

DACS IV-2000 (256)
Digital Access and
Cross-Connect System IV-2000
Release 4.0
Applications, Planning, and Ordering

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Applications, Planning, and Ordering
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About This Guide

Purpose

The *DACS IV-2000 (256) Release 4.0 Applications, Planning, and Ordering* guide describes features, applications, ordering information, and technical specifications of the Digital Access and Cross-Connect System IV-2000 (DACS IV-2000). New features described in this guide include enhancements to the Synchronizer Module and the Secondary Storage Subsystem, as well as improved input/output. The DACS IV-2000 (256) Release 4.0 positions the customer to evolve to future releases of DACS IV-2000.

This guide includes functional and physical overviews, system architecture, hardware and software information, and system configurations for the DACS IV-2000.

Reason for Reissue

This guide is reissued to revise the features list (in Chapter 2) and to add software ordering information (in Chapter 4). Other minor changes have been made.

Audience

The *DACS IV-2000 (256) Release 4.0 Applications, Planning, and Ordering* guide is intended primarily for network planners and engineers. It assists in the

planning and integration of a DACS IV-2000 into a network and can be used by anyone desiring specific information about the applications, ordering, and technical specifications of the DACS IV-2000 (256).

Document Summary

The parts of this document are summarized below.

- **About This Guide** includes the purpose, the audience, and a summary of this document. It also lists related documents and instructions for ordering the documents.
- **Chapter 1 - Introduction** offers a brief overview of the AT&T 2000 family of transmission products and an overview of the DACS IV-2000 and its benefits.
- **Chapter 2 - System Features** details major features of the DACS IV-2000.
- **Chapter 3 - Applications** describes how the DACS IV-2000 is used in conjunction with networking and other peripheral equipment.
- **Chapter 4 - Ordering Information** contains information to help you order DACS IV-2000 hardware and software. The information is grouped into logical ordering lists.
- **Chapter 5 - Product Support** includes AT&T product support contacts, training information, and warranty data.
- **Appendix A - Technical Specifications** contains technical specifications for the DACS IV-2000.
- **Glossary** gives definitions of terms used in this document.
- **Index** gives page locations of information in this document.



NOTE:

Unless otherwise specified, references in this document to the DACS IV-2000 are to the DACS IV-2000 (256) Release 4.0.

Print Conventions

The following print conventions are used in this guide:

- *Italic* type is used for documentation titles, primarily AT&T customer documents and Bell Communications Research (Bellcore) technical references and technical advisories.
- `Constant width` type is used for output, primarily output messages and responses to input commands.

- **Constant width bold** type is used for information you input, primarily commands.

Related Documents

The following documents provide additional information about the DACS IV-2000, and can be ordered after the general availability date of this release:

- *DACS IV-2000 (256) Release 4.0 Reference Manual*,
AT&T 365-340-700

This manual provides in-depth, encyclopedic information about the DACS IV-2000 for craft, engineers, and system administrators.

- *DACS IV-2000 (256) Release 4.0 Operations and Maintenance*,
AT&T 365-340-701

This manual provides detailed procedures for daily operations, trouble-clearing procedures, and routine maintenance of the DACS IV-2000.

- *DACS IV-2000 (256) Release 4.0 Commands and Messages*,
AT&T 365-340-702

This manual gives a description of each command and its associated output response messages, including error codes. The appendices include command name, parameter, and state modifier acronym tables, activity menus, user privilege codes, state names, and state diagrams.

- *DACS IV-2000 (256) Release 4.0 Quick Reference Job Aids*,
AT&T 365-340-703

These aids are produced on laminated sheets and contain command names, error codes, fuse locations, test access, port addressing, loop-backs, and monitored parameter default and range values.

- *DACS IV-2000 (256) Release 4.0 Software Release Description*,
AT&T 365-340-705

This document contains upgrade procedures for the new software release. It relates the status of problems fixed or found in previous releases and operating issues for the current software release. (This document cannot be ordered as a stand-alone item; it only accompanies the software.)

Electronic Documentation

AT&T's DACS IV-2000 customer documentation is available on CD-ROM. Consult your AT&T account executive for details.

Ordering Documents

To order copies of documents available for this release, send or call in an order using the title and its associated 9-digit document number as provided above.

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Introduction

1

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This chapter introduces the 2000 Product Family and positions the DACS IV-2000 within the network. It lists the benefits that the DACS IV-2000 (256) Release 4.0 offers and provides a system overview that includes architecture, hardware, and configurations.

2000 Product Family

AT&T is focused on a carefully planned and growing product family designed to provide total network solutions. The 2000 Product Family complies with the SONET (synchronous optical network) standard and builds on features that customers have found necessary to set up an efficient and successful network. It includes single-ended maintenance features and in-service upgrade capabilities. The system's modular design allows graceful in-service upgrades to accommodate both synchronous and asynchronous network communications.

The AT&T 2000 Product Family includes:

- **FT-2000 OC-48 Lightwave System.** The FT-2000 OC-48 lightwave system is a high-capacity synchronous digital transmission system.
- **DDM-2000 OC-3/OC-12 Multiplexer.** The DDM-2000 OC-3/OC-12 multiplexer is a low-capacity synchronous digital transmission system. It is designed for loop feeder and interoffice applications.
- **DACS III-2000 Digital Cross-Connect System.** The DACS III-2000 is a software-based, high-capacity, digital cross-connect system that automates many functions performed by manual DSX-3 cross-connect frames.

- **DACS IV-2000 Digital Cross-Connect System.** The DACS IV-2000 is a software-based, high-capacity, digital cross-connect system that merges cross-connect and multiplexer functions.
- **DACScan[®]-2000 Controller.** The DACScan-2000 Controller workstation automates control over diversely located network elements such as the DACS III-2000 and the DACS IV-2000.
- **SLC[®]-2000 Access System.** The SLC-2000 Access System supports standard switch interfaces such as TR08 and TR303, as well as standard feeder interfaces, at DS1 and SONET OC-3 rates.
- **Business Remote Terminal-2000 (BRT-2000).** The BRT-2000 provides access for businesses through fiber-optic telecommunications equipment.

Benefits

The key benefits offered by the DACS IV-2000 are SONET networking, cost effectiveness, flexibility, operating efficiency, revenue generation, and office modernization. These benefits are described in the following sections.

SONET Networking

Release 4.0 provides STS1 interfaces and SONET networking features, allowing for the following capabilities to be provided via the DACS IV-2000:

- Maintains end-to-end SONET connectivity between SONET network elements
- Allows grooming of VT1.5s within STS-1 signals
- Allows cross-connection of STS-1 signals
- Supports a wide range of performance monitoring for SONET signals
- Allows for asynchronous/SONET gateway connections.

Cost Effectiveness

The DACS IV-2000 merges the functions of SONET add/drop and M13 multiplexers with manual DSX-1 cross-connects and performance monitoring systems, and allows centralized and automated operations, administration, maintenance, and provisioning.

The DACS IV-2000 performs VT1.5 grooming (the rearrangement of VT1.5 signals within STS-1 signals), thereby reducing the need for back-to-back SONET multiplexers and allowing interconnection of multiple SONET rings. It also supports a wide range of performance monitoring for SONET signals, and allows

asynchronous facilities to be connected to the SONET network. These capabilities significantly reduce equipment and operating costs.

The DACS IV-2000 is highly modular in design, thus allowing for incremental growth that makes it economical for small, medium, or large traffic cross-section applications. The DACS IV-2000 replaces existing multiplexing and manual cross-connection equipment, thereby facilitating office modernization.

The DACS IV-2000 reduces equipment costs for DS1 grooming by eliminating the need for back-to-back multiplexing equipment. Office space savings as well as significantly reduced cable congestion are also realized. Employing the DACS IV-2000 as a hubbing vehicle to combine and rearrange DS1s on incoming and outgoing DS3 facilities to central office locations results in better use of customer facilities.

Replacement of manual DSX-1 functions by the DACS IV-2000 provides significant operational cost savings. Cross-connections, test access, facility rolls, and maintenance can now be controlled electronically, significantly reducing operating costs.

Flexibility

The DACS IV-2000 design permits a wide range of network applications. With three basic modules (DS1, DS3, STS1/DS3) and four types of interface bays (DS1, DS3, STS1/DS3/DS1, and STS1/DS3), the DACS IV-2000 can be expanded to meet current and future office needs. Its modular design allows incremental circuit pack growth and easy, in-service addition of interface bays. This allows its economical application in a wide range of office sizes and network applications.

Operating Efficiency

The DACS IV-2000 allows centralized control of the DS1, VT1.5, and STS1 operations, administration, maintenance, and provisioning functions. This centralized control opens up new service opportunities, permits faster response time for facility and service order provisioning, and permits faster resolution of trouble reports.

Revenue Generation

The DACS IV-2000 can be used to restore DS1s, DS3s as groups of 28 DS1s, or STS-1s as groups of VT1.5s. The route-restoration capability alleviates concerns regarding service interruptions affecting critical voice and data traffic. This enhances service protection and provides new revenue opportunity. Faster provisioning results in earlier revenue flow, and faster trouble resolution ensures revenue retention.

Office Modernization

AT&T provides a complete office modernization service that allows the advantages of the DACS IV-2000 to be realized in the embedded DS1 facilities and services. Detailed procedures have been developed to "cut over" the embedded manual DSX-1s and discrete M13s to a DACS IV-2000 system. Special tools, provided as part of the service, have been developed to allow an in-service cutover for either wire-wrapped or connectorized network elements. All associated office equipment, including D banks, office repeaters, and digital switches, can be cut over on an in-service basis.

AT&T Network Systems offers engineering and installation expertise that provides experienced, comprehensive service with full assurance of quality. The DACS IV-2000 office cutover service is implemented with highly trained AT&T installers, who work as a team with your office operations staff.

System Overview

The DACS IV-2000 is a software-based, high-capacity, digital cross-connect system that merges cross-connect and multiplexer functions. It helps manage DS1, DS3, and EC-1 facilities more efficiently by automating network route restoration, remote service and facility provisioning, and remote surveillance and test access. Its software-controlled cross-connect facility allows centralization and automation of operation, administration, maintenance, and provisioning functions.

The DACS IV-2000 allows end-to-end SONET connectivity of both access and interoffice facilities, providing the advantages of a wide range of capabilities associated with SONET. The gateway capability of the DACS IV-2000 allows you to operate asynchronous and synchronous network elements as a single transparent network. Additionally, the equipment architecture reduces startup configuration costs, increases modular growth capability, and allows for reduced floor space.

System Architecture

The DACS IV-2000 system architecture (Figure 1-1) consists of DS1, DS3, and STS-1 signal interfaces; a nonblocking switch network that supports both DS1 and SONET virtual tributary (VT) rate signals; and a software-based controller. The controller provides the system intelligence, allowing centralized automated control, primary and secondary memory backup, and local and remote operations interfaces.

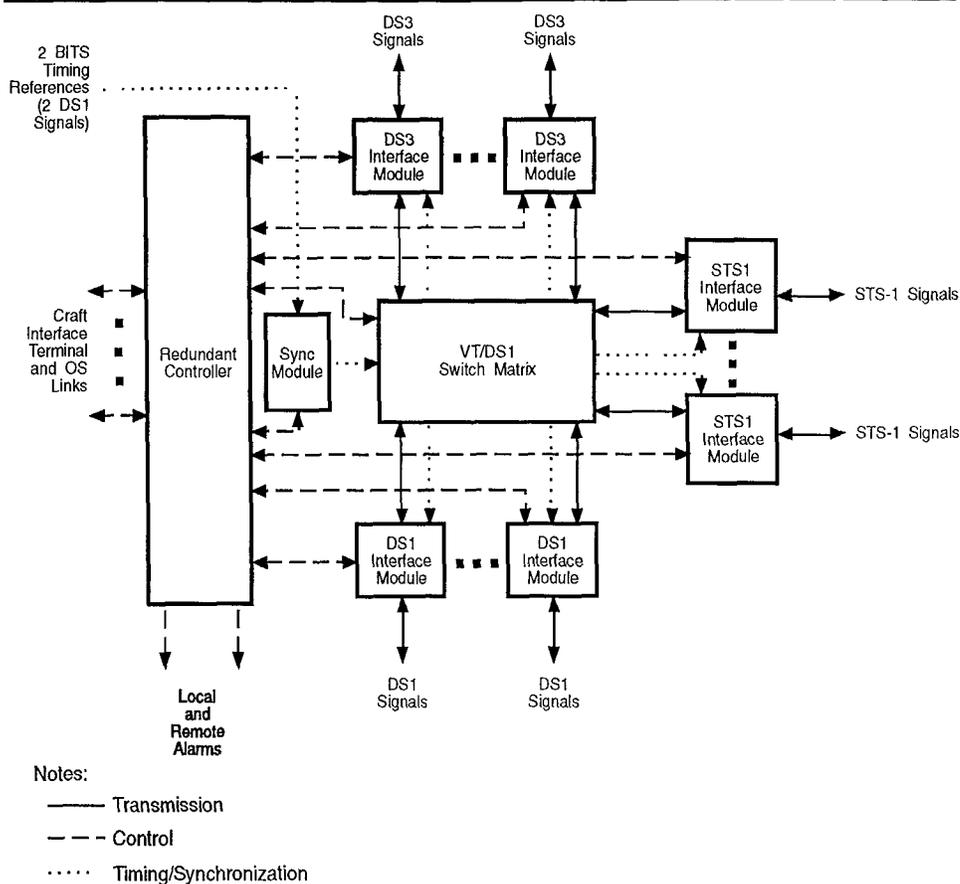


Figure 1-1. DACS IV-2000 System Architecture

Controller Architecture

The DACS IV-2000 architecture (Figure 1-2) is a distributed multiprocessor design that supports concurrent execution and performs real-time operations. The control architecture consists of two systems:

- Redundant Controller System
 - Two Control Complexes (CPU/MTC/SSC circuit packs)
 - Switch Communications Interface
 - Unit Interface
 - Enhanced Communications Interface (ECI)
 - Synchronizer Module

- Unit Controller System
 - Unit Controllers
 - Interface Circuit Packs

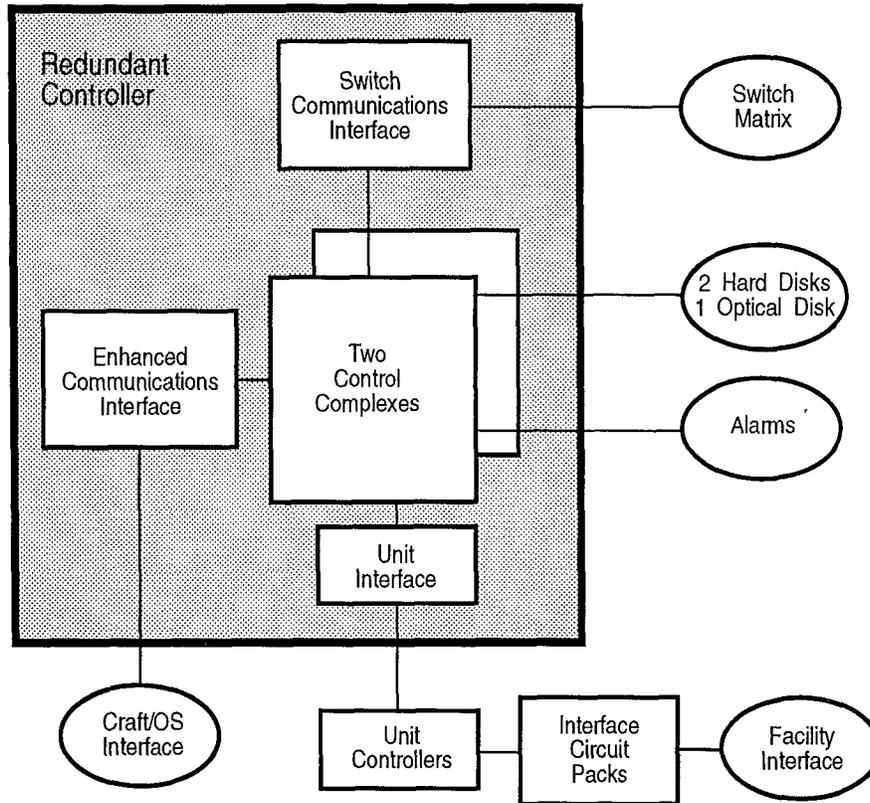


Figure 1-2. System Software Architecture

Redundant Controller System

The central component of the redundant controller system is the duplicated control complex (CC). The duplicated CC:

- Runs application software to perform all system administration functions including cross-connection, provisioning, test access, and synchronization for the SONET interfaces
- Serves as the central point of coordination for all system maintenance functions such as diagnostics, fault recovery, and alarms
- Performs all database management functions for the system, with the secondary storage controller providing the interface between the main processor and the nonvolatile storage devices (disk and optical drives).

The Enhanced Communications Interface (ECI) supports the user interface to the duplicated control complex. The ECI:

- Parses commands and generates messages to support the system interface languages: TL1 (Transaction Language 1), TABS (Telemetry Asynchronous Block Serial), and TBOS (Telemetry Byte-Oriented Serial)
- Provides the physical and electrical interfaces supporting synchronous (X.25) and asynchronous (Snider, telemetry) protocols.

The two ECI circuit packs can be configured to provide redundancy.

The DACS IV-2000 contains a Synchronizer Module, which accepts two external DS1 timing references. In the event of a timing reference failure, the synchronizer automatically switches to the secondary reference. If both references fail, the synchronizer operates in a stratum 3 holdover mode. The synchronizer is fully protected; if one synchronizer side fails, the system switches to the other side.

Unit Controller System

The unit controllers (UCs) maintain the DACS IV-2000 controller system facility interfaces by:

- Providing communications with the interface circuit packs
- Performing real-time maintenance functions, such as hardware fault detection.

Separate individual controllers on some of the enhanced interface circuit packs provide expanded real-time capabilities for features such as enhanced DS1, DS3, and SONET performance monitoring.

Hardware

The DACS IV-2000 Interface Bays are 2 feet 2 inches wide, 7 feet high, and 12 inches deep. The Switch Bay is 2 feet 2 inches wide, 7 feet high, and 13 inches deep. Both the Interface and the Switch Bays use the network bay framework. Equipment shelves that mount on these bays are factory installed. System capacity expansion is achieved by adding additional circuit packs and/or interface bays.

The Switch Bay and STS1/DS3 Interface Bays have forced-air cooling, while the DS1, DS3, and STS1/DS3/DS1 Interface Bays are cooled by free convection. The fan assembly at the bottom of the Switch and STS1/DS3 Interface Bays takes in air near the floor and exhausts it out the top rear of the bay. Unequipped circuit pack slots are not permitted. Functionally unused slots must either contain a circuit pack or be covered with filler assemblies. Heat baffles are used between the shelves on the free-convection-cooled Interface Bays to direct rising heat away from the circuit packs located above.

The initial or startup bay configuration consists of the Switch Bay, one Interface Bay, and two temporary cable end guard assemblies all bolted together as a unit for shipment. This initial configuration is 6 feet 6 inches wide. The Switch Bay is delivered with all its interbay cabling for maximum capacity. Consequently, the cable end guard assemblies are required to store and protect the cables until they are needed. The initial bays are bolted to the floor during installation.

When a growth Interface Bay is provided, the appropriate cable end guard assembly is moved to allow bay placement adjacent to the existing arrangement. The growth bay is bolted to the floor next to its adjacent bay, and the connections are made between it and the Switch Bay. The cable end guard assembly is discarded if all the stored cable has been used on that side of the Switch Bay. Otherwise, it is reattached to the new Interface Bay on the side away from the Switch Bay. Recommended growth is to the left of the Switch Bay until all the cables are used, then to the right of the Switch Bay.

Table 1-1 identifies the different types of bays and their associated modules.

Table 1-1. System Bays and Associated Modules

Bay	Module	Units Per Bay
Switch (SW)	Redundant Controller (RC)	1
	Redundant Controller Power (RC PWR)	1
	Switch Power (SW PWR)	1
	Auxiliary Power (AUX PWR)	1
	Synchronizer (SYNC)	1
	Switch (SW)	1
	Fuse and Alarm Panel (FS & ALM)	1
	Fan Assembly	1
DS1 Interface (INTFC)	DS1 Interface (INTFC)	3
	DS1 Interface-Protection (INTFC-P)	1
DS3 Interface (INTFC)	DS3 Interface-32 (INTFC)	2
STS1/DS3/DS1 Interface (INTFC)	DS1 Interface (INTFC)	1
	DS1 Interface-Protection (INTFC-P)	1
	DS3 Interface-32 (INTFC-32)	0 or 1*
	DS3 Interface-16 (INTFC-16)	0 or 1†
	STS1 Interface-16 (INTFC-16)	0-2*†
STS1/DS3 Interface (INTFC)	DS3 Interface-16 (INTFC-16)	0-4‡
	STS1 Interface-16 (INTFC-16)	0-4‡
	Fan Assembly	1

* STS1/DS3/DS1 Interface Bays can be equipped with an STS1 Interface-16 Module in place of the DS3 Interface-32 Module. When doing so, the capacity of the DACS IV-2000 is decreased by 16 DS3 equivalent signals.

† STS1/DS3/DS1 Interface Bays can be equipped with either a DS3 Interface-16 or STS1 Interface-16 Module in the bottom shelf (STS1/DS3 Interface-16 Shelf).

‡ STS1/DS3 Interface Bays can be equipped with any combination of DS3 Interface-16 and STS1 Interface-16 Modules totaling four.

Bay Configurations

The flexibility afforded by the modular design of the DACS IV-2000 allows it to be set up for initial bay configurations based on traffic requirements. Later, it can be expanded to a number of bay layouts.

The four types of DACS IV-2000 interface bays provide many possible bay layouts for a fully configured system. Figure 1-3 shows six fully-configured systems and the typical order in which the systems are expanded. The six systems are not intended to limit the options, but rather represent the range of DS1 terminations, DS3 terminations, and Electrical Carrier-1 (EC-1) terminations. DS1, DS3, and EC-1 terminations can be combined by interchanging DS3 and STS1 Interface-16 Modules within STS1/DS3/DS1 and STS1/DS3 Interface Bays.

The DACS IV-2000 can be configured to accommodate any changing DS1, DS3, and EC-1 facility needs over time under the cabling constraint that no more than 124/120 equivalent DS3s/STS-1s can be connected on either side of the Switch Bay. Because of this cabling constraint, the Switch Bay is usually located at or near the center of the bay layout, as shown in Figure 1-3. A maximum of two STS1/DS3/DS1 Interface Bays, two DS3 Interface Bays or STS1/DS3 Interface Bays, or four DS1 Interface Bays can be located on either side of the Switch Bay.

When planning the bay layout, keep in mind that the capacity of a DS1 Interface Bay (32 equivalent DS3 signals) is one-half the capacity of an STS1/DS3/DS1 Interface Bay, an STS1/DS3 Interface Bay, or a DS3 Interface Bay.

Digital Systems Access Bay

For DS1 applications requiring 22-gauge cable, consider using a Digital Systems Access Bay (DSAB) to eliminate potential cable congestion. For more information on the DSAB, refer to the *Digital Systems Access Bay (DSAB) System Reference Guide* (AT&T 365-301-135).

For DS1 applications in EMI installations, 26-gauge cable must be used to enter the system. If distance dictates 22-gauge cable in the central office, DSAB bays are again recommended.

Bay Layout and Growth Order		DS1 Interface	DS3 Interface*	STS1 Interface*																				
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DS1 INTFC Bay	DS1 INTFC Bay	DS1 INTFC Bay	DS1 INTFC Bay	Switch Bay	DS1 INTFC Bay	DS1 INTFC Bay	DS1 INTFC Bay	DS1 INTFC Bay	DS1 INTFC Bay															

* The STS1/DS3/DS1 INTFC Bays are assumed to be equipped with a standard configuration of one DS3 Interface-32, one DS3 Interface-16 or STS1 Interface-16, one DS1 Interface, and one DS1 Interface-Protection Module.

† Adjacent bays can be added to either the left or right side

Figure 1-3. Sample System Configurations

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This chapter introduces the new features that are available for the DACS IV-2000 (256) Release 4.0 and summarizes features that were introduced in earlier releases.

New Features

The DACS IV-2000 (256) Release 4.0 offers the following new features:

- Enhanced Secondary Storage Subsystem
- Enhanced Synchronizer Module
- LED for Manual Protection Switch
- Duplex Power Configuration.

Enhanced Secondary Storage Subsystem

The enhanced Secondary Storage Subsystem (SSS) consists of a Secondary Storage Controller (SSC), one per Controller Complex; two Primary Storage devices (PRI-1 and PRI-2); and a Secondary Storage device (SEC). For Release 4.0, the SSS incorporates a new architecture, which upgrades the existing SSS to the industry-standard Small Computer System Interface (SCSI) and improves the overall system performance of the SSS.

Functionally, the enhanced SSS is responsible for database backup and storage. With this release, the SSS includes two new hard disks and a removable optical disk to:

- Upgrade the volatile RAM memory to store relevant system information (such as switch settings and cross-connect maps)
- Increase the primary nonvolatile memory (PRI-1 and PRI-2) to 248 Mbytes
- Enhance the SEC by replacing the tape with an optical disk drive, which:
 - increases storage capacity to 128 Mbytes
 - increases speed
 - stores system database and the program control out of the equipment or off-site for backup purposes.

With the addition of the optical disk, you are positioned for growth; that is, you will be able to advance to Release 5.0 and beyond.

The enhanced SSS:

- Improves controller reliability
- Provides faster access and data transfer times
- Increases database capacity for future feature enhancements
- Improves input/output availability.

The increased input/output availability permits acceptance, processing, and execution of incoming commands even during manual or autonomous backups between the primary and secondary nonvolatile memory devices. Cross-connect commands can be executed during backups from working memory to the primary disks.

The DACS IV-2000 Release 4.0 uses the industry-standard SCSI interface for both the primary and secondary nonvolatile memory storage devices.

The enhanced Secondary Storage Controller circuit packs (SSC5, PRI5, and SEC5) are fully compatible with the Redundant Controller shelf; that is, no hardware or wiring changes are required to accommodate these circuit packs. The SSC5, PRI5, and SEC5 circuit packs are plug-compatible with the SSC2, PRI2, and SEC2 circuit packs. They occupy the same physical space, size, and location as the SSS of Release 3.0.

Enhanced Synchronizer Module

DACS IV-2000 synchronization (first introduced in Release 3.0) allows the DACS IV-2000 to act as a gateway between synchronous and asynchronous networks. The DACS IV-2000 Release 4.0 provides enhancements to the Synchronizer Module for improved compliance with Bellcore TR-NWT-001244, *Clocks for the Synchronized Network: Common Generic Criteria* (Issue 1, June 1993) and Bellcore TR-NWT-000253, *Synchronous Optical Network (SONET) Transport Systems: Common Generic Criteria* (Issue 2, December 1991).

In addition to its previous capabilities, the Synchronizer Module now:

- Has LEDs on its circuit packs to indicate an active or alarm state (see “Circuit Pack Alarms” later in this chapter)
- Supports field-upgradable firmware to minimize future hardware changes
- Offers improved lock-time performance
- Locks to an external reference when modulated with input jitter per TR-NWT-001244.

The synchronizer module should contain the same version (one or two) circuit packs on each side. However, to facilitate a smooth transition to version two, the software supports both version one circuit packs (DPLL1, DS1TX1, TBS31) and version two circuit packs (DPLL2, DS1TX2, TBS32). In normal operation, all three packs on the same SYNC side must be of the same version; otherwise, the synchronizer circuit packs cannot be restored via the `LRST-EQPT` command. If the same version circuit packs are on both SYNC sides and the circuit packs are not in a failed state, no synchronizer hardware-related alarms appear on the system.

The intensity, arrangement, label position, and spacing for the LEDs comply with the requirements of TR-TSY-000824, *OTGR Section 10.1: User System Interface System Access* (Issue 2, February 1988).

LED for Manual Protection Switch

To aid in identifying a circuit pack that has been manually switched to protection, this feature lights the red ALM LED on the interface or switch circuit packs (SWIF, MUX, SWIO, SMUX, or SWCS) when the circuit pack has been manually switched to protection. This is a provisionable feature.

When a manual protection switch has been performed, the red ALM LED on the circuit pack that was switched to protection is constantly lit for the duration of the protection switch. The output response to the command that was used to manually switch the circuit pack to protection contains a warning message that the red ALM LED on the protected circuit pack is lit as a result of this operation.

Duplex Power Configuration

Previous releases of the DACS IV-2000 (256) were powered by a single power plant through a Battery Distribution Fuse Board (BDFB). While the existing DACS IV-2000 (256) frames upgraded to Release 4.0 are powered in this manner, the duplex power configuration for new frame orders ensures optimum reliability.

With the duplex power architecture, the system receives power from two -48V diverse power plants. (A diverse power plant is one that does not share common components, such as BDFBs, rectifiers, batteries, and cable racks.) All -48V power feeds from the BDFB are fused separately at the BDFB and connected to two independent central office battery plants in such a way that loss of one plant does not affect traffic or result in any loss of service. For more information, see “Power Specifications” in Appendix A.

New frame orders are wired for duplex power and contain the ED-9C114-30 Main Fuse Panel, which contains LEDs for each fuse.

Other Features

The DACS IV-2000 (256) Release 4.0 supports the following features, which were introduced in previous releases:

- SONET Networking
- Upgrade
- Cross-Connections
- Special Service (Redlined) Connections
- Bridging and Rolling
- Loopbacks
- Test Access
- Link Association
- Performance Monitoring
- Redundant Controller
- Nonvolatile Backup Memory
- Alarm Reporting
- Deny UC Removal with Protected Circuit Pack
- Supported Operations Systems
- Craft and OS Interfaces
- Input Command Routing
- Security
- Facility Maintenance
- Frame Maintenance
- Protection Switching
- Automatic Circuit Pack Restoral.

SONET Networking

The DACS IV-2000 provides SONET networking, which is the ability to perform all of the functionality associated with SONET interconnection. The SMUX circuit pack terminates an EC-1 facility and allows for cross-connection of the entire STS-1 SPE, demultiplexing of VT1.5-based STS-1s and cross-connection of VT1.5s to other SONET interfaces, or cross-connection of DS1s. This same circuit pack also provides in-line performance monitoring of the SONET signal, including VT1.5 tributaries of the STS-1. Additional circuit packs are not required, and no deloading of switch capacity is required to accommodate the SONET performance monitoring feature. The DACS IV-2000 also supports operational, maintenance, and administrative features necessary for full SONET networking capability.

SONET Interface

The DACS IV-2000 is fully compliant with SONET STS-1 industry standards, allowing interconnection with AT&T's transmission equipment (DDM-2000 and FT-2000) and any other vendor equipment that meets these standards. The DACS IV-2000 provides for EC-1 SONET termination on STS1 interfaces. STS1 interfaces are housed in STS1/DS3 Interface-16 modules located in the STS1/DS3/DS1 bay or the STS1/DS3 interface bay.

- The STS1/DS3 interface bay can house up to four STS1/DS3 Interface-16 modules.
- The STS1/DS3/DS1 Interface Bay can house any combination of the following, for a maximum total of 64 DS3 equivalents:
 - DS1 Interface module (8 DS3 equivalents)
 - DS3 Interface-32 module (32 DS3 equivalents)
 - STS1/DS3 Interface-16 module (16 DS3 equivalents).

The DS3 Interface-32 module in the STS1/DS3/DS1 Bay can be upgraded to an STS1 Interface-16 module; however, this results in a reduction of total system capacity, because 16 slots in the module must be left unequipped.

The STS1/DS3 Interface-16 module can be equipped with either SMUX and SMUXP circuit packs to support STS-1 signals or MUX2 and MUX2P circuit packs to support DS3 signals. An STS1/DS3 Interface-16 module is dedicated to either STS1 or DS3 interfaces; it does not support a mix of STS1 and DS3 interfaces.

The STS1/DS3 Interface-16 module is designed to support fifteen service circuit packs and one protection circuit pack. Each SMUX circuit pack terminates one EC-1 line and supports all of the SONET capabilities described in this chapter.

Upgrade

You can upgrade from a DACS IV-2000 (256) Release 3.0 to a DACS IV-2000 Release 4.0. (You cannot upgrade directly from a Release 2.0 to Release 4.0; you

must first upgrade to Release 3.0.) The upgrade includes the in-service replacement of the Main Controller Module with the Redundant Controller Module equipped with the enhanced SSS.

Any configuration of the Release 3.0 system can be upgraded to Release 4.0. The only hardware change required for the upgrade is replacement of the existing SSC, PRI, and SEC circuit packs with the corresponding circuit packs of the enhanced SSS. If SONET interfaces are used for Release 4.0, then the Clock Generator circuit pack must be upgraded to CLKGN3; the Synchronizer Module circuit packs may be version one or version two.

The upgrade procedure includes conversion of the Release 3.0 database to the optical disk media used in Release 4.0.

Cross-Connections

The DACS IV-2000 provides end-to-end SONET cross-connections and SONET/asynchronous gateway connections. This feature allows SONET-to-SONET and SONET-to-asynchronous signal interworking.

The DACS IV-2000 electronically cross-connects DS1, VT1.5, and STS-1 signals. The cross-connections are implemented with a three-stage space division switch. The DACS IV-2000 switch network is nonblocking and can perform the following types of cross-connections:

- STS-1 (clear-channel SPE) signals between SONET interfaces (SMUX circuit packs). By cross-connecting STS-1 (clear-channel SPE) signals, SONET end-to-end path connectivity is maintained via the DACS IV-2000.
- VT1.5 signals between SONET interfaces. VT1.5 end-to-end path connectivity is maintained through the DACS IV-2000 with this type of cross-connection.
- DS1 signals between SONET interfaces. DS1 signals are accessed by terminating the path of the VT1.5 signals and extracting the DS1 signal.
- DS1 gateway cross-connection between SONET and DS1/DS3 interfaces. These types of cross-connections provide the SONET/asynchronous gateway connection.
- DS1 signals between DS1/DS3 interfaces.

The DACS IV-2000 can perform one-way, two-way, and bridged cross-connections. These functions can be performed on DS1, VT1.5, and STS-1 signals. The DACS IV-2000 implements cross-connections from commands received over one of the administrative links from either a local terminal or from a centralized operations center. In addition to implementing cross-connections, commands are provided for map retrieval. These commands are used to retrieve more data about input ports that are mapped to output ports. In addition, data can be retrieved about DS1 ports that are transmitting quasi-random signals.

Special Service (Redlined) Connections

Circuits that are sensitive or require special care when changing or deleting (such as 911) should be made as special service connections to prevent inadvertent changes in status. When entering cross-connections (one-way, two-way, or broadcast), the connections can be specified as special service (redlined) connections.

Connections specified as special service can only be deleted or modified if they are identified as special service connections using the RDLN value in the Special Service Type parameter, or the YES value in the INCL parameter.

Bridging and Rolling

The DACS IV-2000 can bridge DS1 connections by cross-connecting the DS1, DS3, or STS1 input port of any connection to any DS1, DS3, or STS1 output port without affecting service in the existing path. This feature is used for DS1 facility rolling.

