. In the event of a failure, either one or both can be activated.

Fault Conditions

In accordance with CCITT and other recommendations, DACS II detects the following fault conditions on each 2.048-Mb/s link:

- Loss of incoming 2.048-Mb/s signal (LOS)/loss of 2.048 Mb/s frame alignment (LOFA).
- AIS (alarm indication signal).
- EER (excessive error rate) in the frame alignment signal.
- RAI (remote alarm indication) received in TS0 bit 3 of the nonframing word (if provisioned).
- Remote alarm indication received in TS0 bit 4 of the nonframing word. For the enhanced 2.048 Mb/s feature package, this bit can be provisioned for a RAIS (remote AIS) or RBER (remote BER) indication sent upstream over the facility.
- Remote loss of synchronization alarm indication (SFI) received in TS0 bit 5 of the nonframing word. For the enhanced 2.048 Mb/s feature package, this bit can be provisioned to indicate that the DACS II is deriving internal timing from its own internal clock. In the receive direction, the DACS II monitors bit 5 for indication of remote loss of network synchronization.
- Transmic 1G remote alarm indication received in bits 3 through 8 of the nonframing word. This provisionable state is described in the description section of this chapter.

If time slot 16 is used to carry channel-associated signaling information, then the following additional fault conditions are detected in accordance with CCITT recommendations:

- Loss of multiframe alignment (LMA)/loss of signal in TS 16 (TS 16 LOS).
- Alarm indication signal in TS 16 (A16).
- Remote alarm indication in TS 16 bit 6 frame 0.

Consequent Actions to Fault Conditions

The DACS II has two modes of consequent actions: CCITT G.732 and enhanced per channel alarm processing. In either case, the alarm declaration for declared 2.048-Mb/s alarms is the same. Table 14-9 summarizes the alarm classifications.

Table 14-9. Alarm Classification for 2.048 Mb/s Alarms

Detected Alarm	DACS II Classification
LOS/LOFA	PMA Major
AIS	MI
EER	PMA Major
RAI	MI
RAI4	MI
SFI	MI
LMA	PMA Major
TS 16 LOS	PMA Major
A16	MI
RMA	MI

CCITT G.732 Consequent Actions: In this mode, DACS II performs consequent actions consistent with CCITT Recommendation G.732 for 2.048-Mb/s ports. DACS II performs consequent actions upon detection of the fault condition, but not during the declaration of the alarm (for example, DACS II inserts AIS upon detection of the LOFA fault condition. It does not wait until the alarm is declared). DACS II consequent actions are shown in Table 14-10.

Table 14-10. DACS II G.732 Consequent Action (Note)

Fault Condition	Data Channels	Signaling Bits	Remote Action
LOS/LOFA	AISD	AISS	Bit 3
AIS	AISD	AISS	Bit 3 and/or Bit 4
BER>10^{-3}	AISD	AISS	Bit 3 or Bit 4
RAI	NA	NA/AISS (optional)	NA
RAI4	NA	NA/AISS (optional)	NA
SFI	NA	NA	NA
LMA	NA	AISS	RMA
RMA	NA	NA/AISS (optional)	NA
A16	NA	AISS	RMA

Note:

AISD = All 1s to received data bits
AISS = All 1s to received signaling bits
NA = No Action.

The timing of DACS II consequent actions is summarized as follows:

- *Insertion of AISD* — This is enacted within 2 ms of the detected fault. The insertion of AISD is also terminated within 2 ms of the cleared fault condition.
- *Insertion of AISS* — This is enacted within 5 ms of the detected fault. The insertion of AISS is also terminated within 5 ms of the cleared fault condition. Note that AISS is not inserted on transparent type connections.

The consequent actions for setting remote alarm bits depend on how the remote alarm bits were provisioned on the 2.048-Mb/s interface. In summary, the following general comments apply:

- When only bit 3 is required (that is, the basic CCITT 2.048-Mb/s interface), bit 3 is sent back upstream within 2 ms of the fault condition (AIS, LOFA/LOS, ERR).

- When both bits 3 and 4 are being used as remote alarm bits, they are sent back upstream after 144 ms of the detected fault.
- It is also possible to use both bit 3 and bit 4 as remote alarm bits with bit 3 having a fast response and bit 4 having a slower response. In this case, bit 3 and bit 4 are being used as remote alarm bits; bit 3 can be sent back upstream within 2 ms of the fault condition while bit 4 can be sent after 144 ms of the defected fault. This scenario, however, does not allow complete independence in the information carried in bit 3 and bit 4. For example, consider the case when bit 4 is used as a remote indicator for AIS. When AIS is detected, bit 3 will be sent back upstream within 2 ms (this is the CCITT action). After 144 ms, bit 4 will also be sent back upstream to indicate AIS was detected.
- The RMA bit (bit 6 of TS 16 in frame 0) is sent back upstream within 5 ms of the detected fault condition.

Enhanced Per-Channel Alarm Processing (Trunk Conditioning): The DACS II offers the option of an enhanced per-channel alarm processing method of consequent action. The choice between G.732 consequent actions and the enhanced per-channel alarm processing consequent action is made on a per-2.048-Mb/s basis during the provisioning of each termination. The main differences between the enhanced method of consequent actions and the G.732 method are the following:

- Per-channel control of data bits and signaling bits (that is, consequent action is not limited to all 1s). In this manner, the consequent actions for the data bits and the signaling bits for each cross-connection can be uniquely specified and are not limited to all 1s.
- Signaling is "frozen" to the last known good state when a fault condition is detected until the alarm is declared. After the alarm is declared, the consequent action on the signaling bits is performed. After an insertion of all 1s on affected time slots, a per-channel insertion word other than all 1s can be specified.

2.048-Mb/s Digital Line Performance Monitoring

In addition to detection of fault conditions, the DACS II employs extensive performance monitoring on each incoming 2.048-Mb/s signal. These capabilities allow for quality of service measurement as specified in CCITT Recommendation G.821. The DACS II monitors the following indicators on each 2.048-Mb/s termination:

- DM (Degraded Minutes)
- SES (Severely Errored Seconds)
- ES (Errored Seconds)
- US (Unavailable Seconds); also called Failed Seconds

- SLIP (Slip Events)
- CRC4 Check Block Error Events (CRC4) (only measured on signals employing CRC4)
- FRER (Framing Error Events)
- LFA (Loss-of-Frame Alignment Events)
- MER (Multiframe Alignment Error Events) (only measured on signals that employ Channel Associated Signaling in TS 16).

When the 2.048-Mb/s primary employs CRC4, CRC4 check block errors are used to calculate the parameters specified in CCITT Recommendation G.821 (that is, DM, ES, SES, and US). When CRC4 is not used by the 2.048-Mb/s signal, framing errors are used to calculate the parameters in CCITT Recommendation G.821.

System thresholds are initialized for each parameter when the DACS II frame is provisioned. Three optional thresholds may be initialized for each parameter that makes use of thresholds (the default threshold is the maximum count of the range for that parameter). When a 2.048-Mb/s termination is provisioned on the DACS II frame, one of the four thresholds provisioned for the frame may be selected for generating messages for each respective parameter. For example, the Degraded Minutes 1 hour counter has a range of 1 through 60. When the frame is provisioned, three system thresholds may be selected between 1 and 60. The fourth threshold is the value 60. After this has been done, the 1-hour Degraded Minutes threshold chosen for any 2.048-Mb/s termination may be any one of the four values. The alarm classification of the threshold-crossing event (that is, prompt maintenance alarm, deferred maintenance alarm, maintenance information only, or no classification) is flexible and is also done on a per-2.048-Mb/s basis when provisioning the 2.048-Mb/s interface. Table 14-11 presents the respective ranges from which system thresholds may be selected for each parameter monitoring parameter. The remaining parameters — LFA, MER, FRER, and CRC4 — are only accumulated and may not have thresholds specified.

Table 14-11. System Threshold Ranges for 2.048 Mb/s Terminations

Parameter	Range
Degraded Minutes (1 Hour)	1-60
Degraded Minutes (24 Hour)	1-1440
SERS (15 Minute)	1-900
SERS (24 Hour)	1-65535
ERS (15 Minute)	1-900
ERS (24 Hour)	1-65535
US (15 Minute)	1-900
US (24 Hour)	1-65535
SLIP (15 Minute)	1-900
SLIP (24 Hour)	1-65535

DACS II offers utility commands to:

- Display the current count for all performance parameters for selected transmission links
- Display the current count of a particular parameter for selected or for all transmission links
- Clear the count of a particular parameter for selected or for all transmission links
- Clear the count of all parameters for a selected transmission link.

The daily counts and current alarm state of all transmission links are also displayed automatically as part of a daily report. By default, the daily report is issued at midnight and all parameter counts and alarm states are reported. The time of day for the daily report and the parameters and alarm state to be included in the report are user definable. A status command is also available which gives a summary of the current status of a specified primary block including the alarm state, all parameter counts, options selected, and message threshold settings.

2.048-Mb/s Signal Access

DACS II offers two enhanced maintenance operations for accessing 2.048 Mb/s signals.

- *Output Monitoring Points* — Output monitoring points are available for each outgoing 2.048-Mb/s signal on the DACS II. These monitoring points are accessible directly from the front of the 2.048 Mb/s circuit pack. Monitoring points can be used to monitor outgoing 2.048-Mb/s signals from a DACS II frame.
- *2.048-Mb/s Loopbacks* — Commands are offered to manually execute or retire 2.048-Mb/s loopbacks (all 256 bits of a frame). The loopback, when executed, is performed on the DACS II input. The downstream action (the direction opposite the loopback) can be either to insert all 1s on the received time slots or to transparently cross-connect the received time slots. When the all 1s signal is chosen, DACS II disables alarm processing and resets the alarm states and performance-monitoring counts of the received 2.048-Mb/s signal.

Specification Summary

Frame Configuration

- *One-Bay Frame* — 660 mm wide, 2134 mm high, by 305 mm deep.
- *Two-Bay Frame* — 1320 mm wide, 2134 mm high, by 305 mm deep.
- *Three-Bay Frame* — 1980 mm wide, 2134 mm high, by 305 mm deep.
- *Additional Interface Bay(s)* (for CEF) — 660 mm wide, 2134 mm high, by 305 mm deep.
- *Frame Weight* — 412 kg (3 bay frame with two DSPUs). Each bay approximately 140 kg.

Climate

- *Normal Ambient Temperature* — 4 to 38 degrees Celsius
- *Short Term Temperature Limits* — 1 to 49 degrees Celsius
- *Normal Ambient Humidity* — 20% to 50%
- *Short Term Limits* — 20% to 80%.

Line Interfaces

- *Termination Capacity* — Five hundred and twelve 2.048-Mb/s bidirectional ports.
- *Nominal Line Rate* — 2.048-Mb/s.
- *Line Code* — HDB3.
- *Electrical Interface* — CCITT G.703 (75Ω unbalanced and 1200Ω balanced).
- *Frame Structure* — CCITT G.704.
- *Multiframe Structure* — Channel associated signaling (CCITT G.704) or non-signaling associated.

Synchronization

- *Inputs* — Up to eight (fully duplicated).
- *Timing References* — Complies with CCITT G.735. Received traffic or non-traffic-carrying 2.048-Mb/s streams; external sources at 512-kHz, 1000-kHz, 1544-kHz, 2048-kHz, and 5000-kHz; 64-kb/s (DDS) composite clock; 1.544-Mb/s DS1 streams; and BSRF analog signals.
- *Internal Stability* — CCITT local exchange and CCITT toll exchange.
- *Output* — 2048-kHz sine wave (CCITT G.703).

Cross-Connect Network

- *Size* — Modular growth up to 16,384 x 16,384 cross-points. Expansion achieved through addition of 4096 x 4096 TSIs and other circuit packs.
- *Type* — Nonblocking, single-stage, fully duplicated, time-based switch.
- *Cross-Connect Capabilities* —
    1. Unidirectional, bidirectional, point-to-point, and broadcast 64-kb/s channels.
    2. International gateway (A/μ law conversion programmable per channel).
    3. Cross-connection of channel associated signaling bits (programmable per channel).

Control System

- Software-based control structure.
- Distributed processing (1-Mb/s intraframe local area network distributed over eight high performance processors).
- Magnetic disk and tape for nonvolatile memory storage and software upgrades.

Communication System

- *Available Ports* — Up to six administrative ports.
- *Type* — Serial asynchronous (RS-429/423) and serial synchronous (RS-429/423). Passively adaptable to RS-232C.
- *Rates* — 300, 600, 1200, 2400, 4800, and 9600 b/s.
- *Configuration* — Either 6 asynchronous or 4 asynchronous and 2 synchronous.
- *Language* — PDS (Bellcore) or MML (CCITT) programmable per link or user.
- *Protocol* — Asynchronous use SCCSAI; synchronous use X.25.

64 kb/s Test Access

- *Primary Interfaces* — Up to four ports may be dedicated for 64 kb/s test access.
- *Test Ports per Test Primary* — 12 test ports.
- *Modes* — Monitor, split, and terminate and leave (released and activate), test port loop, and hub.

Power

- *Input Voltage* — Nominal supply of –48 Vdc with tolerable range of –42.5 to –52 Vdc.
- *Power Dissipation* — 1150 Watts for a fully loaded 3-bay frame without DSPUs.
- *Power Dissipation* — 1585 Watts for a fully loaded 2-bay frame with DSPUs.

Alarming

- *Classification —*
  1. *Critical PMA —* Critical service-affecting alarm
  2. *Major PMA —* Service-affecting alarm
  3. *Main Controller Major —* Main Controller failure
  4. *Minor DMA —* Non-service-affecting alarm
  5. *Maintenance Information (MI) —* Information only.
- *Alarm Contact Types —*
  1. Local Visual
  2. Local Audible
  3. Remote Alarm.
- *Alarm Contact Ratings —*
  1. *Maximum Current —* 1.0 Amps
  2. *Maximum Voltage —* 48 Volts
  3. *Maximum volt amp rating —* 25 Volt Amps
  4. Transient noise suppression devices (diodes, networks, or other devices) must be used to protect terminations from inductive load transients.

