Lucent Technologies
Bell Labs Innovations

Lucent Technologies
2000 Product Family

Operations Interworking Guide

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Title: Lucent Technologies 2000 Product Family

Operations Interworking Guide

Identification No.: 824-102-147   Issue No.: 2   Date: July 1997

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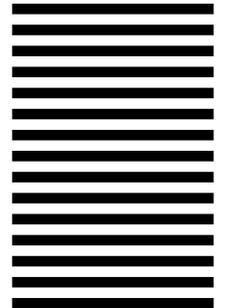Company/Organization: _____ Date: _____

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About This Document

Purpose

This Operations Interworking (OI) guide provides supplementary but necessary information about Lucent Technologies' OI features for the 2000 Product Family systems. It is for anyone planning, using, or maintaining subnetworks containing a mixture of FT-2000, and DDM-2000 OC-3, OC-12, and FiberReach Multiplexers.

Intended Audiences

This OI guide is primarily for system planners, engineers, and craft personnel. However, it may be used by anyone desiring specific information about the features, applications, engineering, and ordering considerations of the 2000 Product Family in order to take advantage of their OI capabilities.

Conventions Used

In this document, the product name "DDM-2000 OC-3" is used to mean DDM-2000 OC-3 Multiplexers and *SLC*®-2000 Access Systems, which can be mixed as required by the network application. The product name "DDM-2000" is used to mean DDM-2000 OC-3 and OC-12 Multiplexers, *SLC*-2000 Access Systems, and DDM-2000 FiberReach. The product name "FT-2000" is used to mean FT-2000 OC-48 Add/Drop-Rings Terminals.

To clarify interface terminology, the terms **single 0x1** and **dual 0x1** have been replaced with the term **ring (0x1) low-speed interface(s)** or simply (0x1). The terms single and dual are used in describing homing topologies. The term **1+1** has been replaced by the term **linear (1+1) low-speed interface(s)** or simply (1+1). See the "Glossary" for definitions of these terms.

Reason for Reissue

This document, Issue 2, replaces the *Lucent Technologies 2000 Product Family, Operations Interworking Guide*, Issue 1.

Changes in this issue are noted by bars (|) in the outside page margin. Major changes include:

- Deletion of transmission and protection switching related information and restructuring of remaining text.

- Inclusion of new software releases:

    — FT-2000 OC-48 Add/Drop Rings Terminals (R7.0, R7.1, R7.2)

    — DDM-2000 OC-12 Multiplexers (R5.1)

    — DDM-2000 OC-3 Multiplexers (R9.1, R11.0 Ring / R8.1 Linear)

    — *SLC*-2000 Access Systems (R3.3 COT / R4.1-R4.4 RT)

    — DDM-2000 FiberReach (R2.1).

Refer to Chapter 1 for the complete list of OI-compatible products and software releases. Non-OI compatible software releases are not included in this document.

Related Documentation

The following documents provide additional information about the Lucent Technologies 2000 Product Family. Documentation is listed in descending order of high-speed transmission rate (OC-48 through OC-1).

FT-2000 OC-48 Lightwave System Documentation

■ Number — 365-575-100

Title — *FT-2000 OC-48 Lightwave System, Applications, Planning, and Ordering Guide*

Audience — System planners and engineers

Content — Features, applications, general description, system planning/ engineering, and ordering information

■ Number — 365-575-101

Title — *FT-2000 OC-48 Lightwave System, Quick Reference Guide*

Audience — End-user maintenance personnel

Content — Abbreviated list of common report commands and a trouble clearing procedure that can be used to clear most trouble

■ Number — 365-575-102

Title — *FT-2000 OC-48 Lightwave System, User/Service Manual*

Audience — Maintenance personnel

Content — Detailed description, technical specifications, commands and reports, and operations and maintenance procedures for the FT-2000

■ Number — 365-575-122

Title — *FT-2000 OC-48 Add/Drop-Rings Terminal Provisioning Job Aid (Releases 4, 5, 6, and 7)*

Audience — End-user maintenance personnel

Content — List of provisionable parameters, original values, options, and the corresponding inputs for the FT-2000 OC-48 Add/Drop-Rings Terminal

■ Number — 365-575-123

Title — *FT-2000 Threshold Crossing Alert (TCA) Parameters Provisioning Job Aid (Releases 4, 5, 6, and 7)*

Audience — End-user maintenance personnel

Content — List of provisionable TCA parameters, original values, and the corresponding inputs for the FT-2000 OC-48 Add/Drop-Rings Terminal

- Number — 824-102-148

  Title — *FT-2000 OC-48 Lightwave System Operations Systems Engineering Guide*

  Audience — Engineers

  Content — Operations systems engineering information for the FT-2000 OC-48 Lightwave System

- Number — Comcode 107559833

  Title — *FT-2000 OC-48 Lightwave System, Software Release Description, Release 6.0.0-RPTR*

  Audience — End-user maintenance personnel

  Content — Status of problems fixed and known problems for Release 6.0.0-RPTR software

  NOTE — The software release descriptions are shipped with the FT-2000 software and are not orderable from the Lucent Technologies Customer Information Center.

- Number — Comcode 107715096

  Title — *FT-2000 OC-48 Lightwave System, Software Release Description, Release 7.0.0-ADR*

  Audience — End-user maintenance personnel

  Content — Status of problems fixed and known problems for Release 7.0.0-ADR software

- Number — Comcode 107741787

  Title — *FT-2000 OC-48 Lightwave System, Software Release Description, Release 6.0.2-ADR*

  Audience — End-user maintenance personnel

  Content — Status of problems fixed and known problems for Release 6.0.2-ADR software

- Number — Comcode 107743437

  Title — *FT-2000 OC-48 Lightwave System, Software Release Description, Release 7.1.0-ADR*

  Audience — End-user maintenance personnel

  Content — Status of problems fixed and known problems for Release 7.1.0-ADR software

■ Number — MIP0030-MV

Title — *Modification Implementation Procedure 0030-MV, FT-2000 End Terminal to 2-Fiber Add/Drop-Rings Terminal Out-of-Service Upgrade*

Audience — Regional Technical Assistance Center (RTAC), Installers, Engineers, and Planners

Content — Procedures for upgrading out-of-service FT-2000 OC-48 1x1 End Terminals to FT-2000 OC-48 Add/Drop-Rings Terminals for 2-Fiber Rings

■ Number — MIP0036-MV

Title — *Modification Implementation Procedure 0036-MV, FT-2000 End Terminal to 2-Fiber Add/Drop-Rings Terminal In-Service Upgrade*

Audience — RTAC, Installers, Engineers, and Planners

Content — Procedures for transferring service off an in-service FT-2000 OC-48 1x1 End Terminal in preparation for the MIP0030-MV out-of-service upgrade to be performed

■ Number — MIP0046-MV

Title — *Modification Implementation Procedure 0046-MV, FT-2000 Add/ Drop Ring Terminal DCC Cable Upgrade*

Audience — RTAC, Installers, Engineers, Planners

Content — Convert an in-service FT-2000 OC-48 ADR Terminal J68974, L3 or equivalent to an ADR Terminal with OC-3 Data Communications Channel (DCC) capability, J68974, L5 or equivalent

DDM-2000 OC-12 Multiplexers Documentation

■ Number — 363-206-208

Title — *DDM-2000 OC-12 Multiplexer Installation Manual*

Audience — Customers planning to install the equipment

Content — Customer installation instructions

■ Number — 363-206-220

Title — *DDM-2000 OC-3/OC-12 Multiplexer Circuit Pack Options Job Aid*

Audience — Maintenance personnel

Content — List of circuit pack options

- Number — 363-206-222

  Title — *DDM-2000 OC-3/OC-12 Multiplexer Acceptance Task List Job Aid*

  Audience — Maintenance personnel

  Content — Check list of acceptance and turnup procedures

- Number — 363-206-290

  Title — *DDM-2000 OC-12 Multiplexer User/Service Manual, Volumes I and II*

  Audience — Maintenance personnel

  Content — Detailed description, technical specifications, commands and reports (Volume I), and operations and maintenance procedures (Volume II) for DDM-2000 OC-12 Multiplexer Release 5.0

- Number — 363-206-291

  Title — *DDM-2000 OC-12 Multiplexers — System Commands Quick Reference*

  Audience — Maintenance personnel

  Content — Abbreviated list of system commands and parameters for DDM-2000 OC-12 Multiplexer Release 5.0

- Number — 824-102-151

  Title — *DDM-2000 Multiplexers Operations Systems Engineering Guide*

  Audience — Engineers

  Content — Operations systems engineering information for the DDM-2000 OC-3, OC-12, and FiberReach Multiplexers

DDM-2000 OC-3 Multiplexers Documentation

- Number — 363-206-201

  Title — *DDM-2000 OC-3 Multiplexer, System Commands Quick Reference*

  Audience — Maintenance personnel

  Content — Abbreviated list of system commands and parameters for DDM-2000 OC-3 Multiplexers through Release 7.2

- Number — 363-206-202

  Title — *DDM-2000 OC-3 Multiplexer User/Service Manual, Volumes I and II*

  Audience — Maintenance personnel

  Content — Detailed description, technical specifications, commands and reports (Volume I), and operations and maintenance procedures (Volume II) for DDM-2000 OC-3 Multiplexers through Release 7.2

- Number — 363-206-204

  Title — *DDM-2000 OC-3 Multiplexer Installation Manual*

  Audience — Customers planning to install the equipment

  Content — Customer installation instructions

- Number — 363-206-220

  Title — *DDM-2000 OC-3/OC-12 Multiplexer Circuit Pack Options Job Aid*

  Audience — Maintenance personnel

  Content — List of circuit pack options

- Number — 363-206-222

  Title — *DDM-2000 OC-3/OC-12 Multiplexer Acceptance Task List Job Aid*

  Audience — Maintenance personnel

  Content — Checklist of acceptance and turnup procedures

- Number — 363-206-280

  Title — *DDM-2000 OC-3 Multiplexer User/Service Manual, Volumes I and II*

  Audience — Maintenance personnel

  Content — Detailed description, technical specifications, commands and reports (Volume I), and operations and maintenance procedures (Volume II) for DDM-2000 OC-3 Multiplexer Releases 8.0 and 9.0

- Number — 363-206-281

  Title — *DDM-2000 OC-3 Multiplexers — System Commands Quick Reference*

  Audience — Maintenance personnel

  Content — Abbreviated list of system commands and parameters for DDM-2000 OC-3 Multiplexer Releases 8.0 and 9.0

- Number — 824-102-151

  Title — DDM-2000 Multiplexers Operations Systems Engineering Guide

  Audience — Engineers

  Content — Operations systems engineering information for the DDM-2000 OC-3, OC-12, and FiberReach Multiplexers

SLC®-2000 Access System Documentation

■ Number — 363-205-004,

Title — *SLC-2000 Multi-Services Distant Terminal (MSDT) Feature, User/Service and Ordering Manual*

Audience — Engineers, network planners, product evaluators, standardization groups, installers, administrators, operation and maintenance personnel, and technical support

Content — Applications, physical and functional description, administration, powering, technical specifications, construction and installation, operation and maintenance [in task-oriented practices (TOP) format], and ordering information

■ Number — 363-208-000

Title — *SLC-2000 Access System, Applications, Planning, and Ordering Guide*

Audience — Network planners, engineers, product evaluators, standardization groups, and ordering personnel

Content — Benefits and features, applications, services, product description, parts list, ordering information, system specifications and requirements, and environmental data. Refer to the customer assembly manual for ordering configurations for central office and remote terminal frame arrangements

■ Number — 363-208-001

Title — *SLC-2000 Access System, User/Service Manual*

Audience — Installers, technicians, engineers, and troubleshooters

Content — System overview, description, introduction to each system interface, administration and provisioning, operations and maintenance procedures (TOP format), and maintenance support information (alarm tables, etc.)

■ Number — 363-208-010

Title — *SLC-2000 Access System, Customer Assembly Manual for RT Frames*

Audience — Customers that plan to install the equipment.

Content — Configuration drawings and detailed instructions for ordering, installing, assembling, and connecting the equipment in a remote terminal (RT) frame arrangement. This document includes installation procedures, cabling and wiring diagrams, the application schematic diagrams (SDs), a parts list, and supporting information. Shelf assembly, cable routing, and frame installation are provided

- Number — 363-208-011

  Title — *SLC-2000 Access System, Customer Assembly Manual for COT Frames*

  Audience — Customers that plan to install the equipment.

  Content — Configuration drawings and detailed instructions for ordering, installing, assembling, and connecting the equipment in a central office terminal (COT) frame arrangement. This document includes installation procedures, cabling and wiring diagrams, the application schematic diagrams (SDs), a parts list, and supporting information. Shelf assembly, cable routing, and frame installation are provided.

- Number — 363-208-022, Issue 4

  Title — *SLC-2000 Access System, Software Release Description — Release 3.02.00*

  Audience — Installers, technicians, engineers, and troubleshooters.

  Content — Provides information about the software release and procedures for implementation. Describes the features and capabilities provided in the release. Lists operating issues from the previous release that have been resolved, the operating issues in this release, and any work-around.

- Number — 363-208-022, Issue 5

  Title — *SLC-2000 Access System, Software Release Description — Release 3.03.00*

  Audience — Installers, technicians, engineers, and troubleshooters

  Content — Provides information about the software release and procedures for implementation. Describes the features and capabilities provided in the release. Lists operating issues from the previous release that have been resolved, the operating issues in this release, and any work-around.

- Number — 363-208-023, Issue 2

  Title — *SLC-2000 Access System, Software Release Description — Release 4.00.02*

  Audience — Installers, technicians, engineers, and troubleshooters

  Content — Provides information about the software release and procedures for implementation. Describes the features and capabilities provided in the release. Lists operating issues from the previous release that have been resolved, the operating issues in this release, and any work-around.

■ Number — 363-208-024, Issue 1

Title — *SLC-2000 Access System, Software Release Description — Release 4.01.00*

Audience — Installers, technicians, engineers, and troubleshooters

Content — Provides information about the software release and procedures for implementation. Describes the features and capabilities provided in the release. Lists operating issues from the previous release that have been resolved, the operating issues in this release, and any work-around.

■ Number — 363-208-024, Issue 3

Title — *SLC-2000 Access System, Software Release Description — Release 4.02.00*

Audience — Installers, technicians, engineers, and troubleshooters

Content — Provides information about the software release and procedures for implementation. Describes the features and capabilities provided in the release. Lists operating issues from the previous release that have been resolved, the operating issues in this release, and any work-around.

■ Number — 363-208-025, Issue 1

Title — *SLC-2000 Access System, Software Release Description — Release 4.03.00*

Audience — Installers, technicians, engineers, and troubleshooters

Content — Provides information about the software release and procedures for implementation. Describes the features and capabilities provided in the release. Lists operating issues from the previous release that have been resolved, the operating issues in this release, and any work-around.

■ Number — 363-208-026, Issue 1

Title — *SLC-2000 Access System, Software Release Description — Release 4.04.00*

Audience — Installers, technicians, engineers, and troubleshooters

Content — Provides information about the software release and procedures for implementation. Describes the features and capabilities provided in the release. Lists operating issues from the previous release that have been resolved, the operating issues in this release, and any work-around.

■ Number — 824-102-149

Title — *SLC-2000 Access System, Operations Systems Engineering Guide*

Audience — Installers, technicians, engineers, and troubleshooters

Content — Provides detailed information about the operating ststem (OS) interface to the *SLC*-2000 Access System (how the systems communicate with each other) for engineering an OS.

DDM-2000 FiberReach Documentation

■ Number — 363-206-300

Title — *DDM-2000 FiberReach Applications, Planning, and Ordering Guide*

Audience — Network planners, equipment engineers, and sales teams

Content — Features, applications, high-level description, operations, administration, maintenance, and provisioning (OAM&P), system planning, ordering, product support, reliability information, technical specifications, and a synchronous optical network (SONET) overview

■ Number — 363-206-301

Title — *DDM-2000 FiberReach User/Service Manual*

Audience — Maintenance personnel

Content — Detailed description, technical specifications, and operations and maintenance procedures for the DDM-2000 FiberReach Multiplexer

■ Number — 363-206-310

Title — *DDM-2000 FiberReach Installation Manual*

Audience — Users planning to install the equipment

Content — Customer installation instructions

■ Number — 824-102-151

Title — DDM-2000 Multiplexers Operations Systems Engineering Guide

Audience — Engineers

Content — Operations systems engineering information for the DDM-2000 OC-3, OC-12, and FiberReach Multiplexers

Related Equipment Documentation

- Number — 363-205-000

    Title — *SLC Series 5 Carrier System Ordering Guide — Loop Transmission Systems* (to be replaced by 363-205-010)

- Number — 363-205-010

    Title — *SLC Series 5 System Applications and Planning Guide*

- Number — 626-500-105

    Title — *80-type Cabinets Ordering Information and Lettering Guide*

- Number — 626-500-115

    Title — *90-type Cabinets Coding and Ordering Information*

- Number — 065-215-200

    Title — *Seismic Network Bay Frame Application, Planning, and Ordering Guide*

- Number — 065-215-250

    Title — *Seismic Network Bay Frame Installation Guide*

- Number — 190-523-101

    Title — *SNC-2000 CPro User Manual Release 3.0*

- Number — 365-576-1x0

    Title — *CPro-2000 User Manual*

- Number — 365-331-000

    Title — *DACS III-2000 Release 2.0 Applications, Planning, and Ordering Guide*

- Number —107564270

    Title — *ITM SNC Users Guide*

    Audience — Operations Personnel

    Content — Integrated Transport Management Subnetwork Controller information

- Number — 365-340-004

    Title — *DACS IV-2000 Release 2.1 Reference Manual*

- Number — 365-301-130

    Title — *System III DSX-3/4, Planning, Engineering, Installation, and Operation System Reference Guide*

- Number — 365-303-102

  Title — *DSX-3 Cross-Connect Bay, Description, Operation, and Maintenance Manual*

- Number — 636-299-120

  Title — **LGX**® *Distribution System, Planning, Engineering, Installation, and Operation System Reference Guide*

- Number — 365-565-500

  Title — *Digital Transmission Systems, FT-Lightwave Booster Amplifier, Description, Engineering, Installation, and Maintenance Manual*

- Number — 363-206-150

  Title — *DDM-Plus User/Service Manual*

- Number — 363-206-151

  Title — *DDM-Plus Installation Manual*

- Number — 363-206-152

  Title — *DDM-Plus Quick Reference Guide*

- Number — 363-206-156

  Title — *DDM-Plus Equipment Engineering and Ordering Guide*

- Number — 363-206-157

  Title — *DDM-Plus Wall DT Installation Manual*

- Number — 365-303-102

  Title — *DSX-3 Cross-Connect Bay, Description, Operation, and Maintenance Manual*

- Number — 365-301-130

  Title — *System III DSX-3/4, Planning, Engineering, Installation, and Operation — System Reference Guide*

- Number — 365-331-000

  Title — *DACS III-2000 Release 2.0 Applications, Planning, and Ordering Guide*

- Number — 365-340-004

  Title — *DACS IV-2000 Release 2.1 Reference Manual*

- Number — 365-575-100

  Title — *FT-2000 OC-48 Lightwave System Applications, Planning, and Ordering Guide*

- Number — 636-299-120

  Title — *LGX*® *Distribution System, Planning, Engineering, Installation, and Operation System Reference Guide*

- Title — **MegaStar*** 2000 Documents

  Comcode 107585648   Installation Manual

  Comcode 407397512   Schematic Package

  Comcode 107585655   Reference Manual

  Comcode 107585671   System Application Manual

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*   Registered trademark of Harris Corporation.

