

Lucent Technologies
Bell Labs Innovations



Lucent Technologies
2000 Product Family

Operations Interworking Guide
For TARP Releases

824-102-144
Issue 3
April 2000

Copyright © 2000 Lucent Technologies. All Rights Reserved.

This material is protected by the copyright laws of the United States and other countries. It may not be reproduced, distributed or altered in any fashion by any entity, including other Lucent Technologies Business Units or Divisions, without the expressed written consent of the Customer Training and Information Products organization.

For permission to reproduce or distribute, please contact your local Lucent Technologies Account Executive or Market Manager.

Notice

Every effort was made to ensure that the information in this document was complete and accurate at the time of printing. However, information is subject to change.

Mandatory Customer Information

Interference Information: Part 15 of FCC Rules

Warning: The hardware provided with 2000 Product Family generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. The hardware has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules. These rules are designed to provide reasonable protection against such interference when the hardware is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the users, at their own expense, will be required to take whatever measures necessary to eliminate the interference.

Security Statement

In rare instances, unauthorized individuals make connections to the telecommunications network through the use of remote access features. In such event, applicable tariffs require that the customer pay all network charges for traffic. Lucent Technologies cannot be responsible for such charges and will not make any allowance or give any credit for charges that result from unauthorized access.

Trademarks

ANSI is a registered trademark of American Standards Institute, Inc.

IBM is a registered trademark of International Business Machines Corporation.

IEEE is a registered trademark of The Institute of Electrical and Electronics Engineers, Inc.

MegaStar is a registered trademark of Harris Corporation.

Microsoft and MS-DOS are registered trademarks of Microsoft Corporation.

5ESS and SLC are registered trademarks of Lucent Technologies, Inc.

TITAN is a registered trademark of Tellabs Operations, Inc.

Limited Warranty

Lucent Technologies provides a 5-year limited warranty to this product. For more information, consult your local Account Executive.

Document Ordering Information

The ordering number for this document is 824-102-147. To order this document, call 1-888-582-3688. For more ordering information, refer to "How to Order Documents" in the section "About This Document."

Customer Assistance and Technical Support

The Lucent Technologies Regional Technical Assistance Center (RTAC) provides a technical assistance telephone number which is staffed 24 hours a day. For technical assistance, simply call 1-800-225-RTAC in accordance with local operating procedures.

Documentation Support

Lucent Technologies provides a telephone number for you to report errors or to ask questions about the information in this document. The support telephone number is 1-888-584-6366. To order documents, see "Document Ordering Information" above.

Developed by Lucent Technologies Network Systems Customer Training and Information Products.

How Are We Doing?

Title: Lucent Technologies 2000 Product Family
Operations Interworking Guide For TARP Releases

Identification No.: 824-102-144 Issue No.: 3 Date: April 2000

Lucent Technologies welcomes your feedback on this Customer Information Product (CIP). Your comments can be of great value in helping us improve our CIPs.

1. Please rate the effectiveness of this CIP in the following areas:

	Excellent	Good	Fair	Poor	Not Applicable
Ease of Use					////////////////////
Clarity					////////////////////
Completeness					////////////////////
Accuracy					////////////////////
Organization					////////////////////
Appearance					////////////////////
Examples					
Illustrations					
Overall Satisfaction					////////////////////

2. Please check the ways you feel we could improve this CIP.

- | | |
|--|---|
| <input type="checkbox"/> Improve the overview/introduction | <input type="checkbox"/> Make it more concise/brief |
| <input type="checkbox"/> Improve the table of contents | <input type="checkbox"/> Add more step-by-step procedures/tutorials |
| <input type="checkbox"/> Improve the organization | <input type="checkbox"/> Add more troubleshooting information |
| <input type="checkbox"/> Include more figures | <input type="checkbox"/> Make it less technical |
| <input type="checkbox"/> Add more examples | <input type="checkbox"/> Add more/better quick reference aids |
| <input type="checkbox"/> Add more detail | <input type="checkbox"/> Improve the index |

Please provide details for the suggested improvement. _____

3. What did you like most about this CIP?

4. Feel free to write any comments below or on an attached sheet.

If we may contact you concerning your comments, please complete the following:

Name: _____ Telephone Number: _____

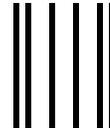
Company/Organization: _____ Date: _____

Address: _____

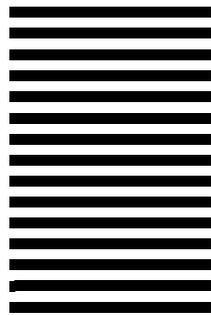
When you have completed this form, please fold, tape and return to address on back or Fax to: 910 727-3043.

----- Do Not Cut — Fold Here And Tape -----

Lucent Technologies
Bell Labs Innovations



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 1999 GREENSBORO, NC

POSTAGE WILL BE PAID BY ADDRESSEE

DOCUMENTATION SERVICES
2400 Reynolda Road
Winston-Salem, NC 27199-2029



How Are We Doing?

Title: Lucent Technologies 2000 Product Family
Operations Interworking Guide For TARP Releases

Identification No.: 824-102-144 Issue No.: 3 Date: April 2000

Lucent Technologies welcomes your feedback on this Customer Information Product (CIP). Your comments can be of great value in helping us improve our CIPs.

1. Please rate the effectiveness of this CIP in the following areas:

	Excellent	Good	Fair	Poor	Not Applicable
Ease of Use					////////////////////
Clarity					////////////////////
Completeness					////////////////////
Accuracy					////////////////////
Organization					////////////////////
Appearance					////////////////////
Examples					
Illustrations					
Overall Satisfaction					////////////////////

2. Please check the ways you feel we could improve this CIP.

- | | |
|--|---|
| <input type="checkbox"/> Improve the overview/introduction | <input type="checkbox"/> Make it more concise/brief |
| <input type="checkbox"/> Improve the table of contents | <input type="checkbox"/> Add more step-by-step procedures/tutorials |
| <input type="checkbox"/> Improve the organization | <input type="checkbox"/> Add more troubleshooting information |
| <input type="checkbox"/> Include more figures | <input type="checkbox"/> Make it less technical |
| <input type="checkbox"/> Add more examples | <input type="checkbox"/> Add more/better quick reference aids |
| <input type="checkbox"/> Add more detail | <input type="checkbox"/> Improve the index |

Please provide details for the suggested improvement. _____

3. What did you like most about this CIP?

4. Feel free to write any comments below or on an attached sheet.

If we may contact you concerning your comments, please complete the following:

Name: _____ Telephone Number: _____

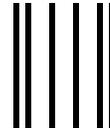
Company/Organization: _____ Date: _____

Address: _____

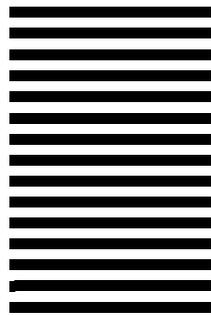
When you have completed this form, please fold, tape and return to address on back or Fax to: 910 727-3043.