Status Panel

- LEDs for summary of frame alarms
- Alarm cutoff button for silencing audible alarms
- System reset and reset enable switches
- TTY1 for temporary maintenance activities
- Lamp test switch.

Duplication

- Cross-Connect Network, synchronizer, DSPU, and traffic-carrying circuit packs handling more than sixty-four 64-kb/s channels are fully duplicated.
- Redundant FTU power packs.

Enhanced 2.048 Mb/s Feature Package

General

The enhanced 2.048 Mb/s feature package of DACS II incorporates all the basic 2.048 Mb/s features plus the additional features discussed in the following paragraphs. These additional features are listed below and fulfill customer requests for use in their own countries.

- Transmic 1G compatibility
- Transmic 2G compatibility
- C-bit processing
- Minor bit error rate alarm and extended signaling freeze delay.

Transmic 1G and 2G are two different types of circuits which differ in the treatment and processing of the spare bits in TS0. Transmic 2G circuits provide additional processing of signaling bit c. C-bit processing requires a new circuit pack designated CPR (C-bit processing) which is equipped in the DSPU (digital signal processing unit).

The spare bits in TS0 consist of:

- Either bit 1 of the FW or bit 1 of the NFW word if CRC-4 is not employed on the 2.048-Mb/s signal. If CRC-4 is employed on the 2.048-Mb/s signal, then the Si (spare international) bits in frames 13 and 15 of the multiframe are spare bits.
- Bits 4 through 8 of the NFW word.

With the enhanced 2.048 Mb/s feature package, each transmitted TS0 spare bit can be independently provisioned to be sourced from one of the following methods:

- Set to logical 1 (specified when the 2.048-Mb/s interface is provisioned).
- Set to logical 0 (specified when the 2.048-Mb/s interface is provisioned).

- Sourced from an incoming TS0 via a cross-connection (specified when the 2.048-Mb/s interface is provisioned and when the cross-connection is provisioned).
- Default logical state if nothing is specified.

In addition, bits 4 and 5 of the NFW word may be independently provisioned as remote alarm bits when the 2.048-Mb/s interface is provisioned. Bit 4 may be either used for a remote alarm bit for the AIS (alarm indication signal) or BER (bit error rate) condition. Bit 5 may be used for a remote alarm bit for loss of external synchronization (that is, whenever DACS II is operating off its internal clock, bit 5 is set to an active state). When either of these bits is provisioned for a remote alarm bit, it will be used only for the specified remote alarm purpose and may not be sourced from another TS0 via a cross-connection. Bit 4 defaults to a 0 and bit 5, to a 1 when the NPC is grown; but these states can be changed using the CHG NPC TS0 command to establish different normal states.

A command is also available to query the provisioned state of the outgoing TS0 spare bits. Thus, this command can be used to see how the outgoing TS0 spare bits have been provisioned in the DACS II data base.

Each received spare bit can be independently monitored for slow varying state changes. In this manner, DACS II monitors and reports state changes for those received spare bits that were provisioned to be monitored. The provisioning of this feature is on a per-2.048-Mb/s basis and is done when the termination is provisioned. A command is also available to query the provisioned state for the monitoring process. This can be used to see whether a spare bit(s) of an incoming TS0 has been provisioned for monitoring.

Independent from monitoring for slow, varying state changes, DACS II offers a command that allows the user to read the last received state of the TS0 bits. In this manner, the DACS II takes a snapshot view of the last received TS0 bits and reports them to the user. This provides an efficient, centralized mechanism for reading TS0 spare bits.

Enhanced NPC Provisioning

For the enhanced 2.048 Mb/s feature package, the NPC is still grown (provisioned) in the DACS II data base as a primary block (type PB or conditionally type PC), but additional xyz options are supported. The same equipment codes of DPC are used with the addition of the TG187 which supports the minor bit error rate and extended signaling freeze capabilities.

The argument xyz is interpreted as a 3-digit hexadecimal number. The 12 bits in xyz, represented as abcd efgh jklm, indicate the selection of provisioning options for the NPC as shown in Table 14-12. Provisioning options a through f are the same as in the basic 2.048 Mb/s feature.

Table 14-12. NPC Provisioning Options xyz (abcd efgh jklm)

Bit	Value	Meaning
"		
a	0 1	CRC-4 multiframe in CTS 0. Non-CRC-4 framing in CTS 0.
b (Note 1)	0 1	NPC is not used as a synchronization source. NPC is used as a synchronization source.
c (Note 2)	0 1	CCITT G.732 consequent action, AIS in signaling. Firmware-controlled consequent action.
d	0 1	NSA (nonsignaling associated). 16-state CAS (channel-associated signaling).
e	0 1	Telephone channel numbering. Channel time-slot numbering (NSA).
f	0 1	Convert the abcd bits of CTS 16 to 1111 if 0000. Transmit the 0000 in the abcd bits transparently.
g (Note 3)	0 1	AIS applied to receive CTS16 for RAI, RAIS, or R16. AIS not applied to receive CTS 16 for RAI, RAIS, or R16.
h (Note 4)	0 1	Bit 5=SFI unaffected by SH (Synchronizer Holdover). Bit 5=SFI inverted on SH on output and detected on input.
jkl (Note 5)	000 001 010 011 100 101 110 111	TS0 bit 3 = RAI indication in 2 ms. TS0 bit 3 = RAI indication in T. (Note 6). TS0 bit 4 = RAIS in T and RAI in 2 ms. (Note 6). TS0 bit 4 = BER detected, RBER enabled in T and RAI in 2 ms (Note 6). TS0 bit 4 = RAIS and RAI in T (Transmic 2G) (Note 6). TS0 bit 4 = BER detected, RBER disabled and RAI in T (Note 6). Transmic 1G bits 3 through 8 in T (Note 6). Unassigned.
m	0	Unassigned; only m = 0 is valid.

*REFERENCE: HEX A=10, B=11, C=12, D=13, E=14, and F=15.

See Notes on continued pages.

Table 14-12. NPC Provisioning Options xyz (abcd efgh jklm) (Continued)

Notes:

1. Clock from NPC synchronizer is enabled if this bit is set to 1; otherwise, it is disabled.
2. The G.732 Consequent Action of inserting the AIS (alarm indication signal) in data channels is applied within 2 ms whether bit c=0 or c=1. When c=1, 480 ms after detection of the local alarm, the AIS in data channels is overridden by the insertion word sourced from the NPC. The insertion word pattern can be specified in the cross-connect command. On 2.048 Mb/s NPCs in gateway, the insertion word always defaults to AIS.

   Bit c also selects the Consequent Actions on signaling bits. When c=0, the AIS in signaling bits is applied within 2 ms. Only c=0 is supported in basic 2.048 Mb/s feature package (except with DS1 gateway) and both AIS and RAI will be applied within 2 ms. When c=1, signaling freeze occurs upon detection of any single framing error or multiframe error and remains in effect until two multiframes without errors are received. If the primary goes into the alarm state, then the trunk-conditioning pattern from the NPC overrides the signaling freeze.

   Bit c also selects the elapsed time for declaring and clearing remote alarms. With c = 0, both remote and local alarms are declared and cleared in 144 ms. With c = 1, only remote alarms are declared and cleared in 144 ms; the local alarms are declared and cleared in 480 ms **except when bits jkl = 011 or 101.**
3. Option g has meaning only if the NPC is provisioned for CAS (bit d=1); otherwise, it is ignored. If option g=0 is selected, the AIS will always be applied to received CTS 16 upon RAI and it will also be applied upon detection of RAIS (remote alarm indication signal) if the NPC is provisioned for RAIS.

   If option g=1 is selected, the AIS will not be applied upon detection of RAI, RAIS, R16.

Table 14-12. NPC Provisioning Options xyz (abcd efgh jklm) (Continued)

4. With bit h=1, TS0 bit 5 is used as an SFI (synchronization failure indication). It is controlled by DACS II software which forces the NPC to invert (or set to an alarm state) when the synchronizer enters the holdover mode. TS0 bit 5 defaults to 1 when the NPC is grown unless it is set to 0 by setting parameter c=0 in the CHG NPC TS0 command. If bit h=1 and a change of state of bit 5 is detected, an information message is generated for Transmic 1G. For all other combinations of xyz, an alarm message is generated upon detection of change of state of spare bit 5. When both b=1 and h=1 and an NPC (used as sync source) receives bit 5 of the NFW in the alarm state, then the NPC will squelch the clock signal it is generating. If the DACS II is using this clock as sync source, the sync pack terminating this clock will recognize the failure and switch sources.

5. For bits jkl=000, TS0 bit 3 which is the RAI (remote alarm indication) is processed as specified in CCITT Recommendation G.704 Section 2. This is the same as in the basic 2.048 Mb/s interface when option c is selected as 0. If jkl does not equal 000, use the TS0 bit 3 as RAI remains unchanged except that TS0 bit 3 is set to 144 ms after detecting the failure. TS0 bit 3 is always set to 0 for nonalarm conditions and is set to 1 for alarm conditions.

   For bits jkl=010 or 100, TS0 bit 4 is used for RAIS to indicate receipt of AIS after 144 ms. Conversely, the receipt of RAIS causes consequent action after 144 ms.

   For bits jkl=011 or 101, BER will be calculated and declared as DMA; and for jkl=011, TS0 bit 4 sends a RBER (remote BER) indication upstream.

   Bit 4 defaults to 1 when the NPC is grown unless it is set to 0 by setting parameter d=0 in the CHG NPC TS0 command.

6. Time T = 144 ms for bit c=0 and 480 ms for c=1 **except when bits jkl = 011 or 101**. For those jkl valves when c=1, then T = 2496 ms for extended signaling freeze (and clear consequent action clears after 624 ms).

Selection of Transmic 1G Capabilities

The recommended xyz options for Transmic 1G are binary 1000 0111 1100 which is equivalent to hexadecimal X'87C. This 12-bit binary pattern corresponds to bits a through m in Table 14-12. As indicated in this pattern, bits jkl are set to 110 to provision the NPC to monitor bits 3 through 8 in the received TS0 of the NFW and interrupt the UC (unit controller) if a change of state is detected in any of these bits. Monitoring of these bits is stopped upon detection of excessive error rate or other severe alarm condition. In the transmit direction, the NPC will automatically set bits 3 through 8 in TS0 of the NFW to the values shown in Table 14-13 when one of the indicated alarm conditions is detected. When the NPC is restored after a failure, bits 3 through 8 in the transmit direction will be set to 0 and the Si bits, to 1.

Table 14-13. Bit Values Resulting From Indicated Alarm Condition

Alarm Condition	Bits 3 and 4	Bits 6,7 and 8
Normal Conditions	00	000
AIS (Alarm Indication Signal)	00	111
BER (Excessive Error Rate)	10	111
LFA or LS (Loss of Frame Alignment or Loss of Signal)	11	11

Selection of Transmic 2G Capabilities

The recommended xyz options for Transmic 2G are binary 0001 0111 1000 which is equivalent to hexadecimal X'178. This pattern enables only that part of Transmic 2G that pertains to bits in TS0. It does not enable the monitoring of the a,b,c, and d bits sourced from the CPR circuit pack. Monitoring of these bits is enabled when the channel is provisioned via the CHG DD command and only when TS16 is cross-connected to the CPR circuit pack. Also, the channel whose signaling C-bit is being monitored must be cross-connected to another channel, and the NPC must be provisioned for CAS.

When the xyz options are set as specified above, the NPC will monitor bits 3 through 5 in the received TS0 of the NFW and interrupt the UC if a change of state is detected in any of these bits. Monitoring of these bits is stopped upon detection of EER or any other severe alarm condition. In the transmit direction, the NPC will set bit 3 to 1 upon detection of:

- Loss of signal
- Excessive error rate
- Loss-of-frame alignment signal.

Also, if jkl is set to 100, the NPC will invert bit 4 from 1 to 0 upon detection of AIS (AIS is all 1s signal). When AIS is stopped, the NPC will set bit 4 to a nonalarm condition (invert from 0 to 1).

When the NPC is restored, bit 3 is set to 0, bits 4 through 8 are set to 1, and the Si (bits in frames 13 and 14 of the CRC multiframe) is set to 0. These are nonalarm settings of the bits.

Selection of Minor BER and Extended Signaling Freeze

These features are incorporated into Release 4 at the request of international customers with leased line applications. The MBER (minor bit error rate) feature allows the NPC on a TG187 pack to be provisioned to calculate BER, declare a DMA, and optionally send a remote indication (RBER) upstream on the facility. One of two calculation methods is used: one using the frame alignment signal which detects BER as low as 10^{-5}, and one using CRC4 (if enabled) which detects BER as low as 10^{-6}. The SFDT (signaling freeze delay time) capability produces a delay of 2496 ms before overwriting the signaling with the DDC or AIS signal and a delay of 624 ms before clearing consequent action. During the onset delay, the signaling condition that existed before the failure is maintained (frozen) to delay service interruption.

These functions are selected by bits jkl which correspond to the z digit in the NPC xyz type field. Values of 011 and 101 for jkl select the minor BER calculation and give a different meaning to bit c of the x digit. When one of these BER options is provisioned, the c = 1 setting then gives extended signaling freeze and consequent action clear times. Options 011 and 101 are for jlk control whether or not the remote indication (RBER) is sent upstream. These capabilities are supported by firmware memory on the TG187 code of plug-in DPC.

C-Bit Processing

An NPC provisioned for CAS contains signaling bits (abcd) in TS16 of each 64-kb/s channel. One of these, the signaling C-bit, supervises and maintains the end-to-end connection for the channel. If DACS II is equipped with CPRs (C-bit processing circuit packs) and the NPC has been provisioned for CAS and Transmic 2G, DACS II will have the capability to monitor and to modify the C-bits of the designated channel(s). The monitor and modify functions are performed independently of one another in DACS II.

Figure 14-1 illustrates the C-bit operation. TS16 of a 2.048-Mb/s line, consisting of time slots requiring C-bit operations, is cross-connected to the CPR pack in the DSPU (digital signal processing unit). The CPR pack contains all the logic necessary to perform the monitoring function and most of the logic to perform the modification function. The DPC pack for the service cross-connection contains the remaining logic required to perform the C-bit modification function. One DPC provides two 2.048-Mb/s terminations and therefore has two NPC numbers associated with it. For illustration purposes, Figure 14-1 shows only one NPC per DPC.