The DACS IV-2000 performs EC-1 facility rolling by bridging an STS1 input port to an STS1 output port without affecting service in the existing path. Rolling consists of breaking the old connection while simultaneously establishing the new connection in less than 1 ms. The DACS IV-2000 supports one-way rolls (each direction of transmission rolled separately) and two-way rolls (both directions rolled together).

The DACS IV-2000 can bridge any VT1.5 connection by cross-connecting the VT1.5 input port to a VT1.5 output port without affecting service in the existing path. This feature allows for VT1.5 facility rolling.

Loopbacks

The wideband loopback feature provides for VT1.5s within incoming STS-1 signals to be looped back through the switch (on a per-tributary basis) to the outgoing STS-1 of the same STS-1 signal. The STS-1 line loopback feature allows for loopback of incoming STS-1 signals to the output direction, and maintains all incoming signal code and format violations and timing. Both loopback features are performed without changing any bits in the looped-back signal.

The following loopback types are available:

- DS1 Loopbacks can be operated on a specified DS1 port or range of DS1 ports, either towards the facility, towards the switch, or through the switch matrix of a DS1 Interface Module, a DS3 Interface Module, or a VT1.5 (DS1) tributary of an STS-1 signal within the system. DS1 loopbacks can be one of the following four types:
 - LPBKL (Line Loopback) loops the signal from the input port to the output port (towards the facility) at the DS1 Interface Module.

- LPBKT (Terminal Loopback) loops the signal from the input port to the output port through the switch matrix in the switch module. DS1 terminal loopbacks are valid for DS1IF1, MUX1, MUX2, or SMUX1 circuit packs.
- LPBKI (Internal Loopback) loops the signal from the output port to the input port (towards the switch) at the DS1 Interface Module.
- LPBKM (DS1 Tributary Loopback) loops a DS1 tributary signal within a MUX2 circuit pack from the input port to the output port (toward the facility) at the DS3 Interface Module. DS1 tributary loopbacks are valid for either near-end or far-end on MUX2 circuit packs only.

The DACS IV-2000 also supports communication with the far-end multiplexer (via the DS3 overhead bits) to establish loopbacks as specified in "Remote Multiplexer Communications" later in this chapter.

- DS3 Line Loopbacks can be operated on an incoming DS3 signal directly to the outgoing direction of the same port. This loopback happens directly in the MUX2 circuit pack. This keeps the signal from entering the switch matrix and thus keeps the amount of hardware encountered to a minimum. Because the signal is not demultiplexed, it retains all its control bits, overhead bits, and bipolar violations. The DACS IV-2000 also preserves the timing of the looped-back signal. The only modification of the DS3 signal occurs when the system regenerates the signal to meet the specifications for an outgoing DS3 signal.
- VT1.5 Loopbacks can be operated on a specified VT tributary of an STS-1 signal as a terminal loopback (LPBKT), which loops the VT1.5 signal from the input port to the output port through the switch matrix in the switch module.
- STS-1 Loopbacks can be operated on a specified STS1 port or range of STS1 ports, either towards the facility or through the switch matrix of an STS1 Interface Module. STS-1 loopbacks can be one of the following types:
 - LPBKL (Line Loopback) loops the signal from the input port to the output port (towards the facility) at the STS1 Interface Module.
 - LPBKT (Terminal Loopback) loops the signal from the input port to the output port through the switch matrix in the switch module. STS-1 terminal loopbacks are valid for near-end on SMUX circuit packs.

STS-1/VT1.5/DS3/DS1 loopbacks are shown in Figure 2-1.

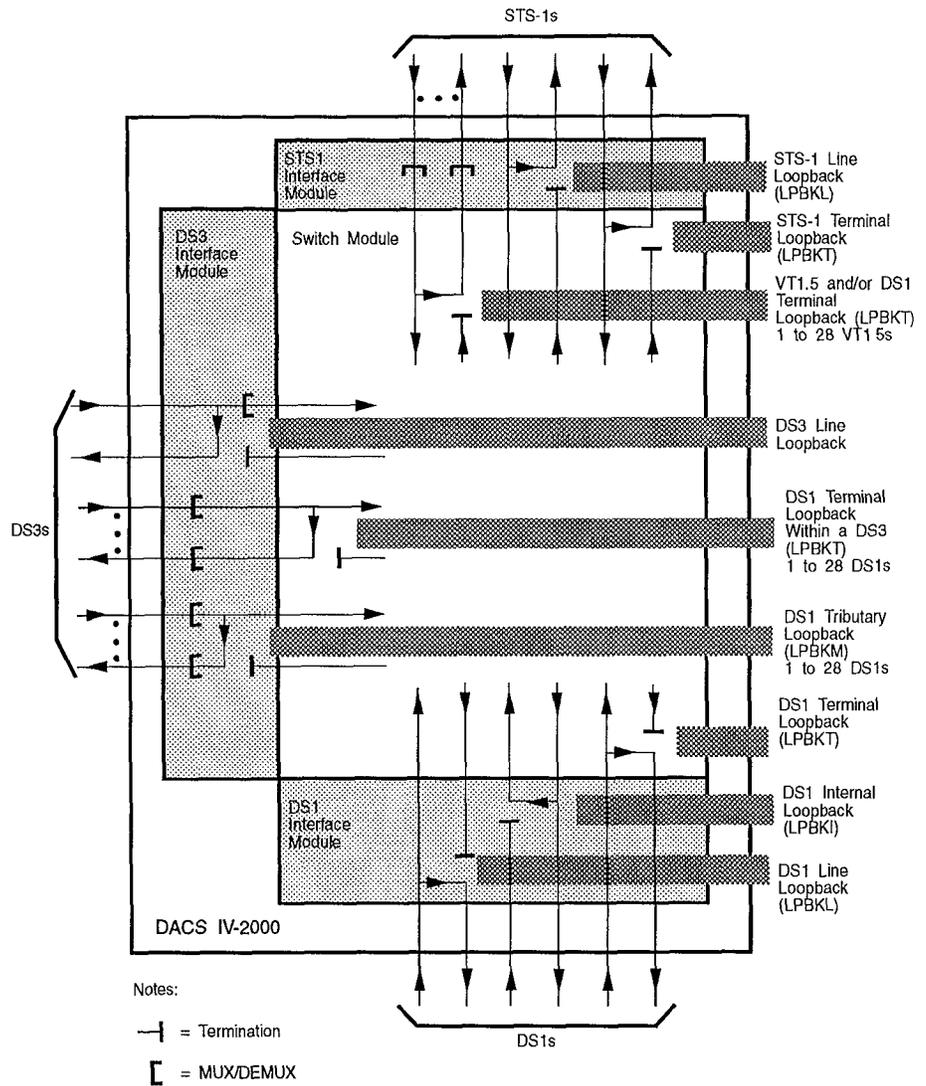


Figure 2-1. DS1, DS3, STS-1, and VT1.5 Loopbacks

Test Access

The DACS IV-2000 supports all the DS1, VT1.5, and STS-1 test access modes specified in Bellcore TR-NWT-000818, *OTGR Section 6.1: Network Maintenance: Access and Testing - Generic Test Architecture* (Issue 1, November 1992). The test access modes supported are MONE, MONF, SPLTA, SPLTB, SPLTE, SPLTF, LOOPE, LOOPF, MONEF, and SPLTEF. With these capabilities, the system can act as a digital test access unit (DTAU).

VT1.5 and STS-1 test access connections are accessed via the SONET interface. Individual VT1.5 tributaries must be accessed externally from an STS-1, for which test access is provided.

The ability to supply and monitor DS1, VT1.5, and STS-1 test signals, split connections, and perform loopbacks can simplify facility turnup and assist in trouble isolation.

Link Association

When making test access and loopback connections, you can specify that the connection is associated with the user ID and link. When a connection is associated with the link, the connection is automatically disconnected or removed when the user that created the connection logs off. When a test access or loopback connection not associated with a link is made, the connection remains when the user that created the connection logs off. The connection is removed with a **DISC-TACC** (test access) or **RES-LPBK** (loopback) command.

Performance Monitoring

This section describes STS-1/VT1.5, DS1, and DS3 performance monitoring.

STS-1 and VT1.5 Performance Monitoring

The DACS IV-2000 provides SONET performance monitoring capabilities for intermediate points on the STS-1 and VT1.5 paths as well as at termination points. In this way, the DACS IV-2000 provides a centralized point for monitoring the health of the SONET network.

For the VT1.5 path, near-end performance monitoring is provided by counting the BIP-2 coding violations using V5 bits 1-2. From these counts, the DACS IV-2000 derives the following parameters:

- Errored Second (ES)
- Errored Second A (ESA)
- Errored Second B (ESB)
- Severely Errored Second (SES)
- Alarm Indication Signal/Loss of Pointer (AIS/LOP) Second (ALS)
- Unavailable Second (UAS).

For the STS-1 path, the DACS IV-2000 provides both near-end and far-end performance monitoring. Near-end STS-1 performance monitoring is accomplished by counting the BIP-8 coding violations using the B3 byte. These counts are used to derive the STS path performance monitoring parameters. The far-end parameters are derived by counting the far-end block errors (FEBEs) using G1 bits 1-4.

The DACS IV-2000 provides all of the line performance monitoring and provides the section performance monitoring required for network elements supporting non-repeated applications (Severely Errored Framing Seconds and Loss of Signal Seconds).

In its implementation of the SONET networking feature, the DACS IV-2000 extends its performance monitoring capabilities of asynchronous signals to SONET signals. Performance monitoring thresholds in the DACS IV-2000 are selectable on a per-parameter, per-channel basis. Threshold crossing alerts are generated when thresholds are reached or exceeded. Performance monitoring reports are available on a scheduled or demand basis. For the SONET signals, the DACS IV-2000 stores 15-minute bins for up to 8 hours, and performance monitoring totals for the current and previous day.

Monitored Parameters

This section lists the performance monitoring parameters.

Near-End Section Parameters

The following section parameters are available for SONET:

- Severely Errored Framing Second (SEFS)
- Loss Of Signal Second (LOSS).

Line Parameters

The following line parameters are monitored by the DACS IV-2000:

- Coding Violation (CV)
- Errored Second (ES)
- Errored Second A (ESA)
- Errored Second B (ESB)
- Severely Errored Second (SES)
- AIS/LOP Second (ALS)
- Unavailable Second (UAS).

Near-End Path Parameters

The following near-end STS and VT path parameters are monitored by the DACS IV-2000:

- Coding Violation (CV)
- Errored Second (ES)
- Errored Second A (ESA)
- Errored Second B (ESB)
- Severely Errored Second (SES)

AIS/LOP Second (ALS)
Unavailable Second (UAS).

Far-End Path Parameters

The following far-end STS path parameters are monitored by the DACS IV-2000:

Coding Violation (CV)
Errored Second (ES)
Errored Second A (ESA)
Errored Second B (ESB)
Unavailable Second (UAS).

DS1 Performance Monitoring

The DS1 performance monitoring feature allows the DACS IV-2000 to monitor the health of DS1 facilities by collecting performance data for those facilities. The parameters that are monitored and measured to determine the health of a facility depend on the framing format and the performance monitoring option. The parameters that are monitored and measured also depend on whether near-end (monitored directly by the DACS IV-2000) or far-end (as updated by the upstream NTE) performance monitoring data are requested.

Framing Format

Framing format may be extended superframe, superframe, or unframed.

- Extended Superframe (ESF) provides path performance monitoring using cyclic redundancy code (CRC) error checking to monitor the health of the incoming DS1 signal path. The CRC code checks for errors in all the bits of the DS1 signal. ESF format also provides a 4-kbit/s data link for communication between network elements connecting the DS1 facility which can be used to send Performance Report Messages as required by the ANSI T1.403 standard.
- Superframe (SF) provides path performance monitoring using DS1 signal framing bits.
- Unframed (UNF) provides line performance monitoring for all DS1 signal formats coded with alternate mark inversion (AMI) or bipolar with 8-zero substitution (B8ZS). Line performance monitoring is performed using bipolar violation counts to monitor the received signal on the facility; this excludes the bipolar violations that are part of the B8ZS code.

Performance Monitoring Options

Performance monitoring options may be full time, camp-on, or scanned.

Full-Time Monitoring

When using the full-time monitoring option, the software monitors the health of incoming DS1 facilities continuously. It supports both DS1s that terminate on DS1

interfaces and DS1 tributaries within a DS3. The DACS IV-2000 offers two types of full-time monitoring: dedicated and bridged.

- Dedicated full-time monitoring continuously checks the health of facilities terminating on a DS1 interface (DS1IF). Any of the 28 DS1s associated with the SWIF circuit pack can be provisioned for dedicated full-time performance monitoring. Dedicated full-time monitoring does not reduce the capacity of the DACS IV-2000.
- Bridged access full-time monitoring can continuously check the health of DS1 tributaries within a DS3 as well as DS1 facilities terminating on a DS1 interface (DS1IF). The DACS IV-2000 monitors these signals by bridging the DS1s to a performance monitoring generator and receiver (PMGR) circuit pack.

Camp-on Monitoring

The camp-on monitoring option allows the DACS IV-2000 to monitor a specified DS1 or group of DS1s. The system provides two camp-on monitoring options: manual and automatic.

- Manual: Selected ports have a bridge of a DS1 signal passing through a SWIF or MUX to a port on a PMGR circuit pack; established using a command.
- Automatic: Occurs when the performance monitoring scanning option detects that a DS1 port has degraded service; that port is automatically connected to an available designated automatic camp-on port.

Scanned Monitoring

The DACS IV-2000 provides scanned monitoring for those DS1 signals that do not need to be monitored on a full-time basis. This option is ideal for checking general network and facility performance health. You can also use scanned monitoring when you require more cost-effective performance monitoring measures. With this method, one PMGR circuit pack can monitor up to 420 DS1 signals whereas one PMGR can monitor only a maximum of 28 DS1s when operating in the camp-on mode.

Scanned performance monitoring is not available for DS1s within VT1.5 signals.

Monitored Parameters

The DACS IV-2000 monitors and reports both path and line performance parameters to verify that service quality objectives specified in terms of these parameters are being met. Performance monitoring only occurs during available time because service quality assessments cannot be determined during a period of service outage.

In addition to the path and line parameters that are monitored and reported, the DACS IV-2000 can detect incoming trouble condition indicators on SF- and ESF-formatted DS1 signals.

Near-End Path Parameters

Path performance monitoring parameters apply only to ESF- and SF-formatted signals; they do not apply to UNF signals. The path parameters are:

- Path Code Violation (CVP)
- Path Out-of-Frame Second (OOFS)
- Path Errored Seconds (ESP)
- Path Bursty Errored Seconds (BESP)
- Path Severely Errored Seconds (SESP)
- Unavailable Seconds (UAS)
- Path Degraded Minute (DM); only for ESF.

Near-End Line Parameters

DS1 line parameters only apply to DS1 signals that terminate on DS1 interface circuit packs in a DACS IV-2000. Line performance parameters are determined using bipolar violations. The line parameters are:

- Line Code Violations (CVL)
- Line Errored Second (ESL)
- Line Severely Errored Seconds (SESL).

Far-End Parameters

Far-end parameters are collected in the system by reading the Extended Superframe (ESF) data link. The ANSI T1.403 standard specifies that the equipment that terminates an ESF DS1 facility monitors the performance of the incoming signal and transmits a performance report to the far end once per second. The report contains performance data for each of the previous four 1-second intervals. The DACS IV-2000 is capable of reading this report and maintaining a database of the far-end performance data.

The parameters defined for near-end paths (except OOFS) are also available for far-end paths. In addition, far-end path parameters include:

- Severely Errored Frame Second (SEFS)
- Controlled Slip Second (CSS).

Trouble Condition Reporting

Facility alarm messages are generated if there is a loss-of-signal (LOS) condition or if the Bit Error Rate (BER) threshold is reached or exceeded. The BER is based on BPVs, the framing bits of the SF format, or the CRC-6 bits of the ESF format. The BER alarm threshold can be provisioned to any one of the following rates: 10^{-3} , 10^{-4} , 10^{-5} , 10^{-6} , 10^{-7} , 10^{-8} , or 10^{-9} errors per second.

In addition to reporting the LOS and BER alarms, the DACS IV-2000 reports incoming alarm indication signal (AIS), yellow alarm, and loss-of-frame (LOF) status conditions.

Data Reporting

The system database maintains running tallies of all the parameters monitored by the DS1 performance monitoring feature. When a parameter count is changed, data is collected based on the parameter and the collection interval previously selected. Each parameter has a predetermined threshold established by the system administrator. If a threshold is reached or exceeded, the system generates a Threshold Crossing Alert (TCA) message over the administrative links. Records of the processed performance monitoring data can be generated. The system also provides the capability to schedule performance reports to be generated according to a defined timetable.

DS3 Performance Monitoring

DS3 performance monitoring provides the following:

- DS3 performance data based on path as well as line parameters
- Processed performance data in compliance with Bellcore TR-TSY-000820, *OTGR Section 10.1: Network Maintenance: Transport Surveillance - Generic Digital Transmission Surveillance* (Issue 2, February 1988), and *AT&T Compatibility Bulletin Number 149 (CB-149)*.
- Performance monitoring data available on all message-based administrative links.

Monitored Parameters

The DACS IV-2000 processes performance data in compliance with CB-149 (PSET#1) and Bellcore TR-TSY-000820, *OTGR Section 10.1: Network Maintenance: Transport Surveillance - Generic Digital Transmission Surveillance* (Issue 2, February 1988) (PSET#2). This applies to the M13 line and C-bit parity formats, and to line monitoring (LCV and DS3 parity) and path monitoring (DS3 F- and M-bits, DS3 CP-BITS, and DS3 far-end block error bits).

The following performance BER metric parameters can be monitored:

- Bipolar Violations (BPV); BPVs monitored but not stored
- Parity (PTY)
- Copy of Parity Bits (CP-BITS)
- F and M Bits Adjusted (FMA-BITS)
- F and M Bits Nonadjusted (FMN-BITS).

At any given time, only one primitive (BER metric parameter) can be monitored on a DS3 port. The CP-BITS primitive is valid only for the C-bit parity format (not for the M13 line format). In addition, the BER alarm threshold can be provisioned to any one of the following rates: 10^{-3} , 10^{-4} , 10^{-5} , 10^{-6} , 10^{-7} , 10^{-8} , or 10^{-9} errors per second.

With DS3 performance monitoring, the software reports all performance parameters and alarm conditions over any of the DACS IV-2000 administrative links. DS3 performance parameters monitored by the DACS IV-2000 are described below.

Parameter Set # 1

The DACS IV-2000 complies with Parameter Set # 1 (PSET#1), as specified by CB-149 requirements. The PSET#1 parameters are:

- Block Error Count (BEC)
- Out-Of-Frame Second (OOFS)
- Errored Second Type A (TPA)
- Errored Second Type B (TPB)
- Errored Second Type C (TPC)
- Unavailable Second (UAS).

Parameter Set # 2

The DACS IV-2000 complies with Parameter Set # 2 (PSET#2), as specified in Bellcore TR-TSY-000820, *OTGR Section 10.1: Network Maintenance: Transport Surveillance - Generic Digital Transmission Surveillance* (Issue 2, February 1988). The PSET#2 parameters are:

- Out-Of-Frame Second (OOFS)
- Coding Violation (CV)
- Errored Second (ES)
- Severely Errored Second (SES)
- Unavailable Second (UAS).

Redundant Controller

The DACS IV-2000 is provided with two control complexes, which maximize control availability and reliability by providing redundancy in the critical parts of the Main Controller and autonomous recovery from controller failures. The following sections describe additional features provided with the Redundant Controller (RC) Module.

Administrative Links

Two ECI circuit packs are provided, allowing for twelve administrative links (six per ECI circuit pack). The ECI circuit packs can provide administrative link redundancy by establishing separate links to critical operating systems from each ECI. The links are identified as CILINK-1-1 through CILINK-1-6 and CILINK 2-1 through CILINK 2-6.

Redundant Power

Duplicated power circuit packs provide redundant power to the RC Module circuit packs, thereby increasing reliability.

Nonvolatile Backup Memory

The two hard disks are the primary (PRI) nonvolatile backup memory devices for the DACS IV-2000. All database changes are automatically recorded on the disks. A removable read/write optical disk is used to download new software and perform periodic, scheduled system database backups.

The DACS IV-2000 provides an option to enable automatic database backups from the primary backup medium to the secondary medium. Automatic database backups can be scheduled to execute once in a 24-hour period on selected days or on every day of the week. The disk database can also be manually backed up to the secondary disk.

Alarm Reporting

The DACS IV-2000 provides three levels of office alarms: critical, major, and minor.

- A critical alarm indicates a severe, service-affecting condition.
- A major alarm indicates a service-affecting failure, main or unit controller failure, or power supply failure.
- A minor alarm indicates an abnormal condition that is not service-affecting.

Alarms are reported in three places: in the central office (office alarms), in the remote maintenance center (remote alarms), and on the circuit packs (circuit pack alarms). The three types of alarms are described below.

Office Alarms

The DACS IV-2000 provides the following local office alarm outputs:

- Critical audible
- Critical visual
- Major audible
- Major visual
- Minor audible
- Minor visual
- Main controller failure (processor major) visual.

Local status indicators are provided on the status panel. Detailed alarm information is provided over administrative links. Software-controlled alarms can be delayed to suppress spurious alarms. (The delay is programmable from 1 to 30 seconds.)

The alarm level of incoming DS1, DS3, and EC-1 facility failures can be changed on a per-port basis to major, minor, or no alarm.

Serial alarm, status, and control (AS&C) telemetry points and parallel alarm closures are provided by the system.

An alarm cutoff (ACO) for turning off the audible alarms is provided both on the status panel and at a remote location. Contact closures for visual alarms remain on until the condition causing the alarm is corrected.

Remote Alarms

The DACS IV-2000 provides four remote alarms: critical, major, minor, and processor major, with local status indicators on the status panel circuit pack. Detailed alarm information is provided over administrative links. Software-controlled alarms can be delayed in order to suppress spurious alarms. (The delay is programmable from 1 to 30 seconds.)

The alarm level of incoming DS1, DS3, and EC-1 facility failures can be changed to major, minor, or no alarm on a per-port basis.

AS&C telemetry points and parallel alarm closures and remote reset are provided by the system. The AS&C points are collected by a telemetry remote in the local office and transmitted to the appropriate operations system (OS).

Circuit Pack Alarms

All circuit packs, except version one synchronizer circuit packs and BXA circuit packs, contain a red LED to aid in trouble isolation. Some circuit packs also contain a green LED to indicate that the circuit pack is active. The LED is mounted so that it is visible while the circuit pack is plugged into the equipment. The power supply circuit packs activate their respective red LEDs when a fault exists, and, because the LEDs are powered from the primary power supply, they light even if logic level power is lost. An alarm indication message is generated for each circuit pack failure.

The Synchronizer Module is a fully duplex module with each synchronizer side comprising three circuit packs: DS1TX2 (DS1 timing extractor 2), TBS32 (stratum 3 time base oscillator 2), and DPLL2 (digital phase lock loop 2). Each circuit pack has a green LED and a red LED.

- The red LED (labeled ALM) indicates circuit pack failures. The red LED on any synchronizer module circuit pack (DPLL2, DS1TX2, TBS32) lights continuously while the circuit pack is in a failed condition.
 - The red LED remains lit for the duration of the failure or 2 seconds, whichever is longer.

- The red LED on the DS1TX2 blinks (1 second on, 1 second off) continuously when a reference failure exists on either timing link. The blinking starts immediately upon failure detection and continues as long as the reference failure exists. The blinking stops as soon as the failure is cleared and the reference is declared valid.
- The green LED (labeled ACT) indicates whether the circuit pack is active.
 - For the DPLL2 and TBS32 circuit packs, the green LED remains lit while the circuit pack is active; that is, the circuit pack is on the active SYNC side. It is extinguished if the circuit pack is not active.
 - For the DS1TX2 circuit pack, the green LED remains lit while the circuit pack is active; that is, the circuit pack is on the active SYNC side and the SYNC is either in normal or fast mode. It is extinguished if the circuit pack is not active.



NOTE:

Whenever the red LED on any synchronizer pack is lit due to any circuit pack failure, the green LED on that circuit pack is extinguished and the circuit pack is removed from service.

Multiple Alarm Processing

This feature improves the correlation and readability of alarm report messages and enhances system performance. The Multiple Alarm Processing and Reporting feature collects multiple alarms that occur within 1 second into a single alarm message. This reduces system overhead and makes alarm messages easier to read and interpret.

Alarm Clear Messages

For each alarm condition reported, a message is sent when the alarm is cleared, regardless of any other active condition on the same report.

CB-149 Alarm Compliance

The DACS IV-2000 software provides a clear delay capability that specifies the length of time from the time a condition clears until the associated TABS/TBOS point is cleared and a message is issued to indicate the cleared condition. The clear delay time is provisionable from 1 to 20 seconds. The alarm is cleared if the condition clears and remains clear for the provisioned clear delay time.

Deny UC Removal with Protected Circuit Pack

You cannot manually request removal of a unit controller (UC) from service if any interface circuit pack in that unit is protected. Denying the removal of the UC when

an interface circuit pack is protected prevents the interface circuit pack from being unprotected under certain situations.

Supported Operations Systems

The DACS IV-2000 provides for communications with various Bellcore and AT&T Operations Systems (OSs). The DACS IV-2000 command message set complies with the current Bellcore TL1 specifications. This message set allows for communicating with Bellcore's OPS/INE and NMA.

Bellcore Operations Systems

The DACS IV-2000 can communicate with the following Bellcore OSs:

- Facility and Equipment Planning System (FEPS) is used by capacity planners to plan equipment and facility usage and to forecast demand for new equipment and facilities.
- Trunks Integrated Record Keeping System (TIRKS) maintains a database of equipment and facilities in the interoffice network to design end-to-end circuits for service provisioning.
- Operations System/Intelligent Network Element (OPS/INE) implements cross-connections in the DACS IV-2000 based on information received from the provisioning system.
- Network Monitoring Analysis (NMA) collects alarms and performance monitoring data from the DACS IV-2000.
- FLEXCOM/Inc supports end-customer control of the DACS IV-2000.
- Integrated Test System (ITS) supports facility testing.

The interface to OPS/INE and NMA is through X.25 links to Bellcore's Operations Communications System (OCS).

In addition to the alarm data from the DACS IV-2000 that are sent to a central OS through TL1 messages, the remote MUX capabilities of the DACS IV-2000 support the communication of alarm data from a DDM-1000 [or any vendor's M13 multiplexer compliant with the Bellcore TR-TSY-000009, *Asynchronous Digital Multiplexer Requirements and Objectives* (Issue 1, May 1986) or ANSI T1.107 specifications] to an alarm-monitoring OS such as NMA. Because of this capability, communications links directly to the remote M13 for alarm data are not required.

In order for the DACS IV-2000 Release 4.0 to interface with current Bellcore OSs and for full support of the Release 4.0 features, the following releases (or later) of the NMA, OPS/INE, and TIRKS software should be used:

NMA - Release 4.2
OPS/INE - Release 1.9
TIRKS - Release 16.2

Figure 2-2 depicts a typical Bellcore environment.

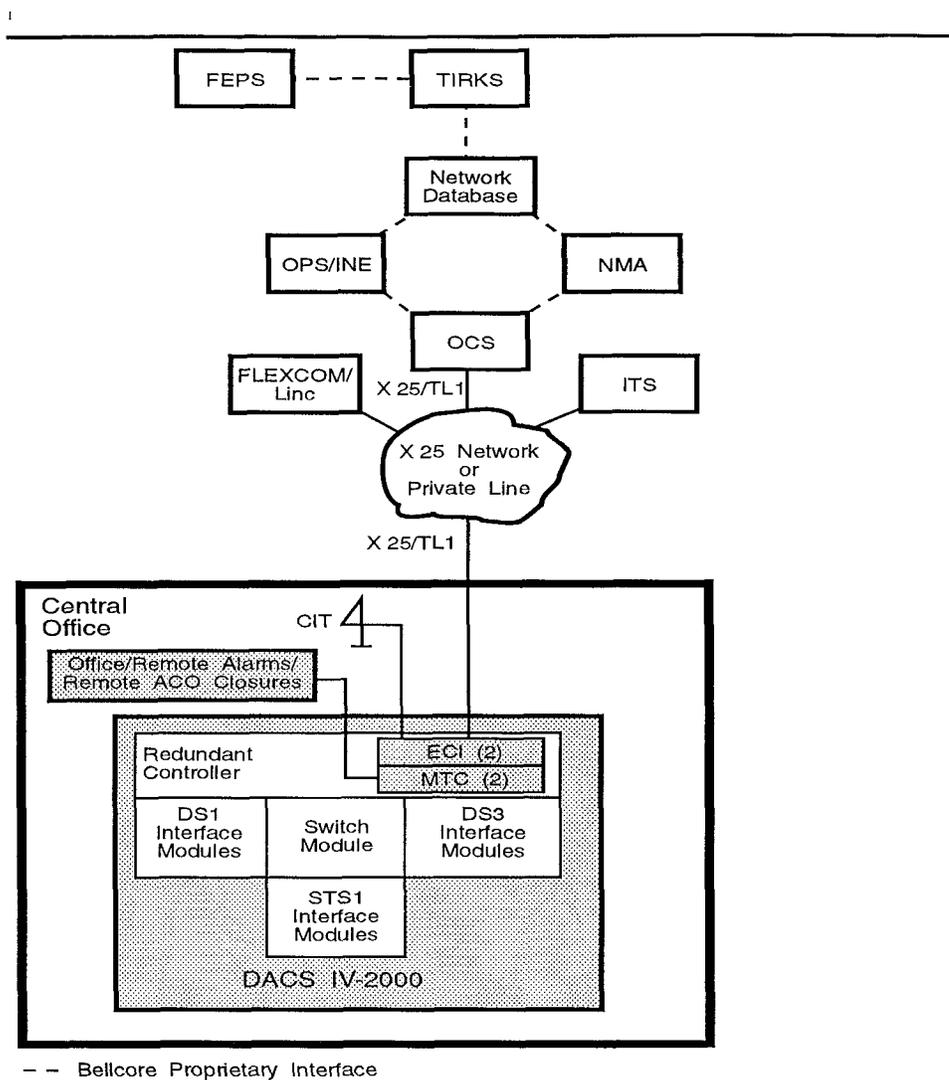


Figure 2-2. Typical Bellcore Operations Systems Environment

AT&T Operations Systems

The DACS IV-2000 can communicate with the following AT&T Operations Systems:

- DACScan-2000 Controller automates control over diversely located network elements, such as the DACS III-2000 and the DACS IV-2000.
- Remote Measuring System - DS1/Switched Access Remote Testing System (RMS-DS1/SARTS) provides remote testing, executes access commands, and provides performance monitoring (on demand) by the DACS IV-2000.
- Switching Control Center System (SCCS) provides management and surveillance of network elements.
- Total Network Management (TNM) provides management and surveillance of network elements. TNM is a migration of the existing SCCS architecture to the AT&T Star Server[®] FT Release 2 fault-tolerant computer platform.

In order for the DACS IV-2000 to interface with current AT&T OSs and for full support of the current DACS IV-2000 features, the following releases (or later) of the DACScan-2000 Controller, RMS-DS1/SARTS, and SCCS/TNM software should be used:

DACScan-2000 Controller - Release 5.2

RMS-DS1/SARTS - Release 5.0.1.6

SCCS - Release 13.3

TNM - Release 4.0

Figure 2-3 depicts a typical AT&T environment.

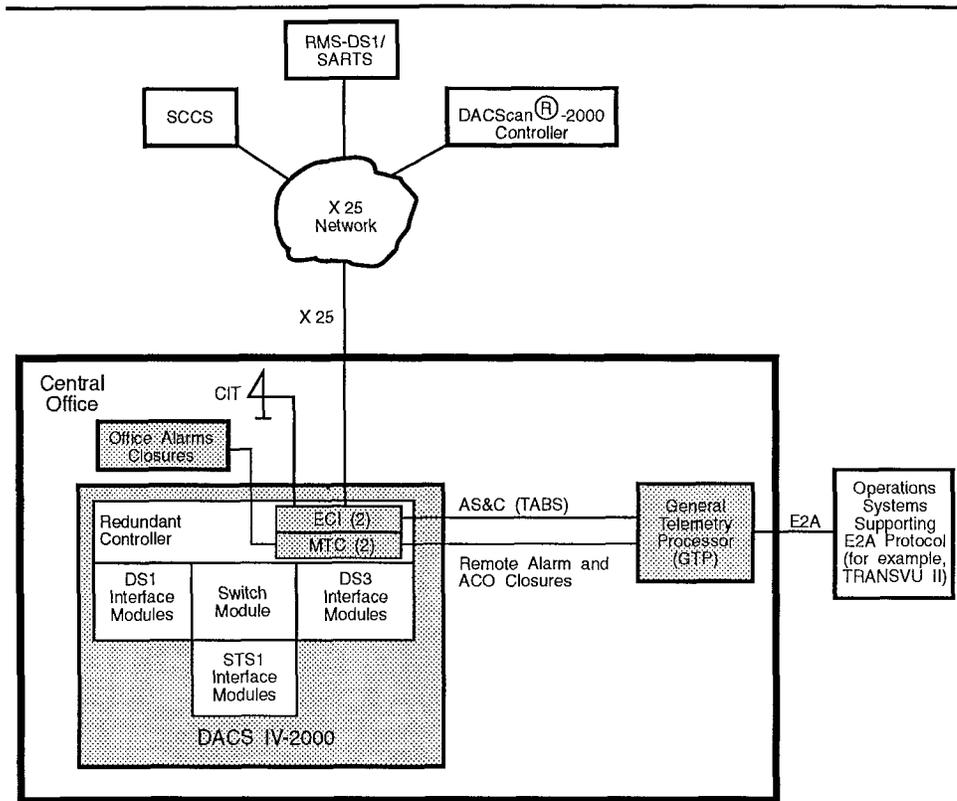


Figure 2-3. Typical AT&T Operations Systems Environment

Craft and OS Interfaces

The craft and OS interfaces of the DACS IV-2000 are used in the operations, administration, maintenance, and provisioning of the system. The interfaces are described in the "Interface Specifications" section in Appendix A.

Input Command Routing

This feature allows input commands and acknowledgment codes from any administrative link at the DACS IV-2000 frame to be echoed to a specified link. Input commands and acknowledgment codes are echoed through autonomous messages (REPT LOCL IN). The following commands support this feature:

- **ACT-ECHO-LINK** activates echoing of input commands from the specified link to another link.
- **CANC-ECHO-LINK** cancels the echoing of input commands from the specified link to another link.
- **RTRV-ECHO-LINK** retrieves the status of echoing of input commands for the specified link.

Security

The DACS IV-2000 provides a security feature that offers secured access to the Main Controller (MC). This feature includes login and password protection, manual logout, and super-user access to administer logins for MC access. Super users can restrict access of other users to only that subset of commands they need to do their job. For example, craft personnel who only need to perform various system queries can be assigned user logins that restrict them from executing potentially service-affecting commands.