Related Drawings

FT-2000 OC-48 Drawings

J68974AK-1	FT-2000 OC-48 Lightwave Terminating Bay (Circuit Packs, Miscellaneous Hardware, and Spare Parts Shipped Separately from Equipment)
J68974E-1	FT-2000 OC-48 Enhanced Lightwave Terminating Bay (Equipment and Circuit Packs Ordered with Equipment)
J68974EK-1	FT-2000 OC-48 Enhanced Lightwave Terminating Bay (Circuit Packs, Miscellaneous Hardware, and Spare Parts Shipped Separately from Equipment)
J68974ES-1	FT-2000 OC-48 Enhanced Lightwave Terminating Bay (Software and Documentation)
J68974R-1	FT-2000 OC-48 Lightwave Repeater Bay (Equipment and Circuit Packs Ordered with Equipment)
J68974RK-1	FT-2000 OC-48 Lightwave Repeater Bay (Circuit Packs, Miscellaneous Hardware, and Spare Parts Shipped Separately from Equipment)
J68974RS-1	FT-2000 OC-48 Lightwave Repeater Bay (Software and Documentation)
SD-5G250-01	FT-2000 OC-48 Lightwave Terminating Bay Application Schematic
SD-5G250-02	FT-2000 OC-48 Enhanced Lightwave Terminating Bay Application Schematic
SD-5G252-01	FT-2000 OC-48 Lightwave Repeater Bay Application Schematic
T-5G250-31	FT-2000 Lightwave Transmission System OC-48 Lightwave Terminating Bay Interconnect Circuit
T-5G250-33	FT-2000 Lightwave Transmission System OC-48 Enhanced Lightwave Terminating Bay Interconnect Circuit
T-5G252-31	FT-2000 Lightwave Transmission System OC-48 Lightwave Repeater Bay Interconnect Circuit
ED-6G994-30	User/Filter Panel
ED-6G995-30	High-Speed Shelf Assembly
ED-6G995-31	Enhanced High-Speed Shelf Assembly
ED-6G999-30	Low-Speed Shelf Assembly
ED-6G999-31	Low-Speed Shelf Assembly
ED-7G000-30	Repeater Shelf Assembly
ED-7G001-10	Method of Cabling for ED-7G001-30 OC-48 Lightwave Terminating Bay

ED-7G001-11   Method of Cabling for ED-7G001-31 OC-48 Enhanced Lightwave Terminating Bay

ED-7G001-20   Cable Assemblies for ED-7G001-30 OC-48 Lightwave Terminating Bay

ED-7G001-24   Cable Assemblies for ED-7G001-31 OC-48 Enhanced Lightwave Terminating Bay

ED-7G001-21   FT-2000 OC-48 Coaxial Cable Assemblies for All EC-1/DS3 Applications (Intraoffice Transmission Cables)

ED-7G001-22   FT-2000 OC-48 Interbay Cable Assemblies (Intra-office Non-Transmission Cables)

ED-7G001-30   FT-2000 Lightwave Transmission System OC-48 Lightwave Terminating Bay Framework

ED-7G001-31   FT-2000 Lightwave Transmission System OC-48 Enhanced Lightwave Terminating Bay Framework

ED-7G002-10   Method of Cabling for ED-7G002-30 OC-48 Lightwave Repeater Bay

ED-7G002-30   FT-2000 Lightwave Transmission System OC-48 Lightwave Repeater Bay Framework

ED-8C500-50   Network Bay Frame

ED-8C800-50   Seismic Network Bay Frame

FPD 804-911-168-1   FT-2000 Lightwave Transmission System OC-48 Lightwave Terminating Bay (with 2 Active Shelves)

FPD 804-911-168-2   FT-2000 Lightwave Transmission System OC-48 Lightwave Terminating Bay (with 3 Active Shelves)

FPD 804-911-168-3   FT-2000 Lightwave Transmission System OC-48 Enhanced Lightwave Terminating Bay with 2 Active Shelves on Nonseismic Framework

FPD 804-911-168-4   FT-2000 Lightwave Transmission System OC-48 Enhanced Lightwave Terminating Bay with 3 Active Shelves on Nonseismic Framework

FPD 804-911-168-5   FT-2000 Lightwave Transmission System OC-48 Enhanced Lightwave Terminating Bay with 2 Active Shelves on Seismic Framework

FPD 804-911-168-6   FT-2000 Lightwave Transmission System OC-48 Enhanced Lightwave Terminating Bay with 3 Active Shelves on Seismic Framework

FPD 804-911-168-10   FT-2000 Lightwave Transmission System OC-48 Repeater Bay with 1 Active Shelf on Nonseismic Framework

FPD 804-911-168-11   FT-2000 Lightwave Transmission System OC-48 Repeater Bay with 2 Active Shelves on Nonseismic Framework

FPD 804-911-168-12   FT-2000 Lightwave Transmission System OC-48 Repeater Bay with 3 Active Shelves on Nonseismic Framework

FPD 804-911-168-13   FT-2000 Lightwave Transmission System OC-48 Repeater Shelf Miscellaneously Mounted

FPD 804-911-168-14   FT-2000 Lightwave Transmission System OC-48 Repeater Bay with 1 Active Shelf on Seismic Framework

FPD 804-911-168-15   FT-2000 Lightwave Transmission System OC-48 Repeater Bay with 2 Active Shelves on Seismic Framework

FPD 804-911-168-16   FT-2000 Lightwave Transmission System OC-48 Repeater Bay with 3 Active Shelves on Seismic Framework.

DDM-2000 OC-12 Drawings

ED-8C724-10   OC-3 and OC-3/OC-12 Combined Bay Arrangements
ED-8C727-10   Typical Bay Arrangements
ED-8C727-15   Cabling Plan (Rear Access)
ED-8C727-16   Cabling Plan (Front Access)
ED-8C727-20   Cable Assemblies
ED-8C727-21   Cable Assemblies
ED-8C727-30   Shelf Assembly
ED-8C727-31   User Panel Assembly
ED-8C727-36   DDM-2000 OC-12 Release 5 Software Ordering
SD-7C513-01   Application Schematic
T7C513-31   Interconnect Wiring Diagram (Rear Access)
T7C513-32   Interconnect Wiring (Front Access)
801-525-168   Floor Plan Data Sheets

DDM-2000 OC-3 Drawings

ED-8C724-10   OC-3 and OC-3/OC-12 Combined Bay Arrangements
ED-8C724-15   Cabling Plan (Rear Access)
ED-8C724-16   Cabling Plan (Front Access)
ED-8C724-20   Cable Assemblies
ED-8C724-21   Cable Assemblies
ED-8C724-22   Cable Assemblies
ED-8C724-30   DDM-2000 Shelf Assembly
ED-8C724-31   User Panel Assembly
ED-8C724-34   Releases 2 and 3 Software Ordering
ED-8C724-36   Release 5 Software Ordering
ED-8C724-37   Release 6 Software Ordering

ED-8C724-10   OC-3 and OC-3/OC-12 Combined Bay Arrangements
ED-8C724-38   Release 7 Software Ordering
ED-8C724-39   Release 8 Software Ordering
ED-8C724-40   Release 9 Software Ordering
ED-8C724-41   Release 11 Software Ordering
ED-8C733-30   Fan, Filter, and Baffle Assemblies
SD-7C510-01   Application Schematic
T7C510-31   Interconnect Wiring (Rear Access)
T7C510-32   Interconnect Wiring (Front Access)
801-525-168   Floor Plan Data Sheets

SLC®-**2000 Access System Drawings**

Not Available.

DDM-**2000 FiberReach Drawings**

ED-8C762-20   DDM-2000 FiberReach Cable Assemblies
ED-8C762-30   DDM-2000 FiberReach Wideband Shelf
ED-8C778-30   DDM-2000 FiberReach Narrowband Shelf (Omaha)
ED-8C843-30   DDM-2000 FiberReach Wideband Shelf Assembly
               equipped with 1 or 2 Wideband Shelves
ED-8C785-30   DDM-2000 FiberReach Narrowband Shelf
ED-8C843-31   DDM-2000 FiberReach Wall DT Unit
ED-8C843-32   DDM-2000 FiberReach *LGX*® Panel
ED-8C843-33   DDM-2000 FiberReach Release 1 Software
ED-8C843-34   DDM-2000 FiberReach Release 2 Software
ED-8C852-30   DDM-2000 DS1 Interconnect Panel
ED-7C516-01   Application Schematic

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Introduction

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Overview

This chapter provides an introduction to 2000 Product Family Operations Interworking (OI) and gives brief descriptions of the individual OI features supported by each of the 2000 Product Family products.

Early system applications of 2000 Product Family network elements (NEs) were compatible for transmission but not necessarily for data communications channel (DCC) and OI communications in all cases. With current systems, the Synchronous Optical Network (SONET) frame provides the necessary elements to allow different products to share a common operations communications link. This communication link uses the section overhead bytes (the DCC) to make 2000 Product Family OI a reality.

OI is available among different 2000 Product Family systems that are connected through optical interfaces. OI enables the interconnection and remote access of 2000 Product Family NEs using the Synchronous Optical Network (SONET) DCC and the X.25 data communications network (DCN) for the operations communications network.

The OI features provide operations support from a single location to remote 2000 Product Family NEs that are in the same SONET subnetwork (a subnetwork consists of a group of SONET NEs with DCC connectivity among the NEs). With this capability you can perform operations, administration, maintenance, and provisioning (OAM&P) on a centralized basis, helping to save you travel time and money.

OI Features

OI features include:

- Remote Craft Access: American Standard Code for Information Interchange (ASCII) Craft Interface Terminal (CIT) remote login

- Remote Operations System (OS) Access: Transaction Language 1 (TL1)/ X.25 Gateway Network Element (TL1-GNE)

- Remote NE Status Features:

    — Remote Office Alarms

    — Remote User Panel Status

    — Remote Alarm Craft Interface Terminal (CIT) Reports

    — Remote Telemetry Byte-Oriented Serial (TBOS) Interface

    — Remote Parallel Telemetry Interface

    — Remote Miscellaneous Discretes via parallel telemetry

- Remote Software Download.

OI Compatibility

OI features should be coordinated between products and software releases (refer to Table 2-1 on page 2-2). NEs that support OI include:

- FT-2000 OC-48 Add/Drop-Rings Terminals (R6.0 - R7.2)

- DDM-2000 OC-12 Multiplexers (R5.0 - R5.1)

- DDM-2000 OC-3 Multiplexers
(Ring: R7.2 - R9.1 & R11.0 / Linear: R8.0 - R8.1)

- *SLC*®-2000 Access Systems
(Central Office Terminal: R3.2 - R3.3 / Remote Terminal: R4.0 - R4.4)

- DDM-2000 FiberReach (R2.1).

Compatibility

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Compatibility

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Overview

This chapter provides engineering information and guidance that must be considered when planning subnetworks that include a combination of different 2000 Product Family network elements (NEs). Use this information in conjunction with the system planning and engineering information in the *Applications, Planning and Ordering Guide*s associated with the specific 2000 Product Family products in the subnetwork being planned. Ordering information for these documents is located in the "About this Document" chapter of this document.

Software Compatibility

The software version guidelines in Table 2-1 must be followed to ensure proper subnetwork Operations Interworking (OI):

Table 2-1.   2000 Product Family Compatibility

Product/Release	DDM-2000 OC-3						DDM-2000 OC-12	
	7.2	8.0	8.1	9.0	9.1	11.0	5.0	5.1
FiberReach, R2.1	X*	X*			X	X		X*
SLC®-2000, R3.2				X		X		
SLC-2000, R3.3	X	X	X	X	X	X	X	X
SLC-2000, R4.2	X			X			X	
SLC-2000, R4.3	X			X			X	
SLC-2000, R4.4	X			X	X	X		X
DDM-2000 OC-3, R7.2	X	X	X	X	X	X	X	X
DDM-2000 OC-3, R8.0	X	X		X	X	X	X	X
DDM-2000 OC-3, R8.1	X		X	X			X	
DDM-2000 OC-3, R9.0	X	X	X	X			X	
DDM-2000 OC-3, R9.1	X	X			X		X	X
DDM-2000 OC-3, R11.0	X	X				X		X
DDM-2000 OC-12, R5.0	X	X	X	X	X		X	
DDM-2000 OC-12, R5.1	X	X			X	X		X
FT-2000, R6.0†	X	X		X			X	
FT-2000, R7.0	X	X	X	X	X		X	X
FT-2000, R7.1‡	X	X			X	X		X
FT-2000, R7.2‡	X	X			X	X		X

∗   FiberReach requires a DDM-2000 OC-3 Release 9.0 or later host;
    DDM-2000 OC-3 Releases 7.2 and 8.x cannot host FiberReach.
†   Supports operations interworking (OI) with OC-3 data communications channel (DCC).
‡   Supports OI with OC-12 DCC, also.

Graphical User Interface and Provisioning Tools

It is recommended that a graphical user interface and provisioning tool (CPro-2000 or ITM SNC) be used to simplify and mechanize administration, maintenance, and provisioning operations for ring networks, especially when dealing with multiproduct subnetworks. Table 2-2 indicates which tool can be used for the NEs in a subnetwork. For more information, refer to 365-576-1x0, *CPro-2000 User Manual*, or 107-564-270, *ITM SNC User's Guide.*

Table 2-2.   Network Element Management Software Compatibility

Product/Release	CPro-2000				ITM SNC			
	3.0	4.0	5.0	6.0	2.1	2.2	3.0	4.0
FiberReach, R2.1			X	X		X	X	X
SLC®-2000, R3.2								
SLC-2000, R3.3	X	X	X	X	X	X	X	X
SLC-2000, R4.2		X	X	X	X			
SLC-2000, R4.3								
SLC-2000, R4.4			X	X		X	X	X
DDM-2000 OC-3, R7.2	X	X	X	X	X	X	X	X
DDM-2000 OC-3, R8.0		X	X	X	X	X	X	X
DDM-2000 OC-3, R8.1			X	X			X	X
DDM-2000 OC-3, R9.0	X	X	X	X	X	X	X	X
DDM-2000 OC-3, R9.1			X	X		X	X	X
DDM-2000 OC-3, R11.0				X				X
DDM-2000 OC-12, R5.0	X	X	X	X	X	X	X	X
DDM-2000 OC-12, R5.1			X	X		X	X	X
FT-2000, R6.0	X	X	X	X	X	X	X	X
FT-2000, R7.0		X	X	X	X	X	X	X
FT-2000, R7.1				X			X	X
FT-2000, R7.2				X			X	X

Data Communications Channel (DCC) Topology Guidelines

The following subnetwork topologies support the Synchronous Optical Network (SONET) DCC OI feature:

- A Bidirectional Line Switched Ring (BLSR) is supported at the OC-48 rate using FT-2000. Connections to other nodes of the subnetwork are through the low-speed OC-3/IS-3 interfaces or OC-12 interfaces for FT-2000 OC-48 R7.1 and R7.2.

- A Path Switched Ring (PSR) is supported at the OC-12 rate using DDM-2000 OC-12 or DDM-2000 OC-3 R11.0. Connections to other nodes of the subnetwork are through the low-speed OC-3/IS-3 interfaces or OC-1 interfaces for DDM-2000 OC-3 R11.0.

- A PSR is supported at the OC-3 rate using DDM-2000 OC-3. Connections to other nodes of the subnetwork are through the low-speed OC-3/IS-3 interfaces or OC-1 interfaces for DDM-2000 OC-3 R9.0, R9.1, and R11.0.

- A PSR is supported at the OC-1 rate using DDM-2000 FiberReach. Connections to other nodes of the subnetwork are through the OC-1 interfaces to the DDM-2000 OC-3 R9.0, R9.1, and R11.0 host shelf.

- Linear OC-3 applications, such as Point to Point, Hubbing and Add/Drop, are supported. Connections to other nodes of the subnetwork are through the main and low-speed OC-3/IS-3 interfaces.

- FT-2000 BLSR directly interworks with DDM-2000 OC-3 PSR, DDM-2000 OC-12 PSR, and with DDM-2000 OC-3 linear applications.

- DDM-2000 OC-12 or DDM-2000 OC-3 R11.0 OC-12 PSR directly inter-works with DDM-2000 OC-3 PSR, FT-2000 BLSR, and with DDM-2000 OC-3 linear applications.

- DDM-2000 OC-3 PSR directly interworks with DDM-2000 OC-12 or DDM-2000 OC-3 R11.0 OC-12 PSR, FT-2000 BLSR, DDM-2000 OC-3 linear applications, and DDM-2000 FiberReach OC-1 PSR.

- DDM-2000 FiberReach OC-1 PSR directly interworks with DDM-2000 OC-3 and DDM-2000 OC-3 R11.0 OC-12 PSR applications.

For the subnetwork to work properly, the activities at both ends of any multiproduct span must be locally planned and coordinated. If alarms can be ignored for an extended period, the work at each end of the span can be completed at different times and/or by different technicians. Assuming that no mistakes are made, network alarms will clear in a short time following the completion of work at both ends. Once the DCC has been established, the technician may remotely communicate with all NEs in a subnetwork.

DCC Limit Considerations

The number of low-speed (LS) DCCs supported simultaneously by a 2000 Product Family NE depends on the product type, the product's software release, and the DCC type (ring [0X1] or linear [1+1]). These limits are summarized in Table 2-3.