----- Do Not Cut — Fold Here And Tape -----

Lucent Technologies
Bell Labs Innovations



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 1999 GREENSBORO, NC

POSTAGE WILL BE PAID BY ADDRESSEE

DOCUMENTATION SERVICES
2400 Reynolda Road
Winston-Salem, NC 27199-2029



Contents

About This Document

■ Overview	xxiii
Introduction	xxiii
Other network elements (NEs) covered	xxiv
Compatibility with previous releases of PF-2000	xxiv
■ Intended Audiences	xxv
Primary users	xxv
■ Conventions Used	xxvi
Product Names	xxvi
Interface Terminology	xxvi
■ Reasons for Reissue	xxvii
What has changed since Issue 2?	xxvii
■ Related Documentation	xxviii
Introduction	xxviii
FT-2000 OC-48 Lightwave System Documentation	xxviii
DDM-2000 OC-12 Multiplexers Documentation	xxx
DDM-2000 OC-3 Multiplexers Documentation	xxxii
SLC [®] -2000 Access System Documentation	xxxiv
DDM-2000 FiberReach Documentation	xxxvii
ITM SNC Documentation	xxxix
CPro-2000 Documentation	xxxix
5ESS TRCU3 Documentation	xl
WaveStar BWM Documentation	xlii
WaveStar 2.5G Documentation	xliii
WaveStar 10G Documentation	xliv
■ Ordering Documents	xlv
How To Order	xlv
Standing Orders	xlvi
■ Commenting	xlvii
How to Comment on This Document	xlvii
■ Electronic Documentation	xlviii

Contents

1	Introduction	
	■ Overview	1-2
	Introduction	1-2
	What Is OI?	1-2
	TARP Release OI versus Non-TARP Release OI	1-2
	■ TARP Release Software	1-3
	What Are The PF-2000 TARP Releases?	1-3
	What Are The PF-3000 TARP Releases?	1-3
	■ OI Features for All TARP Releases	1-4
	Multi-Vendor OI Compatibility	1-4
	Multi-Product OI	1-4
	Seven-Layer OSI Protocol Stack	1-4
	Large Subnetworks	1-5
	IAO LAN	1-5
	ITM SNC Backup And Restore	1-6
	TRCU3	1-6
	■ OI Features for Second Generation TARP Releases	1-7
	Pre-TARP OI Features Supported by Second Generation TARP Releases	1-7
	■ OI Features for TARP and Non-TARP Releases	1-8
	Pre-TARP and TARP Release OI Features	1-8
	Remote Craft Access	1-8
	Remote Operations System (OS) Access	1-8
	Remote Software Download	1-9
	Remote Time/Date Synchronization	1-9
	Backup and Restore	1-9

Contents

2	Compatibility	
	■ Overview	2-2
	Introduction	2-2
	■ Software Compatibility	2-3
	Guidelines	2-3
	Software Compatibility Table	2-4
	EMS, GUI and Provisioning Tools	2-5
	■ Data Communications Channel (DCC)	2-6
	Topology Guidelines	2-6
	Intra-Office Local Area Network (IAO LAN) Interface	2-7
	Establishing the IAO LAN	2-7
	IAO LAN compatibility	2-8
	IAO LAN sample illustration	2-8
	High-Speed DCCs	2-9
	Low-Speed DCCs	2-10
	Optical Rates	2-12
	■ DCC Protection	2-13
	Sample Illustration	2-13
	Protection Guidelines	2-14
	FT-2000 to WaveStar Connectivity	2-16
	DDM-2000 OC-3 or OC-12 Ring (Dual 0x1) Interfaces to WaveStar BWM 2.5G/10G Linear (1+1) Interfaces	2-18
	Protection Guidelines for PF-2000 Optical Interfaces	2-20
	Protection Guidelines for PF-2000 Multi-Product / Multi-Vendor Optical Interfaces	2-21
	■ Directory Services	2-22
	TARP Replaces Lucent Directory Services (LDS)	2-22
	Target Identifier (TID)	2-23
	Network Service Access Point (NSAP)	2-23
	■ Maximum Subnetwork Size	2-24
	Subnetwork Size Guidelines	2-24

Contents

3	Operations Interworking Features	
	■ Introduction	<u>3-2</u>
	Overview	<u>3-2</u>
	■ Remote Craft Access	<u>3-3</u>
	CIT Remote Login	<u>3-3</u>
	■ Remote Operations System Access	<u>3-4</u>
	TL1/X.25 Gateway Network Elements (TL1-GNEs)	<u>3-4</u>
	TL1-GNE vs. TL1-RNE	<u>3-5</u>
	Multiple TL1-GNEs	<u>3-5</u>
	TL1-GNE Selection	<u>3-6</u>
	Examples	<u>3-7</u>
	Maximum number of TL1 logins per PF-2000 TL1-GNE	<u>3-12</u>
	■ X.25 Virtual Circuits	<u>3-13</u>
	PF-2000 TL1-GNE	<u>3-13</u>
	■ TL1 Autonomous Message Routing	<u>3-15</u>
	Overview	<u>3-15</u>
	TL1 Autonomous Message Routing in DDM-2000	<u>3-16</u>
	TL1 Autonomous Message Routing in FT-2000	<u>3-16</u>
	ACID/OS Types	<u>3-17</u>
	ACID/OS Summary Example	<u>3-17</u>
	■ TL1-GNE Reporting for TL1-RNEs	<u>3-18</u>
	OS Communication Failure Messages	<u>3-18</u>
	Error Responses	<u>3-18</u>
	■ TL1/X.25 Message Volume	<u>3-19</u>
	Considerations	<u>3-19</u>

Contents

■ Remote NE Status	3-21
Centralized Operations	3-21
Network Maps	3-22
Eliminated Provisioning	3-23
Remote Communication Failures	3-23
Provisionable Remote NE Status	3-24
Establishing/Maintaining Alarm Group(s)	3-25
■ Remote Software Download	3-26
Introduction	3-26
How It Works	3-27
■ Remote Time and Date Synchronization	3-28
Introduction	3-28
Considerations	3-28
How It Works	3-29
Command Responses	3-29
■ OI Features Summary	3-30
Features and direction of operation	3-30
CIT and TL1 Provisioning Parameters	3-32
New TARP Release Provisionable OI Parameter Guidelines	3-36

4 ITM SNC OI Features

■ Overview	4-2
■ ITM SNC as TL1-GNE	4-3
Introduction to Northbound/Southbound OS Interfaces	4-3
Southbound OS Interface	4-4
Northbound OS Interface	4-4
TL1 Logins	4-5
Maximum Subnetwork Size	4-5

Contents

■ ITM SNC NE Software Management	4-6
Overview	4-6
Software Download	4-7
Simultaneous NE Software Management Tasks	4-8
■ ITM SNC Backup and Restore	4-9
Overview	4-9
Intelligent Backup Feature	4-11
Intelligent Restore Feature	4-11
Other New Backup and Restore Features	4-11
Simultaneous Backups	4-12
■ ITM SNC Automatic Subnetwork Discovery	4-13

5 TID Address Resolution Protocol (TARP)

■ Overview	5-2
Introduction	5-2
■ TARP Translations	5-3
TID-to-NSAP Translations	5-3
TARP Propagation	5-3
NSAP-to-TID Translations	5-4
■ TARP Data Cache (TDC)	5-5
Introduction	5-5
Why it is used	5-5
TDC Accuracy	5-5
■ TARP Provisioning	5-6
What is allowed	5-6
Default Values	5-6
■ TARP Manual Adjacency	5-7
What is it?	5-7
Provisioning	5-7

Contents

6	Subnetwork Partitioning Guidelines	
	■ Introduction	6-2
	■ Advantages of Subnetwork Partitioning	6-4
	■ Area Address Assignment	6-5
	Area Address	6-5
	Area Field	6-5
	Area Terminology	6-6
	Multiple Area Addresses	6-6
	■ Level 2 IS Assignment	6-7
	■ Maximum Subnetwork Sizes	6-8
	■ Engineering Rules and Guidelines	6-10
	Introduction	6-10
	Rule: DCC Connectivity Within An Area	6-11
	Rule: Single Level 2 Subdomain	6-12
	Guideline: Redundant Routes in Level 2 Subdomain	6-13
	Guideline: Level 2 ISs in a Ring	6-14
	Guideline: Level 2 IS Ring Area Topologies	6-15
	Guideline: Adjacent Level 2 ISs within an Area	6-16
	Rule: ITM SNC's Area Address	6-17
	Rule: Level 2 ISs on the IAO LAN	6-18
	Guideline: IAO LAN Redundancy	6-19
7	Subnetwork Partitioning Procedures	
	■ Overview	7-2
	Introduction	7-2
	Default	7-2
	■ Redefining a Subnetwork	7-3
	Adding New Network Elements	7-3
	Combining Existing Subnetworks	7-3