Security Audit

To help system administrators determine whether system security has been compromised, the DACS IV-2000 software provides the Security Audit feature to maintain a record of the following security-related events:

- User logins and all autonomous and manual user logouts
- Login creations, deletions, and changes
- Failed login attempts that result in a link lockout
- Input commands issued by a user with the incorrect security level
- Changes of the system time or date
- Edited link security parameters

- Deleted security audit records.

The audit log maintains the most recent 100 security-related events in nonvolatile memory.

Message Screening

Five message screening values can be provisioned on a per-link and a per-user basis. When logged into a link, the user value has precedence over the link value. The five message screening values are:

- INPUT specifies that the user or link receives responses to its own input commands.
- AUTO specifies that the user or link receives responses to its own input commands and to autonomous messages except for report database change messages due to manual command input.
- ALL specifies that the user or link receives responses to its own input commands, to autonomous messages except for report database change messages due to manual command input, and to responses to input commands from other users.
- DBAUTO specifies that the user or link receives responses to its own input commands and to autonomous messages including report database change messages due to manual command input.
- DBALL specifies that the user or link receives responses to its own input commands, to autonomous messages including report database change messages due to manual command input, and to input commands from other users.

User Priority Levels

Super users can assign priority levels to user logins so that commands entered by users are processed according to the priority level assigned. When commands are entered over the administrative link, the software places each command in a queue. This allows the processor to execute each command one at a time. If a number of commands are in the queue, the processor executes them according to the priority assigned to the user who entered the command.

There are five user priority levels defined as 1 to 5, with 5 being the highest priority level. For example, if the queue contains three commands with the first two entered by a user with a priority level of 3 and the last command entered by a user with a priority of 4, then the processor executes the last command first. If two commands have the same priority, then the processor executes the commands in the order received. This feature is useful in circumstances that require immediate processing of commands, such as enabling cross-connections for restoration.

Command Verification

The DACS IV-2000 contains a command verification feature that reduces the chance of error. The software displays a warning message and requires a confirmation before allowing the processor to execute commands that can affect service or prevent access to the system for extended periods of time. After receiving the warning message, the user has the option to modify, cancel, or execute the command. This feature is disabled for machine-to-machine connections, allowing the OS to operate unimpeded by command reviews and warning messages.

The expanded command verification warning messages also inform you when the execution of a `CPY-MEM` option takes longer than 10 minutes.

X.25 Links

The DACS IV-2000 supports the X.25 Packet Assembler/Disassembler and provides an X.25 flow control.

X.25 Packet Assembler/Disassembler

Using an external Packet Assembler/Disassembler (PAD), an X.25 link can be converted into multiple asynchronous terminal interfaces. The PAD can be used to connect asynchronous terminals to the system for local operation, or to modems for remote (networking) operation. (See Figure 2-4.) The recommended PAD is a MICOM[®] box Type 2 X.25 asynchronous PAD.

X.25 Flow Control

With the X.25 flow control feature, commands are never dropped because of full input buffers if the OSs have been suitably coded. Without the X.25 flow control feature, the DACS IV-2000 cannot accept commands when the input buffers are full; it drops commands and sends back the input acknowledgment `RL` (retry later). With X.25 flow control, the DACS IV-2000 stops acknowledging X.25 commands when the input buffers are full. By not acknowledging commands, back pressure is applied through the X.25 network and stops the sending system from transmitting commands until the DACS IV-2000 is ready to accept them again.

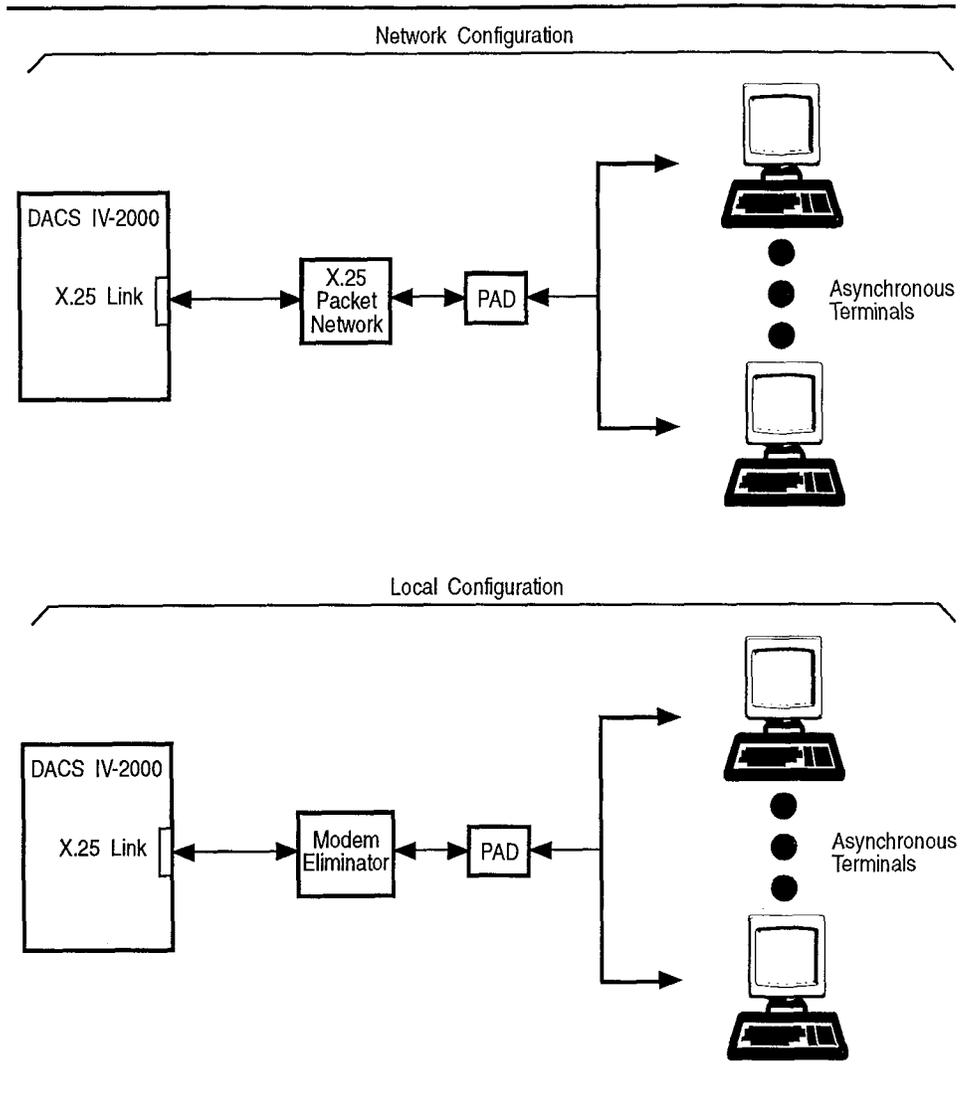


Figure 2-4. X.25 PAD Applications

Facility Maintenance

Facility maintenance consists of monitoring incoming DS1, DS3, and STS-1 signals; generating alarms and messages when failures are detected; and auditing system security. Facility maintenance features provided by the DACS IV-2000 are described in this section.

Application of Special Signals

The DACS IV-2000 automatically supplies a DS1, VT1.5, or STS-1 idle signal to the output ports to drive facilities through the switch. If all 28 DS1 tributaries in a DS3 are idle, the system can be provisioned to transmit a DS3 idle signal on the output port. When an incoming signal failure condition is detected at an input port of the switch, a DS1, VT1.5, or STS-1 AIS is supplied to the corresponding output port to replace the failed signal.

The DACS IV-2000 can be provisioned to provide a DS1 test signal supplied by an external test generator, such as a QRSS. One of the DACS IV-2000 DS1 system ports must be connected to this generator. A command given to the system, using the broadcast capability of the switch matrix, makes this signal available to any outgoing DS1 port (DS1 or DS3 interface circuit pack). The QRSS can be substituted for normal DS1 data (via user command) when needed for test purposes.

The DACS IV-2000 can insert two special signals onto a specified outgoing facility without taking down the established cross-connection. This feature can be used for verification of facility routing or for testing. The two signals that can be applied are an idle (AIS) signal (unframed all ones) or a DS1 test signal from the external signal generator.

Facility Failure Detection

Both DS1 and DS3 ports are monitored for LOS and for BERs that reach or exceed a user-selectable threshold (10^{-3} through 10^{-9} , user-programmable on a per-port basis). BER is determined by checking bipolar violations or parity violations (optionally on DS3 ports). DS3 ports are also monitored for the OOF condition. The occurrence of any of these conditions is indicated by a system alarm, an appropriate facility failure report over the administrative links, and a flashing LED on the interface circuit pack associated with the incoming signal.

DS1 and DS3 Idle Signals

The DACS IV-2000 automatically supplies a DS1 idle (AIS) signal to any output port that is not cross-connected through the DS1 switch. (A DS1 idle signal is identical to a DS1 AIS signal.) If all 28 DS1 tributaries in a DS3 are idle, the system can be provisioned to transmit a DS3 idle signal on the output port. If an incoming signal failure is detected at an input port of the DS1 switch, a DS1 AIS is supplied to the corresponding output port to replace the failed signal.

The detection of signal loss, out-of-frame, or AIS on an incoming DS3 facility causes activation of DS1 AIS on all DS1 tributaries in the DS3 signal.

DS3 AIS and Idle Signals

If a DS3 facility fails before getting to an upstream network element (such as a DACS III-2000), that network element sends a DS3 AIS over the facility to the DACS IV-2000. The AIS inhibits the DACS IV-2000 from generating misleading facility alarms and activates status indications along the path of the DS3 facility. Similarly, if a facility fails coming into the system, the system transmits an AIS to the next network element downstream.

A network element upstream (such as a DACS III-2000) supplies a DS3 idle signal on the DS3 facility if no other signal is connected to the facility at the network element. For example, a DS3 facility can be connected to an incoming port on the DACS IV-2000 coming from a DACS III-2000.

The DACS IV-2000 monitors incoming DS3 ports for DS3 AIS, idle signal, and out-of-frame conditions on the constituent DS2 signals. If the DACS IV-2000 detects any of these conditions, the software does the following:

- Inhibits incoming signal failure alarms
- Provides status indications through serial telemetry and over administrative links, which indicate detection of AIS or idle signals
- If AIS, indicates the type of DS3 AIS format. The system can detect two different formats of AIS. Bellcore TR-TSY-000191, *Alarm Indication Signal Requirements and Objectives* (Issue 1, May 1986), specifies that DS3 AIS signals have valid DS3 framing bits set to a repeating 1010 pattern. An alternate CCITT DS3 AIS format specifies an unframed, all-ones signal.

For DS3 facilities requiring any of these capabilities, the MUX2 and MUXP2 circuit packs, respectively, must be used. For DS3 Interface-32 Modules, you must also use Unit Controller 4 (UC4) and Power E3 (PWRE3) circuit packs.

STS-1 and VT Signal Paths

The DACS IV-2000 uses STS-1 and VT path AIS for the idle signal.

DS1 Signal Pattern

The DACS IV-2000 can be provisioned to provide an outgoing DS1 signal supplied by an external signal generator. This signal can be quasi-random or another signal pattern. One of the DS1 ports must be connected to the external generator. A command given to the system (using the broadcast capability of the DACS IV-2000 switch matrix) makes this signal available to any outgoing DS1 port. The signal from the external generator is transmitted from all DS1 output ports that are provisioned with an output mode of QRSS.

DS1 Input Port Status

The input port status is provisioned in the DACS IV-2000 to mark DS1 input ports as:

- Driven: A good signal is expected and an alarm occurs if the signal is bad.
- Not driven: No valid signal is expected at the port, and the port is not monitored for failures. If the port is formatted, performance monitoring data are accumulated.
- Initialized: The port is considered nondriven until a valid signal is detected, and when a valid signal is received, status automatically changes to driven.

DS3 Mismatch Detection

Each DS3 port is provisioned for either an M13 or a C-Bit Parity signal type. In previous software releases, when a signal that was not in the provisioned format was received on a port, the DACS IV-2000 generated an alarm. The invalid signal was indicated by either one or more DS2 Out of Frame (DS2OOF) or All DS2s Out of Frame (ALLDS2OOF) alarms. With the DS3 Mismatch Detection feature, the system reports the invalid signal, identifies the source of the problem, and indicates that the invalid DS3 signal is due to a C-Bit Parity/M13 format mismatch. This feature requires that Multiplexer 2 (MUX2) circuit packs be installed in the DS3 Interface Module.

Per-Frame Database Change Reports

This feature allows the system to report database changes on a per-frame basis. This feature is provisionable at the frame level.

Port Information Retrieval

The DACS IV-2000 provides a parameter for use when retrieving the status of provisioned ports. Ports are selectable that transmit normal signals, or transmit idle signals, or transmit AIS signals, or transmit a signal from an external DS1 generator.

Automated Facility Turnup Test

Built-in test signal generators and receivers in the DS1 Interface circuit paths can be used during facility turnup to test facility continuity. A new facility is looped back at the distant end, a test signal is applied at the DS1 signal rate, and the presence of the looped-back signal is verified by the test receiver. The system must be equipped with a DS1 Interface Module to have this capability. DS1 and DS3 facilities can be tested, but DS3 facilities are tested as 28 DS1s on an individual DS1 basis. Figure 2-5 provides examples of the automated facility turnup test.

Remote Multiplexer Communications

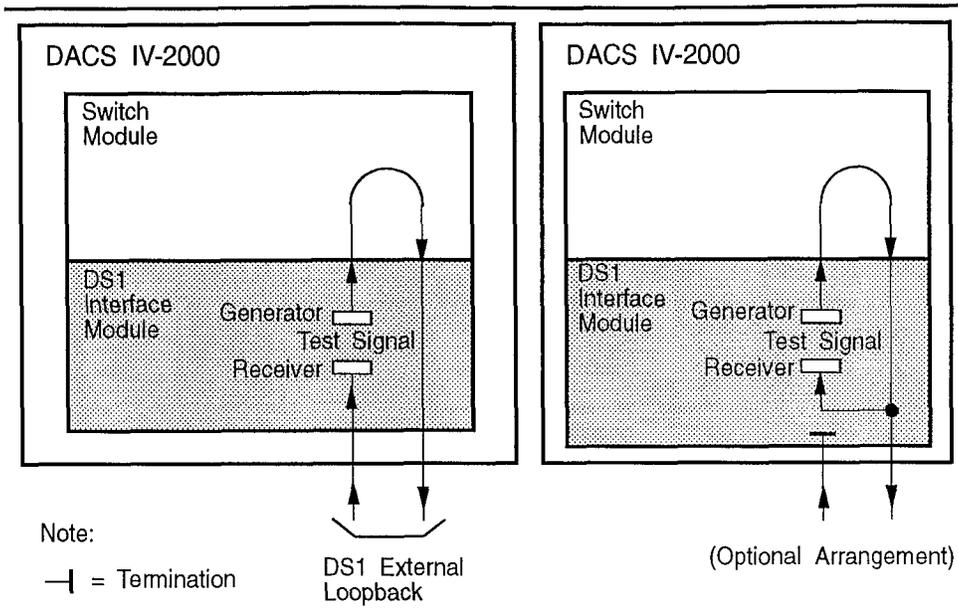
This feature enables the DACS IV-2000 to communicate with far-end multiplexers by using DS3 overhead bits. It allows:

- Far-end loopback control
- Response to far-end loopback commands
- Signaling of alarm conditions to the far end
- Generation of alarms/status messages on far-end conditions.

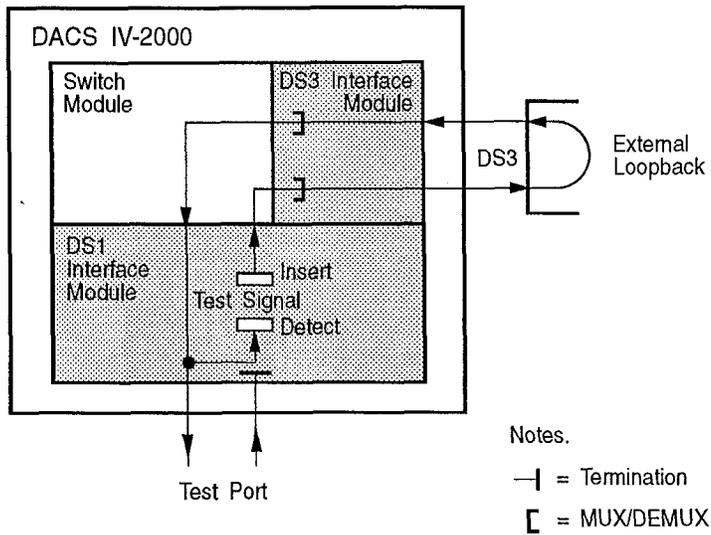
This feature supports the following protocols for communications with multiplexers at the far end of the DS3 facilities:

- DS3 X-bit signaling that indicates far-end DS3 alarm conditions
- DS2 X-bit signaling that indicates far-end DS2 out-of-frame conditions
- DS1 loopback control using the DS2 C-bits as specified in Bellcore TA-TSY-000009, *Asynchronous Digital Multiplexer Requirements and Objectives* (Issue 1, May 1986)
- C-bit parity format far-end alarm and control link for control of DS1 and DS3 loopbacks and reporting of far-end facility and equipment alarm conditions as specified by ANSI T1.107a-1989
- S-bit (DS3 stuff bit) communications link used by AT&T DDM-1000 multiplexers for DS1 loopback operations and reporting far-end and near-end equipment and facility failure conditions.

Function and protocol are specified on a per-port basis. This allows the DACS IV-2000 to match capabilities of the far-end multiplexers. For DS3 facilities requiring the remote multiplexer communication feature, the facility must be equipped with MUX2 and MUXP2 circuit packs.



A. Automated Loopback Transmission Test on a DS1 Port



B. Automated Loopback Transmission Test on a DS3 Port

Figure 2-5. Automated Facility Turnup Test

Frame Maintenance

The features and capabilities of the frame maintenance mechanism are described in this section.

Incorrect Secondary Disk Load Message

When an attempt is made to copy the database from secondary disk to primary disk, system identifiers (system type, system release, and TID) are compared to the system identifiers in memory (WKG). If the identifiers differ, a warning message is generated and the database transfer is not completed.

AS&C Activation on Secondary Disk Failures

This feature facilitates remote operations by providing an Alarm, Surveillance (or Scan), and Control (AS&C) point, which is activated whenever a `CPY-MEM` request to the secondary disk (SEC) fails. These failures may not be confined to failures of the secondary disk. The alarm points are held active until the DACS IV-2000 is polled at Link 4. After being polled, the alarm points are cleared. In addition, if a `REPT BKUP` message is issued with the status parameter set to `FAIL`, the AS&C points are set.

Empty Primary Database Check

An empty database is defined as a database with no units provisioned, but otherwise correct. If the frame is instructed to boot a database with this characteristic, the boot fails and the MC is placed into the OOS-MCOND state. A failure message indicates the nature of the failure. (The MC state can be changed to IS state if necessary.)

Disk Verification

This feature automatically verifies and checks the system's ability to access the hard disk at least once every 15 minutes. This process detects and reports hard disk access failures.

Fault Isolation and Reporting

The DACS IV-2000 can isolate a fault to the incoming facility or equipment. In the case of an equipment failure, the DACS IV-2000 identifies the failed circuit pack by lighting a red LED on the faceplate and generating alarms and administrative link messages.

Fan Filter Replacement Indication

This feature provides a periodic autonomous message alerting you that the fan filter in the Switch Bay needs to be replaced. An autonomous message is generated when the recommended replacement period of 91 days has expired. The message must be acknowledged manually.

New Fan Assembly

The new fan assembly causes the DACS IV-2000 to generate an alarm for a clogged filter condition, and when sensing high preset temperature values.

BNC Connectors

The DACS IV-2000 can be equipped with BNC connectors that allow connections to DS3 and EC-1 facilities. BNC connector panels can be ordered with STS1/DS3/DS1, DS3, or STS1/DS3 interface bays. The BNC connector panel is provided as part of the electromagnetic compatibility (EMC) enclosure to meet the FCC Class A criteria for EMC, but can be provided optionally without the enclosure.

Advantages of the BNC connectors are:

- The coaxial connections are collected in a single place at a convenient and consistent location.
- A quick, positive connection/disconnection is provided.
- Risks are reduced when handling coaxial lines, since they are kept from the backplane areas.
- A more robust connection is available.
- The coaxial splice is eliminated because the 734A and 735A cables can be brought directly to the frame. The need to downsize to a smaller diameter is eliminated.
- Cable routing and precabing are facilitated. Cables can be pulled from either end with less risk, and if necessary, can be trimmed and re-terminated easily. This minimizes the excess slack problem.
- Standard industry-wide hardware is available, and such items as connectors, tools, and cabling can be stocked as necessary.

EMC Enclosures

When fitted with the optional EMC enclosures, the DACS IV-2000 meets the EMC FCC criteria and the electrostatic discharge (ESD) requirements specified in Bellcore TR-NWT-001089, *Electromagnetic Compatibility and Electrical Safety Generic Criteria for Network Telecommunications Equipment* (Issue 2, June 1993).

⇒ NOTE:

Enclosures must be ordered with any new frame and cannot be field retrofitted.

With the EMC option to help eliminate electromagnetic interference (EMI), the entire front of the DACS IV-2000 is covered with EMC doors. Because of this, the visual alarm indicators are only visible when viewed from the front. However, the EMC enclosure provides a Header Designation Assembly (HDA) at the top of each bay to house duplicate alarm indicators so they are fully visible to craft personnel.

Protection Switching

The DACS IV-2000 system architecture divides the circuit packs associated with signal transmission (interfaces and switch matrix) into a number of protection groups. A single failure within a protection group is protected, but additional failures within a single group are not protected. Multiple failures occurring in multiple groups are protected independently within the individual protection groups.

A DS3 interface protection group consists of either a DS3 Interface-32 or DS3 Interface-16 Module. (The DS3 Interface-32 is protected on a 1 x 31 basis; the DS3 Interface-16 is protected on a 1 x 15 basis.) The protectable entity in a DS3 interface protection group is the MUX circuit pack, which supports one DS3 facility.

A DS1 interface protection group consists of all the DS1 Interface Modules within the same bay. The protectable entity in a DS1 interface protection group is a set of three circuit packs (two DS1IF circuit packs and a SWIF circuit pack), which in combination support 28 DS1 facilities.

The switch protection group consists of the switch shelf and the Clock Distributor (CLKDR) circuit packs in the interface modules. The protectable entity in the switch protection group is either an SWIO/CLKDR circuit pack pair or an SWCS circuit pack. When an SWIO or CLKDR circuit pack fails, it is protected by its mate circuit pack. In addition, the associated SWIO or CLKDR circuit pack is switched to protection. To support the additional load that is switched onto the mate circuit packs, additional paths through the switch matrix are used, and these are provided by the spare 32nd SWCS circuit pack.

Protection switching in the switch protection group requires remapping connections. To perform this within the required time interval, the system maintains prestored maps that are used to protect failures of SWIO and SWCS circuit packs. These prestored maps are updated whenever connections in the switch matrix are changed. Mapping is allowed on all circuit packs while they are protected.

In an interface protection group, there is a single protectable entity and a single protection bus available. Therefore, only one protection switch can be performed at a time in that protection group. The DACS IV-2000 protects a single failure in each interface protection group independently of failures in other interface protection groups.

The DACS IV-2000 circuit packs do not protection switch automatically unless they are carrying traffic. This applies to DS1IF, SWIF, MUX, SMUX, and SWIO circuit packs, but it does not apply to SWCS circuit packs because these circuit packs are not associated with specific facilities and because 31 of the 32 SWCS circuit packs must be available at all times to guarantee nonblocking.

The autolock state exists to prevent excessive protection switching caused by an intermittent problem. A circuit pack is put into the autolock state when n protection switches occur within m minutes. All autolocks are automatically released every x hours by the system. The values of n , m , and x are provisionable by the user.

Automatic Circuit Pack Restoral

When a failed circuit pack is replaced, it is automatically returned to service if it passes all system diagnostic tests. This feature applies to all circuit packs except the redundant controller and synchronizer circuit packs.

The UC circuit packs are automatically restored when the system is reset. The system may be reset by pushing the RESET button, issuing an initialization command, or performing a power-on restart.

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This chapter describes the major network applications of the DACS IV-2000. The DACS IV-2000 allows centralization and automation of many network functions currently implemented manually and thus provides an efficient means of managing DS1, VT1.5, and EC-1 circuits and facilities.

The modularity of the system, both in bay and circuit pack design, provides a high degree of flexibility in its deployment in a network. This flexibility allows the DACS IV-2000 to be used economically in a variety of applications to match service needs and to allow cost sharing over those applications.

The major applications of the DACS IV-2000 are:

- SONET connectivity
- SONET/asynchronous gateway
- DS1/VT1.5 grooming
- Broadband STS-1 cross-connection
- Electronic DSX (EDSX)
- Test access and performance monitoring
- Networking
- Digital switch cutover.

SONET Connectivity

The DACS IV-2000 Release 4.0 maintains SONET paths while allowing grooming and rearrangement of VT1.5 signals and rearrangement of STS-1 signals. (See Figure 3-1.) Both the STS-1 and VT1.5 signals can be cross-connected while maintaining continuity of the path overhead. To support STS-1 path connectivity, the DACS IV-2000 provides STS-1 clear-channel Synchronous Payload Envelope (SPE) cross-connect function. Similar to the STS-1 clear-channel SPE cross-connect, the DACS IV-2000 provides a VT1.5 clear-channel SPE cross-connect for maintaining the VT1.5 path.

The ability to groom and maintain VT1.5 paths through a central office is attainable only by using a DACS IV-2000-like SONET digital cross-connect system. Using alternatives, such as back-to-back multiplexers, requires demultiplexing the signal down to asynchronous levels with cross-connection at a DSX-1; this consequently terminates the SONET path. The DACS IV-2000 cross-connects the VT1.5 signal, thus maintaining end-to-end SONET connectivity.

SONET/Asynchronous Gateway

The DACS IV-2000 provides cross-connection of a DS1 signal from a DS1 or DS3 interface to an STS1 interface. At the STS1 interface, the DS1 signal is mapped into a VT1.5 within the STS-1, and SONET overhead is added. Thus, the DACS IV-2000 serves as a gateway between the asynchronous network (incoming DS1s and DS3s) and the synchronous network (outgoing STS-1s), as shown in Figure 3-2.

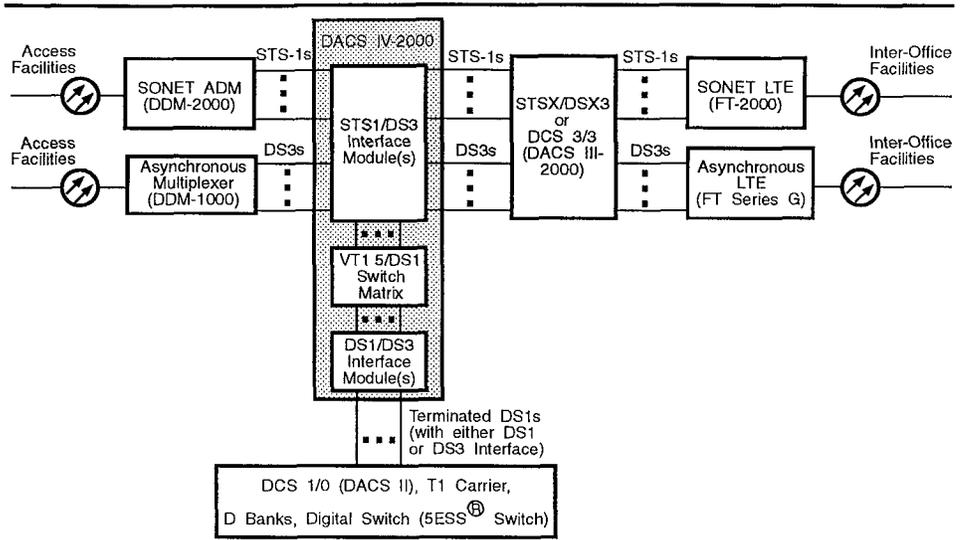


Figure 3-1. SONET Office Architecture with the DACS IV-2000

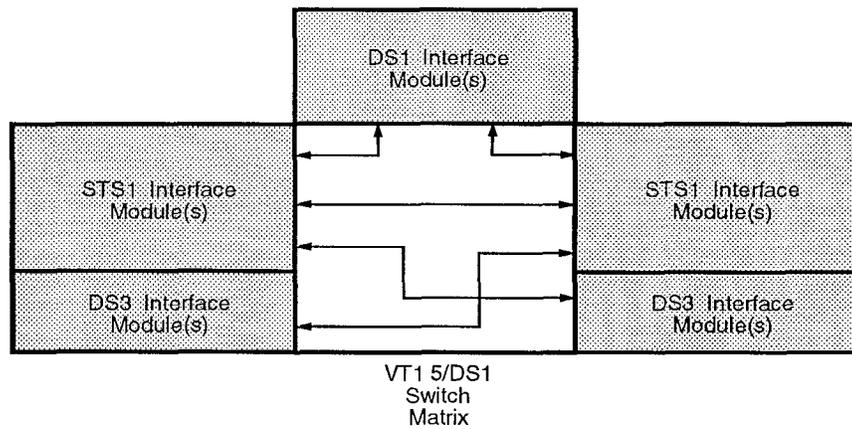


Figure 3-2. DACS IV-2000 Asynchronous Gateway to SONET

Grooming

Grooming is the process of adding or dropping signal tributaries (such as DS1 or VT1.5 signals) to or from a terminating facility (such as a DS3 or EC-1). Grooming is used to maximize the use of high-speed facilities. Grooming can be performed on any signal transmitted under the following conditions:

- From a customer or remote terminal site to an interoffice facility (access grooming)
- From one central office to another (interoffice grooming)
- From one piece of equipment to another within a central office (intraoffice grooming)
- Between carriers at a point of interface

Figure 3-3 illustrates the grooming application.

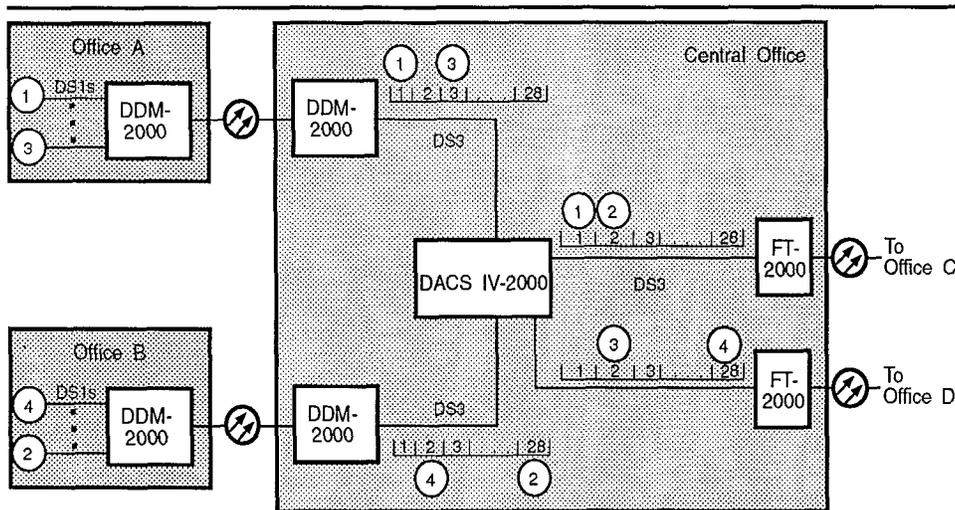


Figure 3-3. DACS IV-2000 Grooming Application

Access Grooming

Access grooming is the rearrangement of tributaries on terminated facilities that come into central offices from customer sites or remote terminals. The DACS IV-2000 offers access grooming for both synchronous and asynchronous facilities.

The increasing use of fiber facilities for loop access and the rapid growth of DS1 services make the DACS IV-2000 economically advantageous for access grooming applications. DS1 signals on SONET EC-1 facilities or DS3 facilities are groomed at the VT1.5 or DS1 signal rate in the DACS IV-2000. DS1 signals terminating on transmission or switching equipment located in the office are cross-connected to the appropriate facility-terminating equipment. Those services not requiring local termination are cross-connected directly to the appropriate interoffice facility transmission equipment. By performing the grooming function of the VT1.5/DS1 signals, the DACS IV-2000 allows efficient packaging of these signals into higher-rate STS-1/DS3 interfaces for connection to both loop and interoffice facilities and to central office equipment. This allows significant equipment cost savings.

The DACS IV-2000 can also groom SLC-2000 carrier system circuits. DS1 signals associated with a remote terminal (RT) that carries only locally switched circuits can be directly routed to the switch. The SLC-2000 carrier system RTs having nonlocally switched circuits or a mixture of locally and nonlocally switched circuits can be routed to a DACS II or central office terminal for DS0 signal processing.

Figure 3-4 shows the manual way of terminating fiber from the loop. Figure 3-5 shows the arrangement with a DACS IV-2000.

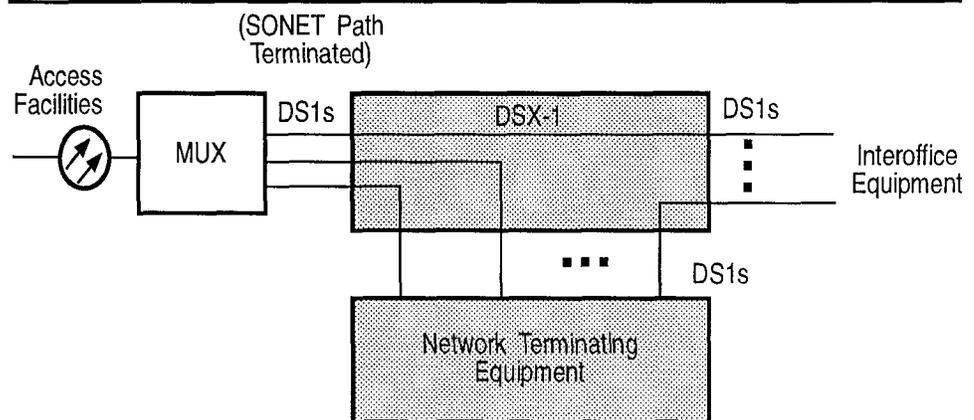


Figure 3-4. Manual Fiber Loop Access Arrangement

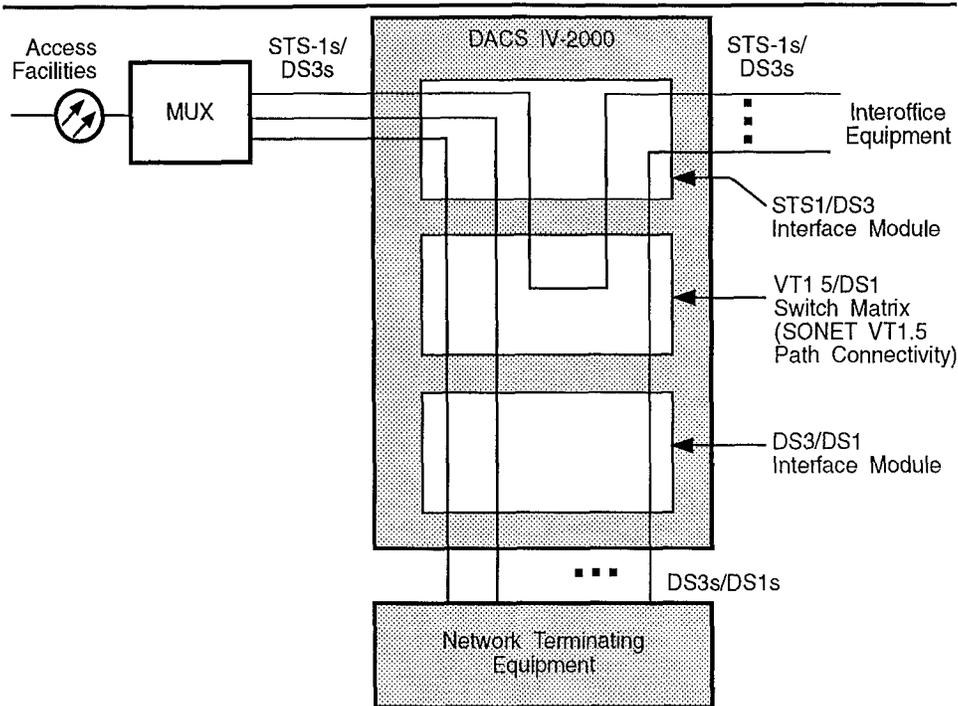


Figure 3-5. Fiber Loop Access with the DACS IV-2000

Interoffice Grooming

Interoffice grooming is the rearrangement of VT1.5 or DS1 tributaries on terminated interoffice EC-1/DS3 facilities. Because the DACS IV-2000 provides multiplexing and demultiplexing functionality and cross-connections at the VT1.5/DS1 signal rates, the need for back-to-back multiplexers for through signals is eliminated.