Table 2-3. Maximum Number of Low-Speed Data Communications Channels (DCCs) per NE

Product type	Software Release	Max. No. Simultaneous LS - DCCs	DCC type
DDM-2000 OC-3	7.2	2	Linear (1+1) OC-3
DDM-2000 OC-3	8.0,8.1	3	Linear (1+1) OC-3
DDM-2000 OC-3	9.0,9.1, 11.0	3	Linear (1+1) OC-3
		12	Ring (0X1) OC-1
SLC®-2000 Access System	3.2-4.4 w/ DDM-2000 OC-3 R7.2, 9.0, 9.1, 11.0	1	Linear (1+1) OC-3
	3.2-4.4 w/ DDM-2000 OC-3 R9.0, 9.1, 11.0	4	Ring (0X1) OC-1
DDM-2000 OC-12	5.0,5.1	4	Linear (1+1), OC-3
		8	Unprotected Ring (0X1) OC-3
		4	Protected Ring (0X1) OC-3
FT-2000 OC-48	6.0-7.0	8	OC-3 1+1* Protected Mode
		8	OC-3 0X1 Operating Mode
FT-2000 OC-48	7.1	8	OC-3 1+1* Protected Mode
		8	OC-3/OC-12 0X1 Operating Mode
FT-2000 OC-48	7.2	8	OC-3/OC-12 1+1* Protected Mode
		8	OC-3/OC-12 0X1 Operating Mode

* Slots must be paired (for example, 1a-1b), and each slot must be provisioned to be 1+1 Protected

For FT-2000 to access the OC-3 DCC, one or more OC-3 low-speed circuit packs (provisioned for 1+1 or 0x1 extension) and the Tributary Overhead Controller (TOHCTL) are required. The TOHCTL can terminate up to eight OC-3 DCCs. FT-2000 supports the OC-12 DCC beginning with FT-2000 R7.1.

Interface requirements and compatibilities for these interconnections are summarized in Table 2-4:

Table 2-4. **Synchronous Optical Network (SONET) Optical Interface Requirements for Data Communications Channel (DCC) Communication**

	FT-2000	DDM-2000 OC-12	DDM-2000 OC-3	DDM-2000 FiberReach OC-1
FT-2000	OC-48 OC-12* OC-3/IS-3	OC-12* OC-3/IS3	OC-12*† OC-3/IS3	
DDM-2000 OC-12	OC-12* OC-3/IS-3	OC-12 OC-3/IS3	OC-12† OC-3/IS3	
DDM-2000 OC-3	OC-12*† OC-3/IS-3	OC-12† OC-3/IS3	OC-12† OC-3/IS3	OC-1‡
DDM-2000 FiberReach OC-1			OC-1‡	OC-1

* FT-2000 OC-48 R7.1 and higher is required for an OC-12 interface to the FT-2000.
† DDM-2000 OC-3 R11.0 is required to allow an OC-3 shelf to support an OC-12 ring.
‡ DDM-2000 OC-3 R9.0 and higher is required for an OC-1 interface to the DDM-2000 FiberReach.

DCC Protection Guidelines

Figure 2-1 shows examples of the protection guidelines described in the following text:
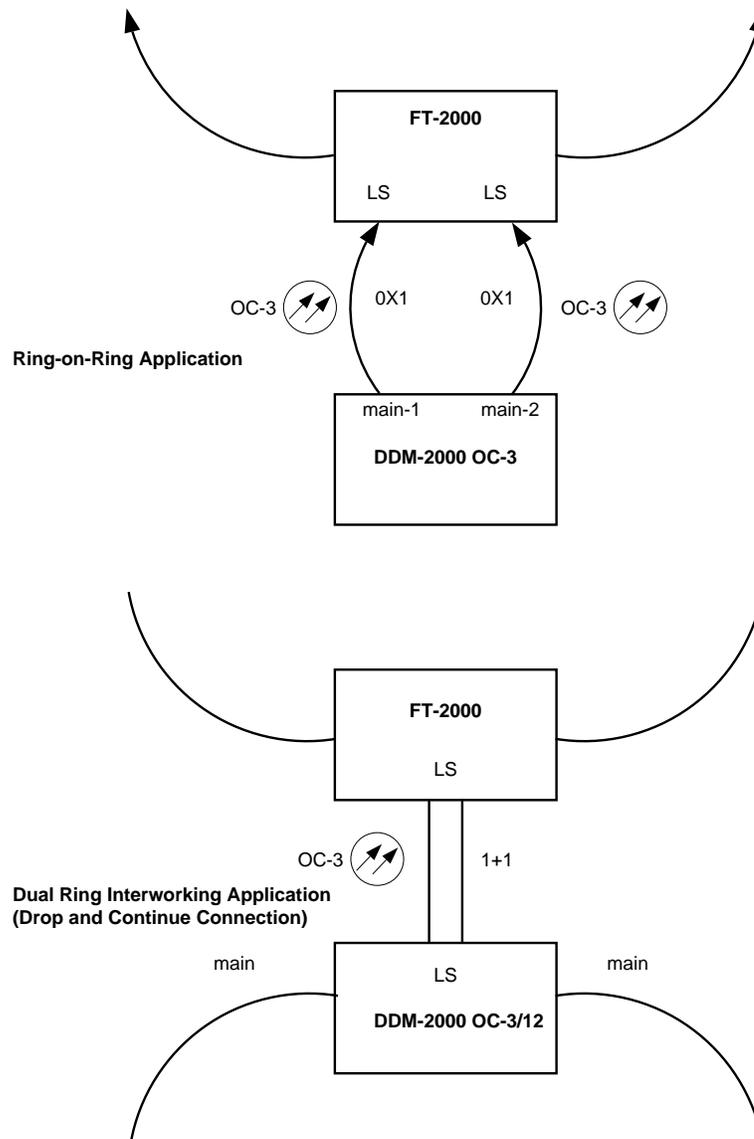

Figure 2-1.   DCC Protection Guidelines for Interworking Rings.

On linear (1+1) optical interfaces, the DCC is protected by transmission line protection.

On ring (0X1) optical interfaces, since there is no line protection switching, DCC redundancy is achieved by using two ring (0X1) optical interfaces.

For proper subnetwork communications using DCC, the protection mode (1+1 or 0x1) of the interfaces of the first shelf must agree with the protection mode of the interfaces of the connecting shelf. The low-speed OC-3 interfaces of a DDM-2000 OC-3 only supports linear (1+1) protection mode, therefore, no protection mode provisioning is necessary. The low-speed OC-1 interfaces of a DDM-2000 OC-3 only supports ring (0x1) protection mode, therefore, no protection mode provisioning is necessary. (Refer to Table 2-3.) Where the user has a choice, manual provisioning of the protection mode (or application) is required. The following options are supported:

1. The protection mode of the DCC in the high-speed main interfaces of all products are fixed and cannot be changed.

2. When the main interfaces of a DDM-2000 OC-3 PSR interconnect to low-speed OC-3 interfaces of a DDM-2000 OC-12, those low-speed interfaces of the DDM-2000 OC-12 must be provisioned for ring (0X1) protection mode.

3. When the main interfaces of a DDM-2000 OC-3 PSR interconnect to low-speed OC-3 interfaces of an FT-2000, those low-speed interfaces of the FT-2000 must be provisioned for ring (0X1) protection mode.

   When the main interfaces of a DDM-2000 OC-12 or DDM-2000 OC-3 R11.0 OC-12 PSR interconnect to low-speed OC-12 interfaces of an FT-2000 R7.1 or R7.2, those low-speed interfaces of the FT-2000 must be provisioned for ring (0x1) protection mode.

4. When the low-speed linear interfaces of a DDM-2000 OC-3 PSR or the main interfaces of a linear OC-3 system interconnect to low-speed OC-3 interfaces of a DDM-2000 OC-12, those low-speed interfaces of the DDM-2000 OC-12 must be provisioned for linear (1+1) protection mode.

5. When the low-speed linear interfaces of a DDM-2000 OC-3 or OC-12 PSR or the main interfaces of a linear OC-3 system interconnect to low-speed OC-3 interfaces of an FT-2000, those low-speed interfaces of the FT-2000 must be provisioned for linear (1+1) protection mode.

Directory Services

The 2000 Product Family supports open systems interconnection (OSI) seven-layer protocol stack architecture over the SONET DCC. This architecture requires network layer 3 names, called network service access points (NSAPs), for addressing NEs, while users at remote operations systems (OSs) and at NE craft interface terminals (CITs) use application layer 7 names, called target Identifiers (TIDs). The NE in each 2000 Product Family subnetwork that hosts and maintains the translations between NSAPs and TIDs for all NEs in the subnetwork is called the directory services network element (DSNE).

Directory Services Network Element (DSNE)

Each subnetwork requires one NE to be the DSNE. Any NE in a SONET subnetwork can act as the DSNE except DDM-2000 FiberReach. Only one NE can be provisioned to be the DSNE at one time, in any subnetwork. 2000 Product Family NEs added to a subnetwork are automatically registered by the DSNE and have access to all OI features.

The DSNE is assigned by user provisioning (CIT `set-ne`, TL1 `ENT-SYS`) (no NE is assigned by default). For multiproduct subnetworks, refer to Table 2-5 for the recommended NE type to be the DSNE.

Table 2-5.   Directory Services Network Elements (DSNE) Assignment in Multiproduct Subnetworks

Network Elements in the Subnetwork				Provision as the DSNE, the Latest Released:
OC-3 R7.2	**OC-3 R8.0/8.1/9.0/9.1**	**OC-12 R5.0/5.1**	**FT-2000 R6.0/7.0/7.1/7.2**	
✔	✔			OC-3
✔	✔	✔		OC-3 or OC-12*
✔	✔	✔	✔	OC-3 or OC-12*
	✔	✔	✔	OC-3 or OC-12*
		✔	✔	OC-12
✔			✔	FT-2000
	✔		✔	OC-3
	✔	✔		OC-3 or OC-12*
✔		✔		OC-12

To choose a DSNE between DDM-2000 OC-3 and OC-12, use the following priority order:
　　1. DDM-2000 OC-3 R11.0
　　2. DDM-2000 OC-3 R9.1 = OC-12 R5.1
　　3. DDM-2000 OC-3 R8.0/8.1/9.0 = OC-12 R5.0
　　4. DDM-2000 OC-3 R7.2.

⇒ **NOTE:**
For DDM-2000 OC-3 R7.2 only, provisioning of an NE to be the TL1-GNE (CIT `set-ne`, TL1 `ENT-SYS`) automatically assigns that NE to be the DSNE, also.

Maximum Subnetwork Size

⚠ **CAUTION:**
The number of NEs, and therefore the subnetwork size, that a particular 2000 Product Family NE can support is release dependent.

Subnetwork Size Guidelines

The NE release that supports the smallest number of NEs determines the subnetwork size that can be accommodated by that NE. The subnetwork maximums that must be observed to guarantee reliable subnetwork OI are specified in Table 2-6:

⇒ **NOTE:**
These limits apply to all NEs in the same DCC domain; if DCC domains are split, larger transmission networks are possible.

Table 2-6.   Product/Release vs. Maximum Subnetwork Size

Product	Release	Max. Subnetwork Size
DDM-2000 FiberReach	2.1	50
DDM-2000 OC-3	7.2	24
DDM-2000 OC-3	8.0	32
DDM-2000 OC-3	8.1	32
DDM-2000 OC-3	9.0	32
DDM-2000 OC-3	9.1	50
DDM-2000 OC-3	11.0	50
DDM-2000 OC-12	5.0	32
DDM-2000 OC-12	5.1	50
FT-2000	6.0	24
FT-2000	7.0	32
FT-2000	7.1	32
FT-2000	7.2	32

The maximum subnetwork size applicable to *SLC*-2000 is determined by the software release of the associated DDM-2000 OC-3.

Subnetwork Planning Examples

The following examples, Figures 2-2 through 2-4, illustrate the guidelines for assigning Transaction Language 1 gateway network elements (TL1-GNEs), DSNE, and alarm gateway network element(s) (AGNEs) in small and large sub-networks. The TL1-GNE and AGNE functions are described in the next chapter.

The first example (Figure 2-2), a small subnetwork with 12 NEs, has two TL1-GNEs, one DSNE, and one AGNE (that is, all NEs in the subnetwork belong to the same alarm group). If growth beyond 16 NEs is anticipated, the functions being performed by NE 7 (AGNE and TL1-GNE) should be further distributed among additional NEs in the subnetwork.
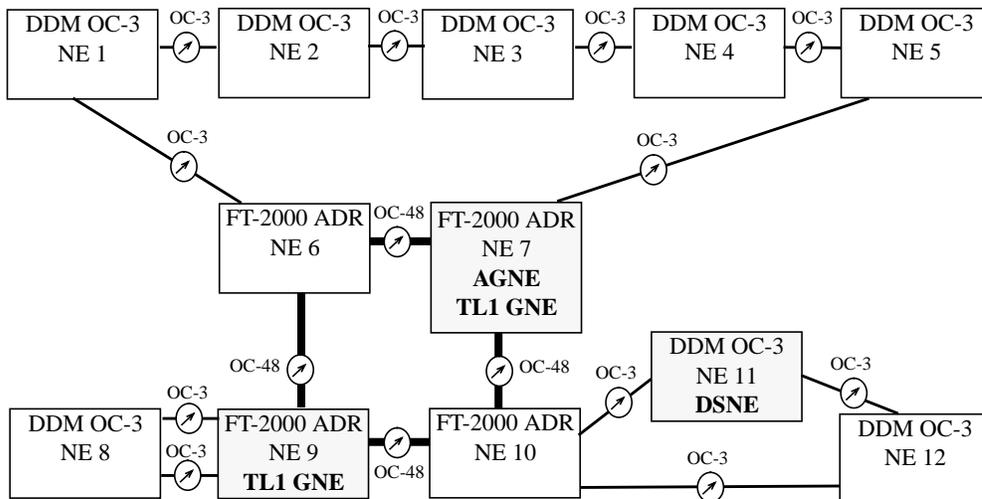
NE 7 is a TL1-GNE and AGNE
NE 9 is a TL1-GNE
NE 11 is the DSNE

Figure 2-2.   Small Subnetwork Example

While the TL1-GNE **must** be an FT-2000, the DSNE should be a DDM-2000 (assuming DDM-2000 OC-3 R8.0 and later). In this example (Figure 2-2), the AGNE could be assigned to either FT-2000 or DDM-2000.

The second example (Figure 2-3), a subnetwork with 23 NEs, has two TL1-GNEs, one DSNE and two AGNEs. In contrast with the first example, each NE in this sub-network is acting as the server for, at most, one OSI stack-based application (that is, the assignment of TL1-GNE, DSNE, and AGNE is distributed among different NEs). Also, in this subnetwork, there are two AGNEs. They could either be providing redundancy for a single alarm group (AG) consisting of the entire subnetwork or they could each be serving distinct AGs within the subnetwork. The choice of AGs is up to the user.
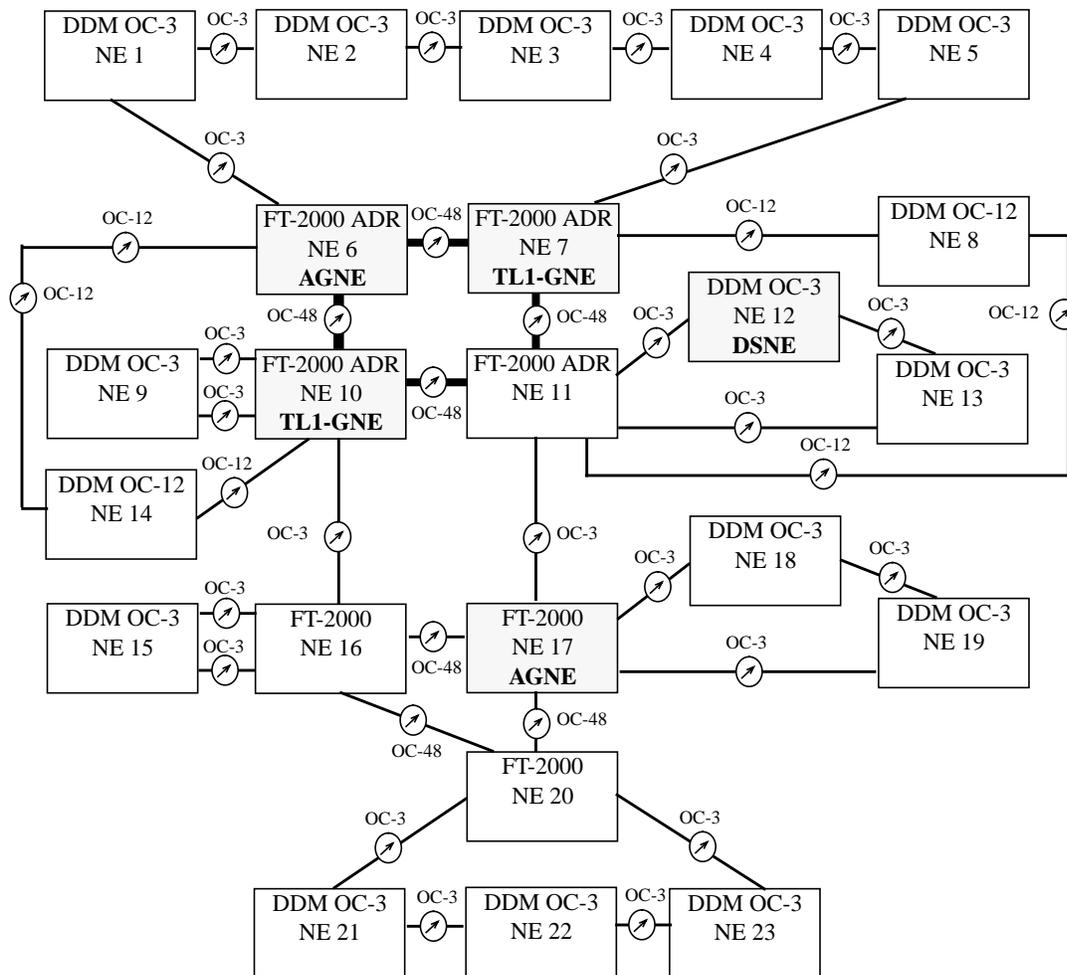
TL1-GNE, DSNE, and AGNE should be assigned
to separate NEs for load balancing

NE 12 is a DSNE

NE 6 and NE 17 are AGNEs

NE 7 and NE 10 are TL1-GNEs

Figure 2-3.   Large Subnetwork Example

While the TL1-GNEs in this example (Figure 2-3), must be FT-2000 NEs and the DSNE should be a DDM-2000 (assuming DDM-2000 OC-3 R8.0, OC-12 R5.0, and later) in this example, the AGNE functions could be assigned to either FT-2000 or DDM-2000 NEs.

The third example (Figure 2-4) illustrates how AGs can be used to limit the number of DDM-2000 NEs reporting via each Telemetry Byte-Oriented Serial (TBOS) interface to eight in subnetworks of more than eight DDM-2000 NEs. Eight is the maximum number of TBOS displays allowed per TBOS interface.

In this example (Figure 2-4), any NE in each AG could have been assigned as the AGNE or backup AGNE. Any NE in either AG could have been assigned as the DSNE, except for the FiberReach NEs.