Contents

■ Subnetwork Partitioning Sequence	7-4
Avoid Isolating NEs	7-4
Provisioning Sub-tending Rings	7-5
Minimizing DCC Subnetwork Disruption	7-5
Selecting a Local NE for CIT Remote Login	7-6
Termination of CIT Remote Logins	7-6
Termination of ITM SNC TL1 Logins	7-6
■ Subnetwork Partitioning Confirmation	7-7
■ Single-Homed Subnetworks	7-8
Introduction	7-8
Provisioning Sequence	7-9
■ Single-Homed Subnetwork via ITM SNC IAO LAN	7-11
Introduction	7-11
Provisioning Sequence	7-13
■ Dual-Homed Subnetworks	7-16
Introduction	7-16
Provisioning Sequence	7-17
■ IAO LAN-Connected Subnetwork	7-19
Introduction	7-19
Provisioning Sequence	7-20

8 Subnetwork Software Upgrade (Pre-TARP Releases to TARP Releases)

■ Overview	8-2
Introduction	8-2
■ Considerations	8-3
Software Upgrade Compatibility	8-3
Upgrade the ITM SNC	8-3

Contents

■ Software Download and Copy	8-4
Definitions	8-4
Recommended Procedures	8-6
■ Remote Operations Guidelines	8-8
General Considerations	8-8
Selecting a Local NE for CIT Remote Login	8-8
Termination of CIT Remote Logins	8-9
Termination of ITM SNC TL1 Logins	8-9
Obsolete Pre-TARP Release OI Parameters	8-10
FT-2000 Specifics	8-11
DDM-2000 OC-3 and OC-12 Specifics	8-12
FiberReach Specifics	8-13
■ Subnetwork Software Upgrade Sequence	8-15
Minimize Subnetwork DCC Disruption	8-15
Upgrade FiberReach First	8-15
DDM-2000 OC-3 and OC-12 and FT-2000 Software Copies	8-15
Avoid Isolating NEs	8-16
■ Subnetwork Software Upgrade Example: Pre-TARP Releases to TARP Releases	8-18
Introduction	8-18
Subnetwork Software Upgrade Assumptions	8-19
Recommended Subnetwork Software Upgrade Sequence	8-20

Contents

A	An Introduction To SONET	
	■ A SONET Overview	A-1
	The Basic Purpose of SONET	A-1
	The History of SONET	A-2
	SONET Definitions	A-3
	■ SONET Signal Hierarchy	A-4
	STS-1 Frames	A-4
	STS-1 Frame Sequence	A-4
	STS-1 Signal Rate	A-5
	STS-1 Payload and Overhead	A-5
	■ SONET Layers	A-6
	Divisions	A-6
	Sections	A-7
	Line	A-7
	Path	A-7
	Overhead	A-8
	Overhead Components	A-9
	■ SONET Frame Structures	A-10
	Section Overhead	A-10
	Line Overhead	A-11
	Path Overhead	A-12
	■ SONET Multiplexing	A-14
	Which Signals are Allowed?	A-14
	Procedures	A-14
	Procedures (continued)	A-15
	■ SONET Demultiplexing	A-16
	Procedures	A-16
	Key Points	A-17
	STS-1 Synchronous Payload Envelope	A-18

Contents

■ SONET Digital Multiplexing Schemes	A-19
Asynchronous Multiplexing	A-19
M13 Format	A-19
Synchronous Multiplexing	A-20
Virtual Tributary Signals	A-21
Concatenated Mode	A-21
■ SONET Interface	A-23
Overview	A-23
SONET Payloads	A-24
Higher Rate Transport	A-25
■ Conclusion	A-26
References	A-26

GL **Glossary**

IN **Index**

Contents

Figures

2-1	IAO LAN Interface Example	2-8
2-2	DCC Protection Guidelines for Interworking Rings	2-13
2-3	FT-2000 to WaveStar Connectivity Using a BLSR OC-48 High-Speed Interface	2-16
2-4	FT-2000 to WaveStar Connectivity Using a 1+1 OC-3 or OC-12 Low-Speed Interface	2-16
2-5	FT-2000 to WaveStar Connectivity Using a 0x1 OC-3 or OC-12 Low-Speed Interface	2-17
2-6	DDM-2000 to WaveStar Connectivity	2-18
3-1	OS Access via the <i>TITAN</i> 5500/S X.25 Port	3-7
3-2	Multiple TL1-GNE OS Access	3-8
3-3	OS Access Via IAO LAN	3-9
3-4	OS Access Via IAO LAN and Multiple TL1-GNEs	3-10
3-5	OS Access Via IAO LAN and X.25 in a Multi-Product/Multi-Vendor Network	3-11
3-6	2000 Product Family OI Compatibility Summary (Sheet 1 of 2)	3-30
4-1	ITM SNC Northbound/Southbound OS Message Concentrator	4-3
6-1	Subnetwork Partitioning List of Symbols	6-2
6-2	Subnetwork Partitioning	6-3
6-3	DCC Connectivity Between NEs in an Area	6-11
6-4	Single Level 2 Subdomain	6-12
6-5	Redundant Routes in the Level 2 Subdomain	6-13
6-6	Number of Level 2 ISs in a Ring	6-14
6-7	Defining Level 2 IS Ring Area Topologies	6-15
6-8	Adjacent Level 2 ISs within an Area	6-16
6-9	ITM SNC's Area Address	6-17
6-10	Level 2 ISs on the IAO LAN	6-18
6-11	IAO LAN Redundancy	6-19
7-1	Single-Homed Subnetwork	7-8
7-2	Single-Homed Subnetwork, ITM SNC On IAO LAN	7-12
7-3	Dual-Homed Subnetwork	7-16
7-4	IAO LAN-Connected Subnetwork, ITM SNC On IAO LAN	7-19
8-1	Example: Subnetwork Software Upgrade (Pre-TARP Releases to TARP Releases)	8-18

Figures

A-1	SONET STS-1 Frame — Simplified Version	A-4
A-2	Section, Line, and Path Definitions	A-6
A-3	SONET Frame Format	A-8
A-4	VT Path Overhead Byte	A-13
A-5	SONET Multiplexing Procedure	A-15
A-6	SONET Demultiplexing Procedure	A-16
A-7	STS-1 Synchronous Payload Envelope in Interior of STS-1 Frame	A-18
A-8	Asynchronous Multiplexing	A-19
A-9	Synchronous Multiplexing	A-20
A-10	STS-3c Concatenated Payload	A-22
A-11	SONET Interface	A-23