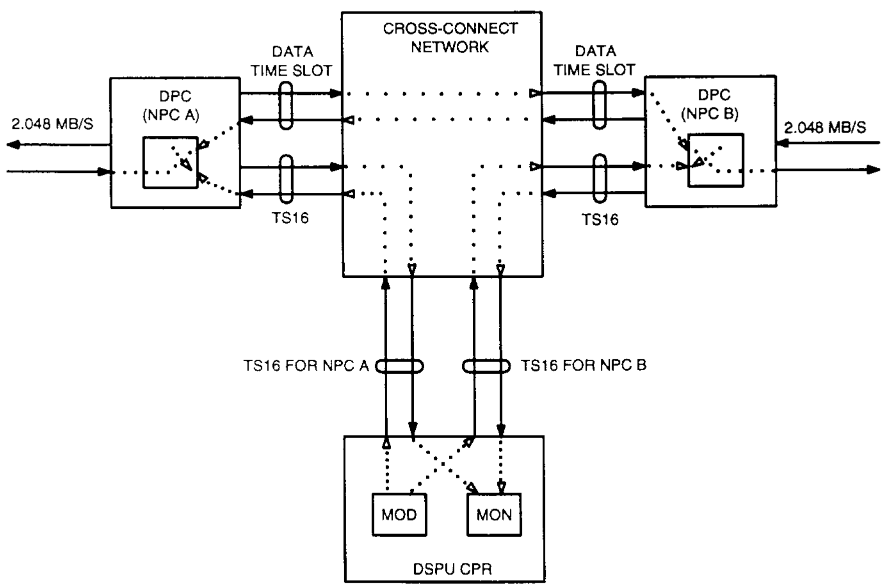

Figure 14-1. C-Bit Operation In DACS II

NPC Provisioning and C-Bit Processing

When a 2.048-Mb/s NPC is provisioned on a DACS II frame, the provisioning process does not automatically determine if C-bit processing is to be performed on any of the time slots of the 2.048-Mb/s line. If the 2.048-Mb/s line has time slots requiring C-bit processing, a separate cross-connect command must be used to cross-connect TS16 of the 2.048-Mb/s NPC to a CPR NPC. The restrictions on CPR equipage are discussed in the next paragraph. Cross-connecting a TS16 of a 2.048-Mb/s NPC to a CPR NPC provides the potential to have incoming C-bits within this 2.048-Mb/s line monitored by the DACS II and outgoing C-bits within the 2.048-Mb/s line modified before leaving DACS II. However, performing this cross-connect function does not specify the monitor and modification attributes for any time slots associated with the 2.048-Mb/s NPC. These attributes must be specified in another command. With the exception of the physical constraints of the DACS II frame and the number of equipped CPR boards in the frame, there are no limitations on the number of 2.048-Mb/s NPCs that can have their respective TS16s used for C-bit processing.

CPR Description

The CPR circuit packs are duplicated in the DACS II frame. An equal number is required in each side of the DSPU. Each CPR circuit pack can handle up to a maximum of one hundred and twenty-eight 2.048-Mb/s NPCs provisioned for C-bit processing in a DACS II frame. If more than 128 NPCs are provisioned for C-bit processing, 2 additional CPR packs (1 for each side of the DSPU) will be required for each additional 128 NPCs. The total number of CPR packs required in a DACS II frame depends on the number of NPCs provisioned for C-bit processing. Table 14-14 summarizes the CPR circuit pack requirements.

Table 14-14. Circuit Pack Requirements

NPCs Provisioned For C-BIT Processing	Required CPR Packs
1 to 128	2
129 to 256	4
257 to 384	6
385 to 512	8

There are no physical requirements on the positioning of the CPR packs in a DSPU shelf, but it is recommended that they be placed in alternate positions in the shelf to allow for future feature enhancements.

The C-bit monitoring and modification functions are performed independently of each other by the CPR pack; therefore, the C-bit of a particular time slot can be either monitored or modified or both at various times.

Provisioning C-Bit Attributes

Monitoring and/or modification of C-bits is initiated with the same DACS II command. This command specifies the NPC number, a contiguous range of time slots within the NPC, and a field to determine the desired C-bit monitoring and modification attributes for the contiguous range of time slots. This field can be used to specify the following functions:

- Begin monitoring or stop monitoring the incoming C-bits of the specified contiguous range of time slots.
- Allow modification or disallow modification of outgoing C-bits of the specified contiguous range of time slots.

The command to specify C-bit attributes can be used on any 2.048-Mb/s NPC that has its TS16 cross-connected to a CPR. This command can be used at any time to initiate or change the attributes of the C-bits associated with time slots within the NPC.

C-Bit Monitoring

C-bit monitoring in DACS II consists of detecting one of three possible states:

- Idle state
- Framed and stable state
- Network alarm state.

Under normal conditions, the DACS II generates a message over the DACS II administrative links whenever there is a detected transition from one of these three possible states to another state. An additional transition that results in a DACS II message is the transition of one framed and stable state to another framed and stable state.

When the DACS II detects a new state of a C-bit that it is monitoring, it generates a message specifying the new state. This message specifies the time slot and the NPC that the C-bit is associated with and whether the new detected state is an idle state, a network alarm state, or a framed and stable state. If the new state is a framed and stable state, the output message specifies the actual C-bit pattern detected in hexadecimal form.

If a local alarm condition requires DACS II to insert AIS or AIS 16 into a 2.048-Mb/s line, C-bit monitoring for time slots within the alarmed line is halted until the alarm condition clears. This occurs whenever AIS, loss of frame alignment, loss of signal, excessive error rate in the frame alignment signal, loss of multiframe alignment, or AIS 16 is received by DACS II on an NPC provisioned for C-bit processing.

C-Bit Modification

C-bit modifications in DACS II are permitted on C-bits within time slots that have been provisioned for C-bit modification. If the time slot has not been provisioned for C-bit modification, the modification request will be denied. C-bit modification is performed by entering a DACS II command. This command specifies the desired C-bit pattern in hexadecimal form, outgoing NPC number, and time slot within the outgoing NPC. If desired, this command can be used to make identical modifications to C-bits associated with a contiguous range of time slots within a 2.048-Mb/s line. An additional command provides the capability to stop any previously specified modification of C-bits. This command stops C-bit modification for the specified C-bit and resumes transparent pass-through of the specified C-bits.

Query Functions

There are two query commands available to assist in the administration of C-bits. One query command provides information specifying whether C-bits have been provisioned to be monitored or modified, and the other is used to retrieve the C-bit patterns being transmitted or received.

DACS II Gateway

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Contents

DACS II Gateway

15

Introduction

Gateway refers to international gateways between countries that use different carrier transmission rates and formats. For the DACS II Gateway application, the different signals are 1.544-Mb/s DS1 and 2.048-Mb/s. The 1.544-Mb/s digital rate is used in the United States, Canada, Korea, and Taiwan while the 2.048-Mb/s rate is used in Europe and most other countries in the world. For Gateway, the DACS II must terminate the different signals on the same frame and make the required conversions between the analog encoding and signaling algorithms to allow cross-connections and test access.

The customer equips the DACS II for Gateway applications by buying the software that allows both DS1 and 2.048 Mb/s terminations and interaction and the associated circuit packs for the different line terminations. The software is loaded from tape that has the DS1 and 2.048 Mb/s terminations activated by bits in the feature package identification code. There is no single bit for activating Gateway, since Gateway consists of DS1 plus 2.048 Mb/s. Once the frame is equipped for Gateway operation, the user can use familiar commands with new fields and channel ranges to cross-connect channels between DS1 and CEPT terminations.

Operational Considerations

Users with experience on DACS II with one type of line termination will find a few interesting differences with both terminations on the frame. The NPCs provisioned for DS1 and 2.048 Mb/s have different NPC type-xyz specifications, different facility performance parameters, and different alarm messages. Messages for setting alarm thresholds or facility reporting in the daily audit will contain facility parameters for both DS1 and 2.048 Mb/s lines. Channel number ranges and use of the trunk conditioning field also differ. The DS1 signal contains 24 DS0 channels and the 2.048 Mb/s contains 30 or 31 telephone channels. Cross-connections between the two will involve these numbers and channel ranges that are limited by the DS1 side. Trunk conditioning is required in Gateway circuits, but it is optional in pure 2.048 Mb/s circuits. For pure 2.048 Mb/s, the <tc> only specifies a different disconnected channel code; but for Gateway and pure DS1, the <tc> field specifies either signaling or TRSP and gives the consequent action if a line fails.

Functional Description

Figure 15-1 depicts the major functions of the DACS II Gateway. Facilities terminate on NPCs (network processing circuits). These are provisioned by commands to provide the required line interface. These also provide facility performance monitoring and perform the signal processing to connect to the CCN/ECCN. Different equipment codes of circuit packs are used for the 1.544-Mb/s and 2.048-Mb/s lines. Each of these circuit packs contains two NPCs and is referred to as a dual pack. The DPC (dual primary circuit) also performs the optional A-law to μ-law signal encoding conversions and the signaling conversions.

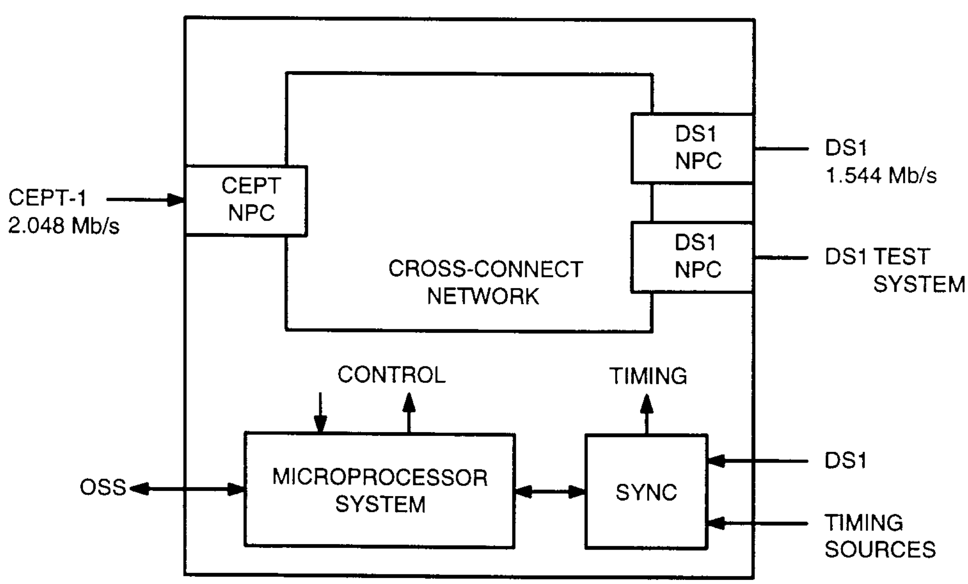

Figure 15-1. DACS II Gateway

The DACS II microprocessor system operates with the software to support provisioning of the equipment and cross-connect features and to interact with OSs (Operations Systems).

Figure 15-1 shows test access via a DS1 TAD (test access digroup) after the channels have been converted to μ-law format, but test access in a Gateway DACS II can be done via either a DS1 NPC or a 2.048 Mb/s NPC depending on which type of test access NPC has been grown and the connecting test access equipment.

Synchronization sources for the SYNC timing links can be derived from either DS1 timing sources or from 2.048 Mb/s timing sources. Again, this depends on the environment in which the DACS II Gateway is deployed.

PCM Code Conversion

Telephone channels within a 1.544-Mb/s DS1 are encoded using the μ-law PCM (pulse code modulation) companding method. Telephone channels within a 2.048-Mb/s primary block are encoded using the A-law PCM companding method. The plug-in DPC packs for the 2.048-Mb/s lines provide the per-channel PCM coding law conversion capability so that channels that are cross-connected between the 1.544-Mb/s and 2.048-Mb/s line rates can be properly encoded. Whenever a Gateway cross-connection is established, A-law to μ-law conversion from the 2.048-Mb/s line to the 1.544-Mb/s side and μ-law to A-law conversion from the 1.544-Mb/s line to the 2.048-Mb/s side of the cross-connection are automatically invoked in the DPC circuit pack. If this conversion is not desired, as would be the case when pure digital data is being cross-connected between the 1.544 Mb/s and the 2.048-Mb/s line rates, the PCM coding law conversion can be turned off by including NAM (no A to μ) keywords in the cross-connect command.

For multipoint conference circuits, the DMB (digital multipoint bridge) circuit pack allows bridging μ-law encoded voice signals. This TM665 DMB pack does not allow bridging A-law encoded voice signals into an A-law voice conference. Bridging commands include the NAM keyword to disable A-law to μ-law conversions to produce data conferences in which all the conference legs contain digital data signals. The conference type is determined by using the NAM keyword when the first DPC leg is connected; this is true for the virtual NPC and BCON conferences as well. The types of conferences that can be produced in the DACS II are as follows:

- μ-law voice conferences in which all legs deliver μ-law signals including all DPC connections (NAM not selected)
- Data conferences in which all legs deliver digital data signals (NAM selected)
- Pure DS1 conferences in which all legs deliver μ-law voice signals or data signals from DS1 digroups.

Signaling

The Gateway feature allows signaling conversion between the respective robbed-bit and CAS (channel associated signaling) formats of the DS1 and 2.048 Mb/s signals on a per-channel basis. Robbed bit signaling states are converted to appropriate abcd signaling states in TS16 (time slot 16) of a 2.048 Mb/s signal for all Gateway cross-connections that require signaling. A direct bit for bit signaling map for 2-state, 4-state, and 16-state signaling is supported. In the 2.048-Mb/s framing format, there are four signaling bits dedicated to each channel. These bits are dedicated for signaling whether or not each channel uses all four bits. Therefore, in those Gateway connections that involve 2-state or 4-state signaling conversion, the unused signaling bits in the 2.048-Mb/s frame are forced to preset values. Cross-connections between channels using robbed bit signaling in 1.544-Mb/s terminations and channels within 2.048-Mb/s terminations that do not use channel associated signaling are not allowed.