The availability of interoffice grooming means that the VT1.5/DS1 signals on one interoffice EC-1/DS3 facility can be cross-connected in the DACS IV-2000 to other interoffice EC-1/DS3 facilities without a DS1 interface in the office. The system can groom VT1.5/DS1 signals from incoming facilities and consolidate those signals destined for the same remote office on a minimum number of facilities. This functionality allows for efficient use of both incoming and outgoing facilities while reducing the amount of equipment needed in an office.

Figure 3-6 shows a grooming method using back-to-back multiplexers and DSX-1 frames. Figure 3-7 shows how the DACS IV-2000 eliminates the need for back-to-back multiplexers and can provide first-cost savings in equipment, reduced floor space, and reduced DS1 cabling and DSX-1 congestion, as well as significant reductions in operating costs.

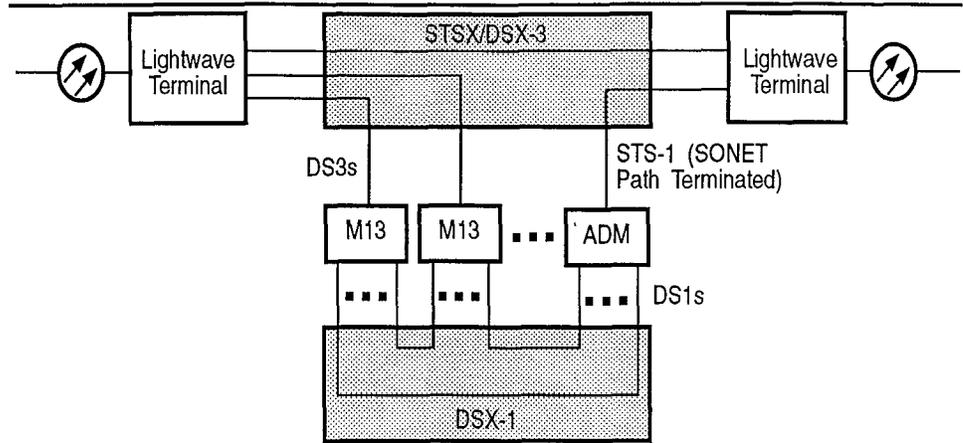


Figure 3-6. Interoffice DS1 Grooming with Back-to-Back Multiplexers

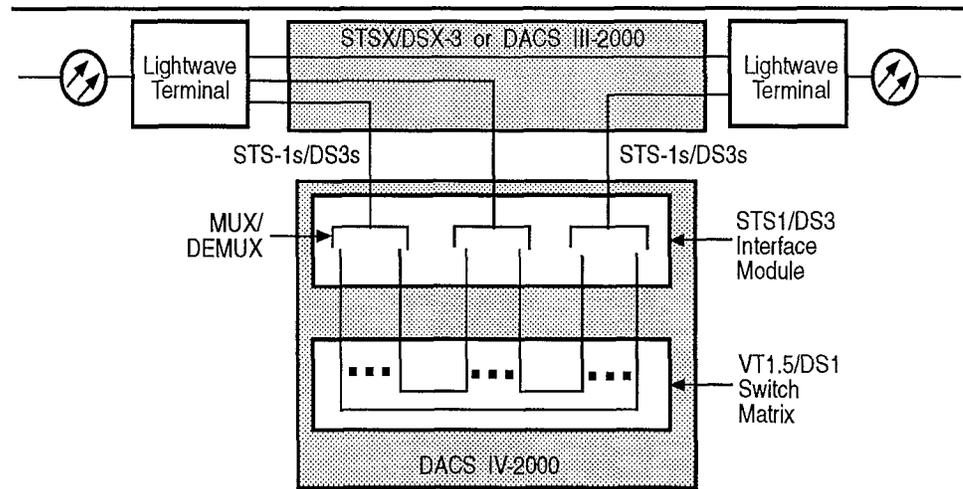


Figure 3-7. Interoffice Grooming with the DACS IV-2000

Because the VT1.5 signals carried within an EC-1 facility fiber are usually destined for several locations, VT1.5 grooming is required to use the SONET interoffice facilities efficiently. A DACS IV-2000 in the local central office allows all these signals to be put on a single STS-1 signal. Grooming of the VT1.5s cannot be done in a manual cross-connect environment.

Without the DACS IV-2000 VT1.5 cross-connect capability, grooming below the STS-1 signal level requires that the SONET signals be terminated and cross-connected at the DS1 signal level. This break in SONET end-to-end path continuity is shown in Figure 3-8.

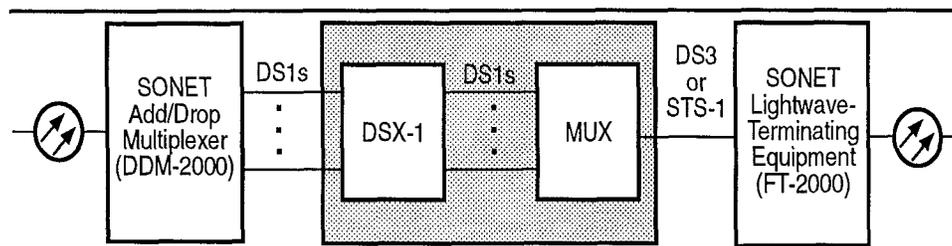


Figure 3-8. Tributary Grooming without the DACS IV-2000

The DACS IV-2000 allows VT1.5 grooming of both the access and interoffice facility while maintaining full SONET path continuity, as shown in Figure 3-9.

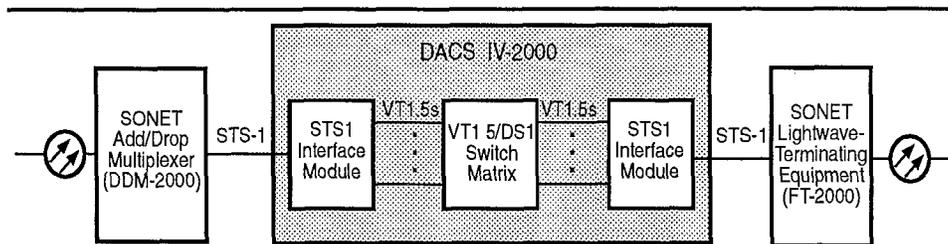


Figure 3-9. End-to-End Path Connectivity with the DACS IV-2000

Intraoffice Grooming

As other network elements (such as the DACS II) are enhanced to provide STS1 interfaces, the VT1.5/DS1 cross-connect capabilities of the DACS IV-2000 can be used economically to perform intraoffice grooming. The DS1 and VT1.5 tributaries on the incoming facilities can be consolidated onto the appropriate intraoffice EC-1/DS3 facility. This office architecture provides cost savings by allowing the use of lower-cost STS1/DS3 interfaces, reducing DS1 cabling, and eliminating the need for DSX-1s.

Point of Interface

The DACS IV-2000 can provide a flexible and economical point of interface for inter-LATA (inter-Local Access and Transport Area) circuits. The point of interface can be at the DS1, DS3, or STS-1 signal level. When it is at the DS1 signal level and the associated access circuits are on fiber (see "Access Grooming" in this chapter), the DACS IV-2000 provides an economical way to groom the locally terminated DS1s from the interexchange carrier (IEC) facilities.

When the point of interface is at the DS3 or STS-1 signal level, the DACS IV-2000 allows DS1 or VT1.5 grooming of the interexchange carrier DS3s or STS-1s to separate those tributaries terminating on the local switch from those terminating on other network elements or going directly to a carrier serving area (DS1 or VT1.5 services). In general, the point of interface is migrating from a DS1 or VT1.5 signal level to a DS3 or STS-1 signal level. When the original DS1 or VT1.5 facility is provided on the DACS IV-2000, rolling to the new facilities can be greatly simplified. The new DS3 or EC-1 facility is terminated on the DACS IV-2000, tested, and the DS1 or VT1.5 services can be rolled to the new DS3 or EC-1 facility. The original interface can then be removed.

Broadband Cross-Connection

The DACS IV-2000 can cross-connect the entire STS-1 SPE while maintaining the path overhead. This capability allows the DACS IV-2000 to provide the functions of a Broadband Digital Cross-Connect (BDCS) as well as the functions of a Wideband Digital Cross-Connect (WDCS). This is particularly advantageous in smaller offices where the number of STS-1 level services is not sufficient to justify a separate BDCS.

Electronic DSX (EDSX)

The operations cost savings provided by the centrally controlled DACS IV-2000 for provisioning, administration, and maintenance allow it to be used as an economical replacement for a manual DSX cross-connect frame and to provide the equivalent functions for the VT1.5 signals. Figure 3-10 shows this configuration.

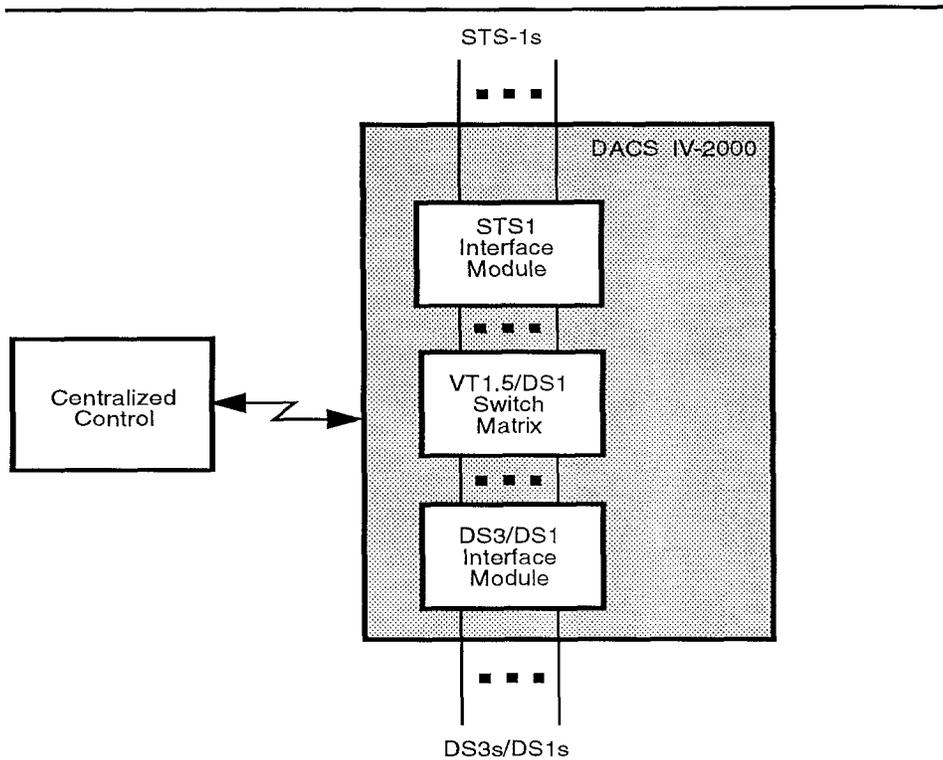


Figure 3-10. The DACS IV-2000 as an Electronic DSX (EDSX)

The DACS IV-2000 provides all of the functions now performed at manual DSX cross-connect frames and provides these functions for the SONET VT1.5 signals. These functions include cross-connection, facility rolling, patching, loopbacks, and test access. The DS1 signals interface the DACS IV-2000 at the DS1 or DS3 signal level, and the VT1.5 signals interface at the STS-1 level.

Centralized control allows faster response times for facility and service orders and faster resolution of trouble reports. This arrangement allows cable distances of up to 1310 feet to network elements, thereby removing the need, in most cases, for intraoffice repeater ties.

In practice, the manual cross-connect replacement application is combined with the grooming and add/drop applications because of the significant cost savings provided by these latter applications. (Figure 3-10 shows this combined application of the DACS IV-2000.)

Test Access and Performance Monitoring

Detailed Performance Monitoring (PM) data must be available for through-facilities and terminating facilities. This is especially necessary when DS1 high-capacity services are provided with DS1 signals terminating on customer equipment, and when DS1 signals terminate on older network elements that do not provide that capability.

To facilitate quick responses to customer trouble reports, centralized test access capabilities must be provided. To accomplish this with manual DSX-1 frames, expensive access equipment must be provided externally. (See Figure 3-11.)

Expensive access equipment can be avoided by using a DACS IV-2000. As shown in Figure 3-12, the DACS IV-2000 provides detailed performance monitoring data and test access configurations under centralized control.

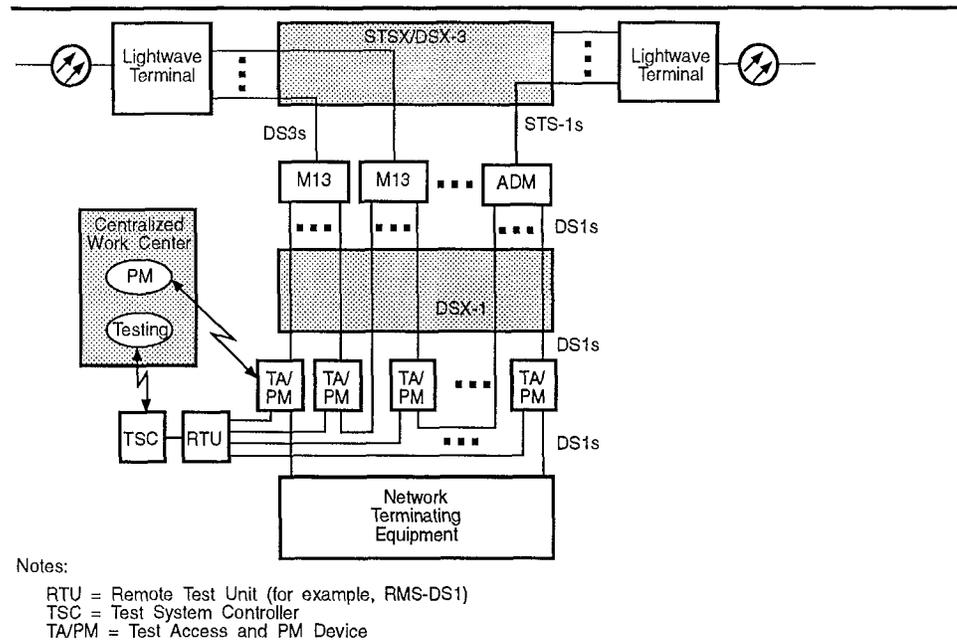


Figure 3-11. DS1 Test Access and Performance Monitoring with DSX-1s

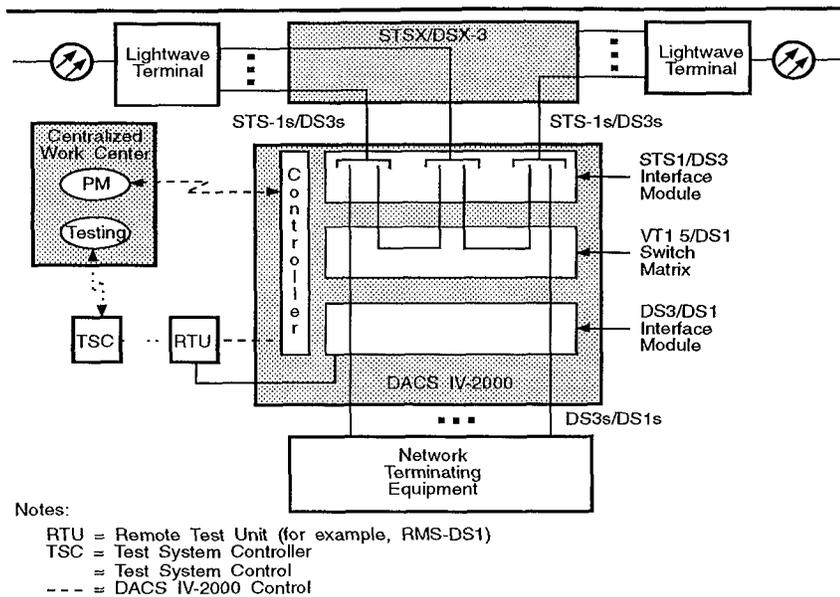


Figure 3-12. DACS IV-2000 Test Access and Performance Monitoring

SONET Performance Monitoring

As the asynchronous network evolves to SONET, performance monitoring is a required feature for both VT1.5 and STS-1 networks. SONET networking with the DACS IV-2000 provides VT1.5 path performance monitoring as well as STS-1 section, line, and path performance monitoring. In the DACS IV-2000, performance monitoring is integrated into the product. Therefore, the performance data are sent directly from the DACS IV-2000 to a centralized work center via one of its administrative links. (See Figure 3-13.)

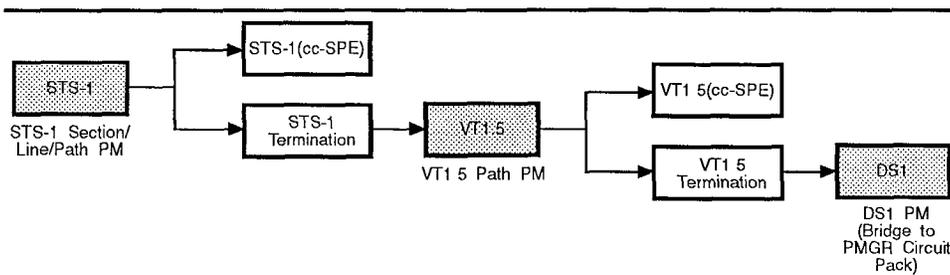


Figure 3-13. DACS IV-2000 SONET Performance Monitoring

The SONET signal enters the DACS IV-2000 at the STS-1 rate. The STS-1 section and line performance monitoring is performed. The STS-1 is either clear-channel SPE cross-connected or terminated and demultiplexed into its VT1.5 tributaries. Regardless of how the STS-1 is processed, the DACS IV-2000 provides STS-1 path performance monitoring data to the user.

- If the STS-1 is clear-channel SPE cross-connected, the DACS IV-2000 terminates the section and line overhead, cross-connects the entire STS-1 SPE (including the path overhead) through the frame, and adds the section and line overhead on the outgoing STS1 interface.

If the STS-1 is terminated and demultiplexed into 28 VT1.5s, either the VT1.5 is clear-channel SPE cross-connected, or it is terminated and further demultiplexed to the DS1 rate. Regardless of how the VT1.5 is processed, the DACS IV-2000 provides VT1.5 path performance monitoring data to the user.

- If the VT1.5 is clear-channel SPE cross-connected, the DACS IV-2000 cross-connects the entire VT1.5 SPE (including path overhead) through the frame.
- If the VT1.5 is terminated, it is demultiplexed down to the DS1 level and cross-connected to the appropriate terminating network element in the office.

Performance monitoring is available for the DS1 signal by bridging to a PMGR circuit pack.

SONET Test Access

The DACS IV-2000 provides a variety of test access modes for STS-1 and VT1.5. This SONET release supports monitoring and splitting of the equipment and the facility for both the A and B directions. Loopbacks, bridging, and rolling capabilities currently used in many asynchronous DACS IV-2000 applications are provided for STS-1 and VT1.5.

Network Applications

Creating a network that includes the DACS IV-2000 and other networking equipment can result in significant savings. The DACS IV-2000 (256) Release 4.0 offers the following network applications:

- Ring interworking
- Centralized network control, provisioning, and maintenance
- VT1.5/DS1 hubbing
- DS1 add/drop
- Route restoration.

Ring Interworking

The DACS IV-2000 provides a cost-effective interconnection point between SONET rings. Models have shown that a SONET ring network costs more if implemented without the DACS IV-2000s at the ring intersection nodes. Significant savings (25 percent in network studies) can be realized by using the DACS IV-2000s to manage bandwidth between SONET rings. (The level of savings depends on the size and complexity of the network.)

The customer interface to the access rings is generally at the DS1 signal level (which for SONET transport is carried in a VT1.5 envelope). Each DS1 signal is usually destined for a different interoffice facility (to a far-end office).

Without a DACS IV-2000, the central office cross-connection between the access and interoffice rings would have to be at the STS-1 signal level to maintain SONET path connectivity. One EC-1 would be required for each far-end destination; as a result, each EC-1 would carry a low number of VT1.5s carrying services. With a DACS IV-2000 performing ring interworking, an STS-1 signal can carry VT1.5s destined for several different far-end offices (different interoffice facilities). The DACS IV-2000 grooms and routes these VT1.5s to the appropriate interoffice EC-1 facility. This provides greater utilization of the EC-1 facilities.

The DACS IV-2000 also allows the SONET rings to interface with asynchronous network terminating elements (the SONET/Asynchronous Gateway feature). Access rings and interoffice rings are shown in Figure 3-14.

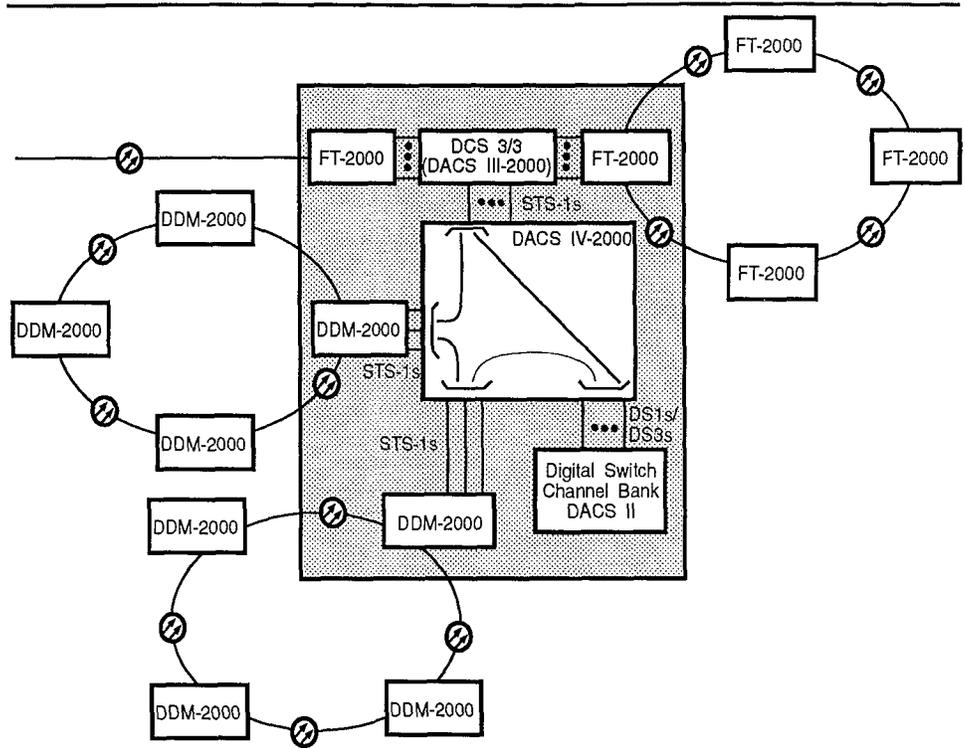


Figure 3-14. DACS IV-2000 Ring Interworking

Centralized Network Control

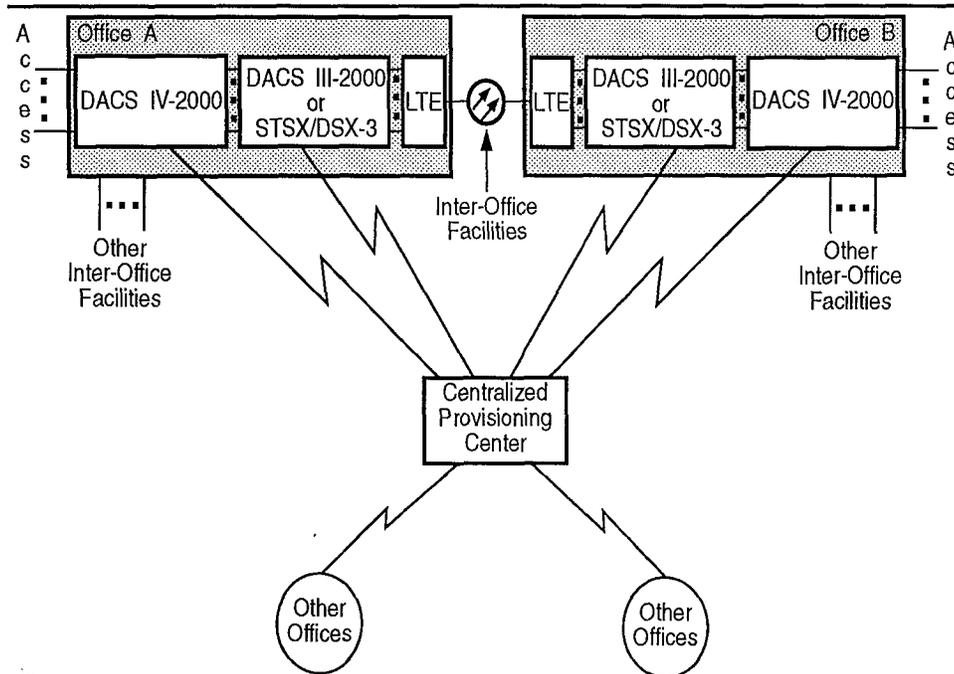
Deployment of the DACS IV-2000 in a network allows centralized control of the network and thus provides greater flexibility, customer responsiveness, and new revenue-generating opportunities, while reducing operating costs. Faster service and facility provisioning time can be provided as well as quick trouble identification and resolution. New service opportunities, such as facility restoration, are made possible by these system features.

Some of the centralized control opportunities using the DACS IV-2000 features and capabilities are network provisioning and network maintenance; they are described below.

Centralized Network Provisioning

The central control allows fast DS1 service and DS1 facility provisioning to provide quick customer response and faster revenue flow.

Figure 3-15 illustrates a centralized provisioning center with an administrative link to the DACS IV-2000 deployed in the network.



Note
LTE = Lightwave Terminal

Figure 3-15. DACS IV-2000 Centralized Provisioning

Centralized Network Maintenance

The DACS IV-2000 equipment and facility maintenance features and the associated alarm reporting messages can be routed to one or more centralized work centers. (See Figure 3-16.)

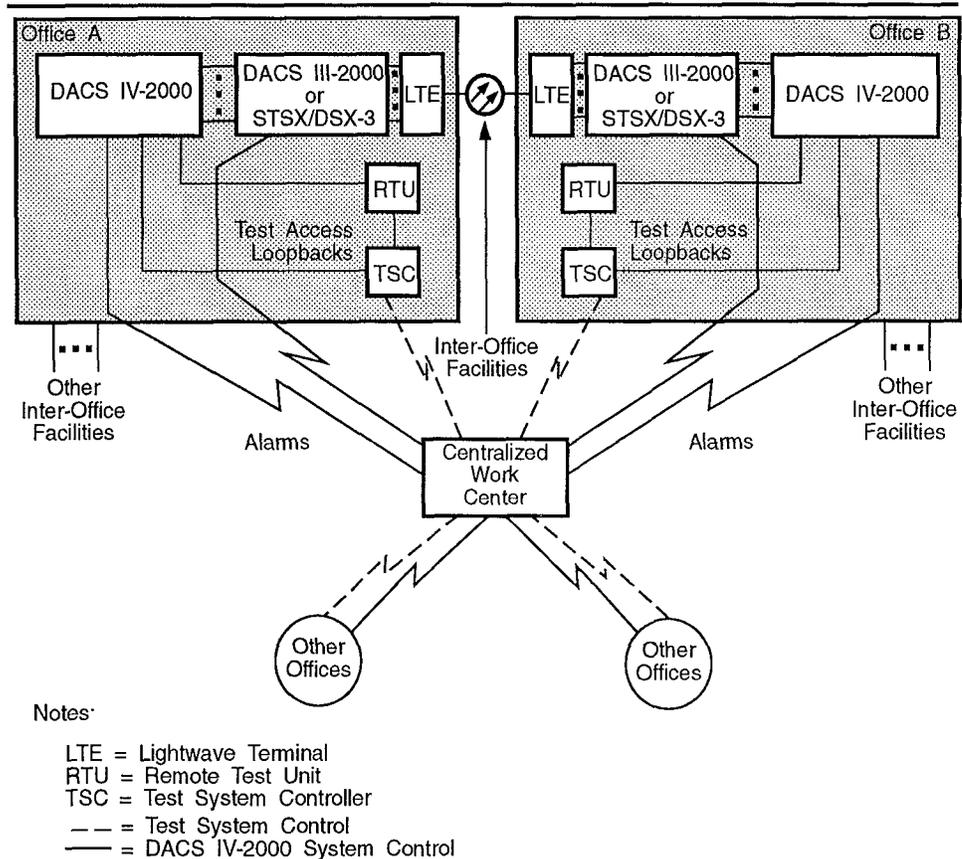


Figure 3-16. DACS IV-2000 Centralized Maintenance

When a centralized DS1 test system is also deployed, testing of any DS1 cross-connected in the DACS IV-2000 can be done from this centralized work center. Trouble isolation is facilitated by the test access, loopback, and alarm features of the DACS IV-2000.

VT1.5/DS1 Hubbing

Hubbing is a well-established network architecture that provides significant savings over a point-to-point network. The DACS IV-2000 can be used to groom VT1.5/DS1 facilities from several end offices, allowing efficient use of the facilities from these offices, as well as between hub offices.

As illustrated in Figure 3-17, when the demand between pairs of offices becomes large enough to justify economically a direct link, a direct link can be constructed, thus relieving part of the load on the hub equipment. The direct link can be either a dedicated EC-1/DS3 facility through-connected in the office or, if the demand is large enough, a dedicated fiber route.

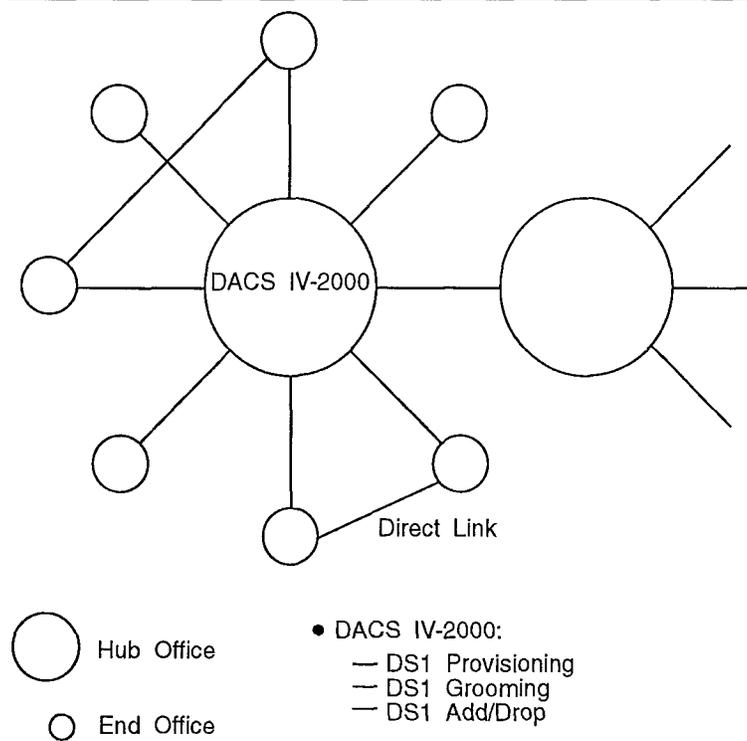


Figure 3-17. DACS IV-2000 Hub Network Application

DS1 Add/Drop

In addition to through VT1.5/DS1s on EC-1/DS3 facilities, DS1s in the EC-1/DS3 facilities may need to be dropped or added at hub office or add/drop locations.

- In a manual environment, add/drop is accomplished using back-to-back multiplexers with a DSX cross-connect frame to access the appropriate DS1s. (See Figure 3-18.)
- With the DACS IV-2000, you do not need back-to-back multiplexers to perform add/drop functions. (See Figure 3-19.)

Figure 3-19 also shows the through-connected VT1.5s/DS1s on the EC-1/DS3 facilities and the DS1-to-DS1 cross-connections within the office.

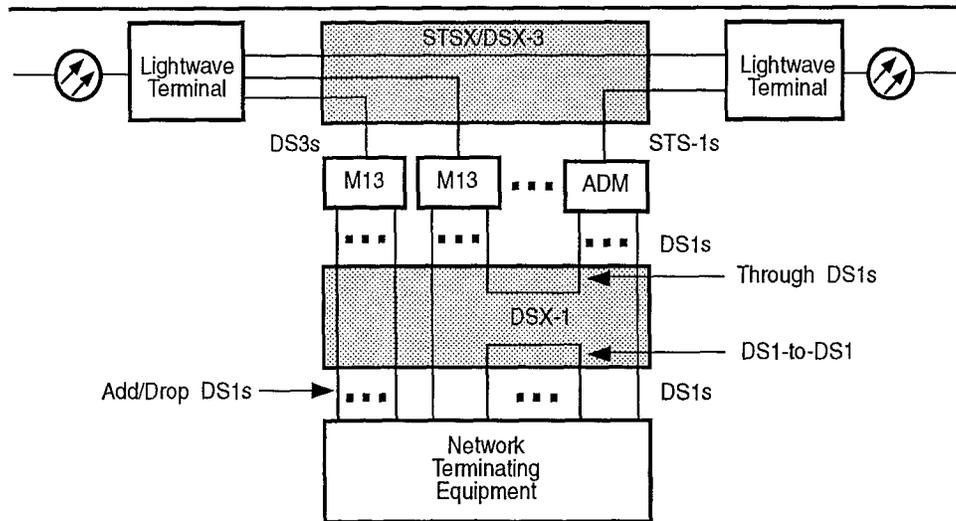


Figure 3-18. DS1 Add/Drop with Multiplexers

Use of the DACS IV-2000 for add/drop functions can result in significant savings in equipment and operating costs, floor space, and DS1 cabling and DSX-1 congestion. In addition, VT1.5s can be dropped from an interoffice facility and interfaced to network terminating equipment at the STS-1 signal level.