Tables

2-1. TARP Release OI Software Compatibility	2-4
2-2. Network Element Management Software Compatibility	2-5
2-3. High-Speed DCC Types Supported	2-9
2-4. Low-Speed DCC Types Supported	2-10
2-5. Optical Interfaces Supporting DCC Communication	2-12
2-6. DCC Protection Modes for PF-2000 Optical Interfaces	2-20
2-7. DCC Protection Modes for PF-2000 Multi-Product / Multi-Vendor Optical Interfaces	2-21
3-1. TL1-RNEs Supported by TL1-GNEs	3-5
3-2. X.25 Virtual Circuit Capacities	3-13
3-3. DDM-2000 TL1/X.25 Interface, Default VC Assignments	3-13
3-4. FT-2000 TL1/X.25 Interface, Default VC Assignments	3-14
3-5. ACID/OS Types	3-17
3-6. OI Parameters Provisioning	3-32
4-1. Maximum Number of NE Software Copies Stored on ITM SNC	4-7
4-2. Maximum Number of Simultaneous Software Management Tasks	4-8
4-3. Maximum Number of Simultaneous Backups	4-12
6-1. NSAP Structure	6-5
6-2. Maximum Area and Subnetwork Sizes per Number of Level 2 ISs	6-8
8-1. PF-2000 NE Software Upgrade Summary	8-14
A-1. Section Layer Overhead Bytes	A-10
A-2. Line Layer Overhead Bytes	A-11
A-3. Path Layer Overhead Bytes	A-12
A-4. SONET Payloads	A-24
A-5. SONET Transport Rates	A-25

Tables

About This Document

Overview

Introduction

This Operations Interworking (OI) guide provides supplementary but necessary information about Lucent Technologies' OI features for the 2000 Product Family (PF-2000) TARP Release Network Elements (NEs). This guide is for anyone planning, using, or maintaining subnetworks containing a combination of:

- FT-2000 R8.1, R9.0, R9.1
- DDM-2000 OC-12 R7.0
- DDM-2000 OC-3 R13.0 and R15.0 (R13.5 for TRCU3)
- DDM-2000 FiberReach R3.0, R3.1, and R4.0.

(Continued on next page)

Overview (Continued)

Other network elements (NEs) covered

This OI Guide discusses operations interworking with the 3000 Product Family (PF-3000) TARP Release NEs and provides for other-vendor NEs such as Tellabs' *TITAN* 5500/S DCS Release 5.0.

The TARP Releases of PF-3000 that are OI compatible with PF-3000 include:

- WaveStar BandWidth Manager (BWM) R2.0
- WaveStar 2.5G R3.0 and
- WaveStar 10G R1.0.

Compatibility with previous releases of PF-2000

The subject (TARP) releases of PF-2000 NEs are optimized to support multi-vendor OI and large partitioned subnetworks; therefore, OI compatibility with previous releases of PF-2000 NEs is not supported. Previous releases of PF-2000 are documented in *Lucent Technologies 2000 Product Family Operations Interworking Guide*, 824-102-147.

* *TITAN* is a registered trademark of Tellabs Operations, Inc.

Intended Audiences

Primary users

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, and engineering considerations of the 2000 Product Family in order to take advantage of their OI capabilities.

Conventions Used

Product Names

In this document, the product name “DDM-2000 OC-3” is used to mean DDM-2000 OC-3 Multiplexers, *SLC*[®]-2000 Access Systems (SONET subsystems only), MegaStar 2000 SONET Radio System, and *5ESS*[®] Switch TRCU3, 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, and *SLC*-2000 Access Systems (SONET subsystems only) and DDM-2000 FiberReach (except in such cases where FiberReach is specifically excluded). The product name “FT-2000” is used to mean FT-2000 OC-48 Lightwave Systems. The product name PF-2000 is used to mean all of the 2000 Product Family products including FT-2000 and DDM-2000.

The product name *TITAN* 5500/S is used to mean Tellabs *TITAN* 5500/S DCS.

Interface Terminology

To clarify interface terminology, the terms **single 0x1** and **dual 0x1** have been replaced with the term **ring (0x1) low-speed interface(s)**. 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)**. See the "Glossary" for definitions of these terms.

Reasons for Reissue

What has changed since Issue 2?

This document, Issue 3, replaces the *Lucent Technologies 2000 Product Family Multi-Vendor Operations Interworking Guide*, Issue 2.

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

- Inclusion of new software releases:
 - FT-2000 OC-48 R9.0 and R9.1
 - DDM-2000 OC-3 R15.0
 - DDM-2000 FiberReach R4.0.
 - Inclusion of operations interworking with:
 - WaveStar BandWidth Manager R2.0
 - WaveStar 2.5G R3.0 and
 - WaveStar 10G R1.0
 - Miscellaneous minor updates/corrections.
-

Related Documentation

Introduction

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

The following documents provide additional information about the FT-2000 OC-48 Lightwave System:

- 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 — 365-575-103
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 R8.1 and later
- Number — 365-575-115
Title — *FT-2000 OC-48 Lightwave System, Installation Manual*
Audience — Customers planning to install and turn up the equipment
Content — Customer installation instructions for the FT-2000 OC-48 Add/Drop-Rings Terminal and FT-2000 OC-48 Repeater Bay platforms

(Continued on next page)

Related Documentation (Continued)

FT-2000 OC-48 Lightwave System Documentation (continued)

- Number — 365-575-121
Title — *FT-2000 OC-48 Repeater Bay/Shelf Provisioning Job Aid (Releases 2, 4, 6, and 8)*
Audience — End-user maintenance personnel
Content — List of provisionable parameters, original values, options, and the corresponding inputs for the FT-2000 OC-48 Repeater Bay/Shelf
- Number — 365-575-122
Title — *FT-2000 OC-48 Add/Drop-Rings Terminal Provisioning Job Aid*
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*
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 — 824-102-147
Title — *2000 Product Family Operations Interworking Guide*
Audience — System planners, engineers, and craft personnel
Content — Operations interworking information for the Lucent Technologies 2000 Product Family systems including Pre-TARP Releases of DDM-2000 Multiplexers and FT-2000 OC-48 Lightwave Systems
- 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

(Continued on next page)

Related Documentation (Continued)

DDM-2000 OC-12 Multiplexers Documentation

The following documents provide additional information about the DDM-2000 OC-12 Multiplexers:

- Number — 363-206-200
Title — *DDM-2000 OC-3/OC-12 Lightwave System, Applications, Planning, and Ordering Guide*
Audience — System planners and engineers
Content — Features, applications, general description, system planning/engineering, and ordering information
- 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 — 363-206-295
Title — *DDM-2000 OC-12 Multiplexer TARP Release 7.0 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 R7.0

(Continued on next page)

Related Documentation (Continued)

DDM-2000 OC-12 Multiplexers Documentation (continued)

- 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 7.0
- Number — 824-102-147
Title — *2000 Product Family Operations Interworking Guide*
Audience — System planners, engineers, and craft personnel
Content — Operations interworking information for the Lucent Technologies 2000 Product Family systems including Pre-TARP Releases of DDM-2000 Multiplexers and FT-2000 OC-48 Lightwave Systems
- 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

(Continued on next page)

Related Documentation (Continued)

DDM-2000 OC-3 Multiplexers Documentation

The following documents provide additional information about the DDM-2000 OC-3 Multiplexers:

- Number — 363-206-200
Title — *DDM-2000 OC-3/OC-12 Lightwave System, Applications, Planning, and Ordering Guide*
Audience — System planners and engineers
Content — Features, applications, general description, system planning/engineering, and ordering information
- 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 — Check list of acceptance and turnup procedures
- Number — 363-206-285
Title — *DDM-2000 OC-3 Multiplexer TARP Release 13 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 Release 13.0. Volume II contains an addendum covering TRCU3.

(Continued on next page)

Related Documentation (Continued)

DDM-2000 OC-3 Multiplexers Documentation (continued)

- Number — 363-206-286
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 Release 13.0
- Number — 824-102-147
Title — *2000 Product Family Operations Interworking Guide*
Audience — System planners, engineers, and craft personnel
Content — Operations interworking information for the Lucent Technologies 2000 Product Family systems including Pre-TARP Releases of DDM-2000 Multiplexers and FT-2000 OC-48 Lightwave Systems
- 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

(Continued on next page)

Related Documentation (Continued)

SLC[®]-2000 Access System Documentation

The following documents provide additional information about the SLC-2000 Access System:

- 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.)