Cross-Connections

All cross-connections currently supported by the DACS II cross-connect network, such as unidirectional and bidirectional point-to-point and multipoint connections, are supported by the DACS II Gateway. Any or all of the 24 DS0 channels of a 1.544-Mb/s signal can be cross-connected to any other or any contiguous (not including TS16 with signaling) channels of a 2.048-Mb/s signal. Only the telephone channels are included in this type of cross-connection. Bit 193 of a 1.544 Mb/s format and time slot zero of the 2.048-Mb/s format are not included.

Test Access

Test access for a DACS II Gateway is provided via either the 1.544-Mb/s TAD (test access digroup) or the 2.048-Mb/s TAP (test access primary). All test access features of both connections are supported by the DACS II Gateway. For Gateway, the PDC either for the TAP or in the accessed circuit provides the A-law to μ-law conversions. Generally, DACS II test access adopts the characteristics of the accessed circuit, but for unmapped terminations the user must determine whether NAM is needed in the test access command. If a TAP is used to access channels with signaling, the TAP must be provisioned for signaling.

Synchronization

With both DS1 and 2.048-Mb/s lines coming to the DACS II Gateway, the SYNC can be equipped to extract timing from either. Up to eight timing links can be connected and are assigned selection priority for switching in case timing link failures occur. When timing is extracted from 2.048-Mb/s lines, specific NPCs in FTUs 1 and 2 can be designated to provide this timing. Connections between these NPCs and the SYNC timing interfaces are made at the miscellaneous wiring terminal strips on the frame.

Equipment Description

As previously stated, there is no hardware that is specific to the Gateway feature for DACS II. The Gateway feature is realized by equipping the frame with both DDCs and DPCs. The DACS II Gateway can be equipped to operate in several ways that affect the useful capacity of the system. Each FTM (facility terminating module) within an FTU/IFTU provides 20 network terminating slots and may be dedicated to house either 1.544-Mb/s or 2.048-Mb/s interfaces, but not both in the same module. If the FTM is used to terminate 2.048-Mb/s DPCs, only 16 of the 20 slots may be used for equipping DPCs for a total capacity of up to 32 bidirectional 2.048-Mb/s terminations. Each DPC supports two terminations. If the FTM is used to terminate 1.544-Mb/s DDCs, all 20 slots may be used for equipping DDCs for a total capacity of up to 40 bidirectional 1.544-Mb/s terminations. Table 15-1 summarizes the number of 1.544- Mb/s or 2.048-Mb/s terminations that are possible in a fully equipped FTU.

Table 15-1. Maximum Configurations and Capacities for FTUs in a Gateway DACS II

FTMs Equipped For 2.048-Mb/s Terminations	FTMs Equipped FOR 1.544-Mb/s Terminations	2.048-Mb/s Termination Capacity	1.544-Mb/s Termination Capacity
4	0	128	0
3	1	96	40
2	2	64	80
1	3	32	120
0	4	0	160

The single-bay DACS II frame mounts one FTU and one DSPU. Multibay frames are available for multiple FTU installations. Upgrading from the single-bay frame to the 2-bay system is a service-affecting upgrade. This upgrade requires a new frame and backplane, but the circuit packs used in the two systems are interchangeable. The upgrade from the 2-bay system to the 3-bay system requires an add-on side bay and is not service-affecting.

Engineering Considerations

Facility Terminations

DS1 Terminations

The 1.544-Mb/s terminations on a DACS II Gateway use the same DS1 hardware plug-in and the same NPC growth options. The robbed bit, DMI (digital multiplexed interface), in-band, and transparent DS1 signaling formats are supported in a DACS II Gateway. The Gateway feature does not require any changes to the already supported robbed-bit signaling. Trunk conditioning can be specified as 16-bit to match the 2.048 Mb/s signaling or as 4-bit and the software will make the conversion.

2.048 Mb/s Terminations

The NPCs on the DPC card are provisioned to produce the required line interface impedance for either the twisted pair or coaxial lines and to produce the required line signal format and alarm bit assignments. The required line signal format includes the signaling mode for all the channels on the primary, either the CAS (channel associated signaling) mode for signaling or NSA (nonsignaling associated) mode for no signaling.

Different methods of channel numbering are associated with the signaling and nonsignaling modes. Telephone channel numbering is used with signaling, and time slot numbering is used without signaling. Telephone channel numbering places the special time slots 0 and 16 out of the range of the other channels so they will be treated separately and will not be included in channel range connections. When an NPC is provisioned, bit e of the xyz field of the GRTH command is used to select the numbering method for the primary. When e = 0 (default setting), the telephone channels method is enabled; when e = 1, the channel time slot method is enabled.

Gateway Conversions

The basic function of the DACS II Gateway is to make the necessary conversions and cross-connect 64-kb/s time slots from/to any supported 1.544-Mb/s facility to/from any 2.048-Mb/s primary. In order for DACS II to make these conversions, there are certain requirements that must be met when NPCs are provisioned and cross-connections are established. These requirements are discussed in the paragraphs that follow.

Signaling Bit Mapping

DACS II automatically converts channel associated signaling formats when cross-connecting from/to 1.544-Mb/s signals to/from 2.048-Mb/s signals. These signaling formats are specified by a b c and d bits in the cross-connect command. When the cross-connection occurs, the abcd bits of the 2.048-Mb/s signal are mapped to the abcd bits of the 1.544-Mb/s signal. The abcd bits are specified in the cross-connect command in an 8-character field <sc> (signaling control). The format of the <sc> field is sc (abcd,abcd), when the first set of abcd bits specifies the state of signaling bits in the FROM direction and the second set of abcd bits specifies the state of the signaling bits in the TO direction. The following values can be specified for the abcd bits in either direction:

- P means that the signaling bit is unchanged and should be sent as received.
- 0 means that the signaling bit should be transmitted as a zero.
- 1 means that the signaling bit should be transmitted as one.
- V means that the signaling bit should be inverted before it is transmitted.
- A dash (-) should be substituted for the signaling bits in the FROM field for a one-way connection to signify that there is no signaling in the FROM direction.

The manipulation of the signaling bits occurs on the DPC only, and the two directions in the <sc> field are controlled independently of one another. If signaling bits are not present in either the FROM or TO time slot, then the TRSP keyword should be specified in the <sc> field. If the field is omitted, the system will automatically transmit a PP01 default pattern or a PPPP default pattern for 16-state signaling.

Effects of <sc> Operation in Cross-Connect Commands

In all Gateway cross-connect commands, the <sc> field applies to all DPC NPCs either by default or by designation in the command.

In Gateway TCON commands, only one of the specified NPCs is the PB-type, the <sc> field applies in both directions of transmission.

In Gateway BCON commands, the <sc> field applies in both directions of transmission to all PB-type NPCs specified in the BCON command.

In a Gateway cross-connection, the PB-type NPC is provisioned for 16-state signaling which is the maximum signaling capacity using all four bits (a, b, c, and d). When the 2.048 Mb/s NPC is cross-connected to a DS1 NPC that uses 2- or 4-state signaling, some of the signaling bits are not used on the DS1 side. The unused bits should be set to specified values. These specified values are set with the <sc> field.

Gateway Cross-Connections

DACS II allows the cross-connection of any 64-kb/s channel of an NPC to any other 64-kb/s channel on the same NPC or another NPC provided the channels on both sides of the connection are compatible. A channel with signaling can only be cross-connected to a channel on a digroup that is provisioned for signaling. When a cross-connection of a channel is made between a 1.544-Mb/s digroup and 2.048-Mb/s primary, DACS II automatically performs the required conversions of signaling and companding laws (A-law to μ-law and vice versa) unless the appropriate keyword (TRSP or NAM) is included in the cross-connect command. TRSP signifies that no signaling bits are present in the FROM or TO direction. The NAM keyword inhibits the A-law to μ-law and μ-law to A-law conversions that would normally occur in the DPC in a Gateway cross-connection.

Effect of Signaling on Gateway Cross-Connections

Both sides of a cross-connection for a Gateway circuit using signaling must be provisioned for signaling. On the DPC side, this means that the NPC must be provisioned for CAS. On the DS1 side, this is accomplished by using the TC form of trunk conditioning in the command as opposed to the TRSP form. Channel time slots 0 and 16 (telephone channel 31) cannot be cross-connected under these conditions. These special channels can only be connected to other time slot 0 or 16 channels with the TRSP form of trunk conditioning.

Cross-connection of a channel in a 2.048-Mb/s signal provisioned without signaling to a channel in a 1.544-Mb/s signal is allowed if the TRSP keyword is included in the cross-connect command. This includes the cross-connection of time slot 16 in a 2.048-Mb/s signal if it is cross-connected as another telephone channel.

Cross-Connect Ranges in Gateway

When cross-connecting a range of channels in the Gateway DACS II, DACS II has the capability to cross-connect any group of N x 64-kb/s channels (where N = 1 through 24) to an equal number of other compatibly provisioned channels. Commands with different values of N in the FROM and TO direction will be denied. When cross-connecting these channels, DACS II will maintain the sequence of the N x 64-kb/s cross-connected channels as well as the bit sequence of each cross-connected channel.

Table 15-2 summarizes allowable cross-connect ranges for NPCs provisioned with and without signaling.

Table 15-2. Allowable Cross-Connect Ranges for Gateway

From or To 2.048-Mb/s Terminations			To or From 1.544-Mb/s Terminations	
NPC Type	**Allowable Ranges**	**Allowable Signaling**	**Allowable Ranges**	**NPC Type**
PB With CAS	Any 1 through 24* out of 30 Channels (Except Channel 16)	2-,4-, or 16-State or TRSP	1 through 24	DE
PB With NSA	Any 1 through 24* out of 31 Channels	TRSP	1 through 24	DE

* Must be numbered consecutively

Trunk Conditioning For Gateway

Trunk conditioning <tc> is a required field in all cross-connect commands between 2.048-Mb/s and 1.544-Mb/s signals. The 2.048 Mb/s side NPC must be grown with a type xyz specification that has bit c = 1 which allows user-defined trunk conditioning to be sent on the DS1 side. The trunk conditioning field defines what is sent on the connecting channel when a carrier failure occurs at the NPC. This trunk conditioning, which consists of signaling and a message insertion word or just an insertion word for nonsignaling circuits, causes trunk conditioning at the far end to indicate trouble and stop charges.

The trunk conditioning is defined separately for the FROM and TO sides of the cross-connection. A carrier failure on one side (FROM, TO) causes the <tc> that was entered for the connecting side to be sent. The <tc> requirement for Gateway is needed to start the consequent action on the DS1 side. The default all 1s signal is sent on the 2.048 Mb/s side for a carrier failure on the DS1 side. Table 15-3 lists the possible specifications for both circuits with signaling and without (transparent).

Table 15-3. Allowed <tc> Combinations

<table>
<tr><th rowspan="2">NPC Type
From - To</th><th colspan="2">Type of Circuit</th><th rowspan="2">Type of IW</th></tr>
<tr><th>With Signaling</th><th>Without Signaling</th></tr>
<tr><td rowspan="4">PB - DE</td><td>TC(X'rs,X'tu),{TRB}</td><td>TRSP,{AIS | TRB | MUX}*</td><td>Standard</td></tr>
<tr><td>TC(X'rs,X'tu),IW X'nn</td><td rowspan="2">TRSP,IW X'nn</td><td rowspan="2">Arbitrary</td></tr>
<tr><td>TC(efghijkl,mnopqrst), IW X'nn</td></tr>
<tr><td>Not allowed†</td><td>TRSP</td><td>Not Specified</td></tr>
</table>

* TRB, AIS, and MUX represent insertion words for the DE type only.

† There is no default value specified for the DE type; therefore, if signaling is present and TC is not specified in a cross-connection involving the DE type NPC, the command is denied.

For a pure 2.048 Mb/s circuit, trunk conditioning is optional to override the default channel idle or disconnect code. When it is specified for a pure 2.048 Mb/s circuit, either a hexadecimal or 8-bit binary notation is used to represent the pattern of the abcd signaling bits (16-state signaling). These notations also occur for DS1 circuits provisioned for ESF which provides 16-state signaling capability, but 4-bit binary words are more commonly found in DS1 circuits. When the <tc> for a Gateway circuit is specified using hexadecimal or 8-bit notation, the abcd bits must be entered with bits ab = cd (for example, hex 5 =

0101) for both the DS1 and 2.048 Mb/s sides. The TC for a Gateway circuit can also be specified in 4-bit notation in which case the DACS II will assign bits cd which are equal to bits ab. Standard insertion words TRB and MUX can be used for Gateway circuits.

Following are the definitions for the hexadecimal digits r, s, t, and u in the TC format for a DS1 NPC using 16-state signaling. The definitions are the same for 2.048 Mb/s NPCs with the exception that:

TC1 = TC2 = TCM (trunk conditioning in multiframe), T1 = 480 ms and T2 = 0

For TC(X'rs, X'tu):

r = From a/b/c/d bits (transmitted for T1 = 2.5 seconds of failure as TC1)
s = From a/b/c/d bits (transmitted for the remainder of failure,
minimum T2 = 12s, as TC2)
t = To a/b/c/d bits (transmitted for T1 = 2.5 seconds of failure as TC1)
u = To a/b/c/d bits (transmitted for the remainder of failure, minimum T2 =
125, as TC2)

Note: r, s, t and u are hexadecimal values; a/b/c/d are binary values.

For a one-way cross-connection, the TC field will be designated with dashes (-) to represent the FROM side of the cross-connection.

DACS II ISX

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DACS II ISX

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Overview

The DACS II ISX (Digital Access and Cross-Connect System II - Integral Shelf Cross-Connect) is a single shelf digital cross-connect system. The DACS II ISX system terminates up to 64 DS-1 or E-1 facilities and also provides DS-0 cross-connect and test access capability. The DACS II ISX Main Shelf is an enclosed shelf that supports the same environmental, ESD and EMC standards as DACS II Release 6.0 Enclosed Frames.

The name DACS (Digital Access and Cross-Connect) describes the main function of the DACS II ISX. It accesses individual DS-0 information channels in the digital signals that are connected to the shelf and also provides test access to individual channels. Test access is provided at the digital signal level eliminating the need for conversion to analog signals.