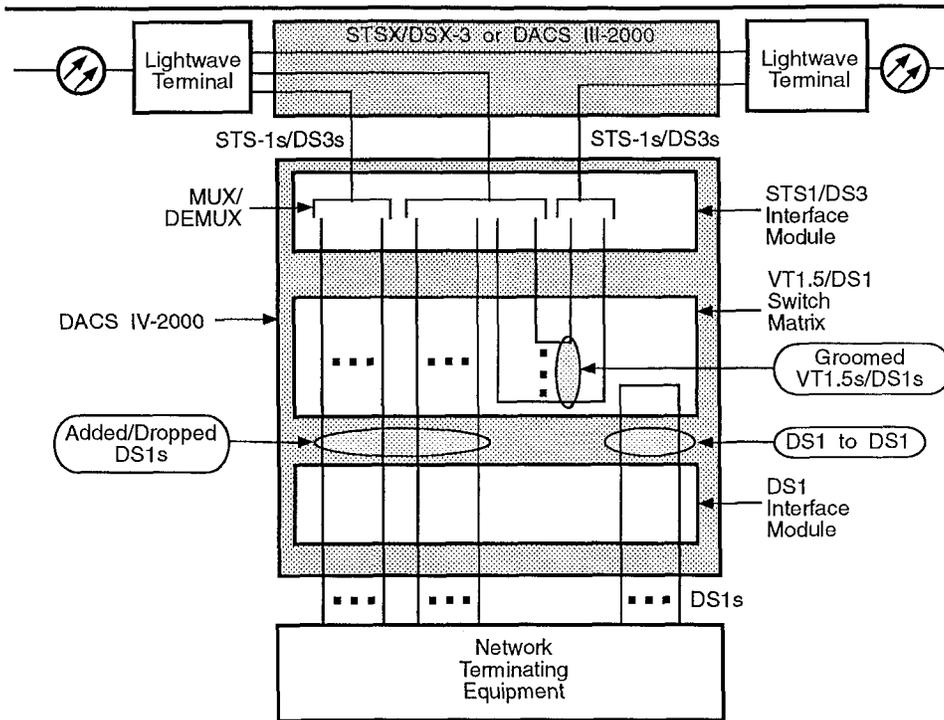


Figure 3-19. DS1 Add/Drop with the DACS IV-2000

Route Restoration

The DACS IV-2000 allows remote and software-controlled route restoration capability for DS1s and VT1.5s, as individual DS1s and DS1 tributaries within DS3s, as tributaries in EC-1s, and for DS1 facilities. The use of the DACS IV-2000 for restoration of STS-1/DS3s (as 28 VT1.5/DS1s) depends on traffic density and grooming requirements. The DACS IV-2000 is generally a more economical restoration tool if it has already been deployed to satisfy VT1.5/DS1 grooming and add/drop needs, and if the number of EC-1/DS3 facilities to be protected is small.

Figure 3-20 shows how the systems in three separate offices communicate with the DACS IV-2000 centralized network administration center to restore transmission following a facility failure. The figure also shows a cut fiber between offices 1 and 2 affecting the normal service path between the two offices. New cross-connections are made electronically to reroute each STS-1/DS3 (as 28 VT1.5/DS1s) affected by the failure onto an unaffected route (dashed lines). Restoration facilities must be available before this can be accomplished.

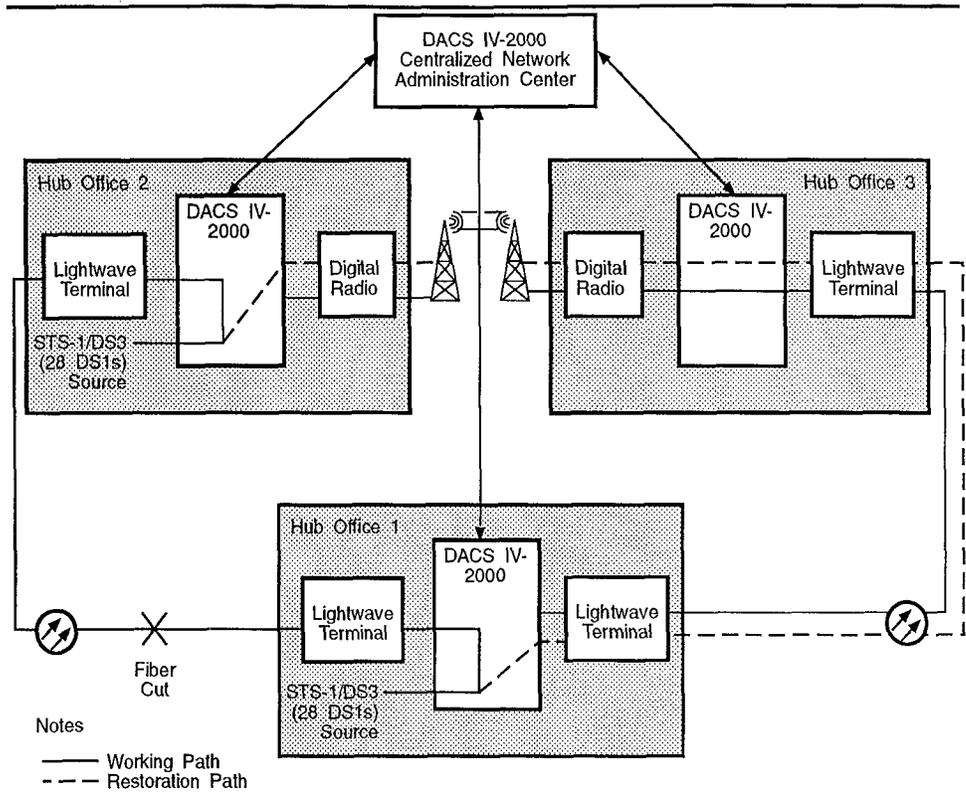


Figure 3-20. Route Restoration with the DACS IV-2000

With the DACS IV-2000, the necessary cross-connections can be made swiftly and accurately under central control. The ability to make the cross-connection electronically from a remote location eliminates the problem of coordinating several craft at different locations to restore service.

DACS Products Total Network Applications

Figure 3-21 shows a total network application of DACS products and the DACScan-2000 controller. The DACS II provides integrated network access and DS0 hubbing. The DACS IV-2000 provides DS1/VT1.5 hubbing, DS1/VT1.5 route restoration, DS1/VT1.5 add/drop, and access grooming capabilities. All DACS products provide the economic advantages and flexibility of centralized and automated operations, administration, maintenance, and provisioning.

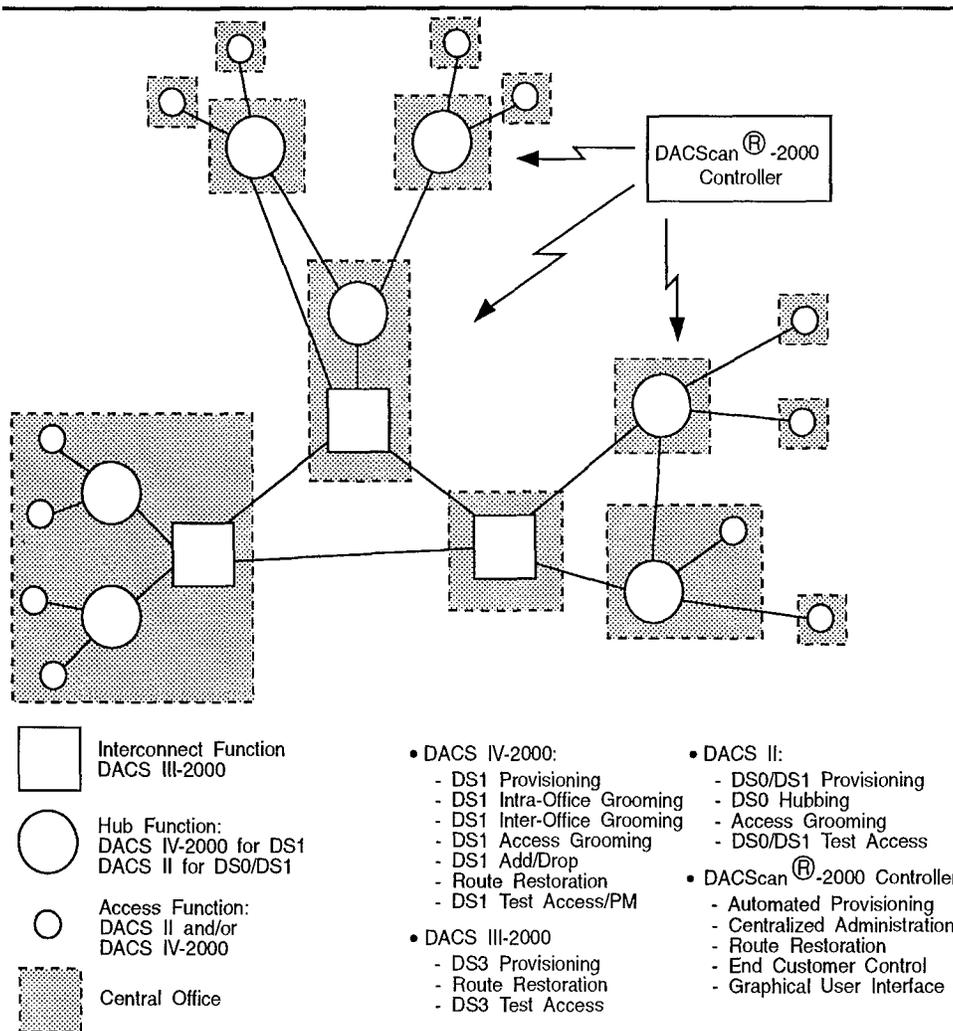


Figure 3-21. DACS Products Total Network Application

Digital Switch Cutover

When an analog-to-digital switch cutover is planned, the DACS IV-2000 can be used to simplify the trunk and, if access is over fiber, the line side cut over from the analog switch to the digital switch. Using a DACS IV-2000 eliminates manual patching and rewiring at the DSX-1 frame, provides continuing operations savings, and positions the office for future enhancements. Figure 3-22 (A) illustrates this application for the trunk side that applies for all switch cutovers.

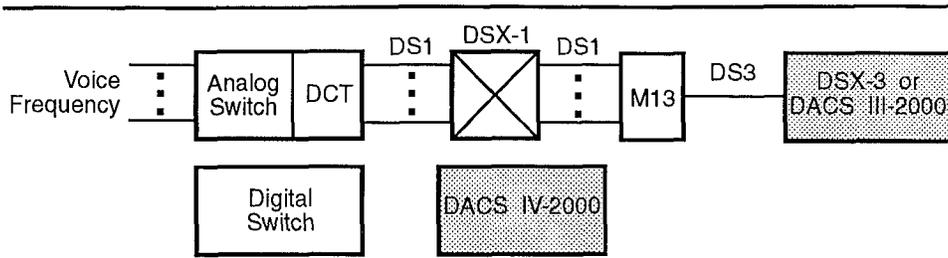
All DS3s that carry circuits on the analog switch are initially in-service rolled over to the DACS IV-2000 and through-connected as shown on Figure 3-22 (B). This places the DACS IV-2000 in series with the original signal path. At the same time, DS1 cabling is installed between the DACS IV-2000 and the new digital switch.

Simultaneously with the Voice Frequency (VF) side cut from the analog to the digital switch, commands are issued to roll the associated DS1s in the DACS IV-2000 to the new digital switch. Figure 3-22 (C) illustrates the final arrangement. The rolling of the associated DS1s is done over an administrative link by issuing commands at the DACS IV-2000, which eliminates the need to patch and rewire at the DSX-1 frame.

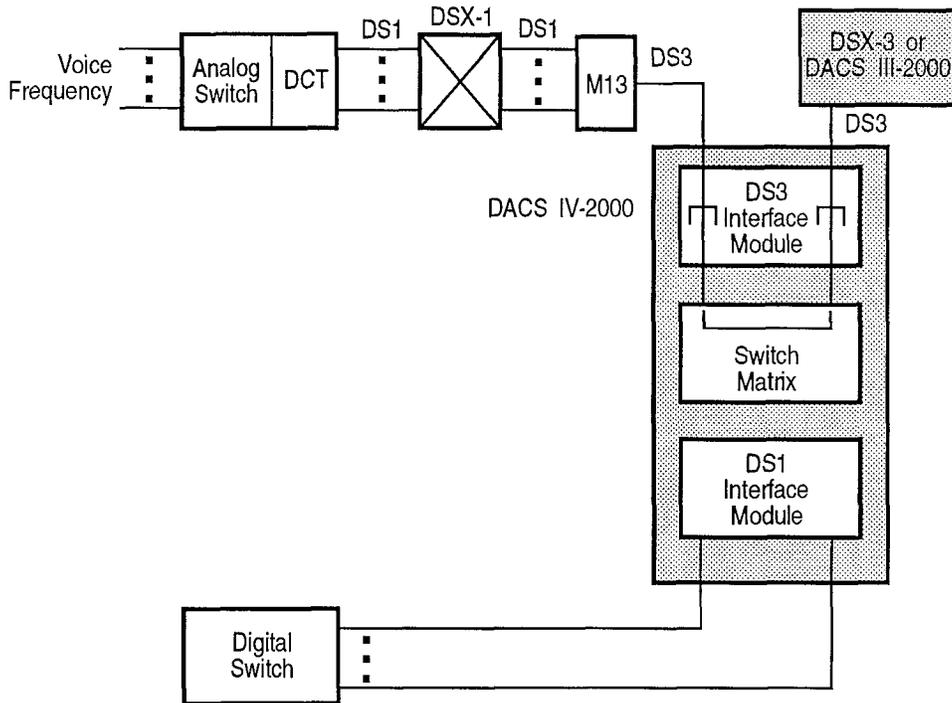
Where access is provided over fiber, both the line side and the trunk side can be simultaneously cut over using the DACS IV-2000. Figure 3-23 shows this procedure.

In addition to through-connecting the trunk side, the access side is through-connected in the DACS IV-2000, as shown in Figure 3-23 (B). This allows simplified board-to-board (office-to-office) testing of the new switch prior to the cutover and results in significant savings. The DACS IV-2000 is used to roll both the access and trunk sides. Also shown in Figure 3-23 (B): the analog switch has been replaced by a digital switch; the access and interoffice DSX-1s and M13 multiplexers have been replaced by the DACS IV-2000; and the Main Distributing Frame and SLC Central Office Terminals have been replaced by a DACS II.

After the switch cutover is complete, the DACS IV-2000 can be used for other grooming and add/drop applications.



A. Initial Configuration

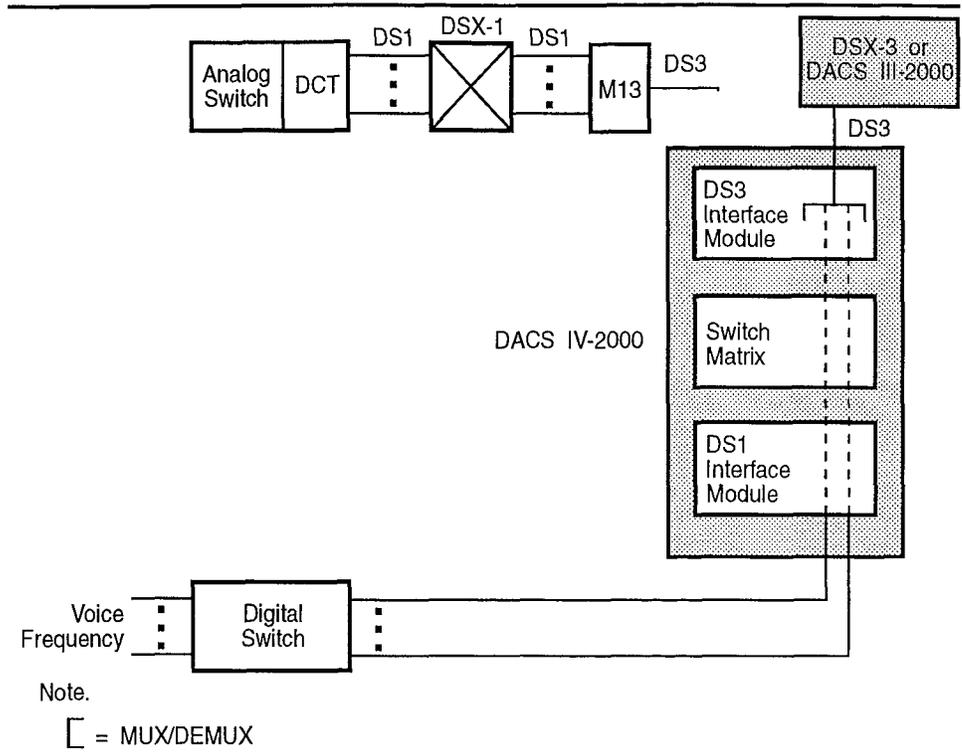


Note:

[] = MUX/DEMUX

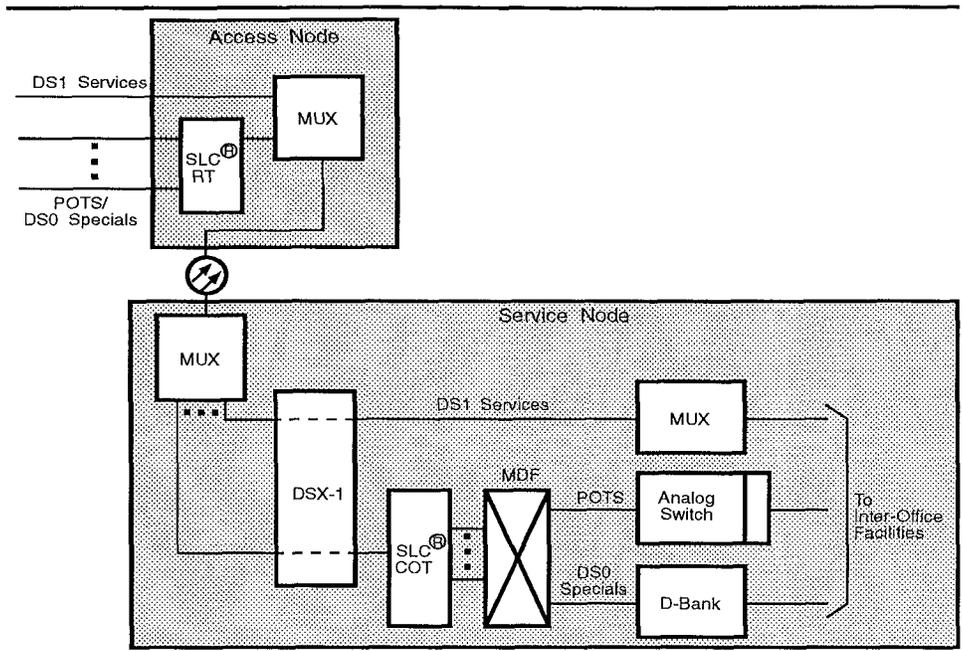
B. DS3s Through-Connected in the DACS IV-2000 System

Figure 3-22. Digital Switch Trunk Side Cutover Assistance (Sheet 1 of 2)

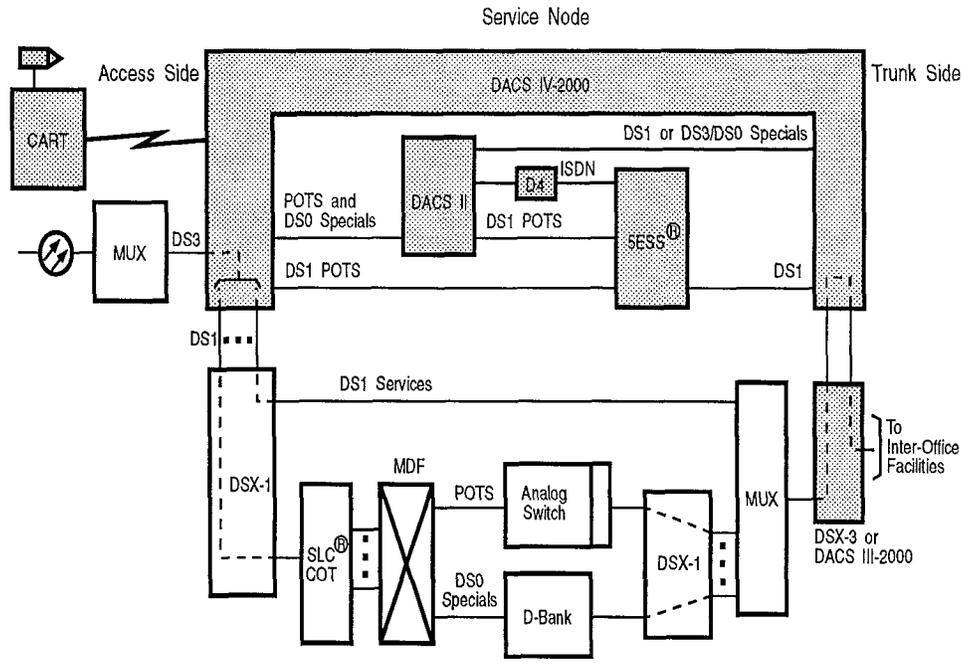


C. After Cutover

Figure 3-22. Digital Switch Trunk Side Cutover Assistance (Sheet 2 of 2)

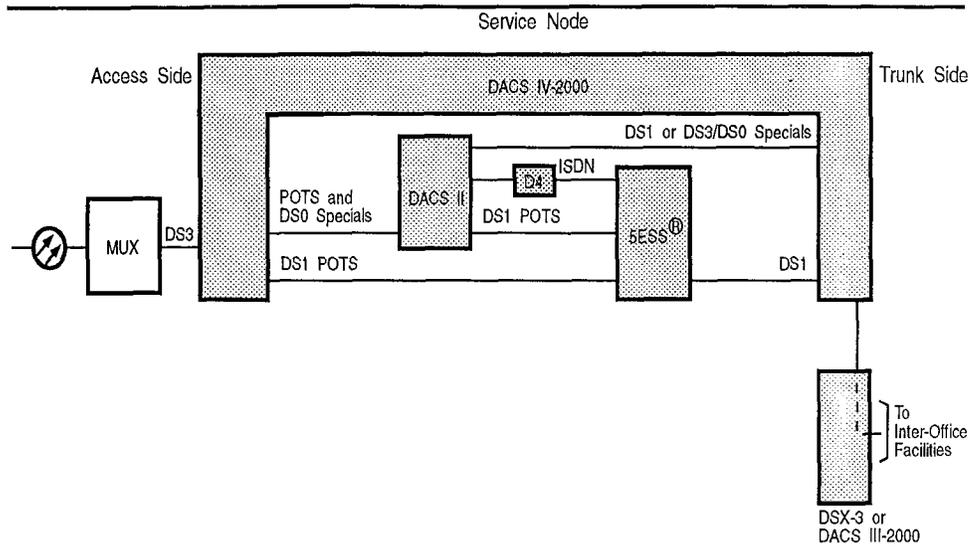


A. Initial Configuration



B. DS3s Through-Connected in the DACS IV-2000 System

Figure 3-23. Digital Switch Fiber Access Cutover Assistance (Sheet 1 of 2)



C. After Cutover

Figure 3-23. Digital Switch Fiber Access Cutover Assistance (Sheet 2 of 2)

Ordering Information

4

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Ordering Information

4

This chapter contains ordering lists for the DACS IV-2000 (256) Release 4.0 hardware and software.

Figure 4-1 shows the possible bay arrangements for the DACS IV-2000 (256). It illustrates how the four types of interface bays can be configured to accommodate any changing DS1, DS3, and EC-1 facility under the cabling constraint that no more than 124/120 equivalent DS3/STS-1 lines be connected on either side of the Switch Bay. The Switch Bay (bay position 5) must be filled first; bays can then be added to the left, then to the right. A maximum of two STS1/DS3/DS1 Interface Bays, two DS3 Interface Bays or STS1/DS3 Interface Bays, or four DS1 Interface Bays can be located on either side of the Switch Bay.

Table 4-1 provides a cross-reference between equipment names and equipment codes for the DACS IV-2000 (256) Release 4.0 circuit packs.

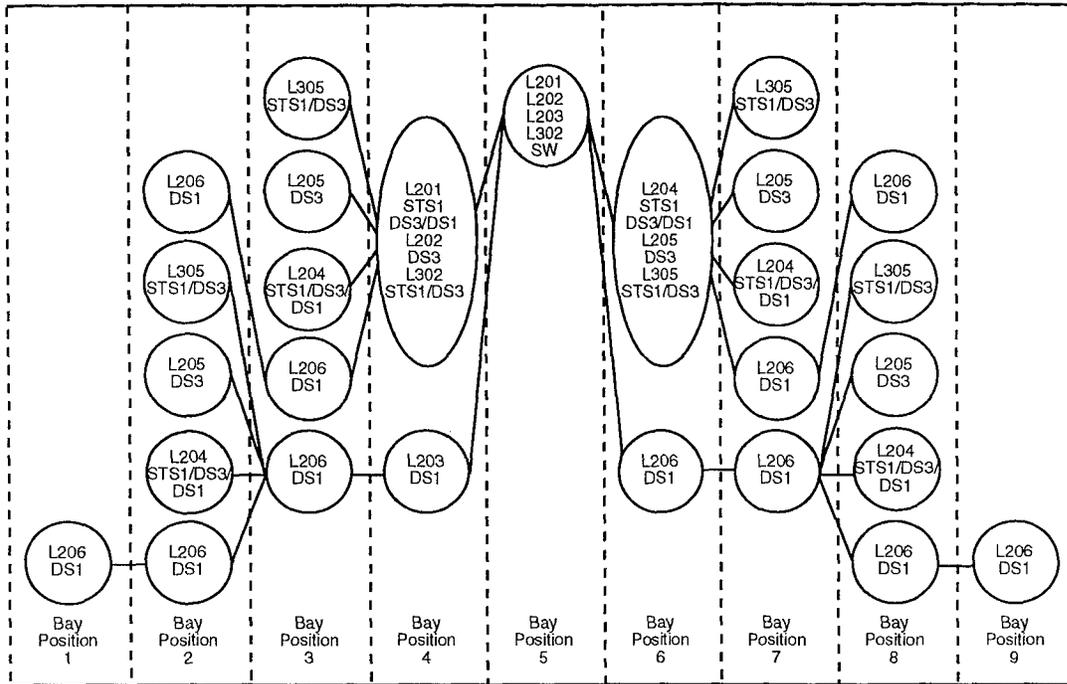


Figure 4-1. Possible Bay Arrangements for the DACS IV-2000 (256)

Table 4-1. Circuit Pack Equipment

Functional Name	Circuit Pack or Equipment Code	Used In	Number Required
AWR-type filler assembly	846103760	SW Mod	As required*
AWS-type filler assembly	846960664	SYNC Mod	2
BXA1 (bus extender A 1)	AKM64	DS1 INTFC Mod DS1 INTFC-P Mod DS3 INTFC-16 Mod DS3 INTFC-32 Mod STS1 INTFC-16 Mod	As required†
CLKDR1 (clock distributor 1)	AKM56	DS1 INTFC Mod DS1 INTFC-P Mod DS3 INTFC-16 Mod STS1 INTFC-16 Mod DS3 INTFC-32	2 per module 4 per module
CLKGN3 (clock generator 3)	AWR11	SW Mod	2††
CPU2 (central processing unit 2)	AWP6	RC Mod	2
DPLL2 (digital phase lock loop 2)	AWP15	SYNC Mod	2
DS1IF1 (DS1 interface 1)	AKM46/ AKM46B	DS1 INTFC Mod DS1 INTFC-P Mod	2-16 per module** 2-14 per module
DS1IP1 (DS1 interface [protection] 1)	AKM47	DS1 INTFC-P Mod	2 per module
DS1RY1 (DS1 relay 1)	AKM48	DS1 INTFC Mod DS1 INTFC-P Mod	4 per module
DS1TX2 (DS1 timing extractor 2)	AWS9	SYNC Mod	2
ECI3 (enhanced communications interface 3)	AWP8	RC Mod	2

Table continued on next page. See footnotes at end of table.

Table 4-1. Circuit Pack Equipment (Continued)

Functional Name	Circuit Pack or Equipment Code	Used In	Number Required
Fan assembly	ED-9C130-30,G1	SW Bay	1
Fan assembly	ED-2C816-30,G3	STS1/DS3 Bay	1 per bay
FBA (fuse board A)	ED-2C962-30,G1	SW PWR Mod	1
FBB (fuse board B)	ED-2C960-30,G1	SW PWR Mod	4
FBC (fuse board C)	ED-2C963-30,G1	SW PWR Mod	1
FBD (fuse board D)	ED-2C961-30,G1	SW PWR Mod	4
FBF (fuse board F)	ED-9C051-30,G2	RC PWR Mod	1
FBG (fuse board G)	ED-9C052-30,G2	RC PWR Mod	1
FBH (fuse board H)	ED-9C053-30,G3	RC PWR Mod	1
FBI (fuse board I)	ED-9C055-30,G1	RC PWR Mod	1
MTC3 (maintenance interface 3)	AWR10	RC Mod	2 ^{††}
MUX2 (multiplexer 2)	AKM68B	DS3 INTFC-16 Mod DS3 INTFC-32 Mod	1-15 per module [‡] 1-31 per module [‡]
MUXP2 (multiplexer protection 2)	AKM70	DS3 INTFC-16 Mod DS3 INTFC-32 Mod	1 per module [‡] 1 per module [‡]
MUXPS1 (multiplexer protection switch 1)	AKM53	DS3 INTFC-16 Mod DS3 INTFC-32 Mod STS1 INTFC-16	1 per module

Table continued on next page See footnotes at end of table.

Table 4-1. Circuit Pack Equipment (Continued)

Functional Name	Circuit Pack or Equipment Code	Used In	Number Required
PMGR1 (performance monitor test signal generator receiver 1) [optional]	AKM66	DS1 INTFC Mod DS1 INTFC-P Mod DS3 INTFC-16 Mod DS3 INTFC-32 Mod	1-8 ^{††} 1-7 ^{††} 1-14 ^{††} 1-16 ^{††}
PRI5 (primary off-line storage 5)	ERB5	RC Mod	2
PWRA (power A; simplex configuration)	552A2	SW PWR Mod	4
PWRA (power A; duplex configuration)	566A	SW PWR Mod	4
PWRE3 (power E3)	556C	AUX PWR Mod DS1 INTFC Mod DS1 INTFC-P Mod DS3 INTFC-16 Mod DS3 INTFC-32 Mod STS1 INTFC-16 Mod	2 per module
PWRF (power F)	427AB	RC PWR Mod	2
PWRG (power G)	428AA	RC PWR Mod	2
SCI3 (switch communications interface 3)	AWR2C	RC Mod	2
SEC5 (secondary off-line storage 5)	ERB6	RC Mod	1
SMUX1 (SONET multiplexer 1)	AKM84	STS1 INTFC-16 Mod	1-15 per module [‡]
SMUXP1 (SONET multiplexer protection 1)	AKM85	STS1 INTFC-16 Mod	1 per module [‡]
SSC5 (secondary storage controller 5)	AWP14	RC Mod	2
STPNL (status panel)	ED-9C049-30,G2	RC Mod	1

Table continued on next page. See footnotes at end of table.

Table 4-1. Circuit Pack Equipment (Continued)

Functional Name	Circuit Pack or Equipment Code	Used In	Number Required
SWCS2 (switch center stage 2)	AWS1B	SW Mod	32
SWIF2 (switch interface 2)	AKM50	DS1 INTFC Mod DS1 INTFC-P Mod	1-8 per module
SWIO1 (switch input/output 1)	AWR6	SW Mod	2-32**
TBS32 (stratum 3 time base oscillator 2)	AWS8	SYNC Mod	2
UC2 (unit controller 2)	AKM59B	DS1 INTFC Mod DS1 INTFC-P Mod DS3 INTFC-16 Mod DS3 INTFC-32 Mod STS1 INTFC-16 Mod	1 per module
UI2 (unit interface 2)	AWR12	RC Mod	1

Notes:

* The AWR-type filler assemblies are installed in the switch module in place of AWR6 (SWIO1) circuit packs when the switch module is not equipped with the full complement of 32 AWR6 circuit packs.

† The AKM64 circuit packs are used in these modules when they are not filled to capacity with AKM46B, AKM50, AKM68B, or AKM84 circuit packs.

‡ One protection and at least one service circuit pack must be installed.

** Must be installed in adjacent pairs.

†† Two identical MTC3 circuit packs (slots labeled MTC); two identical CLKGN3 circuit packs (CLKGN2 for non-SONET applications running without the synchronizer).

‡‡ PMGR is an optional circuit pack that can be used to replace only SWIF or MUX circuit packs. (It cannot be used as a replacement for an SMUX circuit pack.)

Hardware (J98786A-1) Lists

This section supplies list numbers and other component information grouped for your ordering convenience. Quantities necessary for a given configuration are also listed.

The J-drawing number associated with all the lists is J98786A-1. It should be used for complete ordering information.

This section provides ordering information for:

- Startup systems
- Growth bays
- Startup modules
- Interface circuit packs
- BNC interconnect panels
- EMC enclosures
- Redundant controller retrofits
- Release 4.0 retrofits
- TTY connector adapters (ED-2C646-30)
- Fuses
- Miscellaneous equipment.

The AT&T sparing recommendations are given below.

Sparing

The AT&T circuit pack recommendation is 10 percent per circuit pack code, with a minimum of one spare per code. However, operating company sparing policies should prevail.

The fuse sparing recommendation is 5 percent per fuse value, with a minimum of five spares per value.

Startup Systems

Lists 201, 67, 80, 364, and AB

Framework, assembly, wiring, equipment, and circuit packs for the initial two bays, which comprise one Switch Bay with redundant controller (including enhanced Secondary Storage Subsystem) and synchronizer, and one STS1/DS3/DS1 Interface Bay with interfacing for the first 28 DS1 and first DS3 or STS-1 service signals and with switching for the first 420 DS1, 15 DS3, or 15 STS-1 service signals. If the lower DS3 INTFC-16 module is to be used as an STS1 INTFC-16 module, List 344 is also required. (List 344 is provided later in this section under "Interface Circuit Packs.")