(Continued on next page)

Related Documentation (Continued)

SLC®-2000 Access System Documentation (continued)

- 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 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.

(Continued on next page)

Related Documentation (Continued)

SLC®-2000 Access System Documentation (continued)

- 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 — 824-102-147
Title — *2000 Product Family Operations Interworking Guide*
Audience — System planners, engineers, and craft personnel
Content — Operations interworking information for the Lucent Technologies 2000 Product Family systems including Pre-TARP Releases of DDM-2000 Multiplexers and FT-2000 OC-48 Lightwave Systems
- 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 system (OS) interface to the *SLC-2000 Access System* (how the systems communicate with each other) for engineering an OS.

(Continued on next page)

Related Documentation (Continued)

DDM-2000 FiberReach Documentation

The following documents provide additional information about the DDM-2000 FiberReach:

- 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 — 363-206-305
Title — *DDM-2000 FiberReach Multiplexer Wideband/Narrowband Shelf TARP Release 3.0 User/Service Manual*
Audience — Maintenance personnel
Content — Detailed description, technical specifications, and operations and maintenance procedures for the DDM-2000 FiberReach Multiplexer
- Number — 363-206-302
Title — *DDM-2000 FiberReach Wideband Shelf System Commands Job Aid*
Audience — Users planning to install the equipment
Content — Customer installation instructions
- Number — 363-206-310
Title — *DDM-2000 FiberReach Installation Manual*
Audience — Users planning to install the equipment
Content — Customer installation instructions

(Continued on next page)

Related Documentation (Continued)

DDM-2000 FiberReach Documentation (continued)

- Number — 824-102-147
Title — *2000 Product Family Operations Interworking Guide*
Audience — System planners, engineers, and craft personnel
Content — Operations interworking information for the Lucent Technologies 2000 Product Family systems including Pre-TARP Releases of DDM-2000 Multiplexers and FT-2000 OC-48 Lightwave Systems
- 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

(Continued on next page)

Related Documentation (Continued)

ITM SNC Documentation

The following documents provide additional information about ITM SNC:

- Number — 107-564-270
Title — *Integrated Transport Management SubNetwork Controller (ITM SNC) Users Guide*
Audience — Operations Personnel
Content — Integrated Transport Management Subnetwork Controller information
- Number — 107-564-288
Title — *Integrated Transport Management SubNetwork Controller (ITM SNC) System Administration Guide*
Audience — Administration Personnel
Content — Integrated Transport Management Subnetwork Controller information

CPro-2000 Documentation

The following documents provide additional information about CPro-2000:

- Number — 365-576-130
Title — *CPro-2000 User Manual, R7.0*
- Number — 365-576-140
Title — *CPro-2000 User Manual, R8.0*
- Number — 365-576-150
Title — *CPro-2000 User Manual, R9.0*
- Number — 365-576-160
Title — *CPro-2000 User Manual, R10.0*

(Continued on next page)

Related Documentation (Continued)

5ESS TRCU3 Documentation

The following 5ESS documents provide additional information applicable to the TRCU3:

- Number — 235-040-100
Title — *OA&M Planning Guide*
- Number — 235-070-100
Title — *Administration and Engineering Guidelines*
- Number — 235-080-100
Title — *Translation Guide (TG5)*
- Number — 235-100-125
Title — *System Description*
- Number — 235-105-110
Title — *Maintenance Requirements and Tools*
- Number — 235-105-220
Title — *Corrective Maintenance*
- Number — 235-105-231
Title — *Hardware Change Procedures - Growth*
- Number — 235-105-331
Title — *Hardware Change Procedures - Degrowth*
- Number — 235-105-500
Title — *Maintenance Reference Handbook*
- Number — 235-118-253
Title — *Recent Change Reference 5E12 Software Release*
- Number — 235-120-010
Title — *Compact Digital Exchange (CDX) Reference Guide*
- Number — 235-600-111
Title — *Translations Data 5E12 Software Release*
- Number — 235-600-121
Title — *Populations Rule Language (PRL) Data 5E12 Software Release*

(Continued on next page)

Related Documentation (Continued)

5ESS TRCU3 Documentation (continued)

- Number — 235-600-223
Title — *Translation/Dynamic Data Reference 5E12 Software Release*
- Number — 235-600-243
Title — *Translation/Dynamic Data Domain 5E12 Software Release*
- Number — 235-600-500
Title — *Asserts*
- Number — 235-600-700/750
Title — *Input/Output Messages Manual*
- Number — 235-700-125
Title — *Circuit Pack Compatibility Guide*

(Continued on next page)

Related Documentation (Continued)

WaveStar BWM Documentation

The following documents provide additional information about WaveStar BandWidth Manager:

- Number — 365-370-100
Title — *WaveStar BandWidth Manager Installation Manual*
Content — Provides a a step-by-step guide to system installation and setup. It also includes information needed for preinstallation site planning and postinstallation acceptance testing.
- Number — 365-370-101
Title — *WaveStar BandWidth Manager Applications, Planning, and Ordering Guide*
Content — Presents a high-level overview of the system, describes its applications, gives planning requirements, engineering rules, ordering information, and technical specifications.
- Number — 365-370-102
Title — *WaveStar BandWidth Manager User/Service Manual*
Content — Provides a detailed description of the product step-by-step information for use in daily system operations. The manual demonstrates how to perform system provisioning, operations, and administrative tasks. It also provides procedures for routine maintenance, troubleshooting, diagnostics, and component replacement.
- Number — 365-370-103
Title — *WaveStar BandWidth Manager Provisionable Parameters Job Aid*
Content — Provides unit numbering diagrams, system mappings, equipment module diagrams and tables, system test procedures, and performance monitoring procedures.
- Number — 365-370-104
Title — *WaveStar BandWidth Manager Operations Systems Engineering Guide*
Content — Provides detailed information on TL1 commands, messages, and error codes.

(Continued on next page)

Related Documentation (Continued)

WaveStar 2.5G Documentation

The following documents provide additional information about WaveStar TDM 2.5G:

- Number — 365-371-101
Title — *WaveStar TDM 2.5G Applications, Planning, and Ordering Guide*
Content — Presents a high-level overview of the system, describes its applications, gives planning requirements, engineering rules, ordering information, and technical specifications.
- Number — 365-371-102
Title — *WaveStar TDM 2.5G User/Service Manual*
Content — Provides a detailed description of the product step-by-step information for use in daily system operations. The manual demonstrates how to perform system provisioning, operations, and administrative tasks. It also provides procedures for routine maintenance, troubleshooting, diagnostics, and component replacement.
- Number — 365-371-103
Title — *WaveStar TDM 2.5G Provisionable Parameters Job Aid*
Content — Provides unit numbering diagrams, system mappings, equipment module diagrams and tables, system test procedures, and performance monitoring procedures.
- Number — 365-371-104
Title — *WaveStar TDM 2.5G Cross-Connection Job Aid*
Content — Provides unit numbering diagrams, system mappings, equipment module diagrams and tables, system test procedures, and performance monitoring procedures.
- Number — 365-371-106
Title — *WaveStar TDM 2.5G Installation Manual*
Content — Provides a step-by-step guide to system installation and setup. It also includes information needed for preinstallation site planning and postinstallation acceptance testing.
- Number — 365-371-107
Title — *WaveStar TDM 2.5G Operations Systems Engineering Guide*
Content — Provides detailed information on TL1 commands, messages, and error codes.