DACS II ISX uses a process called TSI (Time Slot Interchange) to electronically cross-connect single DS-1 or E-1 channels. Channels with common destinations are collected thereby increasing the amount of traffic that is sent over digital transmission lines and terminal equipment.

The DACS II ISX has four asynchronous links and one synchronous X.25 link for local or remote operator control and computer-based operations that may consist of an I-2000 Controller. (The optional I-2000 Controller for DACS II ISX allows for remote provisioning, centralized control and monitoring of DACS networks.) An operator can be positioned close to the shelf (for example, local) or at an office that is located at a distance away from the shelf (for example, a remote office).

The operator can communicate with DACS II ISX with one of two languages: PDS (Program Documentation Standard) or MML (Man to Machine Language). By using commands (messages) that are available with either language, the operator can direct DACS II ISX to set up or remove cross-connections, test the lines that are terminated, and various other functions.

Physical Description

The main shelf is rack-mountable on either a 19" ANSI/EIA standard frame, a 2' 2" Network Bay Frame (NBF), or a 600mm ETSI standard frame. The main shelf provides facility termination and non-blocking cross-connection for up to 2048 timeslots (64kb/s channels). The main shelf is designed with an Expansion Interface to support the potential future addition of a DACS II ISX Expansion Shelf. The Expansion Shelf will support facility termination and non-blocking cross-connection for up to an additional 2048 timeslots.

System Level Functions

The DACS II ISX is comprised of the following functional entities. Each of the items listed below is described in detail in the sections that follow.

- Two NPMs (Network Processing Modules)
- Two SXCs (Synchronizer/Cross-Connects)
- One MC (Main Controller)
- One SP (Status Panel)
- Three PUs (Power Units)

The following functional entities are not provided with Release 1.0; however, they are listed here for completeness.

- Two TLIs (Timing Link Interfaces)
- Three MCPs (Main Controller Peripherals)

Figure 16-1 shows the front view of the DACS II ISX Main Shelf functional entities.

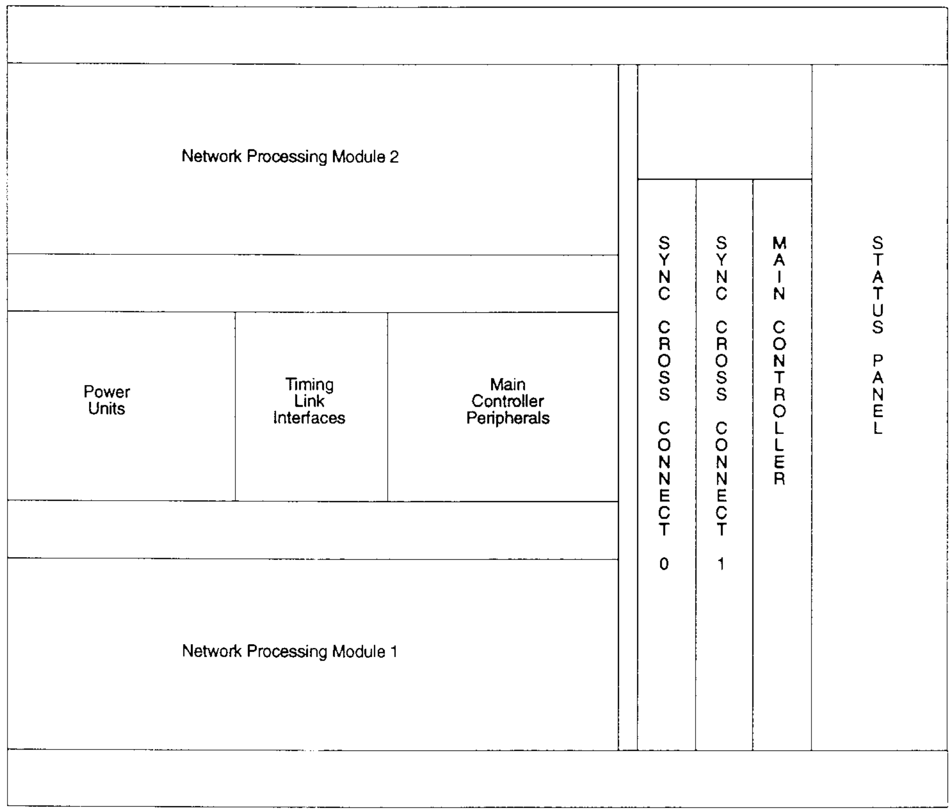

Figure 16-1. DACS II ISX Main Shelf Functional Entities

Figure 16-2 shows the open-door front view physical layout of a DACS II ISX Main Shelf fully equipped with Enhanced Dual Digroup Circuit (EDDC) cards. The EDDC cards are described in the section that follows.

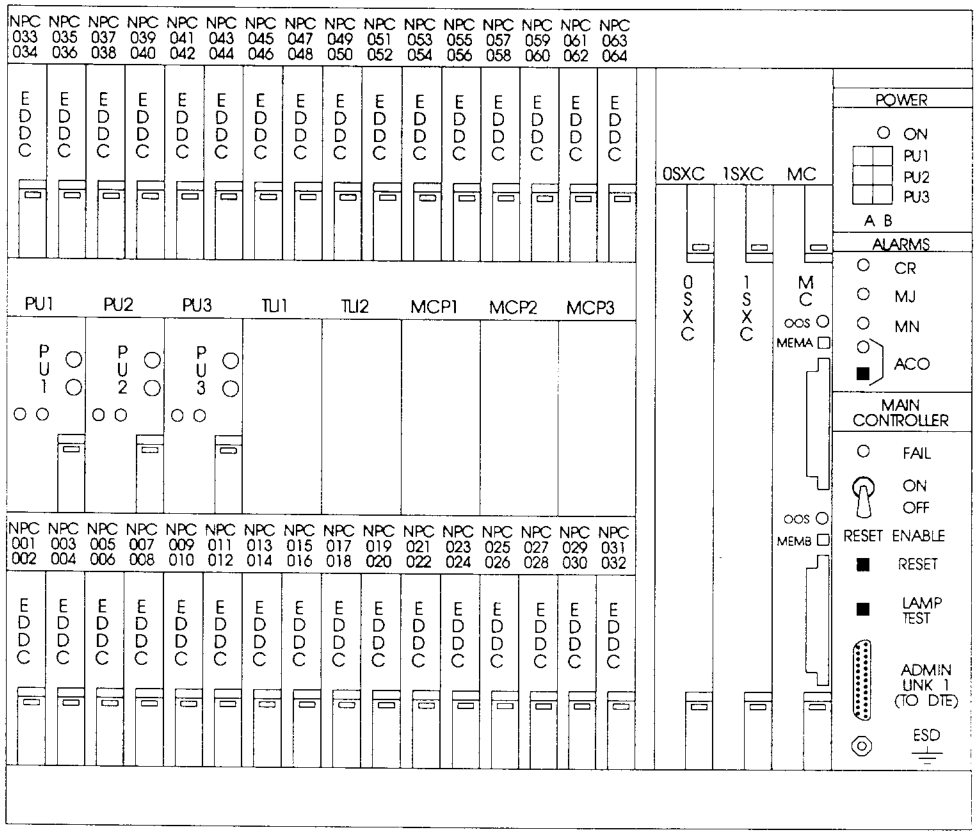

Figure 16-2. DACS II ISX Fully Equipped Main Shelf (1.544 Mb/s Interface)

Figure 16-3 shows the open-door front view physical layout of a DACS II ISX Main Shelf fully equipped with Enhanced Dual Primary Circuit (EDPC) cards. The EDPC cards are described in the section that follows.

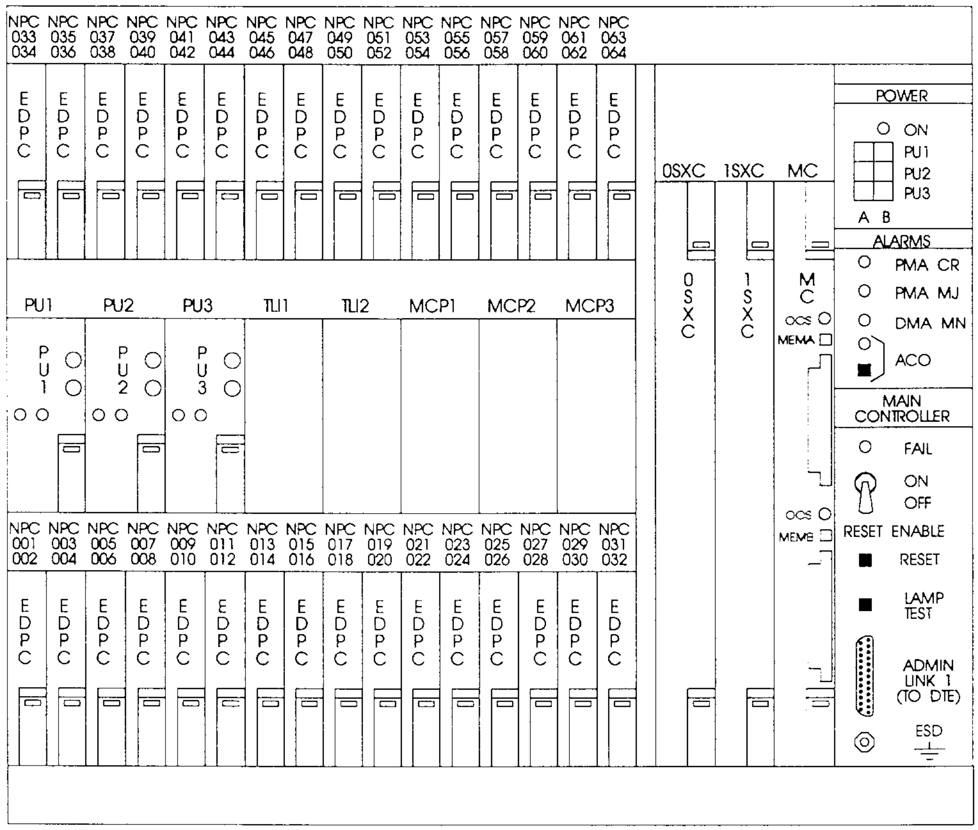

Figure 16-3. DACS II ISX Fully Equipped Main Shelf (2.048 Mb/s Interface)

Network Processing Modules (NPMs)

The Main Shelf contains two Network Processing Modules (NPMs), referred to as NPM1 and NPM2. Each NPM has 8 card slots. Each slot can contain dual DS-1 line circuit packs, dual E-1 line circuit packs, or Digital Signal Processing cards.

In DACS II ISX Release 1.0, the NPMs are equipped with either DS1 or E1 facility terminating circuit pack plug-ins. Each DACS II ISX facility terminating circuit pack contains two Network Processing Circuits (NPCs) and terminates two DS1 or E1 facilities. An NPM contains 16 circuit pack plug-in slots and terminates up to 32 facilities.

If an Expansion Shelf is developed at some future time to double the system's DS1/E1 termination capacity, its two Network Processing Modules will be termed NPM3 and NPM4.

In DACS II ISX Release 1.0, both DS1 and E1 facility terminating circuit packs can be equipped in NPMs. However, there are limitations regarding the positioning of circuit packs in a DACS II ISX shelf which is equipped with both types. A Network Processing Module is divided into two Network Processing Sub-Modules. Each Network Processing Sub-Module contains 8 circuit pack plug-in slots and terminates up to 16 facilities.

Facility interface connectors are provided for cabling on a Network Processing Sub-Module basis. Separate transmit and receive Facility Interface Connectors are provided for each Network Processing Sub-Module. In addition, Facility Interface Adapter Panels, which can be equipped to change from the 50-pin D-connectors used for 100 ohm or 120 ohm twisted pair facility connections to a set of 75 ohm co-axial facility connectors, are provided on a Network Processing Sub-Module basis. Therefore, shelves with mixed facility types are segregated on a Network Processing Sub-Module basis. A Network Processing Sub-Module can contain either DS1 facilities, 120 ohm E1 facilities, or 75 ohm E1 facilities. Figure 16-4 shows an adapter panel connected to Sub-module 1.

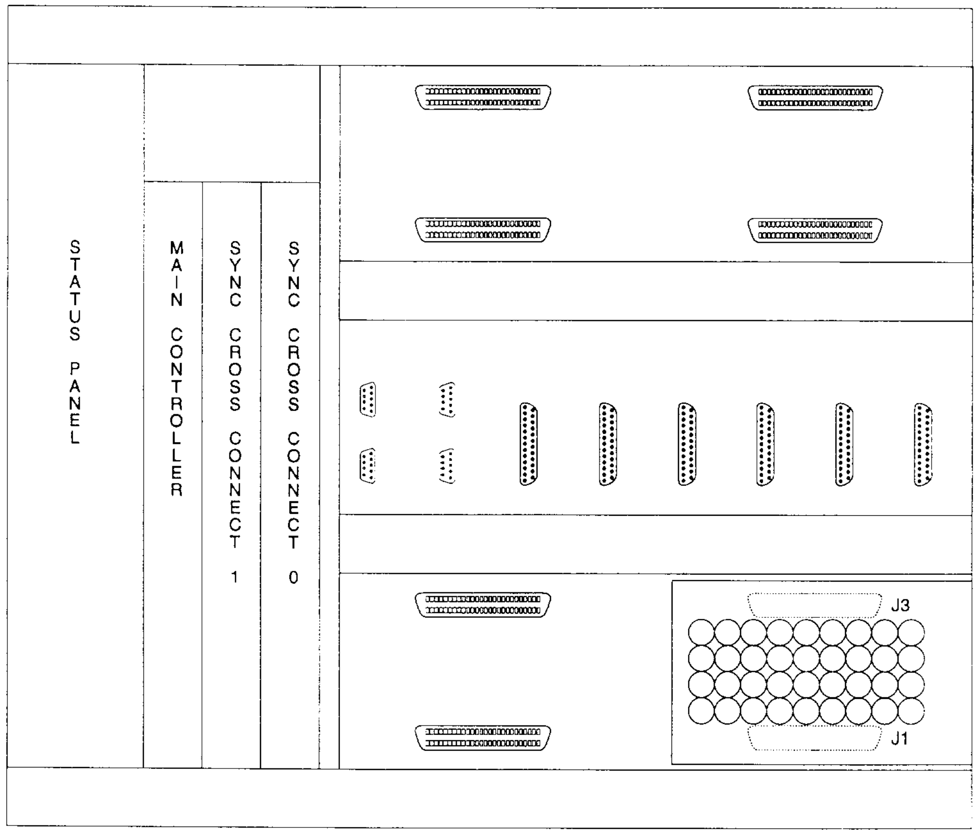

Figure 16-4. Adapter Panel (Shown Connected to Sub-Module 1)

The following dual DS1 or E1 facility terminating circuit packs can be equipped in DACS II ISX Release 1.0 Network Processing Modules:

- Enhanced Dual Digroup Circuit (EDDC) - TG191

  This circuit pack terminates two DS1 signals with D4 SuperFrame, Extended SuperFrame (ESF), or T1 Data Multiplexer (T1DM) framing format. NPCs on an EDDC are provisioned as "DA" type facilities, which provide enhanced DS1 Performance Monitoring compliant with ANSI T1.403 and Bellcore TR-TSY-000820 standards.