DDM OC-3 NE 1 AG 1 — OC-3 — DDM OC-3 NE 2 AG 1 — OC-3 — DDM OC-3 NE 3 AG 1

OC-3, OC-3

DDM OC-12 NE 4 AG 1 — OC-12 — DDM OC-12 NE 5 AG 1 — OC-12 — DDM OC-12 NE 6 AG 1 — OC-3 — DDM OC-3 NE 7 AG 2

OC-12, OC-12, OC-3

TBOS Interface for AG 1

DDM OC-12 NE 8 AG 1 **AGNE DSNE** — OC-12 — DDM OC-12 NE 9 AG 1

DDM OC-3 NE 10 AG 2

OC-3

TBOS Interface for AG 2

DDM OC-3 NE 11 AG 2 **AGNE**

OC-3

OC-3, OC-3

CENTRAL OFFICE

DDM OC-3 NE 12 AG 2 — OC-3 — DDM OC-3 NE 13 AG 2

OC-1, OC-1

FiberReach NE 14 AG 2

FiberReach NE 15 AG 2

OC-1, OC-1

FiberReach NE 16 AG 2

NE 8 is an AGNE for Alarm Group 1
    and provides the TBOS interface for AG 1.
NE 8 is also a DSNE.
NE 11 is an AGNE for Alarm Group 2
    and provides the TBOS interface for AG 2.

Figure 2-4.   Subnetwork Example Illustrating Alarm Groups (AGs) and Telemetry Byte-Oriented Serial (TBOS) Interfaces

Features And Applications

3

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Features And Applications

3

Overview

Operations Interworking (OI) provides the capability to access, operate, provision, and administer remote 2000 Product Family network elements (NEs) from any site in a Synchronous Optical Network (SONET) subnetwork or from a centralized operations system (OS).

This section describes the individual OI features. It also provides application information and guidance that must be considered to use the OI features of 2000 Product Family NEs effectively.

Remote Craft Access

This feature allows a craftperson who is logged into a local NE via an ASCII craft interface terminal (CIT) to establish a remote login session with another 2000 Product Family NE in the subnetwork. The craftperson can then execute commands at the remote NE. This feature also supports the capability to toggle between the local and remote login sessions. All NEs support ASCII CIT user interfaces. The only restriction is that an FT-2000 can only accept login sessions from another FT-2000. FT-2000, however, supports remote login to DDM-2000.

For FT-2000, this feature, specifically the local FT-2000 acceptance of CIT remote logins over a particular DCC, is dependent on user provisioning to enable Port Access (**portacc**)(CIT **set-secu-port**, TL1 **ENT-CID-SECU** (FT-2000 R7.2)). The FT-2000 default value is **ENABLED**.

Remote Operations System (OS) Access

Through this feature, one or more TL1/X.25 OS interfaces may be used to provide OS access to all the 2000 Product Family NEs in a subnetwork. The NE providing the OS interface is called the TL1/X.25 Gateway Network Element (TL1-GNE) because it communicates TL1 commands and messages between NEs via an X.25 interface. FiberReach does not support a directly connected X.25 interface but supports remote OS access via any of the other 2000 Product Family TL1-GNEs. FT-2000 TL1-GNEs support both FT-2000 and DDM-2000 remote NEs, but DDM-2000 cannot serve as the TL1-GNE for FT-2000.

Multiple TL1-GNEs

One or more 2000 Product Family NEs may be used as TL1-GNEs. The number used depends on the application and operations needs. For example, to reduce the number of operations data communication (X.25) links between the subnetwork and the OS, one FT-2000 OC-48 may be used as the GNE for the subnetwork. If OS access redundancy is needed, multiple TL1-GNEs can be used in the same subnetwork. Another reason to use multiple TL1-GNEs could be for load balancing. Load balancing may be in the form of dedicating different TL1-GNEs to each OS or to support more outgoing TL1 logins to remote NEs than a single TL1-GNE can support (refer to Table 3-1). More than one TL1-GNE can contact the same remote NEs at the same time. The same considerations apply to a DDM-2000 subnetwork.

TL1-GNE Selection

The following items should be considered when selecting TL1-GNE(s) in a sub-network:

- The TL1-GNE must be an FT-2000 in subnetworks that contain FT-2000.

- The TL1-GNE should be chosen to reside in a location where X.25 access to the OSs is available.

- In general, any NE (except FiberReach) with X.25 access can be a TL1-GNE to support one or more OS applications.

- *Important:* An NE becomes a TL1-GNE automatically, when the OS X.25 connection is made (except DDM-2000 OC-3 R7.2 requires user provisioning to be assigned as the TL1-GNE (CIT `set-ne`).

- Each subnetwork may have more than one TL1-GNE (except when DDM-2000 OC-3 R7.2 is a TL1-GNE, only one TL1-GNE is allowed in the subnetwork).

Maximum Number of TL1 Logins

Any 2000 Product Family NE serving as a TL1-GNE has a limit on the number of outgoing TL1 logins it can support. Current limits are shown in Table 3-1.

These numbers equate to the number of remote NEs a TL1-GNE can support when there is only one TL1 login to each remote NE. The maximum number of remote NEs decreases if multiple TL1 logins through the TL1-GNE to each remote NE are used (for example, two different OSs accessing the same set of remote NEs through the same TL1-GNE).

Table 3-1.   Maximum Number of Outgoing TL1 Logins per TL1-GNE

TL1-GNE	Max. Number of Outgoing TL1 Logins
DDM-2000 OC-3 R7.2	53
DDM-2000 OC-3 R8.0, R8.1, R9.0	69
DDM-2000 OC-3 R9.1, R11.0	105
DDM-2000 OC-12 R5.0	69
DDM-2000 OC-12 R5.1	105
FT-2000	64

Remote NEs have limitations on the number of simultaneous incoming TL1 logins they can support (refer to Table 3-2).

Table 3-2.   Maximum Number of Simultaneous TL1 Logins per Remote NE

Remote NE Type	Max. Number of Simultaneous Incoming TL1 Logins
DDM-2000 OC-3 R7.2, R8.0, R8.1, R9.0 DDM-2000 OC-12 R5.0	5
DDM-2000 FiberReach R2.1 DDM-2000 OC-3 R9.1, R11.0 DDM-2000 OC-12 R5.1 FT-2000	8

TL1-GNE X.25 Virtual Circuits

Each TL1-GNE can support some number of incoming X.25 virtual circuits (VCs). Current capacities for Switched Virtual Circuits (SVCs) and Permanent Virtual Circuits (PVCs) are shown in Table 3-3.

Table 3-3.   Virtual Circuit Capacities

System	Number of SVC's	Number of PVC's
DDM-2000 OC-3 R7.2	1	3
DDM-2000 OC-3 R8.0, R8.1, R9.0, R9.1, R11.0 DDM-2000 OC-12 R5.0, R5.1	9 Total (in any combination)	
FT-2000 R6.0, R7.0, R7.1, R7.2	6	2

DDM-2000 OC-3 and OC-12 VC default assignments are shown in Table 3-4.

Table 3-4.   DDM-2000 TL1/X.25 Interface, Default VC Assignments

PVC ID	SVC ID	Logical Group	Logical Channel	Default Use
1		0	1	User Definable*
2		0	2	Autonomous Maintenance Messages, User Definable*
3		0	3	Autonomous Provisioning Messages, (REPT DBCHG) User Definable*
	1	0	16	Autonomous Maintenance and Provisioning Messages† User Definable*
	2*	0	17	User Definable*
	3*	0	18	User Definable*
	4*	0	19	User Definable*
	5*	0	20	User Definable*
	6*	0	21	User Definable*

* DDM-2000 OC-3 R8.0 and later (linear), R9.0 and later (rings) / OC-12 R5.0 and later
† DDM-2000 OC-3 R7.2 only

FT-2000 VC default assignments are shown in Table 3-5:

Table 3-5.   FT-2000 TL1/X.25 Interface, Default VC Assignments

PVC ID	SVC ID	Logical Group	Logical Channel	Default Use*
1		0	1	Autonomous Maintenance and Command/Response Messages
2		0	2	Command/Response Messages
	1	0	3	Command/Response Messages
	2	0	4	Command/Response Messages
	3	0	5	Command/Response Messages
	4	0	6	Command/Response Messages
	5	0	7	Command/Response Messages
	6	0	8	Command/Response Messages

* TL1 Autonomous messaging may be provisioned separately for each logical channel.

A TL1-GNE will establish an open systems interconnection (OSI) stack association with a remote NE when an OS sends the TL1-GNE a TL1 command with a target identifier (TID) matching that of the remote NE. Part of the association setup is the exchange of information regarding the type of OS that is requesting access to the remote NE so the remote NE will know which TL1 autonomous message types to output to the OS. If the remote NE accepts the association [for example, when the command is a valid **ACT-USER** [that is, a successful TL1 login)], the TL1-GNE will continue to forward TL1 commands from the OS to the remote NE and TL1 command responses from the remote NE to the OS. If, based on the OS type transmitted to the remote NE by the TL1-GNE, the remote NE generates autonomous TL1 messages, the TL1-GNE will forward them, as well, from the remote NE to the OS.

If the TL1-GNE detects a communication failure between the TL1-GNE and a remote NE, the abnormal termination of any TL1 logins to the remote NE results, thus the TL1-GNE notifies the OS via a TL1 autonomous communication failure message. That is, assuming the OS(s) has an active TL1 login(s) to the TL1-GNE and the TL1-GNE defaults or is provisioned to route TL1 autonomous maintenance messages to the OS(s), in this case, DDM-2000 **REPT EVT** or FT-2000 **REPT ALM** messages.

The TL1-GNE does not report communication failure messages in the following cases, although each may involve terminated TL1 logins:

■ X.25 failures, including X.25 VC resets

■ normal TL1 logout (**CANC-USER**)

■ remote NE TID change, which causes all TL1 logins to the remote NE to be terminated.

The TL1-GNE responds with some TL1 error responses on behalf of remote NEs, again, only if the OS has an active TL1 login to the TL1-GNE. Refer to the TL1 **RTRV-HDR** (and **ACT-USER**) Error Responses in the DDM-2000 Multiplexers *Operations Systems Engineering Guide*, 824-102-151, and *FT-2000 OC-48 Light-wave System Operations Engineering Guide*, 824-102-148.

TL1 Autonomous Message Routing

Each TL1 login to a remote NE will have an Application Context ID (ACID) (DDM-2000) or OS Type (FT-2000) that determines the TL1 autonomous mes-sage types that the remote NE will send to the OS. The ACID/OS type can be provisioned by DDM-2000 OC-3, DDM-2000 OC-12, and FT-2000 on a per X.25 VC basis. DDM-2000 also has the capability to provision the set of autonomous messages that are output by a particular ACID/OS type.

All VCs support command/response messages. The autonomous maintenance messages are all TL1 autonomous messages except **REPT DBCHG**.

If the default assignments in Tables 3-4 and 3-5 do not meet the user's OS needs, DDM-2000 OC-3 R8.0, R9.0 and later, DDM-2000 OC-12 R5.0 and later, and DDM-2000 FiberReach R2.1 and later allows users to specify the routing of TL1 autonomous message types to VCs. This is done in two steps:

1. Each TL1 autonomous message type (for example, **REPT ALM**, **REPT DBCHG**, etc.) can be mapped to any ACID/OS type (using the **ent-tl1msgmap** command at every NE in the subnetwork). The DDM-2000 ACID/OS types are:

   ■ tl1Maintenance

   ■ tl1MemoryAdministration

   ■ tl1Test

   ■ tl1PeerComm

   ■ tl1Other1

   ■ tl1Other2.

2. Each ACID/OS type can be mapped to any of the VCs (using the DDM-2000 **ent-osacmap** command at the TL1-GNE).

The combination of these two steps (mapping TL1 autonomous message type to ACID/OS types and mapping ACID/OS types to VCs) accomplishes the desired mapping of TL1 autonomous message types to VCs.

FT-2000 functions similarly, but FT-2000 has fixed assignments of TL1 autonomous message types to ACID/OS types. The FT-2000 ACID/OS types are:

- Maintenance (MT)

- Memory Administration (MA)

- Command Response (CMDR)

- Other (OTHR)

- None (NONE).

Each ACID/OS type can be mapped to any of the VCs (FT-2000 CIT `set-secu-port`; and FT-2000 R7.2 and later TL1 `ENT-CID-SECU`).

TL1/X.25 Message Volume Considerations

As subnetwork size grows, excessive use of TL1 to send long reports (either on-demand retrievals or scheduled DDM-2000 `REPT PM` messages) over multiple X.25 VCs or from multiple remote NEs simultaneously could cause overload conditions at the TL1-GNE.

Some steps that can be taken to reduce the probability of TL1/X.25 load-related problems are:

1. Use a 19.2 Kbps X.25 link.

2. Where possible, limit the data requested in report retrieval commands, and avoid sending such commands simultaneously to many TL1 remote NEs in the same subnetwork.

3. The same TL1 autonomous message should be routed to no more than three OSs.

4. The retrieval and scheduled reporting (DDM-2000 only) of performance monitoring (PM) data, in particular, is a key area due to the large volume of PM data stored by 2000 Product Family NEs. The following PM-related steps are suggested:

   a. Monitoring of daily PM data instead of 15-minute PM data, when daily PM data is sufficient (for example, for service assurance), is encouraged.

   b. Monitoring only non-zero PM data (by using the default monitored level of 1-UP in `RTRV-PM` and `SCHED-PMREPT` (DDM-2000 only) is encouraged.

c. If using DDM-2000's **SCHED-PMREPT** to generate large (or many) **REPT PM** reports, stagger the output schedules for each TL1 remote NE, and among the TL1 remote NEs in the same subnetwork, to avoid significant overlap.

d. DDM-2000's **REPT PM** messages should be routed to at most two OSs, preferably to just one OS.

e. The Bellcore NMA PM Analysis Polling Process should be used judiciously; at a minimum, NMA should wait for the response to each command sent to a TL1 remote NE before sending another command to the same TL1 remote NE. That is the NMA option recommended by Bellcore (SR-1665, NMA OS Generic Transport NE Interface Support, Issue 5, December 1995).

Remote Network Element (NE) Status

A number of OI features, specifically the remote NE status features, rely on 2000 Product Family NEs sharing information with each other about their status. All of the following Remote NE Status features are limited to NEs within the same sub-network, and more specifically, to NEs assigned to the same alarm group.

Remote Office Alarms

The remote office alarms feature provides the ability of a 2000 Product Family NE located at the Central Office (CO) to generate audible and visual alarms to alert craft personnel to alarm conditions at remote 2000 Product Family NEs.

Any 2000 Product Family NE that is in the CO can support the activation of the office alarms and need not be an alarm group network element (AGNE).

DDM-2000 supports the Alarm Cut Off (**ACO**) function for remote DDM-2000 NEs with the same site number [as well as the same alarm group (AG) number].

For FT-2000, this feature is dependent on user provisioning to enable Remote Office Alarms (**ROA**) (CIT **set-fecom**, TL1 **ENT-FECOM** (FT-2000 R7.1 and R7.2)). The FT-2000 default value is Disabled.

Remote User Panel Status

The User Panel LED features of the 2000 Product Family provide craft personnel with information on the status of NEs without requiring a CIT. DDM-2000 also provides the capability to show a composite status of the complete subnetwork (including FT-2000 remote NEs) and scan through different remote DDM-2000 sites (up to eight distinct sites including the local site, plus a composite of sites 9 through 64, if assigned) to determine the location of an alarm condition shown in the subnetwork composite.

The User Panel features of the FT-2000 provide the local FT-2000 status plus a summary far-end activity indication of the status of all FT-2000 and DDM-2000 remote NEs. Prior to FT-2000 R7.0; DDM-2000 OC-3 R8.1, R9.1; DDM-2000 OC-12 R5.1; and FiberReach R2.1, the DDM-2000 remote user panel composite did not include FT-2000 remote NEs.

For FT-2000, the Summary Far End Activity Indication feature is dependent on user provisioning to enable Remote Activity Reporting (**RAR**) (CIT **set-fecom**, TL1 **ENT-FECOM** (FT-2000 R7.1 and R7.2)). The FT-2000 default value is Disabled.

Remote Alarm CIT Report

The remote alarm CIT report provides the ability to include alarm indications for remote 2000 Product Family NEs in the local CIT alarm report (DDM-2000 CIT **rtrv-alm** report, FT-2000 CIT **rtrv-ntalm**, TL1 **RTRV-ALM-NTWK**).

For FT-2000, this feature is dependent on user provisioning to enable Remote Activity Reporting (**RAR**) (CIT **set-fecom**, TL1 **ENT-FECOM** (FT-2000 R7.1 and R7.2)). The FT-2000 default value is Disabled.

Remote Telemetry Byte-Oriented Serial (TBOS) Interface (DDM-2000 and FiberReach only)

The remote TBOS interface feature enables a 2000 Product Family NE that is equipped with a TBOS interface to relay TBOS information for up to eight 2000 Product Family NEs (including itself).

Also included in this feature is the ability of a second 2000 Product Family NE to act as a "watchdog" that provides a backup TBOS update in case the primary TBOS update fails. DDM-2000 TBOS-related provisioning is described in 824-102-151, *DDM-2000 Multiplexers Operations Systems Engineering Guide*.

FT-2000 can only accept TBOS status updates from remote FT-2000 repeaters.

Remote Parallel Telemetry Interface

The remote parallel telemetry interface feature enables a 2000 Product Family NE that is equipped with a parallel telemetry interface to relay alarm information through this medium for remote 2000 Product Family NEs. FT-2000 can relay alarm information, via parallel telemetry, for both FT-2000 and DDM-2000 remote NEs, but DDM-2000 only relays alarm information via parallel telemetry for other DDM-2000 NEs. DDM-2000 remote parallel telemetry-related provisioning is described in 824-102-151, *DDM-2000 Multiplexers Operations Systems Engineering Guide*.

For FT-2000, this feature is dependent on user provisioning to enable *either* Remote Activity Reporting (**RAR**) or Remote Office Alarms (**ROA**) (CIT **set-fecom**, TL1 **ENT-FECOM** (FT-2000 R7.1 and R7.2)). The FT-2000 default value is Disabled.

Remote Miscellaneous Discretes via Parallel Telemetry (DDM-2000 only)

Miscellaneous discretes provide the ability to report, via parallel telemetry, certain external conditions that can occur at remote NEs, environmental conditions, for example, to systems monitoring the state of a network. Also, the capability to control certain actions at the remote NE is provided through miscellaneous discrete controls. DDM-2000 Remote Miscellaneous Discretes via Parallel Telemetry-related provisioning is described in 824-102-151, *DDM-2000 Multiplexers Operations Systems Engineering Guide*.

Miscellaneous discretes reports and controls are also supported by the remote TL1/X.25 OS Access and TBOS features.

Alarm Groups (AGs)

By default, all 2000 Product Family NEs in a subnetwork are assigned to the same AG. This is typically sufficient for all supported subnetworks.

For current subnetworks, the NE status traffic can be handled by one AG. As the network size grows, it may become advantageous to partition the subnetwork into smaller AG sizes. The 2000 Product Family of NEs provides the capability to allow users to partition their large subnetworks into AGs within which alarms are shared, thus limiting the total number of NEs with which each NE must share its alarm information.