List 201

Maximum: One List 201 per frame

(1) ED-2C975-30,G1, G4, G7, GA, GB	Initial Bay Framework (including two temporary cable end guard assemblies)
(2) AKM46B	DS1IF1 (DS1 interface 1)
(2) AKM47	DS1IP1 (DS1 interface 1 - protection)
(4) AKM48	DS1RY1 (DS1 relay 1)
(2) AKM50	SWIF2 (switch interface 2)
(1) AKM53	MUXPS1 (multiplexer protection switch 1)
(4) AKM56	CLKDR1 (clock distributor 1)
(2) AKM59B	UC2 (unit controller 2)
(2) AKM64	BXA1 (bus extender 1)
(1) AKM68B	MUX2 (multiplexer 2)
(1) AKM70	MUXP2 (multiplexer protection 2)
(4) AWR6	SWIO1 (switch input/output 1)
(32) AWS1B	SWCS2 (switch center stage 2)
(4) 552A2	PWRA (power A)
(6) 556C	PWRE3 (power E3)
(4) ED-2C960-30,G1	FBB (fuse board B)
(4) ED-2C961-30,G1	FBD (fuse board D)
(1) ED-2C962-30,G1	FBA (fuse board A)
(1) ED-2C963-30,G1	FBC (fuse board C)
(8) 70G	0.5A Fuse
(8) KS-19780,L2	10A Fuse

List 67

Equipment, power, and circuit packs required in addition to List 201, 202, or 203 to provide a redundant controller/auxiliary power/synchronizer shelf assembly with enhanced secondary storage. (Do not order with List 63.)

(1) ED-2C975-30,G18	Initial Bay Framework
(2) AWP6	CPU2 (central processing unit 2)
(2) AWP8	ECI3 (enhanced communications interface 3)
(2) AWP14	SSC5 (secondary storage controller 5)
(2) AWR2C	SCI3 (switch communications interface 3)
(2) AWR10	MTC3 (maintenance interface 3)
(1) AWR12	UI2 (unit interface 2)
(2) ERB5	PRI5 (primary off-line storage 5)
(1) ERB6	SEC5 (secondary off-line storage 5)
(2) 427AB	PWRF (power F)
(2) 428AA	PWRG (power G)
(1) ED-9C049-30,G2	STPNL (status panel)
(1) ED-9C051-30,G2	FBF (fuse board F)
(1) ED-9C052-30,G2	FBG (fuse board G)
(1) ED-9C053-30,G3	FBH (fuse board H)
(1) ED-9C055-30,G1	FBI (fuse board I)

List 80

Wiring and equipment required in addition to List 201 to provide for redundant power operation (duplex power option).

(4) 566A	PWRA (power A)
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List 364

Circuit packs required in addition to List 63, 67, or 302, or in addition to List 361, for field modification to provide enhanced synchronization.

(2) AWP15	DPLL2 (digital phase lock loop 2)
(2) AWR11	CLKGN3 (clock generator 3)
(2) AWS8	TBS32 (stratum 3 time base oscillator 2)
(2) AWS9	DS1TX2 (DS1 timing extractor 2)
(2) 846960664	Blank Filler Circuit Pack

⇒ NOTE:

A label kit is available to designate shelf numbers. The comcode for the label kit for the I/O interface modules is CC847201001.

List AB

Rearrangement of internal local cabling to support the duplex power configuration. (Future shipments will automatically contain this arrangement.)

Startup Systems (Continued)

Lists 202, 67, 80, and 364

Framework, assembly, wiring, equipment, and circuit packs for the initial two bays, which comprise one Switch Bay with redundant controller (including enhanced Secondary Storage Subsystem) and synchronizer, and one DS3 Interface Bay with interfacing for the first DS3 service signal and with switching for the first 15 DS3 service signals.

List 202

Maximum: One List 202 per frame

(1) ED-2C975-30, G2,G4,G7,GB	Initial Bay Framework (including two temporary cable end guard assemblies)
(1) AKM53	MUXPS1 (multiplexer protection switch 1)
(4) AKM56	CLKDR1 (clock distributor 1)
(1) AKM59B	UC2 (unit controller 2)
(1) AKM68B	MUX2 (multiplexer 2)
(1) AKM70	MUXP2 (multiplexer protection 2)
(2) AWR6	SWIO1 (switch input/output 1)
(32) AWS1B	SWCS2 (switch center stage 2)
(4) 552A2	PWRA (power A)
(4) 556C	PWRE3 (power E3)
(4) ED-2C960-30,G1	FBB (fuse board B)
(4) ED-2C961-30,G1	FBD (fuse board D)
(1) ED-2C962-30,G1	FBA (fuse board A)
(1) ED-2C963-30,G1	FBC (fuse board C)
(4) 70G	0.5A Fuse
(4) KS-19780,L2	10A Fuse

List 67

Equipment, power, and circuit packs required in addition to List 201, 202, or 203 to provide a redundant controller/auxiliary power/synchronizer shelf assembly with enhanced secondary storage. (Do not order with List 63.)

(1) ED-2C975-30,G18	Initial Bay Framework
(2) AWP6	CPU2 (central processing unit 2)
(2) AWP8	ECI3 (enhanced communications interface 3)
(2) AWP14	SSC5 (secondary storage controller 5)
(2) AWR2C	SCI3 (switch communications interface 3)
(2) AWR10	MTC3 (maintenance interface 3)
(1) AWR12	UI2 (unit interface 2)
(2) ERB5	PRI5 (primary off-line storage 5)
(1) ERB6	SEC5 (secondary off-line storage 5)
(2) 427AB	PWRF (power F)
(2) 428AA	PWRG (power G)
(1) ED-9C049-30,G2	STPNL (status panel)
(1) ED-9C051-30,G2	FBF (fuse board F)
(1) ED-9C052-30,G2	FBG (fuse board G)
(1) ED-9C053-30,G3	FBH (fuse board H)
(1) ED-9C055-30,G1	FBI (fuse board I)

List 80

Wiring and equipment required in addition to List 202 to provide for redundant power operation (duplex power option).

(4) 566A	PWRA (power A)
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List 364

Circuit packs required in addition to List 63, 67, or 302, or in addition to List 361, for field modification to provide enhanced synchronization.

(2) AWP15	DPLL2 (digital phase lock loop 2)
(2) AWR11	CLKGN3 (clock generator 3)
(2) AWS8	TBS32 (stratum 3 time base oscillator 2)
(2) AWS9	DS1TX2 (DS1 timing extractor 2)
(2) 846960664	Blank Filler Circuit Pack

⇒ NOTE:

A label kit is available to designate shelf numbers. The comcode for the label kit for the I/O interface modules is CC847201001.

Startup Systems (Continued)

Lists 203, 67, 80, and 364

Framework, assembly, wiring, equipment, and circuit packs for the initial two bays, which comprise one Switch Bay with redundant controller (including enhanced Secondary Storage Subsystem) and synchronizer, and one DS1 Interface Bay with interfacing for the first 28 DS1 service signals and with switching for the first 420 DS1 service signals.

List 203

Maximum: One List 203 per frame

(1) ED-2C975-30,G5, G7, GB	Initial Bay Framework (including two temporary cable end guard assemblies)
(2) AKM46B	DS1IF1 (DS1 interface 1)
(2) AKM47	DS1IP1 (DS1 interface 1 - protection)
(4) AKM48	DS1RY1 (DS1 relay 1)
(2) AKM50	SWIF2 (switch interface 2)
(2) AKM56	CLKDR1 (clock distributor 1)
(1) AKM59	BUC2 (unit controller 2)
(4) AKM64	BXA1 (bus extender 1)
(4) AWR6	SWIO1 (switch input/output 1)
(32) AWS1B	SWCS2 (switch center stage 2)
(4) 552A2	PWRA (power A)
(4) 556C	PWRE3 (power E3)
(4) ED-2C960-30,G1	FBB (fuse board B)
(4) ED-2C961-30,G1	FBD (fuse board D)
(1) ED-2C962-30,G1	FBA (fuse board A)
(1) ED-2C963-30,G1	FBC (fuse board C)
(8) 70G	0.5A Fuse
(8) KS-19780,L2	10A Fuse

List 67

Equipment, power, and circuit packs required in addition to List 201, 202, or 203 to provide a redundant controller/auxiliary power/synchronizer shelf assembly with enhanced secondary storage. (Do not order with List 63.)

(1) ED-2C975-30,G18	Initial Bay Framework
(2) AWP6	CPU2 (central processing unit 2)
(2) AWP8	ECI3 (enhanced communications interface 3)
(2) AWP14	SSC5 (secondary storage controller 5)
(2) AWR2C	SCI3 (switch communications interface 3)
(2) AWR10	MTC3 (maintenance interface 3)
(1) AWR12	UI2 (unit interface 2)
(2) ERB5	PRI5 (primary off-line storage 5)
(1) ERB6	SEC5 (secondary off-line storage 5)
(2) 427AB	PWRP (power F)
(2) 428AA	PWRG (power G)
(1) ED-9C049-30,G2	STPNL (status panel)
(1) ED-9C051-30,G2	FBF (fuse board F)
(1) ED-9C052-30,G2	FBG (fuse board G)
(1) ED-9C053-30,G3	FBH (fuse board H)
(1) ED-9C055-30,G1	FBI (fuse board I)

List 80

Wiring and equipment required in addition to List 203 to provide for redundant power operation (duplex power option).

(4) 566A	PWRA (power A)
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List 364

Circuit packs required in addition to List 63, 67, or 302, or in addition to List 361, for field modification to provide enhanced synchronization

(2) AWP15	DPLL2 (digital phase lock loop 2)
(2) AWR11	CLKGN3 (clock generator 3)
(2) AWS8	TBS32 (stratum 3 time base oscillator 2)
(2) AWS9	DS1TX2 (DS1 timing extractor 2)
(2) 846960664	Blank Filler Circuit Pack

➤ NOTE:

A label kit is available to designate shelf numbers. The comcode for the label kit for the I/O interface modules is CC847201001.

Startup Systems (Continued)

Lists 302, 68, 80, 364, AC, and AJ

Framework, assembly, wiring, equipment, and circuit packs for the initial two bays; comprises the Switch Bay with redundant controller (including enhanced Secondary Storage Subsystem) and synchronizer, and one STS1/DS3 Interface Bay with switching for the first 15 STS-1 or DS3 service signals.

If the lower DS3 Interface-16 Module is to be used as an STS1 Interface-16 Module, List 344 is also required. (List 344 is provided later in this section under "Interface Circuit Packs.")

List 302

Maximum: One List 302 per frame

(1) ED-2C975-30,G14	Initial Bay Framework (including two temporary cable end guard assemblies and built-in redundant controller)
(2) AWP6	CPU2 (central processing unit 2)
(2) AWP7	SSC2 (secondary storage controller 2)
(2) AWP8	ECI3 (enhanced communications interface 3)
(2) AWR2C	SCI3 (switch communications interface 3)
(2) AWR6	SWIO1 (switch input/output 1)
(2) AWR10	MTC3 (maintenance interface 3)
(1) AWR12	UI2 (unit interface 2)
(32) AWS1B	SWCS1 (switch center stage 1)
(2) 427AB	PWRF (power F)
(2) 428AA	PWRG (power G)
(4) 552A2	PWRA (power A)
(2) 556C	PWRE3 (power E3)
(1) ED-9C046-30,G1	PRI2 (primary off-line storage 2)
(1) ED-9C049-30,G2	STPNL (status panel)
(1) ED-9C050-30,G1	SEC2 (secondary off-line storage 2)
(1) ED-9C051-30,G1	FBF (fuse board F)
(1) ED-9C052-30,G1	FBG (fuse board G)
(1) ED-9C053-30,G2	FBH (fuse board H)
(1) ED-9C055-30,G1	FBI (fuse board I)
(4) ED-2C960-30,G1	FBB (fuse board B)
(4) ED-2C961-30,G1	FBD (fuse board D)
(1) ED-2C962-30,G1	FBA (fuse board A)
(1) ED-2C963-30,G1	FBC (fuse board C)
(10) 70G	0.5A Fuse
(10) KS-19780,L2	10A Fuse

List 68

Power and circuit packs required in addition to List 302 to provide enhanced secondary storage (factory upgrade).

(2) AWP14	SSC5 (secondary storage controller 5)
(2) ERB5	PRI5 (primary off-line storage 5)
(1) ERB6	SEC5 (secondary off-line storage 5)
(2) 427AB	PWRF (power F)
(3) WP90247,L313	5A Fuse

NOTE:

Labels and fuses are provided for the following upgrades:

ED-9C051-30, G1 to G2
ED-9C052-30, G1 to G2
ED-9C053-30, G2 to G3

List 80

Wiring and equipment required in addition to List 302 to provide for redundant power operation (duplex power option).

(4) 566A	PWRA (power A)
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List 364

Circuit packs required in addition to List 63, 67, or 302, or in addition to List 361, for field modification to provide enhanced synchronization.

(2) AWP15	DPLL2 (digital phase lock loop 2)
(2) AWR11	CLKGN3 (clock generator 3)
(2) AWS8	TBS32 (stratum 3 time base oscillator 2)
(2) AWS9	DS1TX2 (DS1 timing extractor 2)
(2) 846960664	Blank Filler Circuit Pack

List AC

Rearrangement of internal local cabling to support the duplex power configuration. (Future shipments will automatically contain this arrangement.)

List AJ

Equipment always required in addition to List 302.

(1) ED-2C975-30,GP	Initial Bay Framework
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NOTE:

A label kit is available to designate shelf numbers. The comcode for the label kit for the I/O interface modules is CC847201001.

Growth Bays

List 204

Framework, assembly, wiring, equipment, and circuit packs for a growth bay to support Release 4 features; comprises a DS1/DS3 Interface Bay with interfacing for 28 DS1 service signals and one DS3 service signal and with switching for an additional 420 DS1 and 15 DS3 service signals.

If the lower DS3 Interface-16 Module is to be used as an STS1 Interface-16 Module, List 344 is also required. (List 344 is provided later in this section under "Interface Circuit Packs.")

Maximum: Three List 204 per frame

(1) ED-2C934-30, G1,GA,GB	STS1/DS3/DS1 Interface Bay Framework
(2) AKM46B	DS1IF1 (DS1 interface 1)
(2) AKM47	DS1IP1 (DS1 interface 1 - protection)
(4) AKM48	DS1RY1 (DS1 relay 1)
(2) AKM50	SWIF2 (switch interface 2)
(1) AKM53	MUXPS1 (multiplexer protection switch 1)
(4) AKM56	CLKDR1 (clock distributor 1)
(2) AKM59B	UC2 (unit controller 2)
(2) AKM64	BXA1 (bus extender 1)
(1) AKM68B	MUX2 (multiplexer 2)
(1) AKM70	MUXP2 (multiplexer protection 2)
(4) AWR6	SWIO1 (switch input/output 1)
(4) 556C	PWRE3 (power E3)
(8) 70G	0.5A Fuse
(8) KS-19780,L2	10A Fuse

List 205

Framework, assembly, wiring, equipment, and circuit packs for a growth bay to support Release 4 features; comprises a DS3 Interface Bay with interfacing for one DS3 service signal and with switching for an additional 15 DS3 service signals in the switch shelf assembly.

Maximum: Three List 205 per frame

(1) ED-2C968-30, G1,GA	DS3 Interface Bay Framework
(1) AKM53	MUXPS1 (multiplexer protection switch
(4) AKM56	CLKDR1 (clock distributor 1)
(1) AKM59B	UC2 (unit controller 2)
(1) AKM68B	MUX2 (multiplexer 2)
(1) AKM70	MUXP2 (multiplexer protection 2)
(2) AWR6	SWIO1 (switch input/output 1)
(2) 556C	PWRE3 (power E3)
(4) 70G	0.5A Fuse
(4) KS-19780,L2	10A Fuse

List 206

Framework, assembly, wiring, equipment, and circuit packs for a growth bay to support Release 4 features; comprises a DS1 Interface Bay with interfacing for 28 DS1 service signals and with switching for an additional 420 DS1 service signals.

Maximum: Seven List 206 per frame

(1) ED-2C870-30, G1	DS1 Interface Bay Framework
(2) AKM46B	DS1IF1 (DS1 interface 1)
(2) AKM47	DS1IP1 (DS1 interface 1 - protection)
(4) AKM48	DS1RY1 (DS1 relay 1)
(2) AKM50	SWIF2 (switch interface 2)
(2) AKM56	CLKDR1 (clock distributor 1)
(1) AKM59B	UC2 (unit controller 2)
(4) AKM64	BXA1 (bus extender 1)
(2) AWR6	SWIO1 (switch input/output 1)
(2) 556C	PWRE3 (power E3)
(8) 70G	0.5A Fuse
(8) KS-19780,L2	10A Fuse

List 305

Framework, assembly, wiring, and equipment for a growth bay; comprises one STS1/DS3 Interface Bay to accommodate interfacing for an additional 60 STS-1 or 60 DS3 service signals and four protection lines and with circuit packs for switch interfacing for an additional 15 STS-1 or 15 DS3 service signals in the switch shelf assembly.

When List 305 is equipped with List 341, the main switch must be equipped with a redundant controller and Synchronizer Module.

Maximum: Three List 305 per frame

(1) ED-9C090-30, G1	STS-1/DS3 Interface Bay Framework
(2) AWR6	SWIO1 (switch input/output 1)
(10) 70G	0.5A Fuse
(10) KS-19780,L2	10A Fuse



NOTE:

A label kit is available to designate shelf numbers. The comcode for the label kit for the I/O interface modules is CC847201001.

Startup Modules

List 230

Circuit packs required in addition to List 1, 3, 4, or 6 (if List 1 or 3 is equipped with List 251) or in addition to List 201, 203, 204, or 206 to provide interfacing for the first 28 DS1 signals with Release 4 support in an unequipped DS1 Interface Module.

Maximum: One List 230 per List 1, 4, 201, or 204
Three List 230 per List 3, 6, 203, or 206

(2) AKM46B	DS1IF1 (DS1 interface 1)
(4) AKM48	DS1RY1 (DS1 relay 1)
(1) AKM50	SWIF2 (switch interface 2)
(2) AKM56	CLKDR1 (clock distributor 1)
(1) AKM59B	UC2 (unit controller 2)
(2) 556C	PWRE3 (power E3)

List 240

Circuit packs required in addition to List 1, 2, 4, or 5 (if List 1 or 2 is equipped with List 251) or in addition to List 201, 202, 204, or 205 to provide interfacing for the first DS3 signal with Release 4 support in an unequipped DS3 Interface-32 Module

Maximum: One List 240 per List 1, 2, 4, 5, 201, 202, 204, or 205

(1) AKM53	MUXPS1 (multiplexer protection switch 1)
(4) AKM56	CLKDR1 (clock distributor 1)
(1) AKM59B	UC2 (unit controller 2)
(1) AKM68B	MUX2 (multiplexer 2)
(1) AKM70	MUXP2 (multiplexer protection 2)
(2) 556C	PWRE3 (power E3)

List 243

Circuit packs required in addition to List 302 or 305 to provide interfacing for the first DS3 service signals in an unequipped STS1/DS3 Interface-16 Module.

Maximum: Four List 243 per List 302 or 305

(1) AKM53	MUXPS1 (multiplexer protection switch 1)
(2) AKM56	CLKDR1 (clock distributor 1)
(1) AKM59B	UC2 (unit controller 2)
(1) AKM68B	MUX2 (multiplexer 2)
(1) AKM70	MUXP2 (multiplexer protection 2)
(2) 556C	PWRE3 (power E3)

List 343

Circuit packs required in addition to List 302 or 305 to provide interfacing for the first STS-1 service signals in an unequipped STS1/DS3 Interface-16 Module.

Maximum: Four List 343 per List 302 or 305

- | | |
|------------|--|
| (1) AKM53 | MUXPS1 (multiplexer protection switch 1) |
| (2) AKM56 | CLKDR1 (clock distributor 1) |
| (1) AKM59B | UC2 (unit controller 2) |
| (1) AKM84 | SMUX1 (SONET multiplexer 1) |
| (1) AKM85S | MUXP1 (SONET multiplexer protection 1) |
| (2) 556C | PWRE3 (power E3) |

Interface Circuit Packs

List 231

Circuit packs required in addition to List 1, 3, 4, or 6 (if List 1 or 3 is equipped with List 251) or in addition to List 201, 203, 204, or 206 to provide interfacing for an additional 28 DS1 signals with Release 4 support in a DS1 Interface Module or DS1 Interface Protection Module.

Maximum: Thirteen List 231 per List 1, 4, 201, or 204
Twenty-seven List 231 per List 3, 6, 203, or 206

(2) AKM46B	DS1IF1 (DS1 interface 1)
(1) AKM50	SWIF2 (switch interface 2)

List 241

Circuit packs required in addition to List 1, 2, 4, or 5 (if List 1 or 2 is equipped with List 251) or in addition to List 201, 202, 204, 205, 302, or 305 or for field modification of List 41 to provide interfacing for an additional DS3 service signal with Release 4 features in a DS3 Interface-16 Module or DS3 Interface-32 Module.

Maximum: Forty-four List 241 per List 1, 4, 201, or 204
Sixty List 241 per List 2, 5, 202, 205, 302, or 305

(1) AKM68B	MUX2 (multiplexer 2)
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List 341

Circuit packs required in addition to List 343 or 344 or to field upgrade (with List 342 and 345 or 346) a DS3 service signal and provide interfacing or increase capacity for one STS-1 service signal in an STS1/DS3 Interface-16 Module

Maximum: Fourteen List 341 per List 343 or 344
Fifteen List 341 per List 342 and 345 or 346

(1) AKM84	SMUX1 (SONET multiplexer 1)
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List 344

Circuit packs required in addition to List 201 or 204 to provide interfacing for the first STS-1 service signals when the lower DS3 Interface-16 Module is to be used as an STS1/DS3 Interface Module.

(1) AKM84	SMUX1 (SONET multiplexer 1)
(1) AKM85	SMUXP1 (SONET multiplexer protection 1)

BNC Interconnect Panels

List 70

Equipment required in addition to List 201 to provide a DS3 interconnect panel for a non-EMC-shielded arrangement.

(1) ED-2C975-30,G12 Initial Bay Framework

List 71

Equipment required in addition to List 202 to provide a DS3 interconnect panel for a non-EMC-shielded arrangement.

(1) ED-2C975-30,G13 Initial Bay Framework

List 72

Equipment required for field conversion of a non-EMC-shielded interconnect panel to EMC.

List 73

Equipment required in addition to List 204 to provide a DS3 interconnect panel for a non-EMC-shielded arrangement.

(1) ED-2C934-30,G5 STS1/DS3/DS1 Interface Bay
Framework

List 74

Equipment required in addition to List 205 to provide a DS3 interconnect panel for a non-EMC-shielded arrangement.

(1) ED-2C968-30,G5 DS3 Interface Bay Framework

List 75

Equipment required to field retrofit an existing DS1/DS3 Interface Bay with BNC interconnect panel, in a non-EMC-shielded arrangement.

(1) ED-2C934-30,G6 STS1/DS3/DS1 Interface Bay
Framework

List 76

Equipment required to field retrofit an existing DS3 Interface Bay with BNC interconnect panel, in a non-EMC-shielded arrangement.

(1) ED-2C968-30,G6 DS3 Interface Bay Framework

List 371

Equipment required in addition to List 302 to provide a BNC interconnect panel for a non-EMC-shielded arrangement.

(1) ED-2C975-30,G15 Initial Bay Framework

List 374

Equipment required in addition to List 305 to provide a BNC interconnect panel for a non-EMC-shielded arrangement.

(1) ED-2C090-30,G2 STS1/DS3 Interface Bay Framework



NOTE:

A label kit is available to designate shelf numbers. The comcode for the label kit for the BNC panel is CC847334463.

EMC Enclosures

List 151

Equipment required in addition to List 201 to provide factory-installed EMC shielding (BNC panel included) for one DS1/DS3 initial bay arrangement.

(1) ED-2C975-30,G8	Initial Bay Framework
(1) ED-9C115-31,G1	EMC Shielded Assembly

List 152

Equipment required in addition to List 202 to provide factory-installed EMC shielding (BNC panel included) for one DS3 initial bay arrangement.

(1) ED-2C975-30,G9	Initial Bay Framework
(1) ED-9C115-31,G1	EMC Shielded Assembly

List 153

Equipment required in addition to List 203 to provide factory-installed EMC shielding for one DS1 initial bay arrangement.

(1) ED-2C975-30,G10	Initial Bay Framework
(1) ED-9C115-31,G1	EMC Shielded Assembly

List 154

Equipment required in addition to List 204 to provide factory-installed EMC shielding (BNC panel included) for one DS1/DS3 growth bay.

(1) ED-2C934-30,G3	DS3/DS1 Interface Bay Framework
(1) ED-9C115-31,G2	EMC Shielded Assembly

List 155

Equipment required in addition to List 205 to provide factory-installed EMC shielding (BNC panel included) for one DS3 growth bay.

(1) ED-2C968-30,G3	DS3 Interface Bay Framework
(1) ED-9C115-31,G2	EMC Shielded Assembly

List 156

Equipment required in addition to List 206 to provide factory-installed EMC shielding for one DS1 growth bay.

(1) ED-2C870-30,G2	DS1 Interface Bay Framework Assembly
(1) ED-9C115-31,G2	EMC Shielded Assembly

List 352

Equipment required in addition to List 302 to provide factory-installed EMC shielding (BNC panel included) for STS1/DS3 initial bay arrangement.

(1) ED-2C975-30,G17	Initial Bay Framework
(1) ED-9C115-31,G1	EMC Shielded Assembly

List 355

Equipment required in addition to List 305 to provide factory-installed EMC shielding (BNC panel included) for STS1/DS3 growth bay.

(1) ED-9C090-30,G4	Switch Bay Framework
(1) ED-9C115-31,G2	EMC Shielded Assembly

Release 4.0 Retrofits

List 66

Power and circuit packs required for field modification to provide a redundant controller with link expansion and enhanced secondary storage.

(1) ED-2C975-30,G18	Initial Bay Framework
(2) AWP6	CPU2 (central processing unit 2)
(2) AWP8	ECI3 (enhanced communications interface 3)
(2) AWP14	SSC5 (secondary storage controller 5)
(2) AWR2C	SCI3 (switch communications interface 3)
(2) AWR10	MTC3 (maintenance interface 3)
(1) AWR12	UI2 (unit interface 2)
(2) ERB5	PRI5 (primary off-line storage 5)
(1) ERB6	SEC5 (secondary off-line storage 5)
(2) 427AB	PWRF (power F)
(2) 428AA	PWRG (power G)
(1) ED-9C049-30,G2	STPNL (status panel)
(1) ED-9C051-30,G2	FBF (fuse board F)
(1) ED-9C052-30,G2	FBG (fuse board G)
(1) ED-9C053-30,G3	FBH (fuse board H)
(1) ED-9C055-30,G1	FBI (fuse board I)

List 69

Power and circuit packs required in addition to List 302 to provide enhanced secondary storage (field modification).

(2) AWP14	SSC5 (secondary storage controller 5)
(2) ERB5	PRI5 (primary off-line storage 5)
(1) ERB6	SEC5 (secondary off-line storage 5)
(2) 427AB	PWRF (power F)
(3) WP90247,L313	5A Fuse
(1) 847398781	Fuse Label
(1) 847398799	Fuse Label
(1) 847398807	Fuse Label

NOTE:

Labels and fuses are provided for the following upgrades:

ED-9C051-30, G1 to G2
ED-9C052-30, G1 to G2
ED-9C053-30, G2 to G3

List 364

Circuit packs required in addition to List 63 or 67 to provide enhanced synchronization.

(2) AWP15	DPLL2 (digital phase lock loop 2)
(2) AWR11	CLKGN3 (clock generator 3)
(2) AWS8	TBS32 (stratum 3 time base oscillator 2)
(2) AWS9	S1TX2 (DS1 timing extractor 2)
(2) 846960664	Blank Filler Circuit Pack

List 365

Circuit packs required in addition to List 63, 67, or 302 for field upgrade to the new synchronizer (no previously provided synchronization feature).

(2) AWP15	DPLL2 (digital phase lock loop 2)
(2) AWR11	CLKGN3 (clock generator 3)
(2) AWS8	TBS32 (stratum 3 time base oscillator 2)
(2) AWS9	DS1TX2 (DS1 timing extractor 2)
(2) 846960664	Blank Filler Circuit Pack

List 366

Circuit packs required in addition to List 63, 67, or 302, or in addition to List 361, for field modification to provide enhanced synchronization (previously provided synchronization exists).

(2) AWP15	DPLL2 (digital phase lock loop 2)
(2) AWS8	TBS32 (stratum 3 time base oscillator 2)
(2) AWS9	DS1TX2 (DS1 timing extractor 2)

TTY Connector Adapters
(ED-2C646-30)

Group 1

Assembly, wiring, and equipment for one DACS TTY connector adapter to convert from a 37-pin connector (EIA-449 standard) to a 25-pin connector (EIA-232 standard) when connecting to a modem (less than 50 feet).

Group 2

Assembly, wiring, and equipment for one DACS TTY connector adapter to convert from a 37-pin connector (EIA-449 standard) to a 25-pin connector (EIA-232 standard) when connecting to a terminal.

Group 3

Assembly and equipment for one DACS TTY connector adapter to provide for a direct connector of two pair of signal leads (EIA-423 and EIA-449 standards).

Group 7

Assembly, wiring, and equipment for one DACS TTY connector adapter to convert from a 37-pin connector (EIA-449 standard) to a 25-pin connector (EIA-232 standard) when connecting to a DTE such as an X.25 PAD.

Group A

Equipment for DACS TTY connector adapters. Always required in addition to Group 1 through Group 11.

(2) 843987603

Screw

Fuses

The fuses used in the DACS IV-2000 (256) Release 4.0 are listed in Table 4-2.

Table 4-2. Fuses

Type	Location	Amperage	Comcode	Quantity
KS-19780,L8	ED-2C940-30 Fuse Panel	12 (load)	400848602	See Note 1
KS-19780,L2	ED-2C940-30 Fuse Panel	10 (load)	997964697	See Note 1
70D	ED-2C940-30 Fuse Panel	5 (indicator)	100203355	See Note 1
70B	ED-2C940-30 Fuse Panel	2 (indicator)	100203330	See Note 1
70G	ED-2C940-30 Fuse Panel	0.5 (indicator)	100203389	See Note 1
WP91768,L115	ED-9C114-30 Fuse Panel	12	407749847	6
WP91768,L114	ED-9C114-30 Fuse Panel	10	405750431	See Note 1
WP91768,L107	ED-9C114-30 Fuse Panel	2	406747527	1
77D	Switch Power Module	10	406547067	See Note 2
78J	Switch Power Module	7.5	406547307	See Note 3
WP90247,L314	Redundant Con- troller Power Module	7.5	406520833	4 on ED-9C055 (fuse board I)
WP90247,L313	Redundant Con- troller Power Module	5	406520825	See Note 4
WP90247,L309	Redundant Con- troller Power Module	2	406520791	See Note 5

Table continued on next page. See footnotes at end of table.

Table 4-2. Fuses (Continued)

Type	Location	Amperage	Comcode	Quantity
WP90247,L306	Redundant Controller Power Module	1	406520783	See Note 6
WP90247,L303	Redundant Controller Power Module	0.5	406520767	2 on ED-9C055 (fuse board I)

Notes.

1. Quantities depend on system configuration installed (see SD-96673-01)
2. 14 on ED-2C960 (fuse board B), 12 on ED-2C962 (fuse board A).
3. 14 on ED-2C961 (fuse board D); 12 on ED-2C963 (fuse board C).
4. 6 on ED-9C051 (fuse board F); 6 on ED-9C052 (fuse board G); 7 on ED-9C053 (fuse board H).
5. 1 on ED-9C052 (fuse board G); 2 on ED-9C055 (fuse board I)
6. 2 on ED-9C051 (fuse board F); 2 on ED-9C052 (fuse board G).

Miscellaneous Equipment

List 20

Circuit packs required to provide switching for an additional 16 DS3 service signals or 448 DS1 service signals in the switch shelf assembly.

Maximum: Two List 20 per List 1, 4, 201, or 204
Three List 20 per List 2, 5, 202, 205, 302, or 305
One List 20 per List 3, 6, 203, or 206

(2) AWR6 SWIO1 (switch input/output 1)

List 21

Circuit packs required when List 20 is not provided to maintain a forced-air air-cooling channel in the switch shelf assembly.

Maximum: Fourteen List 21 per List 1 or 201
Fifteen List 21 per List 2, 3, 203, or 302

(2) 846103760 Blank Filler Circuit Pack

List 50

Circuit pack required to provide bus continuity in a DS1 Interface Module, DS1 Interface Protection Module, DS3 Interface-16 Module, or DS3 Interface-32 Module.

(1) AKM64 BXA1 (bus extender 1)

List 103

Equipment required in addition to List 201, 202, 203, 204, 205, or 206 to provide front cover protection for one Input/Output Bay Interface Module.

Maximum: Two List 103 per Lists 202 or 205
Four List 103 per List 201, 203, 204, or 206

(1) 846874162 Left Mounting Bracket
(1) 846874170 Right Mounting Bracket

List 106

Equipment required in addition to List 201, 202, 203, 204, 205, or 206 to retrofit front cover protection for one Input/Output Bay Interface Module.

Maximum: Two List 106 per Lists 202 and 205
Four List 106 per List 201, 203, 204, or 206

(1) 846874162 Left Mounting Bracket
(1) 846874170 Right Mounting Bracket

List 109

Equipment and wiring required in addition to List 201, 202, 203, or 302 to provide a factory-installed LAN interface.

(1) ED-2C975-30,G19 Initial Bay Framework

List 110

Equipment required for one field-installed LAN interface retrofit kit.

(1) ED-9C129-30,G1 LAN Interface Assembly
(1) 104371514Retainer

List 116

Equipment required for one factory-installed LAN interface kit.

(1) ED-9C129-30,G3 LAN Interface Assembly
(1) 104371514 Retainer



NOTE:

List 110 or 116 required for upgrade from Release 3.0.

List 245

Circuit pack required for field modification of List 1, 2, or 3 (if List 1, 2, or 3 is equipped with List 251) or List 4, 5, or 6 to provide the following Release 2 features: DS1 performance monitoring and DS1 test signal generation and reception.

(1) AKM66 PMGR1 (performance monitor test signal generator receiver 1; optional)

List C

Equipment required to provide a blank cover for the DS3 performance monitoring circuit pack position on the DS3 Interface-16 Module or DS3 Interface-32 Module.

Maximum: One List C per List 1, 2, 4, 5, 40, 201, 202, 204, 205, or 240
Four List C per List 302 or 305

(1) 846138337 Blank Cover

List AF

Equipment required to provide a front cover for an unequipped DS3 Interface-32 Module or STS1/DS3 Module.

Maximum: One List AF per List 1, 2, 4, 5, 201, 202, 204, or 205
Four List AF per List 302 or 305

(1) 847038791 DS3 Interface Module Front Cover

Software (J987865SD-5) Lists

This section supplies list numbers for ordering the DACS IV-2000 (256) Release 4.0 software.