(Continued on next page)

Related Documentation (Continued)

WaveStar 10G Documentation

The following documents provide additional information about WaveStar BandWidth Manager:

- Number — 365-371-301
Title — *WaveStar TDM 10G Applications, Planning, and Ordering Guide*
Content — Presents a high-level overview of the system, describes its applications, gives planning requirements, engineering rules, ordering information, and technical specifications.
 - Number — 365-371-302
Title — *WaveStar TDM 10G User/Service Manual*
Content — Provides a detailed description of the product step-by-step information for use in daily system operations. The manual demonstrates how to perform system provisioning, operations, and administrative tasks. It also provides procedures for routine maintenance, troubleshooting, diagnostics, and component replacement.
 - Number — 365-371-303
Title — *WaveStar TDM 10G Provisionable Parameters Job Aid*
Content — Provides unit numbering diagrams, system mappings, equipment module diagrams and tables, system test procedures, and performance monitoring procedures.
 - Number — 365-371-304
Title — *WaveStar TDM 10G Cross-Connection Job Aid*
Content — Provides unit numbering diagrams, system mappings, equipment module diagrams and tables, system test procedures, and performance monitoring procedures.
 - Number — 365-371-306
Title — *WaveStar TDM 10G Installation Manual*
Content — Provides a a step-by-step guide to system installation and setup. It also includes information needed for preinstallation site planning and postinstallation acceptance testing.
 - Number — 365-371-307
Title — *WaveStar TDM 10G Operations Systems Engineering Guide*
Content — Provides detailed information on TL1 commands, messages, and error codes.
-

Ordering Documents

How To Order

To order additional copies of this document and/or request placement on the standing order list, send or call in an order as follows:

Customer	Mail Order	Telephone Order <i>(Monday through Friday)</i>
Commercial Customers *	Lucent Technologies Customer Information Center Attention: Order Entry Section 2855 N. Franklin Road P.O. Box 19901 Indianapolis, IN 46219	Within USA: 1-888-LUCENT8 (1-888-582-3688) <i>7:30 a.m. to 6:30 p.m. EST</i> FAX: 1-800-566-9568 From Europe, The Middle East & Africa: Toll 1-317-322-6416 From Canada, the Caribbean & Latin America: Toll 1-317-322-6646 From Asia, the Pacific Region & China: Toll 1-317-322-6411 Worldwide: FAX: 1-317-322-6699
RBOC/BOC	Process through your Company Documentation Coordinator	

* For commercial customers, a check, money order, purchase order number, or charge card number is required with all orders. Make checks payable to Lucent Technologies.

Lucent entities should use Form IND 1-80.80 FA, available through the Customer Information Center.

(Continued on next page)

Ordering Documents (Continued)

Standing Orders

One-time orders include a binder (if applicable) and the document contents for the current issue in effect at the time of order. Also, you may request placement on the standing order list for all later reissues of the document. The standing order list for each document provides automatic distribution for all reissues of the document. Regional Bell Operating Company (RBOC)/BOC customers should process document orders or standing order requests through their Company Documentation Coordinator. For questions regarding standing orders or to be placed on a standing order list, call the applicable Lucent Technologies Customer Information Center number listed previously.

Commenting

How to Comment on This Document

Feedback forms are located immediately after the title page of this document. Please fill out the form and return it to the address stamped on the front of the form or FAX it to the number provided on the form.

If the feedback forms are missing, send comments on this document to:

Lucent Technologies
Customer Technical Support and Information
2400 Reynolda Road
Winston-Salem, NC 27106

You may also report errors or request changes to this document by calling the toll free number, **1-888-584-6366**, and giving the 9-digit document number.

Electronic Documentation

Documentation for the DDM-2000 Multiplexer is now available in electronic form, on compact disk, read-only memory (CD-ROM). CD-ROM has many advantages over traditional paper documentation, including cost savings, search and retrieve capability, and the assurance of the most current documentation.

CD-ROM is available by annual subscription (on standing order).

- To order, call your Technical Information Resource Manager, your Lucent Technologies Account Executive, or the Lucent Technologies Customer Information Center (1-800-432-6600).
 - For pricing information, contact your Lucent Technologies Account Executive or the Lucent Technologies Customer Information Center (1-800-432-6600). The CD-ROM Product Line Order Number for the All Access and Transport Products Grouping is 300-100-010.
 - For technical information, call Lucent Technologies Documentation Support (1-888-584-6366).
-

Introduction

1

Contents

■ Overview	2
■ TARP Release Software	3
■ OI Features for All TARP Releases	4
■ OI Features for Second Generation TARP Releases	7
■ OI Features for TARP and Non-TARP Releases	8

Overview

Introduction

This chapter provides an introduction to 2000 Product Family (PF-2000) Operations Interworking (OI) for the Target Identifier Address Resolution Protocol (TARP) software releases and gives brief descriptions of the new features associated with these releases.

What Is OI?

OI enables the interconnection and remote access of network elements (NEs) using the Synchronous Optical Network (SONET) data communications channel (DCC), the Intra-Office Local Area Network (IAO LAN), and/or the X.25 data communications network (DCN) for operations communications.

The OI features provide operations support from a single location to remote 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. Both the craft interface terminals (CITs) and the operations systems (OS) interfaces can access local and remote NEs.

TARP Release OI versus Non-TARP Release OI

The TARP Releases of DDM-2000 and FT-2000 are GR-253 compliant and support multi-vendor OI using a new OSI stack for TARP instead of Lucent Directory Services (LDS). OI compatibility is still supported but not OI compatibility with previous PF-2000 software releases. In summary:

- This new OI Guide (824-102-144) documents:
 - Multi-vendor OI
 - Using TARP
 - PF-2000/Wavestar OI.
 - The previous OI Guide (824-102-147) documents:
 - Lucent-only OI
 - Using LDS.
-

TARP Release Software

What Are The PF-2000 TARP Releases?

The PF-2000 TARP Release NEs are:

- FT-2000 R8.1, R9.0, and R9.1
- DDM-2000 OC-12 R7.0
- DDM-2000 OC-3 R13.0 and R15.0 (R13.5 for TRCU3)
- DDM-2000 FiberReach R3.0, R3.1, and R4.0.



NOTE:

DDM-2000 OC-3 R9.8 was made available as an early version of TARP Release software but has been replaced by DDM-2000 OC-3 R13.0. Therefore, DDM-2000 OC-3 R9.8 is not covered in this document.

What is the PF-2000 TARP Release Element Management System (EMS)?

ITM SNC R5.0, R6.0, R8.0, R9.0, and R10.

What is the PF-2000 TARP Release Graphical User Interface (GUI) and Provisioning Tool?

CPro-2000 R7.0, R8.0, R9.0, and R10.0.

What Are The PF-3000 TARP Releases?

The PF-3000 TARP Release NEs that are compatible with PF-2000 are:

- WaveStar BandWidth Manager (BWM) R2.0
- WaveStar 2.5G R3.0 and
- WaveStar 10G R1.0.

What is the PF-3000 TARP Release Element Management System (EMS)?

Subnetwork Management System (SNMS)

What is the PF-3000 TARP Release Graphical User Interface (GUI) and Provisioning Tool?

WaveStar CIT

OI Features for All TARP Releases

Multi-Vendor OI Compatibility

To support multi-vendor OI, Target ID Address Resolution Protocol (TARP) replaces Lucent Directory Service (LDS) used by previous software releases. Both LDS and TARP are directory services that provide TID-NSAP translations. LDS supports additional Lucent-only features, but TARP is the established multi-vendor standard for SONET NEs that support Transaction Language 1 (TL1) OS interfaces. The TARP Data Cache (TDC) function reduces the frequency of TARP propagation throughout the subnetwork and improves performance. No directory services network element (DSNE) is required for TARP.