AGs are defined to associate NEs of similar service area or function where each member of the AG needs to know the alarm and status information of all other members of the AG. This knowledge allows each NE to support the Remote NE Status Features just described for all the NEs in its AG. AGs do not have any effect on remote craft access, remote OS access, or remote software download.

Alarm Grouping has the following advantages:

- Number of OSI stack associations grows linearly, instead of exponentially, as group size increases.

- Controls traffic under "alarm storm" conditions.

- Reduces NE-NE per-link traffic substantially.

- Can support up to 50 nodes based on the maximum subnetwork sizes supported. (Refer to Table 2-6 on page 2-11).

- Can be used to limit the number of DDM-2000 NEs reporting via each TBOS interface to eight. (Refer to Figure 2-4 on page 2-16).

FT-2000 may be provisioned as belonging to no AG (i.e., AG=0), in which case FT-2000 will not share its alarm information with any other NE in the subnetwork.

If the whole subnetwork is not simply assigned, as by default, to a single AG, it is recommended, but not required, that AGs be defined by sets of NEs that:

— are closely coupled by function (for example, ring members),

— are related as peers, and

— need to know each other's alarm status.

To take advantage of most Remote NE Status features, at least one member of the AG should be located in a CO.

Again, if an AG strategy is not desired, all NEs in the subnetwork default to the same AG.

Figure 3-1 gives a visual example of how a typical SONET subnetwork topology could be partitioned into AGs:
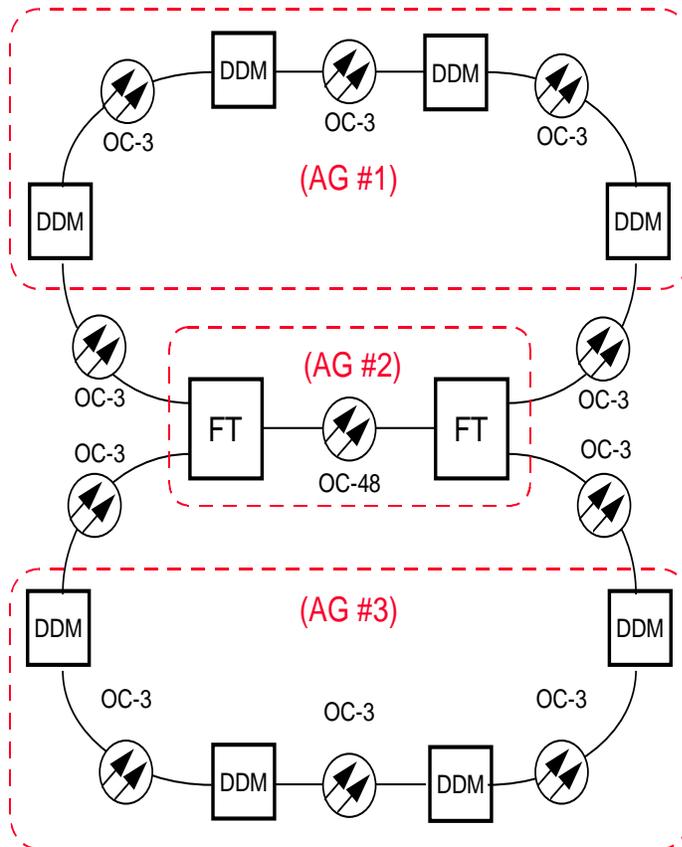

Figure 3-1.   Rings Sharing Common High-Speed Link

Alarm Gateways Network Elements (AGNEs)

Since members of an AG must know each other's alarm status, it is necessary to convey each alarm occurrence from a member of the AG to all members of the AG. For this reason, 2000 Product Family NEs provide an AGNE approach. In this approach, an NE in the AG is designated as AGNE for the AG. When an alarm occurs in the AG, the node where the event occurred sends a Remote NE Status message to the AGNE. A short time later, the AGNE forwards this information (along with possibly other recent alarm occurrences) to all nodes in the AG.

If redundancy is desired, two (maximum) AGNEs can be provisioned. The limit of two AGNEs per AG is recommended to avoid potential DCC communications congestion.

Even if the default AG (see previous discussion, "Alarm Groups") for all NEs is used, at least one AGNE **must** be provisioned in that AG. An "AGNE communication failure" alarm will be raised if there is no AGNE in an AG.

Remote Network Element Status and Alarm Group Guidelines

The following guidelines must be followed to ensure reliable alarming and to maintain subnetwork integrity:

- Each DDM-2000 and FT-2000 can be manually provisioned to be a member of an AG. By default, all FT-2000 and DDM-2000 NEs are in the same AG.

- Each AG must have at least one NE manually provisioned to be the AGNE. Any NE in the AG can be picked as the AGNE.

- Another NE in the same AG can also be provisioned to be an AGNE for redundancy.

- In subnetworks of greater than 16 NEs, distribute the assignments of TL1-GNE, AGNE, and DSNE among different NEs.

For FT-2000, AG numbers and AGNEs are dependent on user provisioning (CIT **set-ne**, TL1 **ENT-SYS**). The AG number default value is **255**, but no AGNE is assigned by default.

Remote Software Download

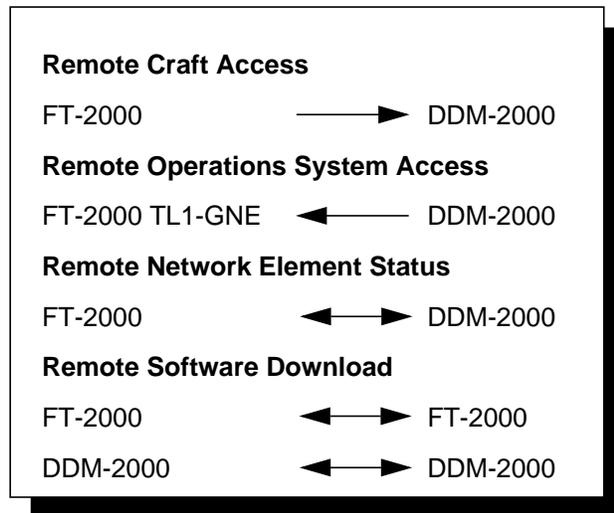The Remote Software Download feature includes two capabilities:

1. Remote NE-NE Software Copy from a local NE to a remote NE of the same type (for example, from one DDM-2000 OC-3 to another DDM-2000 OC-3, or from one FT-2000 to another FT-2000).

2. Remote PC-NE Software Download from a personal computer (PC) connected to a local NE to a remote NE, in which case both the local NE and the remote NE are required to be DDM-2000 NEs but not necessarily the same DDM-2000 product type (for example, the PC may be connected to a DDM-2000 OC-12 to download software to a DDM-2000 OC-3 or a DDM-2000 FiberReach).

This feature reduces the need to travel to remote sites when the software version of a 2000 Product Family NE is being upgraded throughout a subnetwork.

FT-2000, DDM-2000 OC-3 R9.1, DDM-2000 OC-12 R5.1, and later, accept the downloading of dormant software copies. The dormant software copies are not activated immediately. FT-2000 activates the dormant software copy when the FT-2000 is reset. DDM-2000 OC-3 R9.1 and OC-12 R5.1 accept an apply command that activates the dormant software 30 minutes later. DDM-2000 OC-3 R11.0, OC-12 R7.0, and later, accept an apply command that can be scheduled to be applied at any time the user specifies. Software *cannot* be downloaded as a dormant copy in FiberReach. This reduces the time that incompatible NEs would be isolated during cut-over to a new software release, and reduces the total time required to upgrade a subnetwork.

OI Features Summary

Figure 3-2 lists the OI features and indicates the direction of operation between 2000 Product Family NEs. Table 3-6 lists the provisionable OI parameters and the CIT and TL1 commands used to provision the parameters.

Remote Craft Access

FT-2000 ⟶ DDM-2000

Remote Operations System Access

FT-2000 TL1-GNE ⟵ DDM-2000

Remote Network Element Status

FT-2000 ⟷ DDM-2000

Remote Software Download

FT-2000 ⟷ FT-2000

DDM-2000 ⟷ DDM-2000

Note: This summary does not address all of the qualifications that apply to FT-2000 and DDM-2000 OI compatibility; any qualifications are specified earlier in this chapter.

Figure 3-2.   2000 Product Family OI Compatibility Summary

Table 3-6.   OI Parameters Provisioning

Parameter	CIT		TL1		Defaults
	DDM-2000	**FT-2000**	**DDM-2000**	**FT-2000**	
AG Number	`set-ne`	`set-ne`	`ENT-SYS`	`ENT-SYS`	255
AGNE	`set-ne`	`set-ne`	`ENT-SYS`	`ENT-SYS`	(none)
DCC Enable/ Disable	`set-fecom`	`ent-asgnmt-dcc` `dlt-asgnmt-dcc`	`ENT-FECOM`	`ENT-ASGNMT-DCC` `DLT-ASGNMT-DCC` (R7.1 / R7.2)	Enabled (DDM-2000) Disabled (FT-2000)
DCC User Side/ Network Side	`set-fecom`	`ent-asgnmt-dcc` `dlt-asgnmt-dcc`	`ENT-FECOM`	`ENT-ASGNMT-DCC` `DLT-ASGNMT-DCC` (R7.1 / R7.2)	See Command Pages (DDM-2000) Network (FT-2000)
DSNE	`set-ne`	`set-ne`	`ENT-SYS`	`ENT-SYS`	(none)
Remote Activity Reporting (RAR)	N/A	`set-fecom`	N/A	`ENT-FECOM` (R7.1 / R7.2)	Disabled
Remote Craft Port Access	N/A	`set-secu-port`	N/A	`ENT-CID-SECU` (R7.1 / R7.2)	Enabled
Remote Office Alarms (ROA)	N/A	`set-fecom`	N/A	`ENT-FECOM` (R7.1 / R7.2)	Disabled
Site and NE Numbers	`set-ne`	N/A	`ENT-SYS`	N/A	Site 5 NE 32 (64)
Target Identifier (TID)	`set-ne`	`set-ne`	`ENT-SYS` or `SET-SID`	`ENT-SYS` or `SET-SID`	Site# NE# (DDM-2000) ATT-FT-2000 R6.0 / R7.0 LT-FT-2000 R7.1 / R7.2

Table 3-6.   OI Parameters Provisioning—*Continued*

Parameter	CIT		TL1		Defaults
	DDM-2000	**FT-2000**	**DDM-2000**	**FT-2000**	
TL1-GNE	`set-ne` OC-3 R7.2 only	N/A	`ENT-SYS` OC-3 R7.2 only	N/A	(none)
TL1/X.25 ACID/OS Type	`ent-osacmap*` `ent-tl1msgmap*`	`set-secu-port`	`ENT-OSACMAP*` `ENT-TL1MSGMAP*`	`ENT-CID-SECU` R7.1 / R7.2	See Command Pages
TL1/X.25 Autonomous Message Types	`ent-tl1msgmap*`	N/A	`ENT-TL1MSGMAP*`	N/A	See Command Pages
X.25 Packet Size	`set-x25`	`set-ne`	`ENT-SYS`	`ENT-SYS`	256
X.25 VCs	`ent-osacmap*` `dlt-osacmap*`	`set-secu-port`	`ENT-OSACMAP*` `DLT-OSACMAP*`	`ENT-CID-SECU` R7.1 / R7.2	See Command Pages or Table 3-4 (DDM-2000) Table 3-5 (FT-2000)

* DDM-2000 OC-3 R8.0, OC-12 R5.0, and FiberReach R2.1, and later.
All FT-2000 DCC references are to FT-2000's low-speed DCC interfaces.
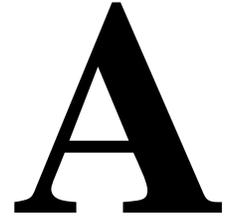
A SONET Overview

<div style="text-align: right; font-size: 4em; font-weight: bold;">A</div>

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A SONET Overview

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</div>

Overview

This section briefly describes the Synchronous Optical Network (SONET).

History

In the early 1980's, the American National Standards Institute (ANSI) recognized the need for an optical signal standard for future broadband transmission. The ANSI T1X1 subcommittee began working on optical signal and interface standards in 1984. In 1985, Bellcore proposed a network approach to fiber system standardization to T1X1. The proposal suggested a hierarchical family of signals whose rates would be **integer multiples** of a basic modular signal. The proposal further suggested a synchronous multiplexing technique, leading to the coining of the term *Synchronous Optical NETwork* (SONET).

The International Telephone and Telegraph Consultative Committee (CCITT) first showed interest in 1986. Conferences held through 1987 and 1988 resulted in coordinated specifications for both the American National Standard (SONET) and the CCITT-International Standard, Synchronous Digital Hierarchy (SDH). Approval of both sets of standards occurred in late 1988.

Basic Purpose

The basic purpose of SONET is to provide a standard synchronous optical hierarchy with sufficient flexibility to accommodate digital signals that currently exist in today's network as well as those planned for the future.

SONET currently defines standard rates and formats and optical interfaces. These and other related issues continue to evolve through the ANSI committees. SONET ultimately will permit an optical midspan meet in a multivendor environment.

The American National Standard defines the following:

- Optical parameters (*ANSI*[*] T1.106-1988)

- Electrical parameters (*ANSI* T1.102-1993 Draft)

- Multiplexing schemes to map existing digital signals (for example, DS1, DS2, and DS3) into SONET payload signals (*ANSI* T1.105-1991)

- Criteria for optical line automatic protection switch (APS) (*ANSI* T1.105-1991)

- Overhead channels to support standard operation, administration, maintenance, and provisioning (OAM&P) functions (*ANSI* T1.105-1991).

Technical Overview

SONET Signal Hierarchy

The SONET signal hierarchy is based on a basic "building block" frame called the synchronous transport signal - level 1 (STS-1), as shown in Figure A-1 on the following page. The STS-1 frame has a reoccurring rate of 8000 frames per second. Each frame is 125 microseconds.

The STS-1 frame consists of:

- 90 columns (each column is an 8-bit byte)

- 9 rows.

The STS-1 frame is transmitted serially starting from the left with row 1 column 1 on through column 90, then row 2 column 1 through 90, continuing on, row-by-row, until all 810 bytes (9 X 90) of the STS-1 frame have been transmitted.

---

*   Registered trademark of America National Standards Institute

Since each STS-1 frame consists of 810 bytes and each byte has 8 bits, the frame contains 6480 bits a frame. There are 8000 STS-1 frames per second, at the STS-1 signal rate of 51,840,000 (6480 X 8000) bits a second.

The first three columns in each of the nine rows carry the SECTION and LINE overhead bytes. Collectively, these 27 bytes are referred to as transport overhead.

The remainder of the frame, columns 4 through 90, is reserved for payload signals (for example, DS1, DS3, and path overhead) and is referred to as the STS-1 synchronous payload envelope (STS-1 SPE). The optical counterpart of the STS-1 is the optical carrier level 1 signal (OC-1), which is the result of a direct optical conversion. The electrical counterpart of the STS-1 is the electrical carrier level 1 signal (EC-1).
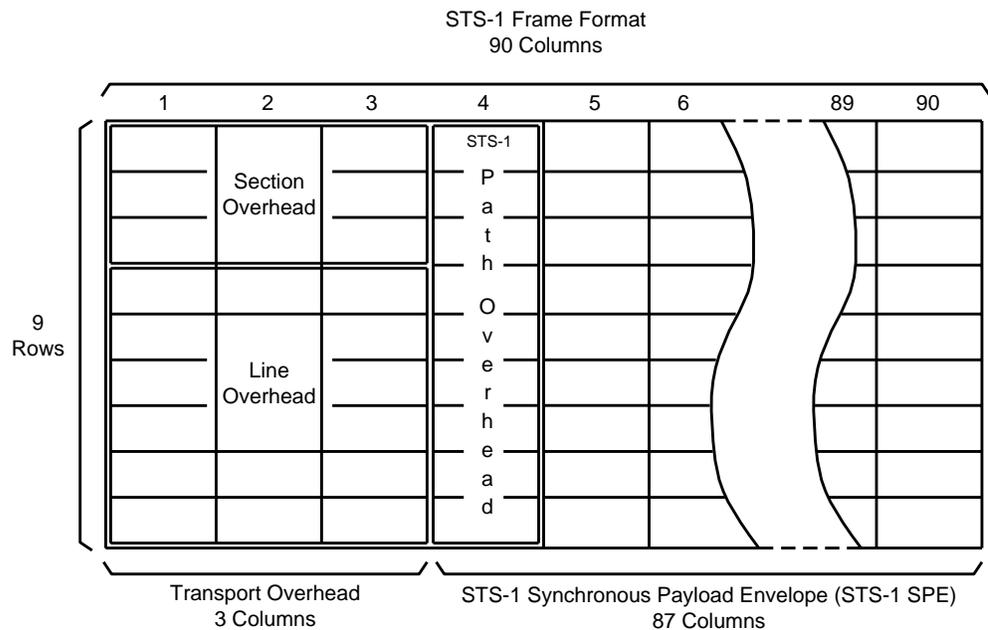
STS-1 Frame Format
90 Columns

Figure A-1.   SONET STS-1 Frame — Simplified Version

SONET Layers

SONET divides its processing functions into three layers. These three layers are associated with equipment that reflects the natural divisions in network spans. Figure A-2 shows these defined layers in a signal path. They include:

- **SECTION** and **Section Terminating Equipment** - the transmission spans between lightwave terminating equipment and the regenerators. The spans between the regenerators are also considered sections. Section terminating equipment provides regenerator functions and terminates the section overhead to provide single-ended operations and section performance monitoring.

- **LINE** and **Line Terminating Equipment** - the transmission span between terminating equipment (STS-1 cross-connections) that provides line performance monitoring. If there are no intervening repeaters, the line terminating equipment also functions as section terminating equipment.

- **STS-1 and VT Path** and **Path Terminating Equipment** - the transmission span for an end-to-end tributary (DS1 or DS3) signal that provides functions including signal labeling and path performance monitoring for signals as they are transported through a SONET network. STS-1 path terminating equipment can also provide cross-connections for lower rate (that is, DS1) signals.   A virtual tributary (VT) is a sub-DS3 payload and is described later in more detail.
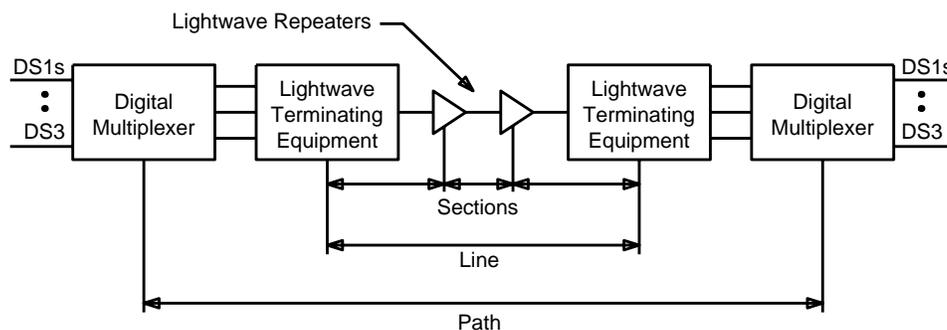

Figure A-2.   Section, Line, and Path Definitions

Each SONET layer has a set of overhead bytes as shown in Figure A-3. These bytes carry information used by various network elements.