List	Description
1	Assembly and equipment required to provide Release 4.0 for initial orders and retrofits from Release 3.0. List 1 includes one optical disk and the software release description (SRD).
2	Assembly and equipment required to provide release software for change notice (CN) applications. List 2 includes one optical disk and the SRD.
3	Assembly and equipment required to provide one blank optical disk for creating backup copies of the DACS IV-2000 Release 4.0 software and/or its databases.
4	Assembly and equipment required to provide one spare optical disk of DACS IV-2000 Release 4.0 software.
A	Documentation kit always required in addition to List 1.
B	System startup disk always required in addition to List M1R for initial orders of DACS IV-2000 Release 4.0 software.
M1R	Application software right-to-use fee always required in addition to List 1 on initial orders of DACS IV-2000 Release 4.0 software.
M1S	Application software right-to-use fee always required in addition to List 1 for retrofits from DACS IV-2000 Release 3.0 to Release 4.0.
P1R	Operating software right-to-use fee always required in addition to List 1 on initial orders of DACS IV-2000 Release 4.0 software.
P1S	Application software right-to-use fee always required in addition to List 1 for retrofits from DACS IV-2000 Release 3.0 to Release 4.0.

Initial Software Ordering

For DACS IV-2000 (256) Release 4.0 software, order the following:

1	J98786SD-5	List 1
1	J98786SD-5	List B
1	J98786SD-5	List M1R
1	J98786SD-5	List P1R
1	J98786SD-5	List A

Upgrading from Previous Releases

When a retrofit from Release 3.0 to Release 4.0 software is required, the following software must be ordered:

1	J98786SD-5	List 1
1	J98786SD-5	List M1S
1	J98786SD-5	List P1S
1	J98786SD-5	List A

Customers currently running software releases prior to Release 3.0 must upgrade to Release 3.0 before upgrading to Release 4.0.

Documentation Kit

The Documentation Kit (List A) comprises the following documents:

- AT&T 365-340-700 - *DACS IV-2000 (256) Release 4.0 Reference Manual*
- AT&T 365-340-701 - *DACS IV-2000 (256) Release 4.0 Operations and Maintenance*
- AT&T 365-340-702 - *DACS IV-2000 (256) Release 4.0 Commands and Messages*
- AT&T 365-340-703 - *DACS IV-2000 (256) Release 4.0 Quick Reference Job Aids*

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AT&T provides comprehensive product support for the DACS IV-2000 Release 4.0 in four areas:

- Technical support
- Training support
- Warranty support
- Account executive support.

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



NOTE:

Supporting documentation for the DACS IV-2000 Release 4.0 is also available. See "About This Guide" for a list of pertinent books and instructions for ordering them.

Technical Support

Technical support for the DACS IV-2000 begins at the user level with the COACH system. The COACH system provides on-line information and trouble resolution features. Problems that cannot be resolved at the local level with the COACH system or documentation can be escalated through the following technical support organizations:

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

COACH System

The COACH system provides DACS IV-2000 users with timely information on new features, problems, solutions, and circuit pack compatibility information. The system also allows you to submit questions and problems to AT&T support people. The system is menu-driven and is designed to operate with American Standard Code for Information Interchange (ASCII) terminals at 1200 baud.

Users are provided with logins and manuals through COACH coordinators in most user companies or directly from AT&T. For more information, contact your AT&T account executive.

Regional Technical Assistance Center

If trouble conditions exist that cannot be solved using the COACH system or documentation, technical assistance is available from the AT&T Regional Technical Assistance Center (RTAC). The closest RTAC in the United States can be reached by calling:

1-800-225-7822

This 800 number is monitored 24 hours a day, seven days a week. During regular business hours, your call is answered by your local RTAC. Outside normal business hours, all calls are answered at a centralized technical assistance center where service-affecting problems are dispatched immediately to your local RTAC. All other problems are referred to your local RTAC on the next regular business day.

Technical Support Organization

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

Training Support

Training support is provided by the AT&T National Product Training Center in Dublin, Ohio. The DACS IV-2000 training courses are listed below.

DG3201 — DACS IV-2000 Overview

Course Description: Intended for people responsible for the planning and implementation of the DACS IV-2000, this 2-day course provides an introduction to the DACS IV-2000.

Prerequisites: Understanding of digital equipment principles and networks.

TR3542 — DACS IV-2000 Operations and Maintenance

Course Description: Intended for operations and maintenance people and their supervisors, this 4-day course provides a comprehensive introduction to the DACS IV-2000.

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

DG3230 — DACS IV-2000 Advanced Operations and Maintenance

Course Description: Intended for DACS IV-2000 technical support people, this 5-day course provides in-depth knowledge of the DACS IV-2000 functions, capabilities, and features.

Prerequisites: Background in the operation and maintenance of digital transmission equipment and an understanding of digital transmission theory and schematic drawings.

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

1-800-TRAINER (select option 2)

1-800-221-1647 (Canada)

Or write to:

AT&T Network Systems
Customer Education and Training
5151 Blazer Memorial Parkway
Dublin, Ohio 43017-8100

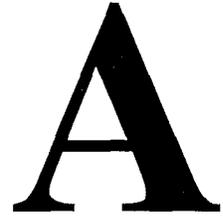
Warranty Support

AT&T provides a limited 5-year hardware warranty for this product. For more information, contact your local AT&T account executive.

Account Executive Support

Your local account executive serves as a single point of contact if you encounter difficulties in any area of product support.

Technical Specifications



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Technical Specifications

A

This appendix describes the technical specifications that must be considered when engineering the DACS IV-2000 (256) Release 4.0 into a network. It provides technical specifications for the following areas:

- Interface
- Commands and messages
- System performance
- Power
- Physical
- Environmental
- Availability and reliability.

Interface Specifications

This section describes the transmission interface and the alarm and control interface specifications for the DACS IV-2000.

Transmission Interface

The transmission interface characteristics of the DACS IV-2000 include the port capacity, signal characteristics, signal impairments, and cable characteristics. Each of these areas is described in this section, and the particular specifications and requirements associated with each area are listed.

Port Capacity

Port capacity defines the number of DS1, DS3, and/or STS1 ports that can be terminated on the DACS IV-2000 and is a function of the number and types of interface bays. The maximum configurations include:

- 6944 DS1 ports for a 9-bay arrangement consisting of all DS1 ports (248 equivalent DS3s)
- 248 DS3 ports for a 5-bay arrangement consisting of all DS3 ports
- 240 STS1 ports for a 5-bay arrangement consisting of all STS1 ports.

Bay arrangements include:

- 9-bay arrangement: one Switch Bay and eight DS1 Interface Bays
- 5-bay arrangement: one Switch Bay and four DS3 Interface-32 Bays
- 5-bay arrangement: one Switch Bay and four STS1 Interface-16 Bays.

The port capacities of the DACS IV-2000 are summarized in Table A-1.

Table A-1. Port Capacity

Item	Value
Maximum System Capacity	Up to 248 equivalent DS3 or 240 STS1 input and output interface ports
Maximum DS1 Port Capacity	Up to 6944 input and output DS1 interface ports
Maximum DS3 Port Capacity	Up to 248 input and output DS3 interface ports
Maximum STS1 Port Capacity	Up to 240 input and output STS1 interface ports

Signal Characteristics

The transmission interfaces to the DACS IV-2000 are DSX-3, DSX-1, and STSX-1 compatible facilities or network elements.

DS3 Signal

The DACS IV-2000 accepts incoming DS3 signals at the specified line rate of 44.736 Mbits/s with the specified B3ZS line code. Acceptable signal formats are asynchronous M13 or C-bit parity. (See Table A-2.)

Table A-2. DS3 Signal Characteristics

Item	Value
Frame Format	Asynchronous M13/C-bit parity
DS3 Line Rate	44.736 Mbits/s \pm 20 ppm
Line Code	B3ZS
Test Load Impedance	75 Ω \pm 5% resistive, unbalanced

DS1 Signal

The DACS IV-2000 accepts incoming DS1 signals at the specified line rate of 1.544 Mbits/s with the specified AMI or B8ZS line code. (See Table A-3.) The DACS IV-2000 is fully transparent to the DS1 bit stream; that is, all overhead and payload bytes are passed through unchanged.

Table A-3. DS1 Signal Characteristics

Item	Value
DS1 Line Rate	1.544 Mbits/s \pm 130 ppm
Line Code	AMI or B8ZS
Test Load Impedance	100 Ω \pm 5% resistive, balanced

STS-1 Signal

The DACS IV-2000 accepts incoming STS-1 signals at the specified line rate of 51.84 Mbits/s with the specified B3ZS line code. (See Table A-4.)

Table A-4. STS-1 Signal Characteristics

Item	Value
STS-1 Signal Format	Conforms to TR-NWT-000253
STS-1 Line Rate	51.84 Mbits/s \pm 4.6 ppm
Line Code	B3ZS
Duty Cycle (measured at output cable terminals)	Nominal 50%, RZ pulse with 1.03V (\pm 10%) peak output amplitude
Frame Synchronous Scrambling	Conforms to TR-NWT-000253
Wideband Power Level	-2.7 dBm to 4.7 dBm (measured at 450 ft)

Signal Impairments

The requirements related to signal impairments in electronic digital signal cross-connect equipment are specified in Bellcore TA-TSY-000241, *Electronic Digital Signal Cross-Connect (EDSX) System Generic Requirements and Objectives* (Issue 4, July 1989). The requirements applicable to the DACS IV-2000 are summarized in the following paragraphs.

DS3 Signal

The jitter accommodation (tolerance) requirement for a DS3 signal input is specified in terms of the amount of sinusoidal jitter (peak-to-peak) that must be accommodated versus the frequency of that jitter. The DACS IV-2000 meets the jitter accommodation requirements for a DS3 signal given in Bellcore TR-NWT-000499, *Transport Systems Generic Requirements (TSGR): Common Requirements* (Issue 4, Revision 1, April 1992). The DACS IV-2000 does not generate more than 0.01 unit interval (UI; timeslots) of rms jitter with a high-pass measurement filter with 12-kHz cutoff frequency. Jitter generation at the DS3 outputs of the DACS IV-2000 is negligible.

The peak signal-to-rms noise (S/N) power ratio for an *all ones* pattern measured over the bandwidth of the digital signal in the DACS IV-2000 is greater than 46 dB on any digital output line signal.

The return loss at a half bit rate (normal cross-connection) measured at the input of a cross-connection in the DACS IV-2000 is greater than 18 dB. The cross-connection must be properly terminated when making this measurement.

The DACS IV-2000 provides better than 46-dB (measured at 22.368 MHz) isolation between any two DS3 output ports.

The DS1-to-DS3 nominal transmission delay (normal cross-connection) through the DACS IV-2000 is 21 μ s for AMI-coded DS1 inputs and 25.5 μ s for B8ZS-coded DS1 inputs. The DS3-to-DS3 nominal transmission delay (normal cross-connection) through the DACS IV-2000 is 19 μ s.

The DACS IV-2000 provides an operational bit error rate (BER) of less than 10^{-10} per cross-connect path across the system regardless of the number of other cross-connections established. The DS3 signal impairment specifications are listed in Table A-5.

Table A-5. DS3 Signal Impairment Specifications

Item	Value
Jitter Accommodation	Conform to TR-TSY-000009 (Figure 7) and TR-NWT-000499 (Figure 7-2)
Jitter Generation (rms)	< 0.01 UI
S/N Power Ratio	> 46 dB for all ones signal pattern
Return Loss at 22.368 MHz (normal cross-connection)	> 18 dB
Crosstalk	> 46-dB isolation between any two DS3 output ports
Transmission Signal Delay DS1 to DS3 (normal cross-connection)	21.0 μ s (AMI), 25.5 μ s (B8ZS)
Transmission Signal Delay DS3 to DS3	19 μ s
Bit Error Rate (BER/cross-connect path)	< 1×10^{-10}

DS1 Signal

The jitter accommodation (tolerance) requirement for a DS1 signal input is specified in terms of the amount of sinusoidal jitter (peak-to-peak) that must be accommodated versus the frequency of that jitter. The DACS IV-2000 meets the jitter accommodation requirements for a DS1 signal given in Figure 7 of Bellcore TR-TSY-000009, *Asynchronous Digital Multiplexer Requirements and Objectives* (Issue 1, May 1986) and Figure 7-2 of Bellcore TR-NWT-000499, *Transport Systems Generic Requirements (TSGR): Common Requirements* (Issue 4, Revision 1, April 1992). The DACS IV-2000 does not generate more than 0.3 UI of rms jitter or more than 1 UI of peak-to-peak jitter over a 10-Hz to 40-kHz jitter spectrum in the absence of input jitter.

The peak S/N power ratio for an *all ones* pattern measured over the bandwidth of the digital signal in the DACS IV-2000 is greater than 46 dB on any digital output line signal.

The return loss at a half bit rate (normal cross-connection) measured at the input of a cross-connection in the DACS IV-2000 is greater than 18 dB. The cross-connection must be properly terminated when making this measurement. The DACS IV-2000 provides better than 46-dB (measured at 772 kHz) isolation between any two DS1 output ports.

The DS1-to-DS1 nominal transmission delay (normal cross-connection) through the DACS IV-2000 is 23.5 μ s for AMI-coded DS1 inputs/outputs and 33 μ s for B8ZS-coded DS1 inputs/outputs. The nominal DS1 line loopback transmission delay is 3 μ s.

The DS1 signal impairment specifications are summarized in Table A-6.

Table A-6. DS1 Signal Impairment Specifications

Item	Value
Jitter Accommodation	Conform to TR-TSY-000009 (Figure 7) and TR-NWT-000499 (Figure 7-2)
Jitter Generation (rms)	< 0.3 UI
Jitter Generation (peak-to-peak)	< 1.0 UI
S/N Power Ratio	> 46 dB for all ones signal pattern
Return Loss at 772 kHz (normal cross-connection)	>18 dB
Crosstalk	> 46-dB isolation between any two DS1 output ports
Transmission Signal Delay DS1 to DS1 (normal cross-connection)	23.5 μ s (AMI), 33 μ s (B8ZS)
Transmission Signal Delay DS1 Line Loopback	3.0 μ s
Bit Error Rate (BER/cross-connect path)	< 1×10^{-10}

STS-1 Signal

The jitter accommodation (tolerance) requirement for an STS-1 signal input is specified in terms of the amount of sinusoidal jitter (peak-to-peak) that must be accommodated versus the frequency of that jitter. The DACS IV-2000 meets the jitter accommodation requirements for an STS-1 signal given in Bellcore TA-NWT-000253, *SONET Transport Systems: Common Generic Criteria for Operations Communications Routing and LAN Support* (Issue 7, September 1992). The DACS IV-2000 does not generate more than 0.01 UI of rms jitter with a high-pass measurement filter with 12-kHz cutoff frequency.

The STS-1 signal impairment specifications are summarized in Table A-7.

Table A-7. STS-1 Signal Impairment Specifications

Item	Value
Jitter Accommodation	Conform to TA-NWT-000253
Jitter Transfer (terminating DS1 signals on STS1 interfaces)	Conform to TA-NWT-000253
Jitter Amplitude (terminating DS1 signals on STS1 interfaces)	< 5 UI peak-to-peak
Jitter Generation (rms)	< 0.01 UI

Cable Characteristics

There are various options available in the types and length of cables and the types of connectors used for interconnection of the DACS IV-2000 either to a DSX-1, DSX-3, STSX-1, or directly to another network element (NE).

DS3 Interface Cable and Connectors

The DACS IV-2000 supports both overhead and underfloor type cable distribution. The DS3 interface cable and connector characteristics are summarized in Table A-8.

Table A-8. DS3 Cable and Connector Characteristics

Item	Value
Maximum Distance to DSX-3 (KS-19224 type cable)	150 ft
Maximum Distance to DSX-3 (734-type cable*)	450 ft
Maximum Distance to DSX-3 (735-type cable)	250 ft
Maximum Distance to DS3 NE (KS-19224 type cable)	300 ft
Maximum Distance to DS3 NE (734-type cable*)	900 ft
Maximum Distance to DS3 NE (735-type cable)	500 ft
DS3 Connector Type (982-type) at the DACS IV-2000	2 x 4
DS3 Connector Type (at DS3 NE)	connectorized

* Identical characteristics to previous 728B-type cable.

DS1 Interface Cable and Connectors

The DACS IV-2000 supports both overhead and underfloor type cable distribution. The DS1 interface cable and connector characteristics are summarized in Table A-9.

Table A-9. DS1 Cable and Connector Characteristics

Item	Value
Maximum Distance to DSX-1 (600-type cable)	655 ft
Maximum Distance to DSX-1 (1249-type cable*)	450 ft
Maximum Distance to DS1 NE (600-type cable)	1310 ft
Maximum Distance to DS1 NE (1249-type cable*)	900 ft
DS1 Connector Type (963T) or Wirewrap at the DACS IV-2000	2 x 14 (in) 1 x 28 (out)
DS1 Connector Type (at DSX-1)	wirewrap

* 1249 is preferred for overhead installation; it is required for underfloor installation.

STS1 Interface Cable and Connectors

The DACS IV-2000 supports both overhead and underfloor type cable distribution. The STS1 interface cable and connector characteristics are summarized in Table A-10.

Table A-10. STS1 Cable and Connector Characteristics

Item	Value
Maximum Distance to STSX-1 (735-type cable or equivalent)	450 ft
Maximum Distance to STS1 NE (734-type cable or equivalent)	900 ft
STS1 Connector Type (982-type) at the DACS IV-2000	2 x 4
STS1 Connector Type (at STSX-1)	connectorized

Alarm and Control Interfaces

The alarm and control interfaces for the DACS IV-2000 consist of office and telemetry alarms, craft, telemetry, and operations systems (OSs). Each of these interfaces is described in this section, and the particular specifications and characteristics associated with each interface are given.

Office and Remote Alarms

The DACS IV-2000 has seven office alarm outputs: Critical Audible, Critical Visual, Major Audible, Major Visual, Minor Audible, Minor Visual, and Main Controller Failure. Contact closures for visual alarms remain latched until the failure is cleared.

The DACS IV-2000 provides a set of relay closures for critical, major, and minor alarms, which can be picked up by a remote telemetry system in the local office and sent to the appropriate OS.

All alarm contacts are rated as follows: maximum current (1.0A), maximum voltage (48V), and maximum volt-ampere (25 VA).

The activation of the alarms is delayed to avoid calling craft personnel to respond to transient errors of short duration. The alarm delay is programmable over a range of 1 to 30 seconds. The alarm delay operates on all audible and visual office alarm outputs, including major and minor visual indicators, autonomous messages, and OS (telemetry) alarm points. The OS status points associated with the delayed alarm points are similarly delayed.

The minimum alarm duration is 20 seconds for all office audible and visual alarm outputs, major and minor visual indicators, and OS (telemetry) alarm points. The minimum duration is not programmable. All alarm points are stretched to a total of at least 20 seconds beyond the programmed delay interval, even if the condition causing the alarm does not persist for the 20-second interval.

The office and telemetry alarm types and requirements for the DACS IV-2000 are summarized in Table A-11.

Table A-11. Office and Telemetry Alarms and Requirements

Item	Value
Office Audible Alarms	Critical, Major, Minor
Office Visual Alarms	Critical, Major, Minor, MC Fail
Remote Telemetry Alarms	Critical, Major, Minor, MC Fail Remote Indicator
Alarm Contact Closure Rating	1.0A, 48V, 25 VA (max)
Alarm Holdoff Delay (non-SONET facilities and equipment)	1 to 30 sec (default 10 sec)
Alarm Clear Delay (non-SONET facilities and equipment)	1 to 20 sec (default 10 sec)
Soak Time — Alarm Onsets (SONET facilities)	1 to 30 sec (default 2 sec)
Soak Time — Alarm Clears (SONET facilities)	1 to 20 sec (default 10 sec)
GTP Poll Time	10 to 60 sec (default 20 sec)

Craft and OS Interfaces

Table A-12 summarizes the characteristics of the links connecting craft and OSs to the DACS IV-2000.

Table A-12. Link Characteristics

Interface	Physical	Baud	Electrical	Functional
CILINK 1-1 and 2-1	EIA-232-D	300, 1200, 2400, 4800, and 9600 Default: 9600	EIA-232-D	Async. Snider
CILINK 1-2 and 2-2	EIA-449	300, 1200, 2400, 4800, and 9600 Default: 2400	EIA-423	Async. Snider
CILINK 1-3 and 2-3	EIA-449	300, 1200, 2400, 4800, and 9600 Default: 9600	EIA-423	Async Snider
CILINK 1-4 and 2-4	EIA-449	Snider: 300, 1200, 2400, 4800, and 9600 TABS/TBOS: 2400 Default: 9600 (Snider) 2400 (TABS/ TBOS)	EIA-485	TABS, TBOS, or async. Snider point-to-point AS&C
CILINK 1-5, 1-6, 2-5, and 2-6	EIA-449	Based on external timing Default: 9600	EIA-423	Sync. X.25 or Async. Terminal Interface with external PAD

Notes:

1. All EIA-423 links are interoperable with EIA-232-D via the use of the suggested adapters. For Snider links DACS IV-2000-to-terminal communication, it is suggested the ED-2C646,G1 adapter be used. For Snider links DACS IV-2000-to-OS via modem communication, it is suggested the ED-2C646,G2 adapter be used.
2. Links 1-2 and 2-2 are electrically compatible with the EIA-232-D (see Note 1) standard up to 4800 baud. Links 1-3 and 2-3 are electrically compatible with the EIA-232-D standard up to 9600 baud. These links may operate with the EIA-232-D above these data rates; however, the 4-percent rise time specification of EIA-232-D is violated.
3. To supply internal timing for the X.25 links, the ED2C646,G7 adapter must be used and the baud rate is fixed at 9600. All baud rates can be used with an external timing source.
4. Links 1-4 and 2-4 have the same characteristics as links 1-2, 1-3, 2-2, and 2-3 when link 1-4 or 2-4 is provisioned as a Snider link.

Protocols

The message interface protocol for links 1-1, 1-2, 1-3, 2-1, 2-2, and 2-3 is Snider, which is defined in Bellcore TR-NWT-000064, *LATA Switching Systems Generic Requirements (LSSGR)*, and FSD 35-08-0100, *SPCS (Stored Program Control Systems) OS Interface, SCCS (Switching Control Center System), Asynchronous Interface*.

The message interface protocol for links 1-4 and 2-4 (TABS/TBOS) is specified in Compatibility Bulletin 149, *Maintenance Standards for Digital Transmission Systems (Issue 4)*.

The message interface protocol for links 1-4 and 2-4 (when provisioned for Snider) is Snider, which is defined in Bellcore TR-NWT-000064, *LATA Switching Systems Generic Requirements (LSSGR)*, and FSD 35-08-0100, *SPCS (Stored Program Control Systems) OS Interface, SCCS (Switching Control Center System), Asynchronous Interface*.

The synchronous links 1-5, 1-6, 2-5, and 2-6 operate up to 9600 baud. The message interface protocol for the four links is X.25 as verified with Bellcore TR-NWT-001213, *Objectives for the Maintenance User Interface of Switching Systems and Transport Systems (Issue 1, March 1992)* or asynchronous terminal interface with the use of an external PAD.

The network layer for the synchronous links is X.25. The DACS IV-2000 meets the CCITT X.25 1984 specification and has been verified with Bellcore TR-NWT-001213, *Objectives for the Maintenance User Interface of Switching Systems and Transport Systems (Issue 1, March 1992)*.

Snider Link Specifications

The specifications for links 1-1, 1-2, 1-3, 2-1, 2-2, and 2-3 are summarized in Table A-13.

Table A-13. Links 1-1, 1-2, 1-3, 2-1, 2-2, and 2-3 Specifications

Item	Value
Craft Interface Terminal Ports	Four EIA-449/EIA-423 asynchronous (1-2, 1-3, 2-2, and 2-3) Two EIA-232-D per EIA IEB No.12 (1-1 and 2-1)
Baud	300, 1200, 2400, 4800, or 9600
Craft Interface Terminal Type	AT&T 4425 or compatible terminal
Craft Interface Terminal Interaction	Command and Menu modes
Craft Interface Interconnections	Connectorized

TABS/TBOS Link Specifications

The DACS IV-2000 has a TABS/TBOS port as an electrical interface to a telemetry-based operations system. The electrical interface specifications are given in Compatibility Bulletin 149, *Maintenance Standards for Digital Transmission Systems* (Issue 4). The interface can be connected to the monitoring equipment on a point-to-point basis. The interface operates at 2400 baud.

All alarm and status indications available over the craft interface link are also available over the TABS/TBOS telemetry link. (Note that the mapping between craft and telemetry interfaces is not on a one-to-one basis.) The only control functions available over the telemetry links are protection switches and locks, and CLKGN circuit pack switches.

The specifications for links 1-4 and 2-4 are summarized in Table A-14.

Table A-14. Links 1-4 and 2-4 Specifications

Item	Value
Telemetry Interface Port	TABS/TBOS or Snider asynchronous point-to-point
Baud	2400
Telemetry Interface Protocol	TABS/TBOS or Snider

X.25 Link Specifications

The DACS IV-2000 has two synchronous EIA-449/EIA-423 ports for electrical interfaces to message-based OSs. The electrical interface specifications are given in EIA Standard 449 (November 1977). The synchronous links have the balanced voltage signals of EIA-423. The functions that can be performed over the synchronous links depend on the OS. The links can be converted to an asynchronous terminal interface with the use of an external PAD.

The specifications for links 1-5, 1-6, 2-5, and 2-6 are summarized in Table A-15

Table A-15. Links 1-5, 1-6, 2-5, and 2-6 Specifications

Item	Value
Physical/Electrical Interface Ports	EIA-449/EIA-423 synchronous or asynchronous
Baud	9600
Message Protocol	X.25 level 2 and 3
Switched Virtual Circuits	Four per link
Cable Length	Up to 50 ft

Command and Message Specifications

The DACS IV-2000 message interface is compatible with two operations systems from Bellcore: the Operations Systems/Intelligent Network Elements (OPS/INE) and Network Monitoring and Analysis (NMA). This message set includes alarm, provisioning, administration, and maintenance (including test access and performance monitoring) commands and messages. This message set, known as Transaction Language 1, Issue 4, is based on the Bellcore special reports, technical advisories, and technical references listed in Table A-16.

Table A-16. Command and Message Specifications

Document Number	Specification
SR-ST5-001665	<i>Network Monitoring and Analysis Generic Network Element Interface Support (Issue 2, December 1992)</i>
SR-ST5-001578	<i>OPS/INE Generic Interface Support (Issue 2, December 1992)</i>
TA-NWT-000199	<i>Specification of Memory Administration Messages at the OS/NE Interface (Issue 7, January 1993)</i>
TA-NWT-000200	<i>Specification of System Maintenance Messages at the OS/NE Interface (Issue 5, December 1990)</i>
TR-NWT-000811	<i>OTGR: Operations Application Messages - TL1 Message Index (Issue 2, May 1992)</i>
TR-NWT-000818	<i>OTGR Section 6.1: Network Maintenance: Access and Testing - Generic Test Architecture (Issue 1, November 1992)</i>
TR-NWT-000833	<i>OTGR Section 12.3: Operations Application Messages Network Maintenance: Generic Requirements for Network Element and Transport Surveillance Messages (Issue 5, Revision 2, April 1993)</i>
TR-NWT-000835	<i>OTGR Section 12.5: Operations Application Messages - Network Element (NE) Security Parameter Administration Messages (Issue 3, Revision 1, May 1991)</i>

System Performance Specifications

The system capabilities and performance specifications for the DACS IV-2000 include switch types and capacity, cross-connection capabilities, boot time, fault tolerance and protection, and maintenance. Each of these areas is described in this section, and the particular specifications and requirements associated with each area are given.

Switch Type and Capacity

All cross-connect related functions in the DACS IV-2000 are accomplished via a nonblocking, 3-stage space division switch. Nonblocking here implies the ability to access any/all of the free paths through the switch so that a connection from an input port to an output port can always be completed.

The switch type and capacity for the DACS IV-2000 are shown in Table A-17.

Table A-17. Switch Capacity

Item	Value
Switch Type	Nonblocking, 3-stage space division switch
Switch Capacity	7168 input and output switch ports (256 equivalent DS3s)

Cross-Connect Capability

The DACS IV-2000 supports four types of cross-connections:

- One-way
- Two-way
- Bridge
- Roll.

The execution time for a command depends on the type of command, speed and status of the administrative links, activities in the DACS IV-2000, and the status of the equipment in the system needed to make the connection.

The cross-connection capabilities of the DACS IV-2000 are described below and summarized in Table A-18.

The cross-connect command to the DACS IV-2000 can be one-way or two-way. The cross-connect setup time specification includes the time from which the system receives the command to the time the connection is made; it does not include the output message. The time to set up a one-way or two-way cross-connection is less than 1 second for DS1 and VT1.5 and less than 3 seconds for STS-1 clear-channel.

The DACS IV-2000 can bridge any existing connection by cross-connecting the input port to a second output port without affecting service (that is, the existing cross-connect path is not affected). The time to set up a bridge is less than 1 second for DS1 and VT1.5 and less than 3 seconds for STS-1 clear-channel.

A tail-end switch occurs when an existing cross-connect path is disconnected and a new cross-connection made at the tail-end of a facility. The in-service rolling operation requires that a tail-end switch be made in less than 2 ms (less than 3 ms for STS-1 clear-channel). In executing the tail-end switch (command), the DACS IV-2000 does not cause more than a 2-ms interruption in the transmission signal (error-free transmission is established within 2 ms), 3 ms for STS-1 clear-channel.

A one-way signal split of an existing cross-connect path between an input port and an output port is accomplished by rerouting the input port signal to a test output port and cross-connecting the signal from the test input port to the output port. The DACS IV-2000 does not cause more than a 2-ms interruption in the signal appearing at the output port (error-free transmission is established within 2 ms), 3 ms for STS-1 clear-channel.

The original cross-connect path is established automatically when the split function is disabled. In establishing the original cross-connection, the system does not cause more than a 2-ms interruption in the signal appearing at the output port (error-free transmission is established within 2 ms).

Table A-18. Cross-Connect Capabilities

Cross-Connect Procedures	Value
One-way Cross-Connect Setup Time	< 1 sec (DS1, VT1.5) < 3 sec (STS-1 clear-channel)
Two-way Cross-Connect Setup Time	< 1 sec (DS1, VT1.5) < 3 sec (STS-1 clear-channel)
Bridge Setup Time	< 1 sec (DS1, VT1.5) < 3 sec (STS-1 clear-channel)
Rolling (Signal Interruption Time)	< 2 ms < 3 ms (STS-1 clear-channel)
One-way Signal Split (Signal Interruption Time)	< 2 ms < 3 ms (STS-1 clear-channel)

Boot Time

The system boot time is the elapsed time from the moment a system reset request is made to the moment the system is ready for an input command. The boot time encompasses the downloading of all the system programs and the latest cross-connect maps from the hard disk to the appropriate controllers. If the information on the hard disk has been corrupted, additional time is required to restore the information to the hard disk from a backup optical disk before the DACS IV-2000 can be booted. The memory update procedures conform to Bellcore TA-NWT-000199, *Specification of Memory Administration Messages at the OS/NE Interface* (Issue 7, January 1993).

The boot time specifications for the DACS IV-2000 are summarized in Table A-19.

Table A-19. Boot Time Specifications

Procedure	Value
Cold Boot Time (from hard disk)	< 15 min
Cold Boot Time (from backup optical disk)	< 15 min
Restart Time (MC, ECI)	< 5 min
Memory Administration Procedures	Conform to TA-NWT-000199

Fault Tolerance and Protection

The DACS IV-2000 can isolate a fault to the facility or equipment, and can isolate the fault to the equipment circuit pack level.

The DACS IV-2000 provides two provisionable input facility signal monitor alarm threshold BERs. The high category shows failures at 10^{-3} , and the low category shows failures at 10^{-6} . If the facility connects to a MUX2 circuit pack (DS3) or a SWIF2 circuit pack (DS1), you can choose from the following bit error rate thresholds: 10^{-3} , 10^{-4} , 10^{-5} , 10^{-6} , 10^{-7} , 10^{-8} , or 10^{-9} errors per second.

If the facility connects to an SMUX circuit pack (STS-1), you can choose from the following section and line bit error rate thresholds: 10^{-3} , 10^{-4} , 10^{-5} , 10^{-6} , 10^{-7} , 10^{-8} , or 10^{-9} . At the local office, the incoming signal failures are indicated at the threshold you've specified (major, minor, or no alarm).

Any single hard equipment failure (a nontransient failure that can cause interruption in the transmission path) in the DACS IV-2000 is protected, and the protection switching capability restores error-free transmission within 60 ms from the moment such a failure occurs. Following a correct protection switch around a

failed circuit pack and after the failed circuit pack is replaced by a new circuit pack, the health of this new circuit pack is checked and service is restored to this new circuit pack from the protection circuit pack automatically. The automatic restoration time is the elapsed time between the replacement of a circuit pack and the restoration of service to this new circuit pack. The automatic restoration time is less than 10 seconds. The automatic restoration does not cause more than a 60-ms interruption in the transmission path.

The DACS IV-2000 supplies DS1 idle (unframed all ones), STS-1 idle, or VT1.5 idle signals automatically to the output ports (toward facilities/DSX-3) to drive facilities that are not cross-connected through the DACS IV-2000. When an existing cross-connect path is disconnected, a DS1, STS-1, or VT1.5 idle signal is substituted at the output port in approximately 3 ms.

⇒ NOTE:

When STS-1 and VT1.5 signals are idle, the DACS IV-2000 outputs STS and VT path AIS, respectively.

The fault tolerance and protection specifications for the DACS IV-2000 are summarized in Table A-20.

Table A-20. Fault Tolerance and Protection Specifications

Item	Value
Cross-Connect Path Monitoring	Continuous
Input Signal Alarm, BER Threshold (DS1 and DS3 interfaces)	$> 10^{-3}$ through 10^{-6} (selectable)
Input Signal Alarm, BER Threshold (DS1 and DS3 interfaces) [optional]	10^{-3} through 10^{-9}
Input Signal Alarm, Section BER Threshold (STS1 interfaces)	10^{-3} through 10^{-9}
Input Signal Alarm, Line BER Threshold (STS1 interfaces)	10^{-3} through 10^{-9}
Input Signal Failure Alarm	Major, Minor, or No Alarm (selectable)
Input Signal Failure Visual Indication	ALM (flashes at 1-sec intervals)
DS1 AIS Substitution Time (DS1 and DS3 interfaces)	< 3 ms
DS1 AIS Substitution Time (STS1 interfaces)	< 50 ms
STS-1 Path AIS Substitution Time	< 125 μ s
VT1.5 Path AIS Substitution Time	< 500 μ s
Protection Switching Time	< 60 ms
Automatic Restoration Time	< 10 sec

Frame Indicators and Controls

Eight visual equipment indicators are provided on the DACS IV-2000 status panel

- CRITICAL signals a critical alarm condition; red
- MAJOR signals a major alarm condition; red
- MINOR signals a minor alarm condition; yellow
- ABNORMAL is reserved for future use
- ACO (alarm cutoff) signals that the audible alarms have been turned off (ACO switch activated); green
- POWER ON indicates that power is present at the status panel; green
- FAILURE (Main Controller Failure) is a processor major alarm that signals a failure in the Redundant Controller Module; red
- FAR END is reserved for future use.

All circuit packs, except version one synchronizer circuit packs, contain a red LED to aid in problem identification. (In addition, some circuit packs contain a green LED to indicate that they are in service.) The LED is mounted so that it is visible while the circuit pack is in the equipment. The LED is controlled by a main/unit controller so that it can be illuminated even if the circuit pack it is mounted in is defective. In addition to the red LEDs, alarm messages are generated for all circuit-pack failures.