- Enhanced Dual Primary Circuit (EDPC) - TG192

  This circuit pack terminates two E1 signals. The EDPC has a software programmable termination impedance, so it terminates both 75 ohm and 120 ohm E1 facilities. NPCs on an EDPC are provisioned as "PA" type facilities, which provide Time Slot 0 processing and enhanced E1 Performance Monitoring compliant with CCITT Blue Book standards.

Synchronizer/Cross-Connects (SXCs)

There are two SXCs (Synchronizer/Cross-Connects) circuit packs. The SXC circuit packs perform clock synchronization and DS-0 cross-connections. They are duplicated to provide failure protection. In the event that one of the packs fails, the other SXC can provide the clock synchronization and DS-0 cross-connections.

The duplicated SXCs are referred to as the Side 0 SXC (0SXC) and the Side 1 SXC (1SXC).

Both SXCs receive Timing References (TRs) in the form of extracted line timing signals from all of the traffic carrying facilities that are terminated on the Main Shelf. The user may specify two facilities from distinct line termination circuit packs to be used as the primary and secondary Timing References. The synchronization function generates system timing signals that are phase locked to the selected Timing Reference. The timing signals are compatible with both North American Stratum 3 and CEPT Local Clock standards.

The cross-connect function on the duplicated SXCs provides fully non-blocking cross-connections for the 2048 timeslots (64kb/s channels) terminated on the Main Shelf. In addition, the SXCs can also support fully non-blocking cross-connections for an additional 2048 timeslots received from the Expansion Shelf.

Timing Link Interfaces (TLIs)

Two TLIs (Timing Link Interfaces) receive timing from non-traffic carrying facilities and also distribute timing signals to other equipment.

The two Timing Link Interface (TLI) circuit pack slots (TLI1 and TLI2) are not equipped in Release 1.0. They provide a future means to time the DACS II ISX from other than traffic-carrying facilities. Each TLI circuit pack will terminate two Timing References via separate Synchronization Sync Ports (SSPs) and then pass the timing to the duplicated SXC circuit packs for synchronization. The two SSPs associated with a TLI circuit pack are referred to as SSP0 and SSP1.

The TLI circuit packs will also be capable of distributing timing. Each TLI will receive system timing from the duplicated SXCs, select timing from the active SXC, and generate two Timing Distributions.

All user input and output connections to the TLIs will be made via the Timing Interface Connectors. Separate transmit and receive Timing Interface Connectors are provided for each TLI slot. In addition, Timing Interface Adapter Panels will be provided on a per-TLI basis to change from the D-connectors used for 100 ohm or 120 ohm twisted pair timing connections to a set of 75 ohm co-axial timing connectors.

Main Controller (MC)

The MC communicates with external network control systems via four asynchronous RS-232 links and one synchronous RS-232 link. The MC communicates with and controls all of the entities in the system and is capable of activating external audible, visual, and remote alarms.

The MC circuit pack is a single board controller which oversees the DACS II ISX system operation. The MC communicates to all DACS II ISX entities and performs the following system functions:

- Provides administrative communication interfaces
- Controls office alarms and status indications
- Performs system provisioning and maintenance
- Maintains system executables and database in non-volatile memory cards.

Communication Interfaces

The MC supports four RS-232D compliant asynchronous Administrative Links (Link 1-Link 4) running the Snider protocol and one RS-232D compliant synchronous Administrative Link (Link 5) running X.25 protocol. The asynchronous links operate up to 9600 baud and the synchronous link operates up to 20k baud. The synchronous X.25 link supports sixteen Virtual Circuits (VCs) with any combination of Switched Virtual Circuits (SVCs) and Permanent Virtual Circuits (PVCs). Standard 25-pin Administrative Link Connectors (TTY1-TTY5) for the five links are mounted on the backplane.

The MC also provides an external communication interface for a Local Area Network (LAN). Communications via the LAN will not be available in Release 1.0.

Alarms

The MC operates contact closures for Local Audible, Local Visible and Remote Office alarms. Connections for both the Local Audible and Local Visible Alarms are made at the Local Office Alarm Connector. Connections for the Remote Alarms are made at the Remote Office Alarm Connector. The MC can be remotely reset via reset control leads accessible at the Remote Reset Connector.

Memory Cards

The MC maintains a copy of the system executables and database on non-volatile memory. This storage space is provided via removable plug-in PCMCIA Memory Cards (PCMCIA is an acronym for Personal Computer Memory Card International Association). The MC circuit pack supports two removable non-volatile PCMCIA Memory Cards. The system maintains fully duplicated backups when both Memory Cards are In Service, but operates in a simplex backup mode if one of the Memory Cards fails or is removed from service. The two Memory Cards supported are referred to as Memory A (MEMA) and Memory B (MEMB).

Main Controller Peripherals (MCPs)

Three Main Controller Peripheral slots (MCP1, MCP2, MCP3) are directly connected to and controlled by the MC to support any future modular growth of additional system components.

In Release 1.0, MCP1, MCP2, and MCP3 are not used. However, in preparation for potential future needs, a standard 25-pin connector for a sixth Administrative Link (TTY6) is directly wired to the MCP1 slot.

Status Panel (SP)

The Status Panel displays system alarm and status indications, and provides manual system controls, a wrist strap ground jack, and a front panel RS-232D DCE 25-pin Administrative Link Connector (TTY1) for Administrative Link 1.

The status panel panel is partitioned into the following three sections:

- Power
- Alarms
- Main Controller

Each item listed above is described in the sections that follow.

Status Panel Power Section

The power section contains a Light Emmiting Diode (LED) labeled ON which when lit, indicates that the DACS II ISX is powered on. In addition, there are six indicating fuses for the redundant office power supply feeders. There is one fuse between Feeder A and each of the three Power Units, and one fuse between Feeder B and each of the three Power Units. The fuse configuration is shown in Figure 16-5.

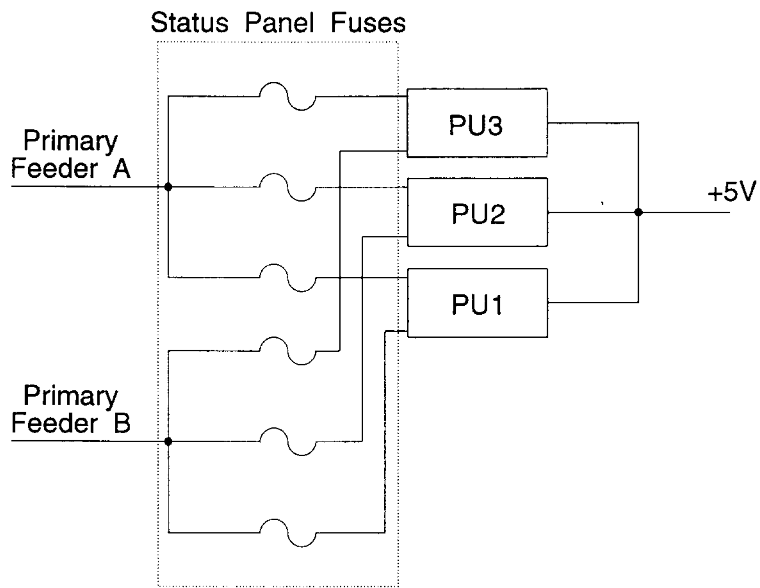

Figure 16-5. DACS II ISX Fuse Configuration

The RJ-45 type LAN Connector is mounted on the back of the Status Panel circuit pack. The connector is accessible from the back of the shelf through a backplane cutout.

Status Panel Alarm Section

There are three LEDs on the alarm section of the status panel which indicate the alarm status of the system. These LEDs are labeled as shown in Table 16-1.

Table 16-1. Status Panel LEDs

Interface		Alarm
1.544 Mb/s	**2.048 Mb/s**	
CR	PMA CR	Critical
MJ	PMA MJ	Major
MN	PMA MN	Minor

There is also a push-button switch labeled ACO (Automatic Cutoff) and a built-in LED that when lit, indicates that all audible alarms have been disabled.

Status Panel Main Controller Section

The main controller section contains an LED labeled FAIL that when lit, indicates a main controller failure. In the event of main controller failure, traffic (service) is not disrupted; however, the circuit pack should be replaced as soon as posible.

A switch labeled "Reset Enable" is used enable/disable the Reset push button. If the Reset push-button is pressed when the Reset Enable swich is in the ON position, all of the alarms on the shelf will be cleared (turned off). Nothing will occur if the Reset push-button is pressed and the Reset Enable swich is in the OFF position.

A push button labeled "Lamp Test" is used to test all of the LEDs on both the Status Panel and on the Power Units. The LEDs should light when the button is pressed. The Main Controller (MC) circuit card must be installed in the shelf for the lamp test to function properly.

Power Units (PUs)

The DACS II ISX is powered by three +5 Volt Power Units, (PU1, PU2, and PU3). The office power supply is connected to the DACS II ISX at the Power Terminal Block mounted behind the Status Panel. The +5 Volt Power Units supply power to all DACS II ISX circuit packs. Each Power Unit is connected to the office power supply via redundant feeders, Feeder A and Feeder B. A fully equipped Main Shelf can be powered by two Power Units. The three Power Units share the load and provide 2+1 redundancy.

NPC Addressing Scheme

The DACS II ISX supports a 3-digit non-hierarchical NPC addressing scheme. With this scheme, NPCs are numbered by counting sequentially from the first NPC in the first Network Processing Module to the last NPC in the last Network Processing Module. Each Network Processing Module contains 32 NPCs.

With this scheme, the NPCs in NPM1 are addressed as NPC 001 through NPC 032. The NPCs in NPM2 are addressed as NPC 033 through NPC 064.

If the Expansion Shelf is developed at some future time to double the DS1/E1 termination capacity, NPCs in NPM3 and NPM4 will be addressed as NPCs 065 through 096 and NPCs 097 through 128, respectively.

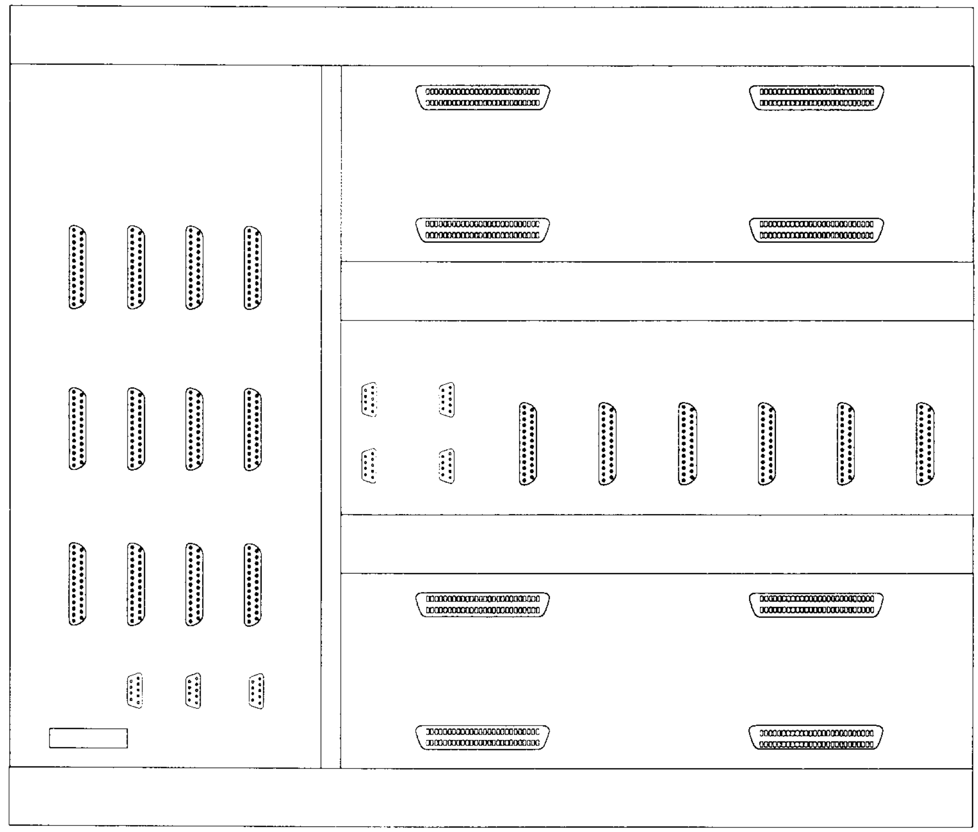

Figure 16-6. DACS II ISX Connectors (Main Shelf Rear View)

Functional Description

The section provides a functional description of the DACS II ISX and is intended to provide the reader with a general knowledge of the circuit pack functions and interworkings.

The basic function of DACS II ISX is to provide access to incoming digital signal bit streams to interchange and interconnect (cross-connect) DS0 channels. This is done electronically within the circuitry without making any digital-to-analog conversions. Access to the channels for testing is also done by cross-connections. For test access, the time slots to be tested are cross-connected (mapped) to the time slots in the test access facility. Direct digital testing can be done by using the remote test system 5A (RTS-5A), remote maintenance system-digital 1 (RMS-D1) test facility, or the SARTS/RMS-I Switched Access Remote Test System. When using RTS-5A, conversions to analog are required to allow testing voice channels. This conversion may be done externally to the

DACS II ISX in the channel bank equipment that terminates the test access facility.