- **Section Overhead** contains information that is used by all SONET equipment including repeaters.

- **Line Overhead** is used by all SONET equipment except repeaters.

- **Path Overhead** is carried within the payload envelope.

  — **STS-1 path overhead** remains with the STS-1 SPE until its asynchronous signal is extracted (for example, DS-3) or until its individual VT1.5 signals are demultiplexed.

  — **VTN (N= 1.5, 2, 3, or 6) path overhead** remains with the VTN until its asynchronous signal is extracted.
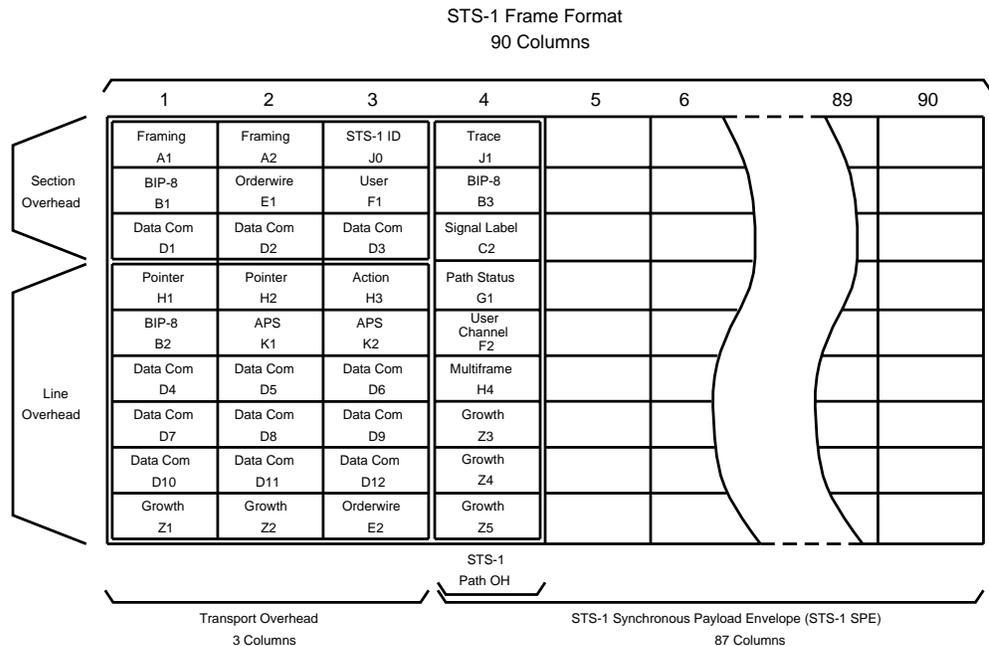
STS-1 Frame Format
90 Columns

	1	2	3	4	5	6		89	90
Section Overhead	Framing A1	Framing A2	STS-1 ID J0	Trace J1					
	BIP-8 B1	Orderwire E1	User F1	BIP-8 B3					
	Data Com D1	Data Com D2	Data Com D3	Signal Label C2					
Line Overhead	Pointer H1	Pointer H2	Action H3	Path Status G1					
	BIP-8 B2	APS K1	APS K2	User Channel F2					
	Data Com D4	Data Com D5	Data Com D6	Multiframe H4					
	Data Com D7	Data Com D8	Data Com D9	Growth Z3					
	Data Com D10	Data Com D11	Data Com D12	Growth Z4					
	Growth Z1	Growth Z2	Orderwire E2	Growth Z5					

STS-1 Path OH

Transport Overhead
3 Columns

STS-1 Synchronous Payload Envelope (STS-1 SPE)
87 Columns

Figure A-3.   SONET Frame Format

SONET Frame Structure

The following pages provide more detailed information on the function of various overhead bytes for each SONET layer.

Section Overhead

- Framing (A1, A2)

    — Provides framing for each STS-1.

- STS-1 ID (J0)

    — Provides the order of appearance in a byte-interleaved STS-N frame; for example, STS-1 #1, STS-1 #2......STS-1 #48. In future applications, this byte will provide a section trace function. For information on STS-N signals, see the "Higher Rate Transport" part of this section.

- Section Bit-Interleaved Parity (BIP-8) (B1)

    — Provides SECTION performance monitoring and is calculated over all bits of the previous STS-N frame. Defined only for STS-1 #1 of an STS-N signal.

- Section Orderwire (E1)

    — Provides a local orderwire for voice communication channel between section terminating network elements, such as repeaters. Defined only for STS-1 #1 of an STS-N signal.

- Section User Channel (F1)

    — Set aside for the user's purpose. Defined only for STS-1 #1 of an STS-N signal.

- Section Data Communications Channel (D1, D2, D3)

    — Is a 192 kb/s message-based channel. Used for alarms, maintenance, control, monitoring, and other communication needs between section terminating equipment. Defined only for STS-1 #1 of an STS-N signal.

Line Overhead

- Line Pointer (H1, H2)

  — Two bytes indicate the offset in bytes between the pointer action byte (H3) and the first byte (J1) of the STS-1 synchronous payload envelope (SPE).

- Pointer Action (H3)

  — One byte is allocated for frequency justification.

- Line Bit-Interleaved Parity (BIP-8) (B2)

  — This byte is for line performance monitoring. This byte is provided in all STS-1 signals within an STS-N signal.

- Line Automatic Protection Switching (APS) (K1, K2)

  — Two bytes used for APS signaling between line level entities. In addition, bits 6, 7, and 8 of K2 are used for line alarm indication signal (AIS) and line far-end receive failure (FERF). Defined only for STS-1 #1 of an STS-N signal.

- Line Data Communications Channel (D4 - D12)

  — Is a 576 kb/s message-based channel.

- Synch. Status (S1)

  — In STS-1 #1, the S1 byte is for synchronization status messages, and only bits 5 through 8 are used.

- Line REI (M0)

  — The M0 byte is for STS-1 line far-end block error (FEBE), and only bits 5 through 8 are used.

- Line Orderwire (E2). Defined only for STS-1 #1 of an STS-N signal.

  — One byte is allocated to be used as an express orderwire between line terminating equipment.

Path Overhead

There are two types of path overheads:

— STS-1 path overhead

— VT path overhead.

STS-1 Path Overhead

The STS-1 path overhead is assigned to and remains with the STS-1 SPE until the payload is extracted and is used for functions that are necessary to transport all synchronous payload envelopes.

■ STS-1 Path Trace (J1)

— Repetitively transmits a 64 byte, fixed length, string so that an STS-1 path receiving terminal can verify its continued connection to the intended transmitter.

■ STS-1 Path Bit-Interleaved Parity (BIP-8) (B3)

— Provides each STS-1 path performance monitoring. This byte is calculated over all bits of the previous STS-1 SPE before scrambling.

■ STS-1 Path Signal Labels (C2)

— Indicates the construction of the STS-1 SPE. A value of 00000000 indicates an unequipped STS-1 SPE. Values for various payload mappings are defined in TR-NWT-000253, Issue 2.

■ STS-1 Path Status (G1)

— Conveys the STS-1 path terminating status, far end block errors (FEBE), and yellow alarm signal conditions back to an originating STS-1 path terminating equipment.

■ STS-1 Path User Channel (F2, F3)

— User communication channel between Path elements.

■ VT Multiframe Indicator (H4)

— Provides a general multiframe indicator for VT-structured payloads.

■ STS-1 Path Automatic Protection Switching (K3)

— Path Automatic Protection Switching

■ TCM - Tandem Connection Maintenance (N1)

— Bits 1-4 used for incoming error monitoring. Bits 5-8 used as communications channel.
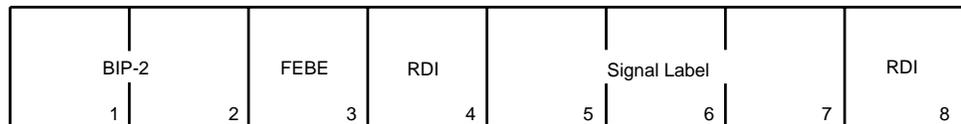
VT Path Overhead

There is one byte of VT path overhead called V5. It occurs on every fourth frame; that is, 2000 times a second.

This byte provides for VT paths the same functions that B3, C2, and G1 provide for STS paths, namely:

- Error checking

- Signal label

- Path status.

The bit assignments of the VT path overhead are specified in the following list and are illustrated in Figure A-4:

— Bits 1 and 2 are used for error performance monitoring (BIP-2).

— Bit 3 is a VT path far-end-block-error (FEBE) indication that is sent back toward an originating VT PTE when errors are detected by the BIP-2.

— Bit 4 and Bit 8 are used for remote defect indication (RDI)

— Bits 5 through 7 provide a VT signal label.

BIP-2		FEBE	RDI		Signal Label		RDI
1	2	3	4	5	6	7	8

VT Path Signal Label Coding:

0 0 0	Unequipped
0 0 1	Equipped-Nonspecific

Figure A-4.   VT Path Overhead Byte

SONET Multiplexing Procedure

SONET has provisions for multiplexing asynchronous DS1s, synchronous DS1s, and asynchronous DS3s. Refer to Figure A-5 and Figure A-6.

The first stage in multiplexing is mapping the input DS1 or DS3 tributary. In the case of DS1 inputs, three time slots (DS0s) are added to the incoming signal thus becoming a VT1.5. An asynchronous DS1 that fully meets the specified rate is mapped into the VT1.5 SPE as clear channel input since no framing is needed.

■ Each VT1.5 carries a single DS1 payload.

■ Four VT1.5s are bundled into a VT group (VT-G).

■ Seven VT-Gs are byte-interleaved into an STS-1 frame.

The VT-G to-STS-1 multiplex is a simple byte-interleaving process, so individual VT signals are easily observable within the STS-1. Thus, cross-connections and add/drop can be accomplished without the back-to-back multiplexing/multiplexing steps required by asynchronous signal formats. The structured VTs are now multiplexed into the STS-1 SPE, and the path, line, and section overhead are added. The final multiplexing, as shown in Figure A-5, provides the scrambled STS-N signal to the optical conversion stage.
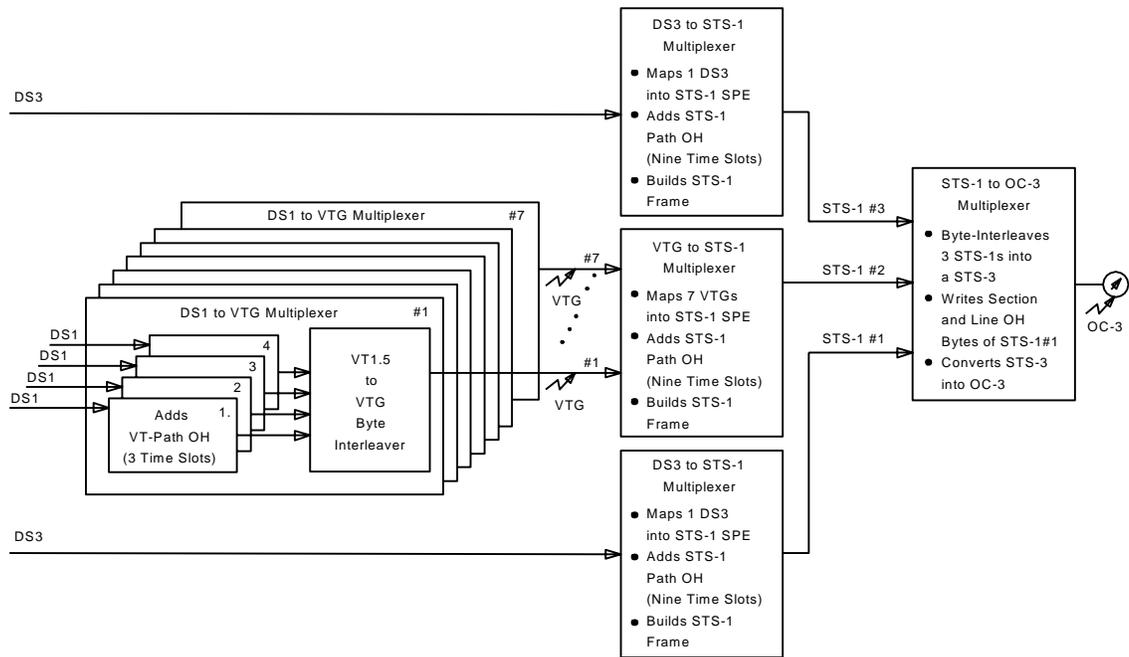
Figure A-5.   SONET Multiplexing Procedure

SONET Demultiplexing Procedure

As shown in Figure A-6, demultiplexing is the inverse of multiplexing. The unscrambled STS-1 signal from the optical conversion stages is processed to extract the section and line overhead and accurately locate the SPE. The next stage processes the path overhead and demultiplexes the VTs. A standard DS3 signal will be provided to the asynchronous network after path overhead processing. For DS1 signals, the individual DS1 VTs are then processed to extract VT overhead and, via the VT pointer, accurately locate the DS1 SPE. Finally, desynchronization of the DS1 SPE provides a standard DS1 signal to the asynchronous network.
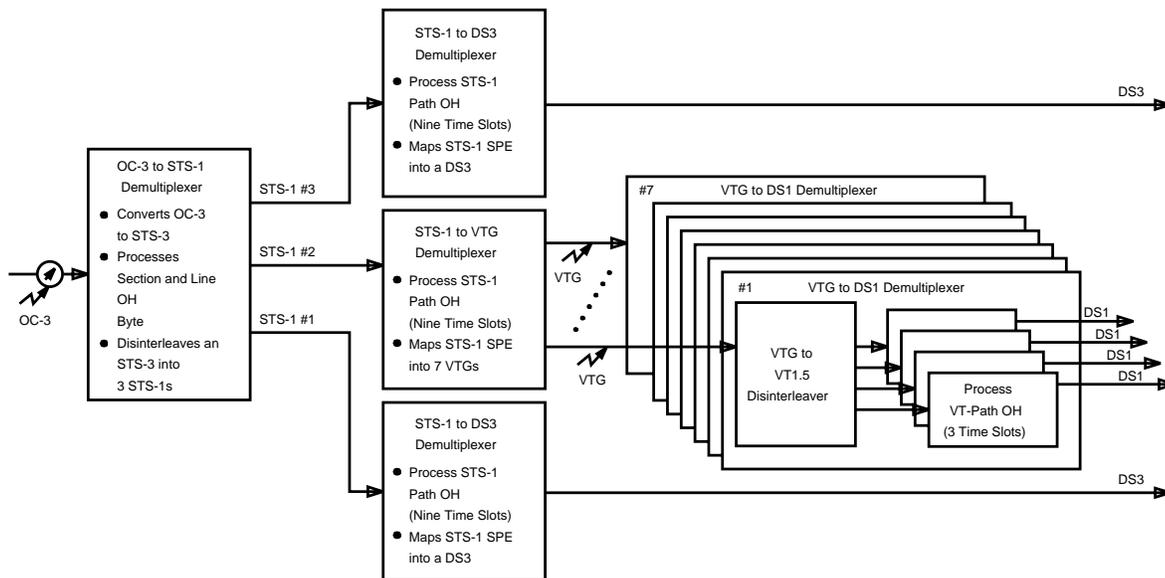

Figure A-6.   SONET Demultiplexing Procedure

Two key points should be noted at this time. First, the SONET frame is a fixed time (125 μs) and no bit-stuffing is used. Second, as shown in Figure A-7, the synchronous payload envelope can *float* within the frame using byte-stuffing. This is to permit compensation for small variations in frequency between the clocks of the two systems that may occur if the systems are independently timed (plesiochronous timing). The SPE can also drift across the 125-μs frame boundary. SONET STS pointers are used to locate the SPE relative to the transport overhead.
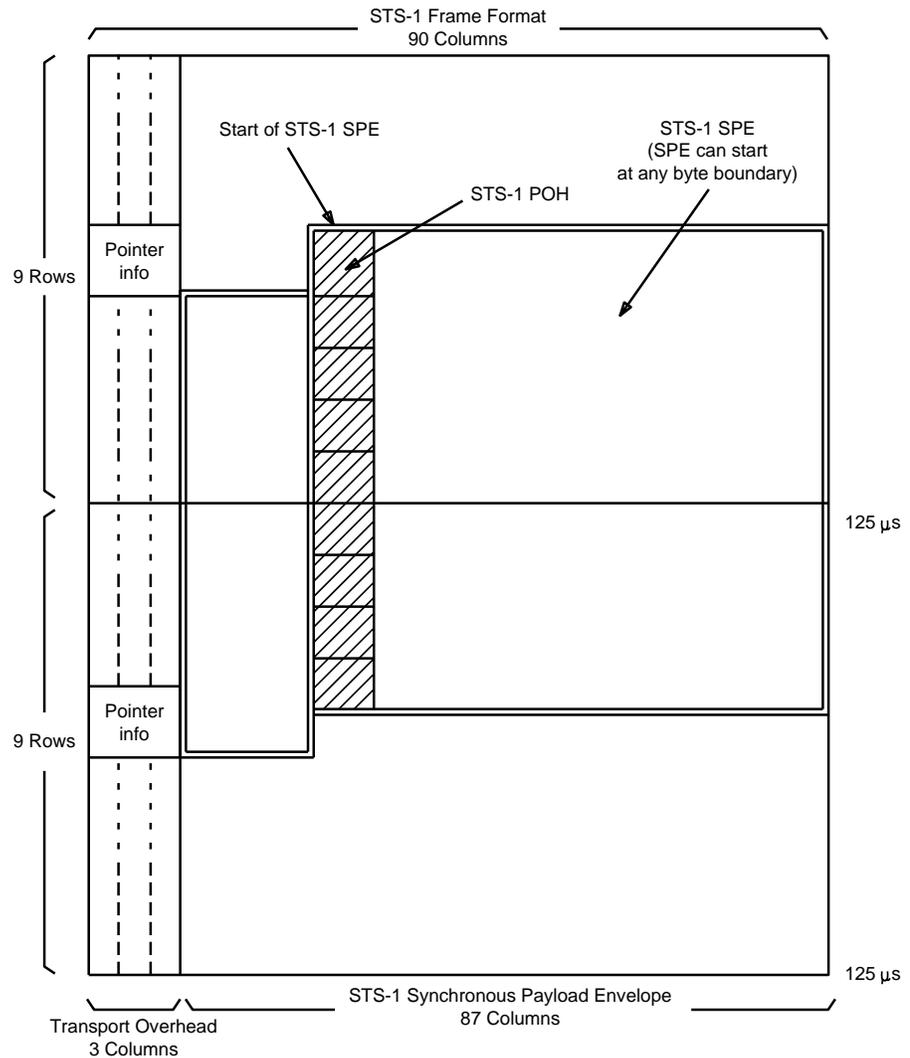
STS-1 Frame Format
90 Columns

Start of STS-1 SPE

STS-1 SPE
(SPE can start
at any byte boundary)

STS-1 POH

9 Rows

Pointer
info

125 μs

9 Rows

Pointer
info

125 μs

Transport Overhead
3 Columns

STS-1 Synchronous Payload Envelope
87 Columns

Figure A-7.   STS-1 Synchronous Payload Envelope in Interior of STS-1 Frame

SONET Digital Multiplexing Schemes

Asynchronous Multiplexing

Currently, fiber optic facilities are primarily used to carry DS3 signals. The DS3 signal consists of a combination of the following payload signals:

- 28 DS1s

- 14 DS1Cs

- 7 DS2s.