For the DS1, DS3, and STS1 interface circuit packs, as well as the DS1TX2 circuit pack, the LED indicators flash continuously at 1-second intervals on circuit packs that have input signal failures, and remain on for failures in the circuit packs themselves. (Circuit-pack failure indicators have a minimum duration of 2 seconds, to distinguish them from incoming signal failures.) The power circuit packs activate their respective LEDs when a fault exists. Because the power circuit pack failure LED is powered from the primary power supply, it lights even when there is a loss of logic level power.

Four controls (momentary-action pushbutton or toggle switches) are located on the DACS IV-2000 status panel:

- LED/LAMP TEST tests all LEDs in the DACS IV-2000 (except FAR END LED)
- RESET, when operated simultaneously with the RESET ENABLE switch, initiates the system reset function
- RESET ENABLE inhibits the reset function from being activated accidentally
- ACO silences the office audible alarms.

The alarm selection criteria in the DACS IV-2000 conform to Bellcore TR-TSY-000191, *Alarm Indication Signal Requirements and Objectives* (Issue 1, May 1986).

The alarm indications for maintenance support are summarized in Table A-21

Table A-21. Visual Indicators

Item	Value or Specification
System Visual Indicators	CRITICAL, MAJOR, MINOR, ACO (alarm cutoff), FAILURE
Circuit Pack Failure Visual Indicator	ALM (2-sec minimum duration); red LED lit
Protection Bus Active Visual Indicator	Green LED lit on MUXPS or DS1RY1
Primary Disk Active Visual Indicator (when disk is spinning)	Green LED lit
Power Feed Status Visual Indicator	Green LED lit
System Controls	LED/LAMP TEST, RESET, RESET ENABLE, and ACO
Power Bus Failure Indicator	BUS ALM
Power Circuit Pack Failure Visual Indicator	ALM; red LED lit
Power Feed Status Visual Indicator	ON
Alarm Selection Criteria	Conform to TR-TSY-000191
CPU (Control Complex) Active Visual Indicator	Green LED lit
Version Two Synchronizer Active Visual Indicator	Green LED lit

Power Specifications

The DACS IV-2000 frame is configured to accept two power supply arrangements, standard (existing frames upgraded to Release 4.0) or duplex (new frame orders). The standard configuration consists of one Battery Distribution Feeder Board (BDFB) powered from a single Lineage[®] 2000 (or equivalent) battery plant. The duplex configuration allows the DACS to be powered from one or two Lineage 2000 (or equivalent) battery plants.

Standard Power Configuration

In the standard configuration, the DACS IV-2000 operates with a Lineage 2000 (or equivalent) battery plant (-48 Vdc nominal) in a central office environment.

Seven power feeders and seven returns are terminated at the Switch Bay and provide power for the entire DACS IV-2000. The feeders are designated by the loads they serve: A, B, C, D, E, F, and G. Each load is fused separately.

- Feeders A, B, C, D, and E (connected through the Fuse and Alarm Panel) supply power to the facility interface bays, the SW PWR Module, and the fan assemblies.
- Feeders F and G (connected directly to the RC PWR Module) supply power to the RC PWR Module.

Duplex Power Configuration

The duplex power feature provides compatibility with the "red and blue" central office power distribution being deployed in the AT&T Network, and with other power-distribution arrangements. The duplex power feature uses one or two -48V diverse power plants. (A diverse power plant is one that does not share common components, such as rectifiers, batteries, BDFBs, and cable racks.)

Four power feeders (A, B, C, and D) and four returns are terminated at the Switch Bay and provide power for the entire DACS IV-2000. Power feeders A and B supply power buses A, B, and E and power feeders C and D supply power buses C, D, and F. All power feeders are connected to the Fuse and Alarm Panel.

When the DACS IV-2000 is powered using two battery plants, the following requirements apply:

- Power feeders to the DACS IV-2000 must be placed in two groups to allow connection to two separate BDFDs.
- Two BDFBs are required.
- Feeders A and B are fed from BDFB-A; feeders C and D are fed from BDFB-B.

Loss of one battery plant or loss of one group of feeders does not cause any loss of service (except where there is only one battery plant supplying power).

The power supply requirements are summarized in Table A-22.

Table A-22. Power Supply Requirements

Item	Value
Primary Supply Voltage	-48 Vdc nominal (-42.5 to -60.0 Vdc)
Secondary Supply Voltage	-48 Vdc
Transient Voltage Limit	-60.0 Vdc
Battery Noise (voice frequency)	< 56 dBrc0
Battery Noise (radiation frequency)	100 mV rms in any 3-kHz band over 10 kHz to 20 MHz
Power Bus Interconnection	Connectorized
Number of Power Feeders	Seven (A,B,C,D,E,F, and G) for standard power Four (A,B,C, and D) for duplex power
Fuse Rating at BDFB (feeders A,B,C,D, E, F, and G)	Depends on bay configuration (see floor plan data sheets)
Maximum Current Drain over A, B, C, D, E, F, and G Feeders (under failure condition)	Depends on bay configuration (see floor plan data sheets)
Maximum Current Drain over E Feeder	< 2.0A

Power Dissipation

Enough redundancy is provided in the DACS IV-2000 so a single failure of a bus or power circuit pack does not affect service. Each power circuit pack is fed through a 12A fuse located in the fuse and alarm panel. A power feed status visual indicator and a power circuit pack failure visual indicator are located on each power circuit pack.

The power dissipation of the DACS IV-2000 bays conforms to Bellcore TR-NWT-000063, *Network Equipment-Building System (NEBS) Generic Equipment Requirements* (Issue 5, September 1993).

Power specification requirements are summarized in Table A-23.

Table A-23. Bay Power Dissipation

Item	Value
Power Circuit Pack Fuse Rating	
PWRA	12A
PWRE	10A
PWRF	7.5A
PWRG	7.5A
Switch Bay Power Dissipation (fully equipped)	1253W
DS1 Interface Bay Power Dissipation (fully equipped)	620W
DS3 Interface Bay Power Dissipation (fully equipped)	597W
STS1/DS3/DS1 Interface Bay Power Dissipation (fully equipped)	770W
STS1/DS3 Interface Bay Power Dissipation (fully equipped)	1105W

Physical Specifications

The floor load from the DACS IV-2000 frames (excluding cable distribution system) averaged across the associated floor area does not exceed 115 lb/ft². Other physical characteristics of the DACS IV-2000 are provided in Table A-24.

Table A-24. Physical Characteristics

Item	Value
DACS IV-2000	Up to nine standard 26 in (W) x 84 in (H) x 12 in (D) bays*
Framework Type	Network Bay
Weight (Switch Bay)	512 lbs
Weight (DS3 Interface Bay)	230 lbs
Weight (DS1 Interface Bay)	440 lbs
Weight (STS1/DS3/DS1 Interface Bay)	450 lbs
Weight (STS1/DS3 Interface Bay)	450 lbs
Floor Load (excluding cable distribution)	Conform to TR-NWT-000063
Maintenance Aisle, Front (minimum width)	30 in
Wiring Aisle, Rear (minimum width)	24 in

* All interface bays are 12 inches deep; the Switch Bay is 13 inches deep.

Environmental Specifications

The environmental considerations for the DACS IV-2000 include the thermal characteristics, handling and transportation requirements, and earthquake, acoustical noise, EMC, and ESD specifications. These environmental specifications conform to Bellcore TR-NWT-000063, *Network Equipment-Building System (NEBS) Generic Equipment Requirements* (Issue 5, September 1993) and TR-NWT-001089, *Electromagnetic Compatibility and Electrical Safety Generic Criteria for Network Telecommunications Equipment* (Issue 2, June 1993).

Each of these areas is described below and the particular specifications and requirements associated with each area are given.

Ambient Characteristics

The DACS IV-2000 remains operational within the following room ambient temperature and humidity limits.

Room ambient refers to conditions at a location 5 feet above the floor and 15 inches in front of the equipment. The short term refers to a period of not more than 72 consecutive hours and a total of not more than 15 days in one year. At the short-term emergency condition of 120°F, the relative humidity must be below 30 percent.

The DACS IV-2000 remains operational when installed in central offices (COs) located from 200 feet below sea level to 13,000 feet above sea level.

The DACS IV-2000 environmental characteristics are summarized in Table A-25.

Table A-25. Environmental Characteristics

Item	Value or Specification
Normal Operating Temperature Range	+40° to +100°F (4.5° to 38°C)
Minimum Short-Term Temperature	35°F (1.7°C)
Maximum Short-Term Temperature	120°F (49°C)
Maximum Rate of Temperature Change	15°F (8.3°C) per hour
Operating Relative Humidity	20 to 55%
Minimum Short-Term Relative Humidity	20%
Maximum Short-Term Relative Humidity	80% or < 0.024 lb of water/lb of dry air, whichever is less
Operational Altitude	From 200 ft below to 13,000 ft above sea level
Equipment Cooling	Natural convection: DS1, DS3, and STS1/DS3/DS1 Interface Bays Forced convection (fans): Switch and STS1/DS3 Interface Bays
Fire Resistance and Dust	Conform to TR-NWT-000063
Standard Heat Dissipation	Conform to TR-NWT-000063

Handling and Transportation

The DACS IV-2000 meets the shock, vibration, temperature, and relative humidity criteria specified in TR-NWT-000063, *Network Equipment-Building System (NEBS) Generic Equipment Requirements* (Issue 5, September 1993) for handling and transportation. (See Table A-26.)

Table A-26. Handling and Transportation Specifications

Item	Value or Specification
Vibration and Shock Design Criteria	Conform to TR-NWT-000063
Temperature (Transportation/Storage)	Conform to TR-NWT-000063
Relative Humidity (Transportation/Storage)	Conform to TR-NWT-000063
Storage/Shipment Altitude	Up to 40,000 ft

Earthquake, Acoustical Noise, EMC, and ESD

The design techniques for the DACS IV-2000 minimize emissions for an open frame design. The objective is to conform to the emission and immunity electromagnetic compatibility (EMC) limits as outlined in Part 15, Subpart J, of the FCC rules for Class A Computing Devices; see TR-NWT-000063, *Network Equipment-Building System (NEBS) Generic Equipment Requirements* (Issue 5, September 1993) and TR-NWT-001089, *Electromagnetic Compatibility and Electrical Safety Generic Criteria for Network Telecommunications Equipment* (Issue 2, June 1993).

The DACS IV-2000 is designed to meet the electrostatic discharge (ESD) requirements specified in TR-NWT-001089, *Electromagnetic Compatibility and Electrical Safety Generic Criteria for Network Telecommunications Equipment* (Issue 2, June 1993).

ESD grounding connections are provided on the front and rear of each bay, and the use of wrist straps is required. EMC enclosures are required for the DACS IV-2000 to be fully compliant with EMC limits and ESD requirements.

The earthquake, acoustical noise, EMC, and ESD specifications are shown in Table A-27

Table A-27. Earthquake, Acoustical Noise, EMC, and ESD Specifications

Item	Value or Specification
Earthquake and Office Vibration	Conform to TR-NWT-000063
Acoustical Noise Limits under Normal Operating Temperatures	< 65 dBA Conform to TR-NWT-000063
Electromagnetic Compatibility (EMC) with EMC Enclosures	Conform to TR-NWT-001089 Part 15, Subpart J, <i>Class A Computing Devices</i>
Electrostatic Discharge (ESD) with EMC Enclosures	Conform to TR-NWT-001089

Availability and Reliability Specifications

Availability and reliability can be defined in terms of the following three components, which are described in this section and summarized in Table A-23.

- Mean time between failures
- Mean time between maintenance activities for the equipment
- Quality and reliability of the software.

Mean Time Between Failures

Mean Time Between Failures (MTBF) indicates the frequency of service-affecting failures within the DACS IV-2000. MTBF is greater than 9000 years per DS3, greater than 17,000 years per DS1, and greater than 9000 years (est.) per EC-1 facility. The outage time is less than 0.012 minute per year per DS3, less than 0.006 minute per year per DS1, and less than 0.012 minute per year (est.) per EC-1 facility as specified in Bellcore TA-NWT-000233, *Wideband and Broadband Digital Cross-Connect Systems Generic Criteria* (Issue 1, November 1993) and TA-NWT-001339, *General Reliability Requirements for Digital Cross-Connect Systems* (Issue 1, November 1993).

Mean Time Between Maintenance Activities

Reliability is specified in terms of Mean Time Between Maintenance Activities (MTBMA), which indicates the frequency of failures within the DACS IV-2000. This is a measurement of how often a maintenance activity occurs and includes both service-affecting and non-service-affecting failures. The MTBMA is greater than 3000 hours for a fully equipped DACS IV-2000 standard bay. The MTBMA specified in Table A-28 is for fully equipped standard bays and depends on bay type.

The MTBMA, MTBF, and outage times are based on 2 hours Mean Time To Repair (MTTR) as specified in Bellcore TA-NWT-000233, *Wideband and Broadband Digital Cross-Connect Systems Generic Criteria* (Issue 1, November 1993) and TA-NWT-001339, *General Reliability Requirements for Digital Cross-Connect Systems* (Issue 1, November 1993).

The availability and reliability specifications for the DACS IV-2000 are summarized in Table A-28.

Table A-28. Availability and Reliability Specifications

Item	Value or Specification
MTBF (per DS3)	> 9000 years (est.)
MTBF (per DS1)	> 17,000 years (est.)
MTBF (per EC-1)	> 9000 years (est.)
Outage Time (per DS3)	0.012 min/year; better than TA-NWT-000233 and TA-NWT-001339
Outage Time (per DS1)	0.006 min/year; better than TA-NWT-000233 and TA-NWT-001339
Outage Time (per EC-1)	< 0.012 min/year; better than TA-NWT-000233 and TA-NWT-001339
MTBMA Switch Bay (fully equipped)	4299 hours
MTBMA DS3 Interface Bay (fully equipped)	4144 hours
MTBMA STS1/DS3/DS1 Interface Bay (fully equipped)	3835 hours
MTBMA DS1 Interface Bay (fully equipped)	5323 hours
MTBMA STS1/DS3 Interface Bay (fully equipped)	4144 hours
MTTR	2 hours
Reliability Prediction Procedure	Conform to TR-TSY-000332, Issue 4

Software Quality and Reliability

The software quality criteria conform to Bellcore TR-TSY-000179, *Software Quality Program Generic Requirements (SQPR)* (Issue 2, June 1993).

The software reliability criteria conform to Bellcore TA-TSY-000282, *Software Reliability and Quality Acceptance Criteria (SRQAC)* (Issue 1, December 1986)

The reliability prediction procedures conform to Bellcore TR-NWT-000332, *Reliability Prediction Procedures for Electronic Equipment* (Issue 5, December 1992).

Glossary

A

Active

The circuit pack or module is in service, not protected. If it is a traffic-carrying circuit pack or module, it is carrying traffic.

Alarm Delay

Specifies (in seconds) the alarm delay for software-detected alarm conditions. Initial value is 10 seconds.

Alarm Indication Signal (AIS)

A signal transmitted downstream if the incoming signal is defective.

All-Ones Signal

Signal that is defined to contain all ones. AIS is an example of an all-ones signal.

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: critical, major, minor, or no alarm.

Autolock

When the system autolocks a circuit pack, it switches to protection and forbids return to the working circuit pack even if the trouble clears. This is caused by multiple protection switches on that circuit pack in a short time period.

Autolock Numbers of Switches

This parameter is the number of times that the system restores a circuit pack to service (after intermittent failures) in a given autolock switching interval before the circuit pack is autolocked.

Autolock Release Time

The number of hours between times when the system automatically releases autolock

Autonomous

An action performed by the system without direction by you.

Auto-provisioning

Put into the provisioned state automatically by the system.

B

B3ZS

Bipolar with 3-zero substitution; a DS3 or STS-1 line code.

B8ZS

Bipolar with 8-zero substitution; a DS1 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 variation (BPV) or parity (PTY). The initial value is BPV.

Bipolar Variation

A variation of the alternating +1, -1 pattern in a 3-level code.

Bit Error Rate Threshold

Point at which an alarm is issued for bit errors.

Blue Code

Same as alarm indication signal (AIS).

Boot

To transfer contents of backup memory into the system's working memory.

Broadcast

To take a signal from a single input port and connect it to multiple output ports.

Byte

Usually refers to a group of eight consecutive binary digits, but sometimes used for bit groups of other sizes.

C

C-bit Parity

Parity checks on blocks of data are used to detect bits in error. C-bit parity is a DS3 format specified by ANSI T1.107 that supports near-end and far-end path performance monitoring, contains far-end alarm/control, and three end-to-end overhead communications channels.

Clear (CL)

The state where an alarm condition no longer exists.

Clear-channel

A channel in which all bandwidth is used, with no overhead bits.

Command Mode

One of two modes used to communicate with the DACS IV-2000. This mode involves entering commands directly into the system without any prompts.

Condition

The type of alarm failure, such as internal and loss of signal.

Control Cable ID

Specifies the controller cable identification associated with an interface module or a DS3 performance monitor (DS3PM) circuit pack (J cable).

Control Complex

A set of circuit packs (CPU/MTC/SSC) that provides all control functions for the DACS IV-2000.

Cross-Connect

Hardware used to interconnect line-terminating equipment, multiplexers, and other equipment, allowing access to these facilities and having the ability to change these facilities as required.

Crosstalk

An unwanted signal induced into one transmission line from another transmission line.

Current Value

In the dialog mode, indicates that the current value of a parameter is used by the system unless you direct otherwise.

D

Database

A record of cross-connections, status of circuit packs and facilities, and other data.

Default

A value the system automatically uses for a parameter if the you do not specify a value.

Delimiter

A punctuation mark (colon or comma) used to separate two parameters in an input message.

Demultiplexer

An electronic device used with a multiplexed signal for recovering signals combined within it and restoring the distinct individual channels of these signals.

Diagnose

To test a circuit pack.

DS1GRP

A group of 28 DS1 ports in a SWIF, MUX, or SMUX [VT1.5(DS1) signals] circuit pack.

DS1 Port

Terminates a DS1 signal on a DS1IF (one of fourteen ports), as part of a DS3 signal on a MUX, or as part of an STS-1(VT1.5) signal on an SMUX circuit pack.

DS1 Signal

A logical signal with a data rate of 1.544 Mb/s (ANSI T1.107). A DS1 signal is produced by combining 192 payload bits and one framing bit; for example, 24 DS0 signals (eight bits per DS0) can be combined with one framing bit, thereby transmitting 193 bits per frame.

DS3 Equivalent

The second item in the address of a port. It refers either to a MUX circuit pack or to an SWIF circuit pack, either of which handles 28 DS1 signals.

DS3 Format

Specifies the line format of a DS3 interface port. The initial value is M13, the common multiplexer format.

DS3 Idle Signal

A signal that can be optionally applied to any DACS IV-2000 output port that is not cross-connected to any input port. This signal lets downstream network elements know that the facility is operating normally even though the DACS IV-2000 is not sending a normal DS3 signal.

DS3 Interface Port

Specifies a DS3 port on a MUX circuit pack. If the value UNIT is given, it indicates all the DS3 interface ports in that DS3 Interface Module.

DS3 Signal

A logical or electrical B3ZS signal with a data rate of 44.736 Mb/s (ANSI T1.107). For the DACS IV-2000, a traffic-carrying DS3 signal is made up of 28 DS1 signals and control bits used for synchronization and other purposes. The DS3 signal consists of a succession of masterframes approximately 106 μ s long. Each masterframe contains seven subframes, each of which consists of eight data blocks. A data block contains one control bit and 84 data bits, with three data bits coming from each of the 28 DS1 signals that make up the DS3 signal.

DSX-1, 2, 3

Digital cross-connect used to interconnect equipment, provide patch capability, and provide test access at the DS1, DS2, or DS3 level.

Duplex Entity

A pair of circuit packs in which one is active and the other is in hot standby (clock generators).

E

Electrical Carrier 1 (EC-1)

The industry standard nomenclature for an electrical STS-1 signal.

Echo

To display an input at a terminal. (A user ID is echoed, but a password is not.)

Electromagnetic Compatibility (EMC)

A measure of equipment tolerance to external electromagnetic fields.

Electromagnetic Interference (EMI)

Interference generated in a circuit by electromagnetic radiation energy coupling.

Electrostatic Discharge (ESD)

Static electrical energy potentially harmful to circuit packs and humans.

Enter

To provision a circuit pack or interface module by a command, not automatically by the system.

Entity

A specific piece of hardware (such as a circuit pack, memory device, or communications link) that has been assigned a name recognized by the system

Entity Identifier

The name used by the system to refer to a circuit pack, memory device, or communications link.

Equalizer

A circuit adjustment used to maintain signal strength within desired limits.

Equipped

The circuit pack or interface module is in the system database and physically in the frame, but is not yet provisioned.

F

Facility

A one-way or two-way circuit connected to the DACS IV-2000 that carries a transmission signal (such as a DS1 or STS-1 signal).

Forced

A traffic-carrying circuit pack (either service or protection) has been deliberately locked into a service-providing state by a manual command despite being bad.

Frame

The smallest repetitive block of digital data being transmitted (for example, 193 bits in a DS1 signal), which contains twenty-four 8-bit bytes and a synchronizing frame bit. Also refers to an assembly of equipment units, such as a DACS IV-2000 frame.

G

Grooming

Rearrangement of DS1/VT1.5 signals in DS3/STS-1 signals.

H

Hardware ID

Specifies the hardware identification (type and version) of a circuit pack.

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 minute, and SS is the second.

Hierarchy

An orderly ranking or sequence of elements, such as that of menus presented at a terminal.

Hit

A momentary disruption of service.

Hot Standby

A circuit pack ready for fast, automatic placement into operation to replace an active circuit pack.

I

Idle

An output port is idle if it is not cross-connected to an input port.

Idle Code

A signal that is transmitted downstream automatically from an idle output port; it can also be transmitted downstream by a manual command from a cross-connected output port. The DS1 idle code (the same as DS1 alarm indication signal) consists of all ones.

In-Service

A state in which the circuit pack is performing normal service functions, in either active or standby mode.

Input Status

The input signal status of a DS1, DS3, VT1.5, or STS1 interface port, which can be:

- DRVN (driven) — where a signal is expected at the port, and the port is being monitored for failures
- NDRVN (not driven) — where no valid signal is expected at the port, and the port is not being monitored for failures
- INIT (initialized) — or unset meaning that the port is considered not driven until a valid signal is detected, at which time it becomes driven
- QRSS (quasi-random signal source) — a DS1 port is provisioned as the QRSS for the system.

Initial values are INIT for a DS1 interface port, DRVN for a DS3, VT1.5, and STS1 interface port, and DRVN for DS1 ports of an DS3 interface port.

J

Jitter

Short-term variations in timing properties of a digital signal.

L

Line

A transmission medium, together with the associated equipment, required to provide the means of transporting information between two consecutive network elements; one network element originates the line signal and the other terminates the line signal.

Line Buildout (LBO)

An attenuating (signal-reducing) element used to keep DS3 or STS-1 output signal strength within desired limits. The line buildout setting for MUX or SMUX circuit packs includes:

- IN — the line buildout is in use, reducing the output signal strength
- OUT — the line buildout is not in use
- INIT — initialized (unset)

Line Code Type

Specifies the code type for a DS1 port terminating in a DS1 circuit pack, B8ZS or AMI.

Line Layer

The third layer of the standard SONET signal, used for reliable transport of the path layer payload and its overhead across the physical medium. The added overhead is accessed at points where STS signals are formed or terminated. Both lower layers (the photonic and section layers) exist to provide transport for this layer.

Link ID

The location and type of a user interface link.

Literal Character

A letter, digit, or symbol that is entered in a command. The first hyphen in UNIT-{1-64} is a literal character; the braces and the second hyphen are not literal characters.

Location

An identifier for a specific circuit pack, interface module, interface port, or communications link.

Loopback

A circuit arrangement that causes a received signal to be returned to its source.

Loopback State

Specifies the state of a DS1, VT1.5, or STS1 port loopback:

- LPBKL (line loopback) — loops the signal from an input port to the corresponding output port in the same circuit pack by a connection in the circuit pack
- LPBKT (terminal loopback) — loops the signal from an input port to the corresponding output port in the same circuit pack by a cross-connection in the switch module
- LPBKI (internal loopback) — loops the signal from an output port to the corresponding input port of the same circuit pack.

M

M13

A standard format used for DS3 signals, produced by a DS1-to-DS3 multiplexer.

Maintenance Condition

A circuit pack state in which some normal service functions are suspended, either because of a problem or to perform special functions (copy memory) that cannot be performed while normal service is being provided.

Mapped

Cross-connected.

Memory Class

One of two types of memory in the DACS IV-2000: PROG (software release) or DBASE (database).

Memory Data

Specifies the data (eight hexadecimal digits) associated with a memory type.

Memory Location

Specifies the equipment, DS1 interface port, DS3 MUX port, or STS1 SMUX port location associated with a memory type.

Memory Type

Specifies the memory device, which may be:

- WKG — working (system) random access memory
- PRI — primary backup (disk)
- SEC — secondary backup (optical disk).

Menu/Prompt Mode

One of two modes used to communicate with the DACS IV-2000. When operating in this mode, the system lets you choose commands from menus and then prompts you for information to complete the command.

Multiplexer

An electronic device that allows two or more signals to pass over one communications circuit.

Multipoint Address

Specifies the Layer 2 (multipoint) address used on a TABS/TBOS link.

N

N-Rate Cable

A cable that carries an N-rate signal (27.648 Mb/s), which includes 14 DS1 signals, half of an STS-1(cc-SPE) signal, 14 STS-1(VT1.5) signals, or half a DS3 clear-channel signal, and timing information.

Network Element

A DACS IV-2000 frame is an example of a network element.

Notification Code

The notification code for alarm and status conditions, which includes:

- MJ — major alarm
- MN — minor alarm
- NA — indicates no alarm (status only)
- CL — cleared alarm.

NOVAL (no value)

In dialog mode, it indicates that no value is used for this parameter unless you enter one.

O

Out-Of-Service (OOS)

The circuit pack 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 1 second.

Output Mode

Specifies what is being transmitted from a DS1, VT1.5, or STS1 output port. The modes are:

- NORM — normal cross-connected data
- TERM (terminated) — idle code
- AIS — alarm indication signal
- QRSS (quasi-random signal source) — an externally generated DS1 test signal, assumed to be quasi-random.

The initial value is NORM.

P

Parity Check

A check that tests whether the number of ones (or zeros) in an array of binary bits is odd or even, used to determine that the received signal is the same as the transmitted signal.

Path

A logical connection between the point at which a standard frame format for the signal at the given rate is assembled, and the point at which the standard frame format for the signal is disassembled.

Path Layer

The highest of the four layers of a standard SONET signal, used to transport services between path-terminating network elements. Examples of such services include DS1s, DS3s (synchronous and asynchronous), and video signals.

Path Overhead (POH)

Informational bytes assigned to, and transported with, the payload until the payload is demultiplexed.

Payload Pointer

The pointer that shows the location of the beginning of the synchronous payload envelope (SPE).

Phase-locked

A synchronizer is phase-locked to an input timing reference when the clock frequency error and the phase-time error remain within a specified range (depending on the stratum level).

Photonic Layer

The lowest of the four layers in a standard SONET signal, used to convert STS signals and OC (optical carrier) signals.

Poll Timing

Specifies (in seconds) how often the system expects a poll request from a remote telemetry on a TABS/TBOS link.

Port

The point of access on an interface circuit pack that connects the DACS IV-2000 to a DS1, DS3, or STS-1 signal.

Primary Line

The second line in an output message

Protocol

Detailed format and procedures used for transmitting digital data.

Protocol Type

Indicates the protocol supported on an interface link.

Provision

To set parameters to establish the environment required for correct interaction of hardware, software, and peripherals.

Provisioned

The circuit pack is ready to perform its intended function. A provisioned circuit pack can be active (ACT), in-service (IS), standby (STBY), provisioned out-of-service (POS), or out-of-service (OOS).

Pulse Code Modulation (PCM)

The process by which analog signals are sampled, quantized, and coded into a digital bit stream.

Q

Quasi-random Signal Source (QRSS)

Equipment that generates a specific, reproducible but complicated digital test signal that resembles a normal traffic-carrying DS1 signal.

R

Redlined

A circuit that is given special protection against unintentional disconnection.

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.

Return to Zero

A code form having two information states termed zero and one and having a third state or an at-rest condition to which the signal returns during each period.

Roll

Operation used when the transmission facility between the system and an upstream system is to be replaced.

S

Section

The portion of a transmission facility, including terminating points, between:

- a terminal network element and a line-terminating network element, or
- two line-terminating network elements.

A terminating point is the point, after single regeneration, at which performance monitoring is done.

Section Layer

The second of the four levels in a standard SONET signal, used to transport an STS frame across a physical medium. This layer uses the photonic layer to form the physical transport.

Side Switch

The autonomous action taken when the active control complex (CC) fails. A side switch takes up to 5 minutes to complete and switches the standby CC to the active state.

Snider

Protocol (message format) used on administrative links.

Software ID

Number that provides the software version information for the system. The software ID contains:

- a 1-digit number that indicates the software release
- a 2-digit number that indicates the issue
- a 3-digit number that indicates the point release.

Split

Test access state in which an incoming signal is cross-connected to the receiver of a test set rather than to a previously connected output port, and a signal from the transmitter of the test set is cross-connected to the previously connected output port.

Standby

The circuit pack is in service but is not providing service functions. It is ready to be used to replace a similar circuit pack either by protection or by duplex switching

State

The state of a circuit pack indicates whether it is defective or normal (ready for normal use).

Stratum 3 Clock

A clock that has a minimum accuracy of ± 4.6 ppm in the absence of input references. In normal operation, a stratum 3 clock accepts a (1 x 1 protected) synchronization input that is traceable to a primary reference source that has a minimum accuracy of $\pm 1 \times 10^{-11}$.

STSX-1

Digital cross-connect used to interconnect equipment, provide patch capability, and provide test access at the STS-1 level.

STS1 Interface Port

Specifies an STS1 port on an SMUX circuit pack.

STS Envelope Capacity

Bandwidth within, and aligned to, the STS frame that carries the STS SPE.

STS Path Overhead

Nine evenly distributed path overhead bytes per 125 μ s, starting at the first byte of the STS SPE. STS path overhead provides for communications between the point of assembly of an STS SPE and its point of disassembly.

STS Payload Capacity

The maximum bandwidth within the STS SPE that is available for payload.

STS-1 Signal

The basic building block signal in the SONET standard. An STS-1 signal has a data rate of 51.84 Mb/s. An STS-1 signal frame consists of 90 columns and 9 rows of 8-bit bytes, for a total of 810 bytes (6480 bits) for a frame length of 125 μ s. The first three columns of an STS-1 signal are the transport overhead, which contains overhead bytes of section (nine bytes) and line (eighteen bytes) layers. The remaining 87 columns of 9 rows of bytes (783 bytes) make up the STS-1 envelope capacity.

STS Synchronous Payload Envelope (STS SPE)

A 125- μ s frame structure composed of STS path overhead and bandwidth for payload.

STS Transport Overhead

The overhead (informational bytes that contain the line and section overhead) added to the STS SPE for transmission.

Subpart

In the Digital Data System, a data bit rate that is 2.4, 4.8, or 9.6 kb/s.

Synchronous

The essential characteristic of time scales or signals such that their corresponding significant instances occur at precisely the same average rate.

Synchronous Network

The synchronization of transmission systems with synchronous payloads to a master (network) clock that can be traced to a reference clock.

Synchronous Payload

Payloads that can be derived from a network transmission signal by removing integral numbers of bits from every frame; that is, no variable bit-stuffing-rate adjustments are required to fit the payload in the transmission signal.

T

Terminated

Output mode in which idle code is transmitted downstream.

Test Mode

Specifies the test access mode.

Tributary

One of the 28 DS1 (1.544 Mb/s) channels in a DS3 (44.736 Mb/s) signal or one of 28 VT1.5 (1.728 Mb/s) channels in an STS-1 (51.84 Mb/s) signal.

U

User Community Authorization Level (UCAL)

Specifies the user authorization level: 5 identifies a super user (system administrator); 1 identifies an ordinary user.

Unit

An interface module; the term is sometimes used instead of entity or subassembly

Unit Type

Specifies the type of interface module:

- 32DS3 — for DS3 Interface-32 Module
- 16DS3 — for DS3 Interface-16 Module
- 16STS1 — for STS1 Interface-16 Module
- DS1 — for DS1 Interface Module
- DS1P — for DS1 Interface-Protection Module.

V

Virtual Tributary (VT)

A structure designed for transporting and switching some STS-1 payloads.

Volatile Memory

Type of memory that is lost if electrical power to it is interrupted.

VT1.5 Port

Terminates a VT1.5 signal that is part of an STS-1 signal on an SMUX circuit pack.

VT1.5 Tributary

A SONET logical signal with a data rate of 1.728 Mb/s. In the 9-row structure of the STS-1 SPE, a VT1.5 occupies three columns. VT-structured STS-1 SPEs are divided into seven VT groups. Each VT group occupies twelve columns of the 9-row structure and, for VT1.5s, contains four VTs per group.

VT Envelope Capacity

Bandwidth within, and aligned to, the VT Superframe that is available for the VT SPE.

VT Group

A 9-row by 12-column structure (108 bytes) that carries one or more VTs of the same size. Seven VT groups (756 bytes) are byte-interleaved within the VT-organized SPE.

VT Path Overhead

One path overhead byte per 500- μ s located at the first byte of the VT SPE. VT path overhead provides for communication between the point of assembly of the VT SPE and the point of its disassembly.

VT Payload Capacity

The maximum bandwidth within the VT SPE that is available for payload.

VT Superframe

The VT is organized into a 500- μ s superframe structure overlaid on, and aligned to, a 125- μ s STS-1 SPE. Contained within this structure is the VT payload pointer and the VT SPE.

VT Synchronous Payload Envelope (VT SPE)

A 500- μ s frame structure carried by the VT, composed of VT path overhead and bandwidth for payload. The envelope is contained within the VT envelope capacity and can have any alignment with respect to it.

W

Wideband Digital Cross-Connect System (WDCS)

A digital cross-connect system that interfaces any one or combinations of SONET, DS3, and DS1 signals and has the basic functionality of cross-connecting at the floating SONET Virtual Tributary 1.5 (VT1.5) or the DS1 level. A SONET WDCS is a DCS that cross-connects at the VT1.5 level and provides SONET signal multiplexing and termination. A DCS 3/1 is a DCS that cross-connects at the DS1 level and provides DS3 multiplexing and termination.

Wideband Loopback

The connection of a VT1.5 [VT1.5(cc-SPE) or VT1.5(DS1)] tributary from an incoming EC-1 facility to the outgoing direction of the same facility. This type of loopback differs from a line loopback in that the signal being looped-back is not at the line rate, and it is necessary to modify the VT pointer bits to perform the loopback. The DACS IV-2000 implements the wideband loopback as a terminal loopback (the loopback point is in the cross-connect network).

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