The two major circuit blocks of the DACS II ISX are the Synchronizer/Cross-Connect (SXC) circuits (0SXC and 1SXC) and the Main Controller (MC) circuit pack. The SXCs produce precise timing waveforms needed to maintain time slot alignment and contains cross-connect networks to accomplish the time slot connections. The MC manages internal and external operations.

Since multiplexing the signal time slots to form higher capacity bit streams is inherent in the cross-connect process, circuit redundancy is needed to protect against the loss of service should a failure occur in a high-channel-capacity pack. Accordingly, all circuit packs carrying more than 120 DS0 channels are duplicated. Similarly, because of their importance, the Synchronizer/Cross-Connect and power units are duplicated. The Synchronizer/Cross-Connects also have the capability of temporarily operating in a stable, free-running mode. Two PCMCIA memory cards are provided on the MC circuit pack to protect against the loss of circuit memory in the event of a power failure.

Main Controller (MC)

The heart of the DACS II ISX microprocessor control system is the main controller (MC). The MC maintains the DACS II ISX operating system, processes input commands and internal interrupt operations, and detects and responds to internal errors and alarms. It communicates with the other circuit packs to execute the time slot cross-connections, and also to monitor the health of the shelf. The MC selects the active SXC circuit pack so that timing may be supplied to the shelf. The MC selects the associated EDDC/EDPC to carry service. Another repsonsibility of the MC is to initiate recovery routines if an error is detected and to report alarms if a failure has occurred.

Nonvolatile PCMCIA Memory Cards

The PCMCIA memory cards are referred to as nonvolatile because they do not require continuous DC power as do the other memory devices in the DACS II ISX. The memory cards contain an up-to-the-minute copy of the cross-connect map and the functional status of the shelf. These records are automatically updated by transfers through the Secondary Storage Controller (SSC) on the MC circuit pack. Since these records are automatically updated, they can be corrupted if a failure occurs or if errors are transferred. This is why there are two memory cards.

If troubleshooting shows that the data on the primary memory card has been corrupted, the data contained on the redundant memory card data base can be used to boot the database into the shelf.

This section is incorrect!!

The tape must be manually updated; thus, the shelf should be queried for out-of-service and failed circuit packs before the data base information is copied to tape. Another use of the tape is to keep a copy of the DACS II ISX internal operating system software. As such, it can be used to boot the shelf memories from scratch if there is a catastrophic failure (a crash) and can be used to load new software (for example, maintenance releases or new generic software loads) into the machine.

Synchronizer/Cross-Connects

During normal operation, both sides are energized but only one side is in service (active). If the active side fails, service is automatically switched to the other SXC. If both SXCs fail, the active SXC enters the "holdover" state. In the holdover state, the SXC retains the last good frequency. DACS II ISX meets the stability requirements for both of the following clock references:

- Domestic Stratum 3
- CCITT Local Exchange

Interconnection of information in the internal bit stream establishes a path through the DACS II ISX that may be a 1- or 2-way cross-connection. The type of connection is controlled by the input command. This path (or map) is determined by the main controller based on the record of used and available paths in the controller memory. The maps are autonomously transferred to the memory cards for backup protection.

The SXC is duplicated so that cross-connections can be reproduced in another network by the main controller without any loss of service should a failure occur on the active side. If the main controller is also out of service when a failure occurs in the SXC, other packs will cause the switchover to the redundant SXC. The switchover can also be manually forced to allow maintenance on the inactive side.

Shelf Alarm Indications

Extensive error detection and handling takes place in the DACS II ISX. For example for a hardware error, the DACS II ISX evaluates all the error inputs including any from power units and reports the results in an ERR ANALYSIS message. These processes and those that check for software errors are not detailed in this manual. General descriptions of the following are provided here:

- Circuit pack failures
- Carrier failure alarms
- Facility performance alarms.

Circuit Pack Failures

Circuit pack communication and operations are continuously monitored by the Main Controller (MC) to check for errors. If errors are detected, the MC institutes an error recovery routine which confirms that the error was not a transient and runs diagnostic tests on the suspect circuit pack. The suspect circuit pack is also removed from service, and service is switched to the other side if the circuit group is duplicated. If the tests fail, an office alarm is registered. If the tests pass, the circuit pack must be manually restored to service.

Carrier Failure Alarms

These show a loss of incoming signal, framing, or high transmission errors or receipt of a remote alarm signal from the equipment at the other end of the line. Incoming failures are reported in an output message as a red alarm, and the receipt of the signal that indicates a local alarm at the other end is reported as a yellow alarm. Either condition also generates an office alarm.

Whenever a red alarm exists, DACS II ISX sends a yellow alarm signal to the other end. Additional carrier failure alarm conditions that are reported in output messages are:

- Simultaneous red and yellow DS1 alarms
- AIS (alarm indication signal), also referred to as the all 1s signal
- Local and remote alarms from a digital multiplex interface frame (DMI/BOS signaling format).

The AIS (all 1s signal) is a digital signal associated with a maintenance alarm detected on a defective maintenance span. DACS II ISX transmits the AIS signal in the direction of the failure as a substitute for the normal signal. It is intended to show other equipment (downstream) that a failure has occurred elsewhere and to inhibit local alarms so that the defective section can be identified by the local alarm indication.

The programmable AIS alarm allows the user to select how the alarm indication signal from the far end will be reported. The DACS II ISX user can select whether a major alarm, minor alarm, or informational alarm (default) is generated.

During a carrier failure, the affected Network Processing Module (NPM) sends trunk conditioning and trouble insertion words out on the channels. Trunk conditioning is used on channels with signaling to cause office switching equipment to discontinue calls and stop charges. Trouble insertion words are sent in the message part of the channel and are necessary to signal trouble on data circuits. The codes for these trunk conditioning or insertion words are entered as part of the cross-connect commands.

Facility Performance Alarms

Microprocessor circuits in the NPMs detect and record various line error conditions. The results of this monitoring are used to provide status information on demand and to register office alarms when prescribed thresholds are exceeded. The monitored parameters vary depending on the type of NPC, but the following list for DS1 lines serves as an example: (1) line bit errors, (2) errored seconds, (3) severely errored seconds, (4) cyclic redundancy check errors, and (5) carrier reframing activity. Current counts are available on demand by requesting the NPC status, and accumulated counts are obtained by requesting the count for a particular facility parameter or as provided in the daily (midnight) report.

The alarm thresholds for the facility parameters are set initially when the NPCs are provisioned for service. Unless specific alarm thresholds are entered, default values apply. Up to three additional values for each alarm can be loaded into the DACS II ISX to serve as options that can be selected initially or by means of a change command.

Status Panel Functions

The status panel conveys status and alarm information regarding the DACS II ISX and provides an administrative port (TTY1) for connection of a console terminal. This is a multiple of administrative link 1 and allows connection of a portable terminal while the regular terminal is disconnected from the back.

There are five LED indicators on the status panel. The classification of the alarms and the color of the LEDs vary on panels used outside the U.S.A. Table 16-2 describes the status panel's alarm LEDs.

Table 16-2. Status Panel LEDs

1.544 Mb/s	2.048 Mb/s	LED	Description
CR	PMA CR	Red	Shelf Alarm - Critical: Indicates a service-affecting failure affecting more than 120 channels.
MJ	PMA MJ	Red	Shelf Alarm - Major: Indicates a service-affecting failure affecting equal to or less than 120 channels.
MN	DMA MN	Yellow	Shelf Alarm - Minor: Indicates a non-service-affecting failure.
FAIL	FAIL	Red	Main Controller - Failure: Indicates a failure of the main controller.
ACO	ACO	Green	Shelf Alarm - ACO (Alarm Cutoff): Indicator that is lighted when the alarm cutoff switch is operated.

There are four switches on the status panel that perform the following functions:

- Shelf Alarm - ACO: Disables the audible alarm
- Shelf Alarm - LAMP TEST: Checks for failed lamps by lighting all lamps on the status panel and on the power units
- Main Controller - RESET ENABLE: Switch that enables (ON position) or disables (OFF position) the main controller reset switch
- Main Controller - RESET: Resets the main controller provided the RESET ENABLE switch is in the ON position.

Powering

Office battery is delivered over two feeders (Primary Feeder A and Primary Feeder B) so that the loss of a feeder will not interrupt service. These feeders are fused with 70-type fuses that provide a visual indication when blown. Office alarms are automatically activated whenever a fuse is blown.

Three Power Units (PUs) in the shelf produce the +5V DC voltages derived from the -48 volt primary feeder input. A red LED on each of the power units, when lit, indicates that the fuse to that power unit is blown. The green LED on each of the power units, when lit, indicates that power is being supplied to the power unit from one of the primary feeders.

Number of Power Units Required

The number of standby power units needed in a power group is determined by the load requirements. As circuit packs are added as service growth occurs, the power unit requirements depend on the number of circuit packs installed.

Feature Functions

Gateway Feature

The DACS II ISX gateway feature enables 1.544 Mb/s and 2.048 Mb/s facilities to coexist within a DACS II ISX system for translation and cross-connection between the two disjointed facilities.

The DACS II ISX performs several functions in providing the gateway feature. The DACS II ISX does μ-law and A-law Pulse Code Modulation (PCM) translation, provides signaling conversion between robbed bit and abcd bit signaling, and performs point-to-point as well as point-to-multipoint DS0 cross-connections. In addition, the DACS II ISX provides a host of performance monitoring and maintenance functions for efficient and effective facility translation and transmission.

When DACS II ISX is used as a gateway between 1.544 Mb/s and 2.048 Mb/s facilities, the 2.048 Mb/s side of the NPM is equipped with the appropriate Enhanced Dual Primary Circuit (EDPC) circuit packs and the 1.544 Mb/s side is equipped with Enhanced Dual Digroup Circuit (EDDC) circuit packs.

The DPC performs the conversions between the 4-bit and 2-bit signaling and the A-law and μ-law voice encoding in the two signals (see Figure 16-7). Cross-connect command fields NAM, <tc>, and <sc>, are applicable for a gateway connection. The NAM field (no A-law to μ-law conversion) disables the conversion for data signals that are already in digital form (no encoding). The <tc> field identifies the type of DS1 circuit to DACS II ISX (signaling or transparent) and specifies trunk conditioning, The <sc> field (signaling conversion) allows setting signaling bits (abcd) to 0 or 1, inverting bits, or passing bits through unchanged. This field is used in gateway to dictate how signaling bits (c and d) which are not used on both sides are to be set.

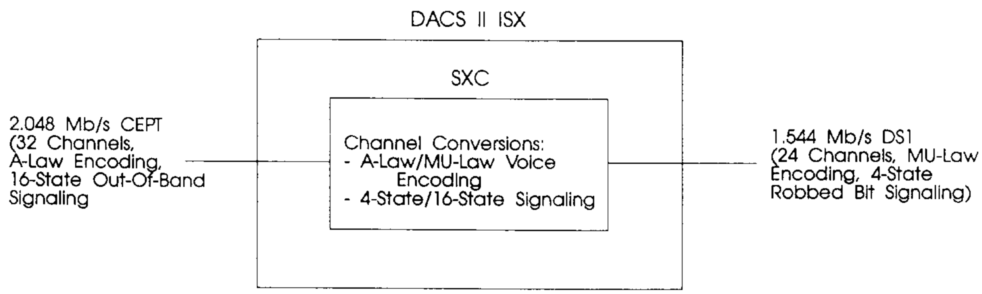

Figure 16-7. Gateway Signal Conversions

Acronyms

A

Introduction

This section contains a list of acronyms, terms, and abbreviations and their meanings.

ABT	Abort
ACO	Alarm Cutoff
AI	Alarm Interface
AIS	Alarm Indication Signal (Also known as all 1s signal)
ALM	Alarm
AMI	Alternate Mark Inversion
AP	Alarm Processor
AS&C	Alarm Surveillance and Control
ATP	All Tests Passed
AUD	Audit
B8ZS	Bipolar Eight Zero Substitution
BBL	Backbone Leg
BC	Bus Controller
BCM	Bit Compression Multiplexer
BCON	Broadcast Cross-Connect
BDIS	Broadcast Disconnect
BER	Bit Error Rate
BI	Bubble Interface
BM	Bubble Memory
BMC	Bubble Memory Controller
BMTR	Back-up Memory Transfer
BOS	Bit Oriented Signaling
BPV	Bipolar Violation

BRAM	Buffer Random Access Memory
BRD	Broadcast
BSC	Bubble Store Controller
BSRF	Basic Synchronization Reference Frequency
BX	Bus Extender
CAS	Channel Associated Signaling
CATP	Conditional All Tests Passed
CBI	CPU Bus Interface
CCB	Cross-Connect Buffer
CCI	Clock and Control Interface
CCIS	Common Channel Interoffice Signaling
CCITT	International Telephone and Telegraph Consultative Committee
CCN	Cross-Connect Network
CCNI	Cross-Connect Network Interface
CEF	Capacity Expansion Frame
CFA	Carrier Failure Alarm
CGA	Carrier Group Alarm
CGC	Clock Generator Circuit
CHG	Change
CI	Communications Interface
CIU	Craft Interface Unit
CLF	Carrier Line Failure
CMAP	Channel Map
COFA	Change-Of-Frame-Alignment
COT	Central Office Terminal
CPR	C-bit Processor
CPU	Central Processing Unit
CP	Circuit Pack
CRC	Cyclic Redundancy Checking
CRO	Clock Reference Oscillator
CSR	Clock Status Receiver
CTU	Channel Test Unit
DACS	Digital Access and Cross-Connect System
DC	Digroup Circuit
DCC	Disconnect Code
DCLU	Digital Carrier Line Unit
DCT	Direct Carrier Trunk
DDB	Digital Data Bank
DDC	Dual Digroup Circuit
DDS	Digital Data System
DIF	Digital Interface Frame
DL	Data Link
DLC	Digital Loop Carrier
DM	Dual Multiplexer
DMA	Deferred Maintenance Alarm