Typically, 28 DS1 signals are multiplexed into a DS3 signal, using an M13 format. Refer to Figure A-8. M13 format is a process that includes bit-interleaving four DS1 into a DS2 signal and then bit-interleaving seven DS2 signals into a DS3. The DS3 rate is not a direct multiple of the DS1 or the DS2 rates due to the bit-stuffing synchronization technique used in asynchronous multiplexing.

Identification of DS0s contained in any DS-*N* signal, except DS1, is complex and DS0s cannot be directly extracted. Thus, an asynchronous DS3 signal must be demultiplexed down to the DS1 level to access and cross-connect DS0 and DS1 signals.

Another disadvantage of the M13 format is there is no end-to-end overhead channel for use by OAM&P groups.
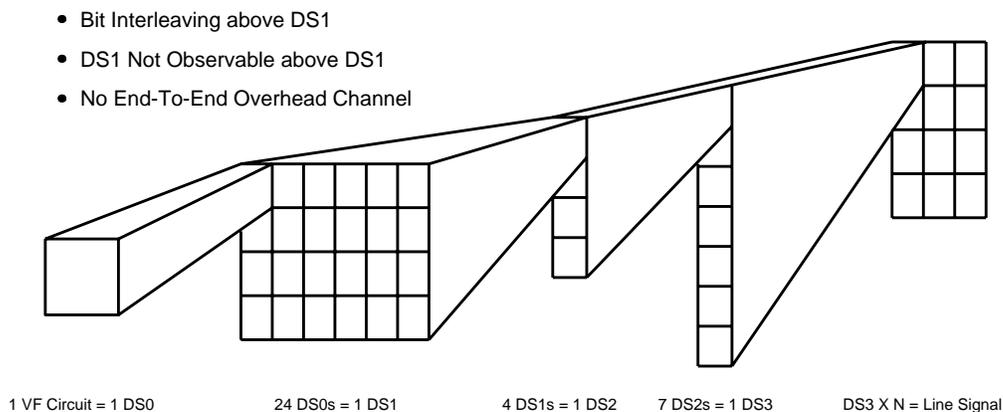
- Bit Interleaving above DS1
- DS1 Not Observable above DS1
- No End-To-End Overhead Channel

1 VF Circuit = 1 DS0   24 DS0s = 1 DS1   4 DS1s = 1 DS2   7 DS2s = 1 DS3   DS3 X N = Line Signal

Figure A-8.   Asynchronous Multiplexing

Synchronous Multiplexing

SONET's method of *byte-interleaving* DS1s to a higher signal rate permits economical extraction of a single DS1 without the need to demultiplex the entire STS-1 SPE. In addition, SONET provides overhead channels for use by OAM&P groups.

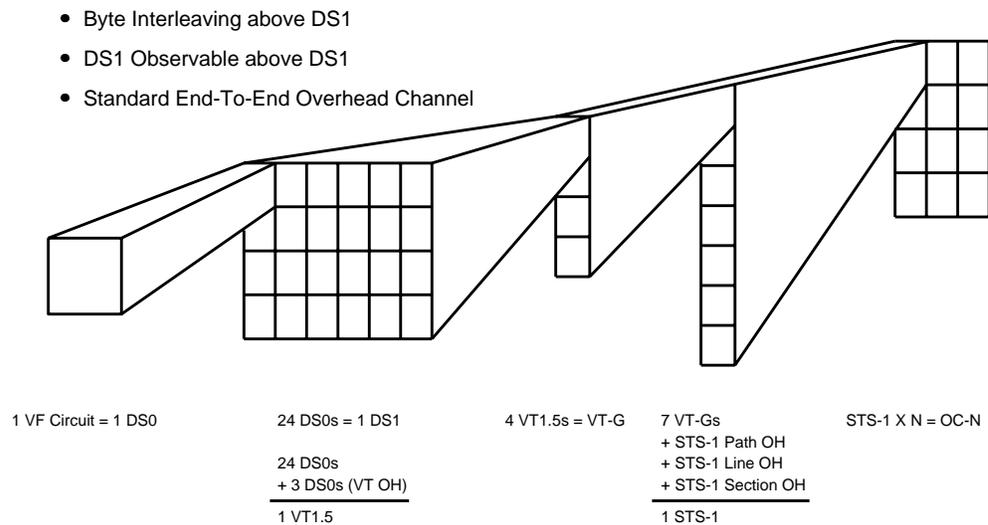In SONET, a single asynchronous DS3 signal is mapped into an STS-1 SPE (Figure A-9).

- Byte Interleaving above DS1
- DS1 Observable above DS1
- Standard End-To-End Overhead Channel

1 VF Circuit = 1 DS0	24 DS0s = 1 DS1	4 VT1.5s = VT-G	7 VT-Gs	STS-1 X N = OC-N

24 DS0s
+ 3 DS0s (VT OH)
————————
1 VT1.5

7 VT-Gs
+ STS-1 Path OH
+ STS-1 Line OH
+ STS-1 Section OH
————————
1 STS-1

Figure A-9.   Synchronous Multiplexing

Virtual Tributary Signals

Sub-DS3 asynchronous signals (DS1, DS1C, DS2 and E1) are *byte-interleaved* into a digital signal called a virtual tributary (VT). The VT is a structure designed for the transport and switching of sub-DS3 payloads. Like the STS-1 signal, the VT signal has a floating pointer that allows each VT SPE to move within the VT structure. There are four sizes of virtual tributaries (VT1.5, VT2, VT3, VT6). Higher rate payloads are transported as one or more concatenated STS-1 signals.

Concatenated Mode

For services requiring multiples of the STS-1 rate, STS-1 path payloads may be shared to create a single broadband payload called a concatenated STS-*N*c (OC-*N*c). STS-1 signals are mapped into an STS-*N*c SPE and transported as a concatenated STS-*N*c signal. This STS-*N*c signal can be carried by an STS-*N* or OC-*N* (or higher level) line signal.

The STS-*N* signal is multiplexed, switched, and transported through the network as a single entity. A concatenation indicator, used to show that the STS-1s of the STS-*N*c signal are linked together, is contained in the STS-1 payload pointer of all but the first STS-1. The line and section overhead is sent on the first STS-1 and the payload pointer for the first STS-1 is applied to all STS-1 signals in the concatenated signal.

Figure A-10 shows an example of an STS-3c SPE. It consists of 3 x 87 columns and 9 rows of bytes. The order of transmission is row by row, from left to right.
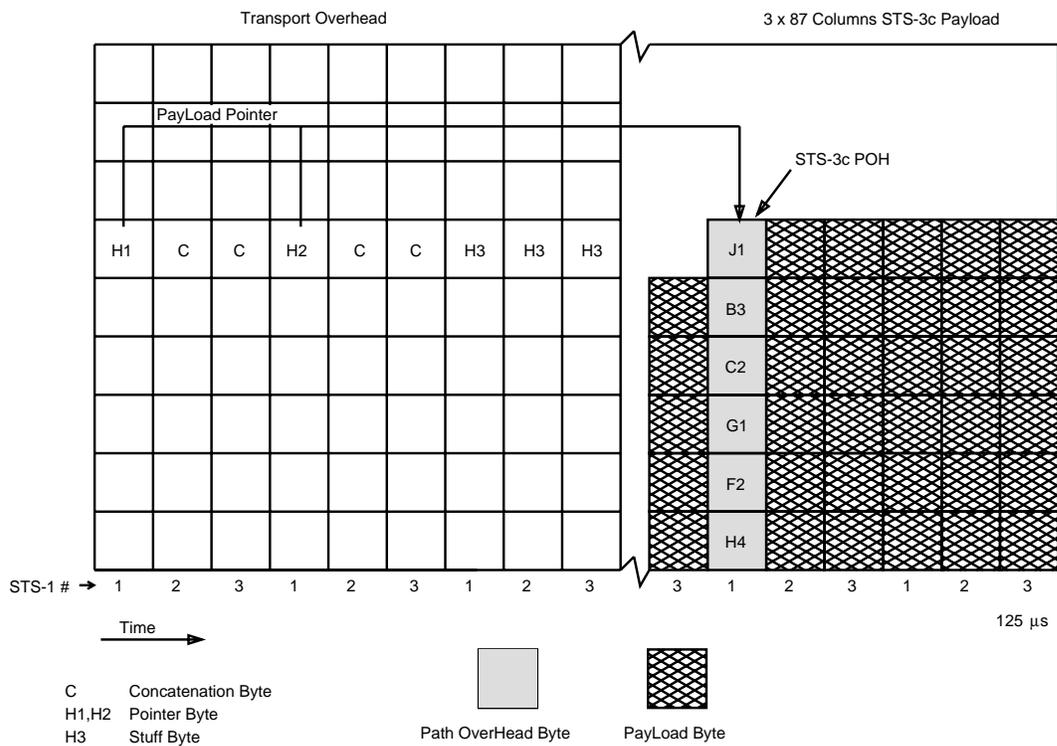

Figure A-10. STS-3c Concatenated Payload

SONET Interface

The SONET interface (Figure A-11) provides the optical midspan meet between SONET network elements. A SONET network element is the hardware and software that processes one or more layers of the SONET signal.
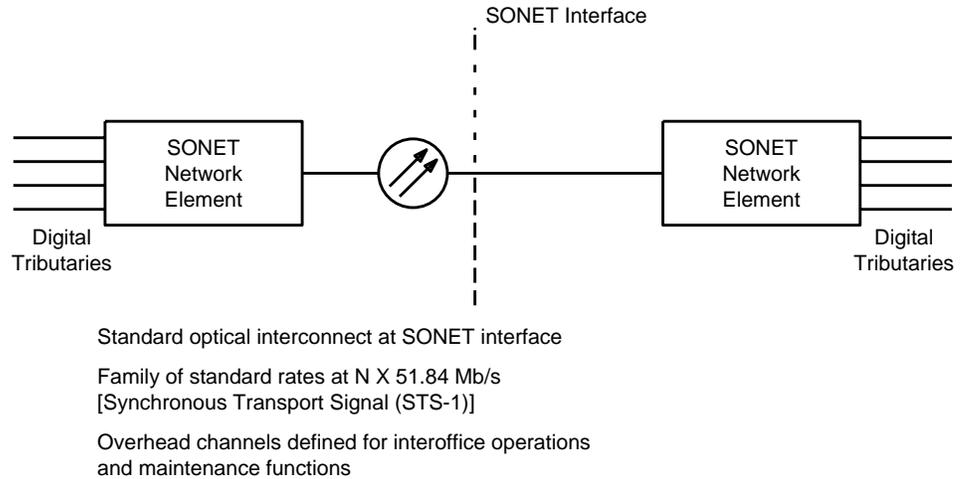

Standard optical interconnect at SONET interface

Family of standard rates at N X 51.84 Mb/s
[Synchronous Transport Signal (STS-1)]

Overhead channels defined for interoffice operations
and maintenance functions

Figure A-11. SONET Interface

SONET Payloads

Table A-1 shows the digital signals that can be transported as SONET payloads.

Table A-1.   SONET Payloads

Input Tributary	Equivalent Channels	Rate	SONET Signal	Rate
DS1	24 DS0s	1.544 Mb/s	VT1.5	1.728 Mb/s
E1 (CEPT)	32 DS0s	2.048 Mb/s	VT2	2.304 Mb/s
DS1C	48 DS0s	3.152 Mb/s	VT3	3.456 Mb/s
DS2	96 DS0s	6.312 Mb/s	VT6	6.912 Mb/s
DS3	672 DS0s	44.736 Mb/s	STS-1	51.840 Mb/s
DS4NA	2016 DS0s	139.624 Mb/s	STS-3c	150.336Mb/s
ATM		149.76 Mb/s	STS-3c	150.336Mb/s
FDDI		125.00 Mb/s	STS-3c	150.336Mb/s
Future payloads		Up to 150 Mb/s		
Future broadband payloads		Greater than 150 Mb/s		

DS1 and DS3 signals are the most important of these signals in the current network. Broadband payloads, such as asynchronous transfer mode (ATM) and fiber distributed data interface (FDDI), with rates of 150 Mb/s and higher, are also important.   Other payloads may be defined for specific applications.

Higher Rate Transport

Higher rate SONET signals are created by byte-interleaving *N* STS-1 to form an STS-*N* signal. The STS-*N* is then scrambled and converted to an optical carrier - level *N* (OC-*N*) signal. The OC-*N* has a line rate of exactly *N* times the OC-1 signal (see Table A-2).

Table A-2.   SONET Transport Rates

OC Level	Line Rate (Mb/s)	Capacity
OC-1	51.84	28 DS1s or 1 DS3
OC-3	155.52	84 DS1s or 3 DS3s
OC-9	466.56	252 DS1s or 9 DS3s
OC-12	622.08	336 DS1s or 12 DS3s
OC-18	933.122	504 DS1s or 18 DS3s
OC-24	1244.16	672 DS1s or 24 DS3s
OC-36	1866.24	1008 DS1s or 36 DS3s
OC-48	2488.32	1344 DS1s or 48 DS3s

Conclusion

The intent of this section is to present a short overview of SONET. More detailed expositions can be found in various literature. An excellent description of SONET can be found in Reference 3.

REFERENCES

1. ANSI T1.106-1988 •American National Standard for Telecommunications -
    Digital Hierarchy Optical Interface Specifications, Single Mode,• and
    ANSI T1.105-1991 •American National Standard for Telecommunications -
    Digital Hierarchy Optical Rates and Formats Specification.•

2. CCITT Recommendations G.707, G.708, G.709.

3. R. Ballert and Y. C. Ching, •SONET: Now It's the Standard Optical
    Network,• *IEEE Communications Magazine*, Vol. 27, No. 3 (March 1989):
    8-15.

4. ANSI T1.102-1993 Draft •American National Standard for
    Telecommunications - Digital Hierarchy Electrical Interface Specifications.•

Procedures For Establishing Multiproduct Subnetworks

B

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Procedures For Establishing
Multiproduct Subnetworks

B

Overview

The following list of Non Trouble Clearing Procedures (NTPs) are taken from current releases of the indicated Practices. These NTPs are essential to establishing operations interworking (OI) between multiproduct subnetworks. Refer to these documents for the actual procedures.

For the subnetwork to work properly, the activities at both ends of any multiproduct span must be locally planned and coordinated. If alarms can be ignored for an extended period, the work at each end of the span can be completed at different times and/or by different technicians. Assuming that no mistakes are made, network alarms will clear in a short time following the completion of work at both ends. Once the data communications channel (DCC) has been established, the technician may remotely communicate with all NEs in a subnetwork.

DDM-2000 OC-3 Procedures

Refer to 363-206-280, *DDM-2000 OC-3 Multiplexer, Operation and Maintenance (TOP)*, for the procedures indicated below:

NTP-013   Establish EC-1 Dual Ring Interworking DDM-2000 OC-3 to OC-12 or FT-2000 Ring Configurations OC-3 Optical Fiber Spans

NTP-018   Establish OC-3 Optical Span Extension Between DDM-2000 OC-12 Ring and DDM-2000 OC-3

NTP-040   Establish Single-Homed OC-3 Access via DDM-2000 OC-12 Backbone Ring

NTP-041   Establish OC-3/IS-3 Dual Ring Interworking DDM-2000 OC-3 to OC-12 or FT-2000 Ring Configurations OC-3 Optical Fiber Spans

NTP-042   Upgrade DDM-2000 OC-3/FT-2000 Dual Ring Interworking Network from EC-1 to OC-3 In Service

NTP-043   Establish Single-Homed FiberReach Access via DDM-2000 OC-3 Backbone Ring

NTP-044   Establish Dual-Homed FiberReach Access via DDM-2000 OC-3 Backbone Ring

NTP-047   Establish Single-Homed OC-3 Access via FT-2000 OC-48 Backbone Ring

NTP-048   Establish Dual-Homed OC-3 Access via FT-2000 OC-48 Backbone Ring

NTP-049   Add OC-3 Optical Span Linear Extension Extension Added Between FT-2000 and DDM-2000 OC-3

NTP-050   Establish Dual-Homed OC-3 Access via DDM-2000 OC-12 Backbone Ring

NTP-051   Upgrade DDM-2000 OC-3/OC-12 Dual Ring Interworking Network from EC-1 to OC-3/IS-3 In Service

NTP-052   Establish FiberReach Access via DDM-2000 OC-3 Release 9 Host Shelf OC-3 Release 8 Linear Configuration

DDM-2000 OC-12 Procedures

Refer to 363-206-290, *DDM-2000 OC-12 Multiplexer, Operation and Maintenance (TOP)*, for the procedures indicated below:

NTP-007 Establish OC-3/IS-3 Optical Span Extension Between FT-2000 and DDM-2000 OC-12 Ring

NTP-008 Establish OC-3/IS-3 Optical Span Extension Between DDM-2000 OC-12 Ring and DDM-2000 OC-3

NTP-011 Establish OC-3/IS-3 Dual Ring Interworking DDM-2000 OC-12 to OC-3 or FT-2000 Ring Configurations OC-3/IS-3 Optical Fiber Spans

NTP-012 Upgrade DDM-2000 OC-12/FT-2000 Dual Ring Interworking Network from EC-1 to OC-3/IS-3 In Service

NTP-013 Upgrade DDM-2000 OC-3/OC-12 Dual Ring Interworking Network from EC-1 to OC-3/IS-3 In Service

NTP-014 Establish EC-1 Dual Ring Interworking DDM-2000 OC-12 to OC-3 or FT-2000 OC-3/IS-3 Optical Fiber Spans

NTP-015 Establish Single-Homed OC-12 Access via FT-2000 OC-48 Backbone Ring

NTP-027 Establish Dual-Homed OC-12 Access via FT-2000 OC-48 Backbone Ring

FT-2000 OC-48 Procedures

Refer to 365-575-102, *FT-2000 OC-48 Multiplexer, Operation and Maintenance (TOP)*, for the procedures indicated below:

NTP-009 Accept Dual Ring Interworking (DRI) Connections to/from an FT-2000 Ring

NTP-010 Add OC3 Low Speed Slot(s)

NTP-012 Add OC12 Low Speed Slot(s)

Glossary

0x1

See Ring (0x1) Low-Speed Interface.