The PF-2000 TARP Releases are developed to be compatible with any other-vendor NEs (including *TITAN* 5500/S R5.0) that also support TARP, OSI, IAO LAN, and TL1/X.25 as specified in Bellcore GR-253. In addition, the TARP Manual Adjacency feature enables PF-2000 NEs to operate in networks that include common management information service element (CMISE)-based NEs which may not support TARP propagation. The PF-2000 TARP Releases support user provisioning of several OSI parameters to allow users to adjust their operations subnetwork, if necessary. For example, to support subnetwork partitioning of large subnetworks, PF-2000 NEs support user provisioning of Network Services Access Point (NSAP) area addresses and Level 2 Intermediate System (IS) functionality.

**NOTE:**

Other-vendor NEs are not supported *within* an FT-2000 OC-48 ring.

Multi-Product OI

PF-3000 NEs (including WaveStar BWM, WaveStar 2.5G, and WaveStar 10G) also support TARP, OSI, and TL1/X.25. Therefore, compatibility between PF-2000 and PF-3000 allows for "multiproduct" OI.

Seven-Layer OSI Protocol Stack

PF-2000 and PF-3000 TARP Releases support the standard open systems interconnect (OSI) protocol stack on the DCC. The key, standard multi-vendor OI application is OS access via TL1/X.25 interfaces.

(Continued on next page)

* Registered trademark of Tellabs Operations, Inc.

OI Features for All TARP Releases (Continued)

Large Subnetworks

Subnetworks of up to 50 NEs are supported without subnetwork partitioning. Subnetworks of up to 256 NEs are supported by partitioning the subnetwork into multiple areas connected via Level 2 ISSs.

IAO LAN

DDM-2000 OC-3 and OC-12 TARP Releases support an IntraOffice LAN (IAO LAN) interface for operations data communications. The IAO LAN is a software-only enhancement that is necessary to support the following ITM SNC R5.0 (and later) features:

- ITM SNC as the TL1-GNE
- ITM SNC software download.

Because the IAO LAN is effectively an extension of the SONET DCC, the IAO LAN may also be used to join multiple, otherwise separate subnetworks. All NE-to-NE OI features that are supported by PF-2000 over the DCC are also supported over the IAO LAN.

DDM-2000 FiberReach and FT-2000 TARP Releases don't support direct IAO LAN interfaces but may communicate over an IAO LAN indirectly via DDM-2000, WaveStar, or another-vendor (such as *TITAN 5500/S*) NE's IAO LAN interface.

(Continued on next page)

OI Features for All TARP Releases (Continued)

ITM SNC Backup And Restore

One of the main functions of ITM SNC is to provide network configuration management capabilities that include the setting of various provisionable parameters.

Because of the complexity and time involved in setting up the various provisioning parameters in the NE, it is highly desirable to backup the NE periodically, so that in the event of a catastrophic failure in the NE which might result in data corruption, this data can be restored from ITM SNC with minimal user intervention.

ITM SNC R5.0 (and later)'s Backup and Restore capabilities have been enhanced to backup only NEs that have reported provisioning changes since the last backup, and to retry backups if backup failures occur. Also, ITM SNC R5.0 (and later) only restores parameter values that don't match an NE's default value, therefore reducing the time to restore an NE.

For additional information, refer to Chapter 4 and to the *ITM SNC User's Guide*, 107-564-270.

TRCU3

DDM-2000 OC-3 R13.5 supports a specific application with the Lucent Technologies *5ESS* Switching System. The DDM-2000 OC-3 shelf in this application is referred to as the TRCU3.

The TRCU3 provides a standard SONET OC-3 or OC-12 path-switched ring interface for connecting the *5ESS* with an associated remote switch module through a SONET network. The TRCU3 collocated with the *5ESS* is the **host** TRCU3 while the TRCU3 located with the remote switch module is referred to as the **remote**. The connection between the *5ESS* and the low-speed side of the host TRCU3 is via a proprietary optical link which is an extension of a *5ESS* internal link referred to as the Network Control and Timing (NCT or NCT2) link. The same NCT or NCT2 connection is used between the remote TRCU3 and the remote switch module.

OI Features for Second Generation TARP Releases

Pre-TARP OI Features Supported by Second Generation TARP Releases

Because the PF-2000 TARP Releases were originally intended to facilitate OS-based centralized operations, and because TL1/X.25 OS access is the key standardized multi-vendor OI application, the following Remote NE Status features were not supported in DDM-2000 OC-12 R7.0, DDM-2000 OC-3 R13.0, and FiberReach R3.0 and R3.1:

- Remote office alarms
- Remote alarm CIT reports
- Remote user panel status (except FT-2000's FE ACTY LED indicator when an OC-48 protection switch is active at another FT-2000 in the same OC-48 ring)
- Parallel telemetry (including CO miscellaneous discrete outputs).

The second-generation TARP releases (DDM-2000 OC-3 R15.0 and FiberReach R4.0), include all of the above Remote NE status features (Refer to "Remote NE Status" in Chapter 3).

 **NOTE:**
FT-2000 still does not support these features.

 **NOTE:**
Telemetry Byte-Oriented Serial (TBOS) is still not available in any TARP release.

OI Features for TARP and Non-TARP Releases

Pre-TARP and TARP Release OI Features

These OI features were supported in the PF-2000 Pre-TARP Releases and are still supported between PF-2000 and PF-3000 TARP Release NEs, even in multi-vendor subnetworks, with the additional enhancements noted.

Remote Craft Access

Craft Interface Terminal (CIT) remote login.

⇒ **NOTE:**
Remote login from a WaveStar CIT to an FT-2000 NE or from an FT-2000 CIT to a WaveStar NE is not possible. However, it is possible to use TL1 cut-through from the WaveStar CIT to login to the FT-2000 NE and enter TL1 commands.

Remote Operations System (OS) Access

TL1/X.25 Gateway Network Element (TL1-GNE). ITM SNC R5.0 (and later) or other-vendor's NE (such as *TITAN 5500/S*) may now be used as the TL1-GNE for PF-2000 TL1-RNEs. Also, DDM-2000 OC-3 and OC-12 may now serve as the TL1-GNE for FT-2000 TL1-RNEs. The WaveStar NCC can also be used as a TL1/X.25 Gateway or TL1/TCP/IP Gateway.

FT-2000 R9.1 enables the FT-2000 to serve as the TL1-GNE for *TITAN 5500/S*, as well as WaveStar 2.5G and 10G. FT-2000 may also serve as the TL1-RNE for WaveStar BWM, 2.5G, and 10G.

(Continued on next page)

OI Features for TARP and Non-TARP Releases (Continued)

Remote Software Download

FT-2000 and DDM-2000 OC-3 and OC-12 TARP Releases accept dormant software copies (in all cases except DDM-2000 forced local downloads) without any disruption of subnetwork communications (i.e., no controller resets). ITM SNC R5.0 (and later) supports remote software download to PF-2000 TARP Release NEs, also.*

**NOTE:**

Remote Software Copy and Remote Login will pass through WaveStar NEs in mixed FT-2000/WaveStar rings.

Remote Time/Date Synchronization

PF-2000 NEs automatically relearn the current time and date at startup (and after controller resets) from other PF-2000 NEs in the subnetwork or from ITM SNC.

Backup and Restore

CPro-2000 creates a file that contains the current equipage, cross connections, and provisionable parameters of an NE that may be used during a Restore command.

**NOTE:**

Backup files created by a Pre-TARP Release of CPro-2000 cannot be used by a TARP Release CPro-2000.

For additional information, refer to the *CPro-2000 User Manual R7.0*, 365-576-130, *CPro-2000 User Manual R8.0*, 365-576-140, *CPro-2000 User Manual R9.0*, 365-576-150 or the *CPro-2000 User Manual R10.0*, 365-576-160.