DMAP	Digroup Map
DMB	Digital Multipoint Bridge
DMI	Digital Multiplex Interface
DOTS	Digital Office Timing Supply
DOY	Day-of-year
DPC	Dual Primary Circuit
DPLL	Digital-Phase Locked Loop
DSAU	Digital Signal Access Unit
DS0	Digital Signal Level 0 (64-kb/s)
DS1	Digital Signal Level 1 (1.544-Mb/s)
DS1C	Digital Signal Level 1C (3.125-Mb/s)
DS3	Digital Signal Level 3
DS3U	DS3 Unit
DSP	Digital Signal Processor
DSPC	Digital Signal Processing Circuit
DSPI	Digital Signal Processor Interface
DSPU	Digital Signal Processing Unit
DSTC	Digital Serving Test Center
DSU	Data Service Unit
DSX	Digital Signal Cross-Connect
DT	Digroup Terminal
DTAC	Digital Test Access Connector
E2A	Type of Alarm Telemetry
EBX	Expanded Bus Extender
ECCN	Expanded Cross-Connect Network
ECI	Enhanced Communications Interface
EDC	Enhanced Digroup Circuit
EER	Excessive Error Rate
EMS	Element Management System
EMTC	Expanded Maintenance Circuit
EPGTC	Extended Pair Gain Test Controller
ERS	Errored Seconds
ESD	Electrostatic Discharge
ESF	Extended Superframe
ESR	Error Source Register
ESR1	Error Source Register 1
ESR2	Error Source Register 2
ETSI	Expanded Time-Slot Interchanger
FAL	Fuse Alarm Lamp
FAS	Frame Alignment Signal
FDL	Facility Data Link
Fe	Extended Superframe Format

FELP	Far End Loopback
FLI	Facility Line Interface
FMAC	Facility Maintenance and Administration Center
FMT	Formatter
FPB	Feature Package B
FPC	Feature Package C
FRADT	Frame Audit
FrEr	Framing (Bit) Error
Fs'	Fs Framing Format
FTM	Facility Terminating Module
FTMI	Facility Terminating Module Interface
FTU	Facility Terminating Unit
FX	Foreign Exchange
FW	Framing Word
HDB	High Density Bipolar
HUBID	Hub Identifier
IDF	Intermediate Distribution Frame
IDLD	Idled
IFTU	Integrated Facility Terminating Unit
INA	Integrated Network Access
ISDN	Integrated Services Digital Network
ISO	Inhibit Signal Overwrite
kb	Kilobit
kb/s	Kilobit per-second
kHz	Kilohertz
LAN	Local Area Network
LATA	Local Access Transport Area
LBRV	Low Bit Rate Voice
LED	Light-Emitting Diode
LFA	Loss of Frame Alignment
LILB	Line Interface Loopback
LLB	Line Loopback
LMA	Loss of Multiframe Alignment
LOS	Loss of Signal
LTD	Local Test Desk
LTP	Local Test Port
Mb	Megabit
Mb/s	Megabit Per Second
MBER	Minor Bit Error Rate
MC	Main Controller
MCP	Main Controller Power
MCR	Microprocessor Clock Receiver
MD	Manufacture Discontinued
MDF	Main Distributing Frame
MI	Maintenance Information
MJU	Multipoint Junction Unit

MLD	Message Language Description
MLT	Metallic Loop Tester
MMA	Multiple Message Alerting
MMFG	Multiplexer-MIU Function Group
MML	Man-Machine Language
MPDIS	Multipoint Disconnect
MPM	Multipoint Mode
MPOP	Multipoint Output Processor
MPUP	Multipoint Upstream Processor
MS	Microprocessor System
MSC	Mobile Switching Center
MSS	Microprocessor System Status
MTBF	Mean Time Between Failure
MTC	Maintenance Circuit
MTTR	Mean Time To Repair
MXR	Multiplexer
NCC	Not Connected Code
NFW	Not Framing Word
NG	Noise Guard
NOBBL	No Backbone Leg
NPC	Network Processing Circuit
NSA	Nonsignaling Associated
NTS	Nodal Timing Supply
NZCS	No Zero Code Suppression
OA&M	Operation, Administration and Maintenance
OCNT	One-Way Cross-Connect, Terminated
OCON	One-Way Cross-Connect
ODIS	One-Way Disconnect
OGT	Outgoing Trunk Circuit
OIU	Office Interface Unit
OOF	Out-Of-Frame
OS	Operations System
PBA	Primary Block Alarm
PBC	Primary Block Circuit
PBF	Primary Block Failure
PBI	Peripheral Bus Interface
PBX	Private Branch Exchange
PCM	Pulse Code Modulation
PCS	Packet Cross-Connect
PDN	Public Data Network
PDS	Program Documentation Standards (Language)
PFS	Primary Frequency Supply
PGTC	Pair Gain Test Controller
PII	Peripheral Interrupt Interface
PLL	Phase-Locked Loop
PMA	Prompt Maintenance Alarm

PNI	Packet Network Interface
POI	Point Of Interface
POTS	Plain Old Telephone Service
PVC	Permanent Virtual Circuit
R16	Remote Alarm Indication in Ts16
RAI	Remote Alarm Indication
RAIS	Remote Alarm Indication Signal
RAM	Random Access Memory
RBER	Remote Bit Error Rate
RDC	Red Circuit
REER	Remote Excessive Error Rate
RMAS	Remote Memory Administration System
RMB	Reverse Make Busy
RMS-D	Remote Measurement System - Digital
RMS-I	Remote Measurement System - International
RT	Remote Terminal
RTS	Remote Test System
RTS-5A	Remote Test System 5A
SARTS	Switched Access Remote Test System
SCC	Subrate Cross-Connect
SCCS	Switching Control Center System
SDE	Synchronization Distribution Expander
SDF	Scan Distribute Function
SDS	Space Division Switch
SECH	Subrate Establish Command
SERS	Severe Errored Seconds
SFDT	Signaling Freeze Delay Time
SI	Synchronous Interface
SLIM	Subscriber Loop Interface Module
SMAS	Switched Maintenance Access System
SONET	Synchronous Optical Network
SPCS	Stored Program Control System
SPU	Synchronizer Power Unit
SRM	Subrate Multiplexer
SSC	Secondary Storage Controller
SSP	Select Synchronization Port
SSRC	Sync Service and Reply Circuit
STC	Serving Test Center
SVC	Switched Virtual Circuit
SYNC	Synchronizer
TABS	Telemetry Asynchronous Block Serial
TAD	Test Access Digroup

TASC	Telecommunications Alarms Surveillance and Control System
TB	Time Base
TC	Trunk Conditioning
TCON	Two-Way Cross-Connection
TD	Timing Distributor
TDDC	Timing Distributor Composite Clock
TDIS	Two-Way Disconnect
TDM	Time Division Multiplexed
T1DM	T1 Data Multiplexer
TLA	Terminate and Leave Activate
TLI	Timing Link Interface
TLP	Transmission Level Point
TLR	Terminate and Leave Release
TP	Test Port
TPR	Test Port Release
TSI	Time Slot Interchange
TX	Timing Extractor
TXB1	Timing Extractor Bipolar DS1
TXB2	Timing Extractor Bipolar 2.048 Mb/s
TXCC	Timing Extractor Composite Clock
TXRC	Timing Extractor BSRF
TXT	Timing Extractor
TXUC	Timing Extractor Unipolar Clock
UAC	Unassigned Channel Signal
UBX	Unit Bus Extender
UC	Unit Controller
USRI	Unit Service Reply Interface
VF	Voice Frequency
VPA	Voice Path Assurance
ZBTSI	Zero Byte Time Slot Interchange
ZCS	Zero Code Suppression

Glossary

A

Active
The entity is in service, not protected. If it is a traffic-carrying entity, it is carrying traffic.

Alarm Delay
Specifies the alarm delay (in seconds) for software-detected alarm conditions. Initial value is 20 seconds.

Alarm Indication Signal (AIS)
A signal trasmitted downstream if the incoming signal is defective.

All ones Signal
Signal which is defined to contain all ones in the terminal-to-terminal mode.

Alphanumeric Characters
Letters and digits.

Alternate Mark Inversion
A DS1 line code in which alternate one bits are positive and negative, but zero substitution is not used.

ASCII Characters
Letters, digits, and symbols used in the American Standard Code for Information Interchange.

Attribute
Alarm indication level: major, minor, or no alarm.

Autolock
When the system autolocks an entity, it switches to protection and forbids return to the working entity even if the trouble clears. This is usually caused by multiple protection switches on that entity in a short time period.

Autolock Number of Switches
This parameter is the number of times that the system restores an entity to service (after intermittent failures) in a given autolock switching interval before the entity is autolocked.

Autolock Release Time
The number of hours between times when the system automatically releases autolock.

Autolock Switching Interval
An interval in minutes (see autolock number of switches).

Autonomous
Done by the system without direction by you.

Autoprovisioned
Put into the provisioned state automatically by the system.

B

B3Zs
Bipolar with 3-zero substitution, a DS3 line code.

Baud Rate
Transmission rate (bits per second) on a link.

BER Metric
Specifies the metric for calculating bit error rate at a DS3 interface port. Options are bipolar variations (BPV) or parity (PTY). (Initial value is BPV).

Bipolar Variation
A variation of the alternating +1, -1 pattern in a 3-level code.

Bit error Rate Threshold
3 stands for 0.001, 6 stands for 0.000001.

Blue Code
Same as AIS

Boot
To transfer contents of backup memory into the system's working memory.

Broadcast
Form a bridge connection.

Byte
Usually refers to a group of eight consecutive binary digits, but sometimes used for bit groups or other sizes.

C

CBIT
A DS3 line code in which parity checks on blocks of data are used to detect bits in error.

Clear (CL)
An alarm condition no longer exists.

Condition
The type of alarm indication.

Cross-Connect
A piece of hardware used to interconnect line-terminating equipment, multiplexers, and other equipment.

Crosstalk
A signal induced into one transmission line from another transmission line.

Current Value
In the dialog mode, it indicates that the current value of a parameter is used by the system unless you direct otherwise.

D

Data Base
A record of cross-connections, status of entities and facilities, and other data.

Default
A value the system automatically uses for a parameter if you do not specify a value.

Delimiter
A punctuation mark (colon or comma) used to separate two parameters in an input message.

Demultiplexer
A device used with a multiplexed signal for recovering signals combined within it and restoring the distinct individual channels of these signals.

Diagnose
Test an entity; also a trouble condition in which a diagnostic test is in progress.

Driven
A driven port is being monitored, and a good signal is expected.

DS1 Port
A DS1 port in either a DS1 interface module or a DS3 interface module.

Duplex Entity
A pair of entities in which one is active and the other is in hot standby (clock generators).

E

Echo
Display an input at a terminal (a user is echoed, but a password is not).

Enter
Provision an entity by a command, not automatically by the system.

Entity
A specific piece of hardware (such as circuit pack, memory device, or link) that has been assigned a name and recognized by the system.

Entity Identifier
The name used by the system to refer to an entity.

Equalizer
A circuit adjustment used to maintain signal strength between desired limits.

Equipped
The entity is in the system data base and physically in the frame, but is not yet provisioned.

F

Forced
A traffic-carrying entity (either service or protection) has been deliberately locked into a service-providing state by a manual command despite being bad.

G

Grooming
Rearrangement of DS1 signals in DS3 signals.

H

Header
The first line of a message.

Header Date
Specifies the current date as YYMMDD, where YY is the last two digits of the year, MM is the month, and DD is the day of the month.

Header Time
Specifies the current time of day as HHMMSS, where HH is the hour (00 to 23), MM is the minutes, and SS is the seconds.

Hierarchy
An orderly ranking or sequence of elements, such as that of menus presented at a terminal.

Hit A disruption of service that lasts for less than 1 second. See Outage.

Hot Standby
An entity ready for fast, automatic placement into operation to replace an active entity.

I

Idle
An output port is idle if it is not cross-connected to an input port.

In Service
The entity is performing normal service functions, either active or standby.

J

Jitter
Short term variations in the property of a digital signal.

L

Link ID
The location and type of a user interface link.

Location
The specific entity involved.

Loopback
A circuit arrangement that causes a received signal to be returned to its source.

M

M13
A standard format used for DS3 signals.

Maintenance
The entity has been locked into a non-service providing state by a manual command.

Maintenance Condition
An entity state in which some normal service functions are suspended, either because of a problem or in order to perform special functions (copy memory) that cannot be performed while normal service is being provided.

Mapped
Cross-connected.

Memory Location
Specifies the equipment, DS1 interace port, or DS3 MUX port location associated with a memory type.

N

Network Element
A DACS II frame is a network element.

Notification Code
The notification code for alarm and status conditions, which include: MJ - major alarm; MN - minor alarm; NA - indicates no alarm (status only); or CL - cleared alarm.

O

Out Of Service (OOS)
The entity is not providing its normal service function (removed from service or protected) either because of a system problem or because it has been removed from service manually.

Outage
A disruption of service that lasts for more than one second. See Hit.

P

Parity Check
To determine whether a block of digital data has been corrupted in transmission, you can use an even-parity format in which an extra bit is added to the block at the transmitter if necessary so that the block always contain an even number of one bits. A parity-checking circuit at the receiving end can determine whether an error has occurred in transmission. An odd-parity format can also be used for the same purpose.

Primary Line
The second line in an output message.

Program
The software that directs the operation of the main controller and other frame elements.

Protocol
Detailed format and procedures used for transmitting digital data.

Protocol Type
Indicates the protocol supported on an interface link.

Provisioned
The entity is ready to perform its intended function.

Pulse Code Modulation (PCM)
The process by which analog signals are sampled, quantized, and coded into a digital bit stream.

R

Released
If an input port, it is not under test access; if an output port, it is not cross-connected to an input port under test access.

Rollover
Operation used when the transmission facility between the system and an upstream system is to be replaced.

S

SNIDER
Protocol (message format) used on administrative links.

Software ID
Gives the software version information for the system: g - is a one-digit number giving the software release; i - is a two-digit number giving the issue; r - is a one-digit number giving the point release.

Standby
The entity is in service but is not providing service functions. It is ready to be used to replace a similar entity either by protection or by duplex switching.

State
The state of an entity indicates whether it is defective or normal, whether it is ready for normal use, etc.

Subrate
In the Digital Data System, a data bit rate that is either 2.4, 4.8, or 9.6 kb/s.

T

Test Mode

Specifies the test access mode.

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