1+1

The 1+1 protection switching architecture protects against failures of the optical transmit/receive equipment and their connecting fiber facility. One bidirectional interface (two fibers plus associated OLIUs on each end) is designated "service," and the other is designated "protection." In each direction, identical signals are transmitted on the service and protection lines ("dual-fed"). The receiving equipment monitors the incoming service and protection lines independently, and selects traffic from one line (the "active" line) based on performance criteria and technician/OS control. In 1+1 both service and protection lines could be active at the same time (service in one direction—protection in the other).

1xN, 1x1

1xN protection switching pertains to circuit pack protection that provides a redundant signal path through the DDM-2000 (it does not cover protection switching of an optical facility; see "1+1"). In 1xN switching, a group of N service circuit packs share a single spare protection circuit pack. 1x1 is a special case of 1xN, with N=1. In 1x1 only one is active at a time.

A

ACO

Alarm Cutoff — A pushbutton switch available on the user panel that can be used to retire an audible office alarm.

Active

Active identifies a 1+1 protected OC-N line which is currently selected by the receiver at either end as the payload carrying signal or a 1x1 or 1xn protected circuit pack that is currently carrying service (see Standby).

AGNE

Alarm Gateway Network Element — A defined NE in an alarm group through which members of the alarm group exchange information.

ANSI

American National Standards Institute

APS

Automatic Protection Switch

ASCII

American Standard Code for Information Interchange — A standard 8-bit code used for exchanging information among data processing systems and associated equipment.

ASNE

Alarm Server Network Element

Automatic Protection Switc

A protection switch that occurs automatically in response to an automatically detected fault condition.

B

Backbone Ring

A host ring.

BLSR

Bidirectional Line Switched Ring

BRI

Basic Rate Interface

Broadband

Any communications channel with greater bandwidth than a voice channel; sometimes used synonymously with wideband.

C

CCITT

International Telephone and Telegraph Consultative Committee — An international advisory committee under United Nations' sponsorship that has composed and recommended for adoption worldwide standards for international communications. Recently changed to the International Telecommunications Union Telecommunications Standards Sector (ITU-TSS).

CD-ROM

Compact Disk, Read Only Memory

Channel

A logical signal within a port. For example, for an EC-1 port, there is one STS-1 channel and sometimes 28 VT1.5 channels. See Port.

Channel State Provisioning

A feature that allows a user to suppress reporting of alarms and events during provisioning by supporting multiple states (automatic, in-service and not monitored) for VT1.5 and STS-1 channels. See Port State Provisioning.

CIT

Craft Interface Terminal

CLK
Clock

CO
Central Office

CP
Circuit Pack

CS&O
Customer Support and Operations

D

DACS IV-2000
Digital Access and Cross-Connect System that provides electronic DS3/STS-1 or DS1/VT1.5 cross-connect capability, eliminating the need for manual DSXs.

DCC
Data Communications Channel — The embedded overhead communications channel in the SONET line. It is used for end-to-end communications and maintenance. It carries alarm, control, and status information between network elements in a SONET network.

DDM-Plus
Lucent's optical and electrical DS1 transport system. DDM-Plus transports up to four DS1s per pair of optical fiber and can provide T1 extension over existing copper wires.

DDM-2000
Lucent's next generation network multiplexers that multiplex DS1, DS3, or EC-1 inputs into EC-1, OC-1, OC-3, or OC-12 outputs.

Default Provisioning
The parameter values that are preprogrammed as shipped from the factory.

Demultiplexing
A process applied to a multiplexed signal for recovering signals combined within it and for restoring the distinct individual channels of these signals.

DEMUX
Demultiplexer — "the DEMUX direction" is from the fiber toward the DSX.

Digital Multiplexer
Equipment that combines by time-division multiplexing several digital signals into a single composite digital signal.

DLC
Digital Loop Carrier

DRI
Dual Ring Interworking — two ring networks interconnected at two common nodes.

Drop and Continue

A technique that allows redundant signal appearances at two central offices in a DRI network, allowing protection against central office failures.

DS1

Digital Signal Level 1 (1.544 M/bs)

DS1 Circuit Pack

The DS1 interface circuit pack interfaces to the DSX-1 panel.

DS3

Digital Signal Level 3 (44.736 M/bs)

DS3 Circuit Pack

The DS3 circuit pack interfaces to the DSX-3 panel.

DSn

Digital Signal Rate n — One of the possible digital signal rates at DDM-2000 OC-3 and OC-12 interfaces: DS1 (1.544 Mb/s) or DS3 (44.736 Mb/s).

DSNE

Directory Services Network Element — A designated network element that is responsible for administering a database that maps network element names (TIDs) to addresses (NSAPs [network service access points]) in an OSI subnetwork. There can be one DSNE per ring. Can also be a GNE.

DSX

Digital Cross-Connect Panel — A panel designed to interconnect equipment that operates at a designated rate. For example, a DSX-3 interconnects equipment operating at the DS3 rate.

DT

Distant Terminal

DTE

Data Terminating Equipment — That part of a data station that serves as a data source (originates data for transmission), a data sink (accepts transmitted data), or both.

Dual 0x1 Cross-Connection

In a single-homed application, the DDM-2000 OC-3/OC-12 Multiplexer uses a dual 0x1 cross-connection to map the VT1.5 channels between the DDM-2000 FiberReach OC-1 and the DDM-2000 OC-3/OC-12 rings. This dual 0x1 architecture means that the VT1.5 path switching is one in the DDM-2000 FiberReach and not in the host DDM-2000. Individual DS1 signals within an STS-1 can therefore be dropped to DDM-2000 OC-3 shelves at several nodes around the ring (see Single 0x1).

Dual Homing

In DDM-2000 FiberReach, a network topology in which two OC-3 shelves serve as DDM-2000 FiberReach Multiplexer hosts supporting up to twelve OC-1 rings. Each DDM-2000 FiberReach Multiplexer ring is interconnected between the two separate hosts. Two *SLC*®-2000 Access Systems serving as DDM-2000 FiberReach hosts can support up to four OC-1 rings (see Single Homing).

E

EC-1, EC-n

Electrical Carrier — The basic logical building block signal with a rate of 51.840 Mb/s for an EC-1 signal and a rate of n times 51.840 Mb/s for an EC-n signal. An EC-1 signal can be built in two ways: A DS1 can be mapped into a VT1.5 signal and 28 VT1.5 signals multiplexed into an EC-1 (VT1.5 based EC-1), or a DS3 can be mapped directly into an EC-1 (DS3 based EC-1).

EEPROM

Electrically Erasable Programmable Read-Only Memory

EIA

Electronic Industries Association

EMC

Electromagnetic Compatibility

EMI

Electromagnetic Interference

EPROM

Erasable Programmable Read-Only Memory

F

FCC

Federal Communications Commission

FE

Far-End — Any other network element in a maintenance subnetwork other than the one the user is at or working on (also called remote).

FE ID

Far End Identification — The 7-segment display on the faceplate of the SYSCTL circuit pack.

FEPROM

Flash EPROM — A new technology that combines the nonvolatility of EPROM with the in-circuit reprogrammability of EEPROM (electrically-erasable PROM).

Free Running

An operating condition of a clock in which its local oscillator is not locked to an internal synchronization reference and is using no storage techniques to sustain its accuracy.

FT-2000

Lucent's SONET OC-48 lightwave system.

Function Unit

Refers to any one of a number of different circuit packs that can reside in the A, B, or C function unit slots on the DDM-2000 OC-3 Multiplexer, or in the A, B, C, or D function unit slots of the DDM-2000 OC-12 Multiplexer.

G

GNE

Gateway Network Element — A network element that has an active X.25 link. Can also be a DSNE (see TL1-GNE).

GR

Bellcore General Requirement

Group

The eight slots that may be equipped.

GUI

Graphical User Interface

H

HS

High-Speed

I

IC

Internal Clock. Used in synchronization messaging.

ID

Identifier (see shelf ID and site ID).

IEC

International Electrotechnology Commission

I/O

Input/Output

IP

Internetwork Protocol

ISDN

Integrated Services Digital Network

ISO
International Standards Organization (see OSI).

L

LAN
Local Area Network

LCN
Local Communications Network

LEC
Local Exchange Carrier

LED
Light Emitting Diode — Used on a circuit pack faceplate to show failure (red) or service state. It is also used to show the alarm and status condition of the system.

Line Timing
The capability to directly derive clock timing from an incoming OC-N signal while providing the user the capability to provision whether switching to an alternate OC-N from a different source (as opposed to entering holdover) will occur if the OC-N currently used as the timing reference for that NE becomes unsuitable as a reference. For example, intermediate nodes in a linear network are line timed (see Loop Timing).

Local
See Near-End.

LOF
Loss of Frame — A failure to synchronize to an incoming signal.

Loop Timing
Loop timing is a special case of line timing. It applies to NEs that have only one OC-N interface. For example, terminating nodes in a linear network are loop timed (see Line Timing).

LOP
Loss of Pointer — A failure to extract good data from an STS-1 payload.

LOS
Loss of Signal — The complete absence of an incoming signal.

LS
Low-Speed

M

Main
Slots on the DDM-2000 shelf in which the OLIU circuit packs are installed.

MJ

Major Alarm

MN

Minor Alarm

MSDT

Multi-Services Distant Terminal

Multiplexing

The process of combining several distinct digital signals into a single composite digital signal.

Mult

Multipling. The cascading of signals in a bay. In the MULT mode, the DS1 external reference can be cascaded to other shelves in a bay using Mult cables. Normally starting with the bottom shelf (Number 1) and working towards the top of the bay.

MUX

Multiplex

N

NE

Near-End. The network element the user is at or working on (also called local).

NE

Network Element — The basic building block of a telecommunications equipment within a telecommunication network that meets SONET standards. Typical internal attributes of a network element include: one or more high- and low-speed transmission ports, built-in intelligence, synchronization and timing capability, access interfaces for use by technicians and/or operation systems. In addition, a network element may also include a time slot interchanger.

Node

In SONET a node is a line terminating element.

Non-Revertive

A protection switching mode in which, after a protection switch occurs, the equipment remains in its current configuration after any failure conditions that caused a protection switch to occur clear or after any external switch commands are reset (see Revertive).

NSA

Not Service Affecting

NSAP

Network Services Access Point — An address that identifies a network element. Used for maintenance subnetwork communication using the OSI protocol.

O

OAM&P

Operations, Administration, Maintenance, and Provisioning

OC, OC-n

Optical Carrier — The optical signal that results from an optical conversion of an STS signal; that is, OC-1 from STS-1 and OC-n from STS-n.

OC-1

Optical Carrier Level 1 Signal (51.84 Mb/s)

OC-3

Optical Carrier Level 3 Signal (155 Mb/s)

OC-3c (STS-3c)

Optical Carrier Level 3 Concatenated Signal — Low-speed broadband signal equivalent to three STS-1s linked together with a single path overhead.

OC-12

Optical Carrier Level 12 Signal (622 Mb/s)

OHCTL

The overhead controller circuit pack provides user access to the SONET overhead channels.

OI

Operations Interworking (formerly referred to as SEO).

OLIU

Optical Line Interface Unit

Operations Interface

Any interface that provides information on the system performance or control. These include the equipment LEDs, user panel, CIT, office alarms, and all telemetry and OS interfaces.

Operations Interworking

The maintenance capability that provides remote access to all DDM-2000 systems from a single location over the DCC (formerly referred to as SEO — Single Ended Operations).

OS

Operations System — A central computer-based system used to provide operations, administration, and maintenance functions.

OS-GNE

Operations System-Gateway Network Element — An OSGNE serves as a single interface to the OS for NEs in the same subnetwork using X.25 interfaces (see TL1-GNE).

OSI

Open Systems Interconnection — Referring to the OSI reference model, a logical structure for network operations standardized by the International Standards Organization (ISO).

P

Pass Through

Paths that are cross-connected directly across an intermediate node in a ring network.

PC

Personal Computer

PMN

Power Minor Alarm

POH

Path Overhead

Port

The physical, electrical, or optical interface on a system (for example, DS1, DS3, EC-1, OC-3, and OC-12 — See Channel).

POTS

Plain Old Telephone Service

Protection Line

As defined by the SONET standard, the protection line is the pair of fibers (one transmit and one receive) that carry the SONET APS channel (K1 and K2 bytes in the SONET line overhead). On a DDM-2000 OC-3 system, a *protection* line is a pair of fibers that terminate on an OLIU circuit pack in the `main-2`, `fn-a-2`, `fn-b-2`, or `fn-c-2` slot (see Service Line).

Product Family 2000

Lucent's line of SONET standard network products providing total network solutions.

PSR

Path Switched Ring

PVC

Permanent Virtual Circuit

R

RAM

Random Access Memory

RBOC

Regional Bell Operating Company

Remote

See Far-End.

Revertive

A protection switching mode in which, after a protection switch occurs, the equipment returns to the nominal configuration (that is, the service equipment is active, and the protection equipment is standby) after any failure conditions that caused a protection switch to occur clear or after any external switch commands are reset (see Non-Revertive).

Ring

A configuration of nodes comprised of network elements connected in a circular fashion. Under normal conditions, each node is interconnected with its neighbor and includes capacity for transmission in either direction between adjacent nodes. Path switched rings use a head-end bridge and tail-end switch. Line switched rings actively reroute traffic over a protection line.

Ring (0x1) Low-Speed Interface

Formerly referred to as dual 0x1 or single 0x1. In ring applications, the DDM-2000 OC-3 and OC-12 Multiplexers use a 0x1 interface meaning both fibers carry service as opposed to a linear (1+1) low speed interface where one fiber is used for service and the other for protection (see 1+1).

RT

Remote Terminal — An unstaffed equipment enclosure that may have a controlled or uncontrolled environment.

RTAC

AT&T Regional Technical Assistance Center (1-800-225-RTAC)

S

Self-Healing

Ring architecture in which two or more fibers are used to provide route diversity. Node failures only affect traffic dropped at the failed node.

SEO

Single-Ended Operations — The maintenance capability that provides remote access to all remote systems from a single location over the DCC (generally obsolete terminology — superseded by the term OI).

Service Line

On a DDM-2000 system, a service (or "working") line is a pair of fibers (one transmit and one receive) that terminate on an OLIU circuit pack in the `main-1`, or `fn-a-1`, or `fn-b-1`, or `fn-c-1` slot. As defined by the SONET standard, the SONET APS channel is not defined on a service (or "working") line (see Protection Line).

SF

Super Frame (format for DS1 signal)

Single 0x1 Cross-Connection

In a dual-homed application, the DDM-2000 OC-3/OC-12 Multiplexer uses a single 0x1 cross-connection to map the VT1.5 channels between the DDM-2000 FiberReach OC-1 and the DDM-2000 OC-3/OC-12 rings. This single 0x1 architecture maps low-speed (LS) to high-speed (HS) on a specified ring rotation. The HS to LS drop is made on the same specified ring with no path switching. Protection is provided at the VT1.5 end points (see Dual 0x1).

Single Homing
In DDM-2000 FiberReach, a network topology in which a single OC-3 shelf serves as a DDM-2000 FiberReach Multiplexer host supporting up to six OC-1 rings. A *SLC*®-2000 Access System serving as a host can support up to two OC-1 rings (see Dual Homing).

Site ID
A switch settable parameter with values of from 1 to 8. Displayed on SYSCTL circuit pack to indicate to which site the user panel alarms and LEDs apply.

SM
Single Mode

SONET
Synchronous Optical Network

SPE
Synchronous Payload Envelope

SRD
Software Release Description

Standby
Standby identifies a 1+1 protected OC-N line which is not currently selected by the receiver at either end as the payload carrying signal, or a 1x1 or 1xn protected circuit pack that is not currently carrying service (see Active).

Status
The indication of a short-term change in the system.

STS, STS-n
Synchronous Transport Signal — The basic logical building block signal with a rate of 51.840 Mb/s for an STS-1 signal and a rate of n times 51.840 Mb/s for an STS-n signal.

STS-1 SPE
STS-1 Synchronous Payload Envelope — A 125-microsecond frame structure composed of STS path overhead and the STS-1 payload.

STS-3c
Synchronous Transport Level 3 Concatenated Signal. See OC-3c.

Subnetwork
Group of SONET network elements with SONET data communications channel (DCC) connectivity among the network elements.

Synchronization Messaging
SONET synchronization messaging is used to communicate the quality of network timing, internal timing status, and timing states throughout a subnetwork.

SYSCTL
The system controller circuit pack that provides overall administrative control of the terminal.

T

T1X1 and T1M1

The ANSI committees responsible for telecommunications standards.

TA

Bellcore Technical Advisory

TABS

Telemetry Asynchronous Byte Serial (Protocol)

TARP

TID Address Resolution Protocol

TBOS

Telemetry Byte-Oriented Serial (Protocol) — Defines one physical interface for direct connection between the telemetry remote and the monitored equipment. An RS-422 port is used to provide the operations system with sufficient alarm and status information to localize a problem to a given DDM-2000 and to determine the severity of the problem.

TID

Target Identifier — The Bellcore name for the system name.

TL1

Transaction Language 1 — A Bellcore machine-to-machine communications language that is a subset of ITU-TSS, formerly CCITT's, human-machine language.

TL1-GNE

Transaction Language 1-Gateway Network Element — A network element that has an active X.25 link directly connected.

TOP

Task Oriented Practice

TR

Bellcore Technical Requirement

TSA

Time Slot Assignment

TSI

Time Slot Interchange

TSO

Technical Support Organization — Supports RTAC and the customers.

U

Unidirectional

A protection switching mode in which the system at each end of an optical span monitors both service and protection lines and independently chooses the best signal (unless overridden by an equipment failure or by an external request, such as a forced switch or lockout). In a system that uses unidirectional line switching, both the *service* and *protection* lines may be *active* simultaneously, with one line carrying traffic in one direction and the other line carrying traffic in the other direction. The K1 and K2 bytes in the SONET line overhead are used to convey to the far end which line the near end receiver has chosen, so that an "active" indication may be made at the far end.

V

VF

Voice Frequency

VT

Virtual Tributary — A structure designed for transport and switching of a sub-DS3 payload.

VT1.5

A 1.728 Mb/s virtual tributary

VT-G

Virtual Tributary Group — A 9-row by 12-column SONET 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 STS-1 synchronous payload envelope.

W

WAN

Wide Area Network

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