* This feature will be useful when upgrading *from* the PF-2000 TARP Releases *to* later releases.

Compatibility

2

Contents

■ Overview	2
■ Software Compatibility	3
■ Data Communications Channel (DCC)	6
■ DCC Protection	13
■ Directory Services	22
■ Maximum Subnetwork Size	24

Overview

Introduction

This chapter provides engineering information and guidance that must be considered when planning subnetworks that include a combination of different PF-2000 and PF-3000 NEs, as well as other-vendor's NEs. |

OI compatibility among NEs is dependent on the NE's support of TARP, the OSI protocol stack on the DCC and IAO LAN (IAO LAN is optional), and TL1/X.25 OS access as specified in Bellcore GR-253-CORE, *SONET Transport Systems: Common Criteria*. In addition, DDM-2000 and FT-2000's TARP Manual Adjacency feature provides a minimum level of compatibility with NEs that support the OSI protocol stack on the DCC and/or IAO LAN but may not support TARP propagation.

Use this information in conjunction with the system planning and engineering information in the *Applications, Planning and Ordering Guides* associated with the specific PF-2000 products in the subnetwork being planned. Ordering information for these documents is located in the "About This Document" chapter of this document.

Software Compatibility

Guidelines

The PF-2000 TARP Releases are compatible, but not with the PF-2000 Pre-TARP Releases due to the introduction of a new OSI stack. PF-2000 TARP Release compatibility with *TITAN* 5500/S R5.0 has been confirmed through cooperative joint testing between Lucent Technologies and Tellabs. PF-2000 TARP Releases are expected to be compatible with other SONET vendor's NEs that also adhere to the multi-vendor OI standards as specified in Bellcore GR-253. (Confirmation of such compatibility is dependent on independent third party testing [e.g., by Bellcore].)

**NOTE:**

Other-vendor NEs are not supported *within* an FT-2000 OC-48 ring.

(Continued on next page)

* Registered trademark of Tellabs Operations, Inc.

Software Compatibility (Continued)

Software Compatibility Table

The software version guidelines in Table 2-1 must be followed to ensure proper subnetwork OI.

Table 2-1. TARP Release OI Software Compatibility

Product/Release	DDM-2000 FiberReach	DDM-2000 OC-3		DDM-2000 OC-12	FT-2000 OC-48*	
	R3.0 / R3.1 / R4.0	R13.0/ R15.0	R13.5	R7.0	R8.1 / R9.0	R9.1
FiberReach R3.0 / R3.1 / R4.0	X	X	X	X	X	X
SLC [®] -2000 COT R3.3	X	X		X	X	X
SLC-2000 RT R4.4 / R4.5 / R4.6 / R4.7	X	X		X	X	X
DDM-2000 OC-3 R13.0 / R15.0	X	X	X	X	X	X
DDM-2000 OC-3 R13.5	X	X	X	X	X	X
DDM-2000 OC-12 R7.0	X	X	X	X	X	X
FT-2000 R8.1 / R9.0 / R9.1	X	X	X	X	X	X
WaveStar BandWidth Manager R2.0	X	X	X	X		X
WaveStar 2.5G R3.0	X	X	X	X		X
WaveStar 10G R1.0	X	X	X	X		X
TITAN [†] 5500/S R5.0	X	X	X	X	X	X

* All FT-2000 NEs in a ring must operate on the same software release.

† Registered trademark of Tellabs Operations, Inc.

Although no DDM-2000 TARP Releases support high-speed optical linear (1+1) interfaces, DDM-2000 OC-3 and OC-12 path-switch rings (PSRs) can interconnect with (1+1) low-speed interfaces on an FT-2000 using Circuit Order NTP-018, "Establish Cross-Connection Between FT-2000 (1+1) OC-3/OC-12 Interface and DDM-2000 OC-3/OC-12 Interface," in the *FT-2000 OC-48 Lightwave System User/Service Manual*, 365-575-103.

(Continued on next page)

Software Compatibility (Continued)

EMS, GUI and Provisioning Tools

It is recommended that a graphical user interface (GUI) and provisioning tool such as Lucent's CPro-2000 or an element management system (EMS) such as Lucent's ITM SNC be used to simplify and mechanize administration, maintenance, and provisioning operations for subnetworks, especially when dealing with multi-product subnetworks. Table 2-2 indicates which tool can be used for the NEs in a subnetwork.

Table 2-2. Network Element Management Software Compatibility

Product/Release	CPro-2000				ITM SNC				
	7.0	8.0	9.0	10.0	5.0	6.0	8.0	9.0	10.0
FiberReach R3.0	X	X	X	X	X	X	X	X	X
FiberReach R3.1		X	X	X			X	X	X
FiberReach R4.0				X					X
SLC [®] -2000 R3.3 COT	X*	X*	X*	X*	X	X	X	X	X
SLC-2000 R4.4 / R4.5 / R4.6 / R4.7 RT	X*	X*	X*	X*	X	X	X	X	X
DDM-2000 OC-3 R13.0	X	X	X	X	X	X	X	X	X
DDM-2000 OC-3 R13.5		X	X	X		X	X	X	X
DDM-2000 OC-3 R15.0				X					X
DDM-2000 OC-12 R7.0	X	X	X	X	X	X	X	X	X
FT-2000 R8.1	X	X	X	X	X	X	X	X	X
FT-2000 R9.0			X	X			X	X	X
FT-2000 R9.1				X					X
TITAN [†] 5500/S R5.0					X [‡]				

* CPro-2000 operation in SLC-2000 is limited to SONET subsystems only.

† Registered trademark of Tellabs Operations, Inc.

‡ Customer access by TL1 Cut-through interface only.

ITM SNC R5.0—R10.0 is also compatible with Pre-TARP Releases of FT-2000 and DDM-2000; CPro-2000 R7.0—R10.0 is not. For more information, refer to the *CPro-2000 User Manual (R7.0, 365-576-130; R8.0, 365-576-140; R9.0, 365-576-150; or R10.0, 365-576-160)*, and/or the *ITM SNC User's Guide, 107-564-270*.



NOTE:

CPro-2000 and ITM-SNC are not compatible with the WaveStar products. The WaveStar CIT has its own GUI and the Subnetwork Management System (SNMS) is the EMS recommended for WaveStar.

Data Communications Channel (DCC)

Topology Guidelines

For the subnetwork to work properly, the activities at both ends of any DCC 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 access all NEs in a subnetwork.

All DDM-2000 DCCs and the FT-2000 low-speed (OC-3 and OC-12) DCCs are dependent on user provisioning to enable communications on each DCC (DDM-2000 CIT **set-fecom** and TL1 **ENT-FECOM**, FT-2000 CIT and TL1 **ent-asgmt-dcc** and **dlt-asgmt-dcc**). The DDM-2000 default is *Enabled* and the FT-2000 default is *Disabled* (for FT-2000 low-speed DCCs only).

The operation of each optical DCC span is also dependent on user provisioning to assign one end of each DCC to be the Network Side and the other end to be the User Side (same commands as above). The FT-2000 default is *Network* and the DDM-2000 defaults vary (see the DDM-2000 command pages).

**NOTE:**

In mixed FT-2000/WaveStar rings, the East line must be cabled to the West line and the West line must be cabled to the East line. The user/network side of the WaveStar NE must be provisioned as “user” for the East line and “network” for the West line for the OC-48 section DCC. See the *FT-2000 OC-48 Lightwave System User/Service Manual*, 365-575-103, for more information.

Data Communications Channel (DCC) (Continued)

Intra-Office Local Area Network (IAO LAN) Interface

An extension of the SONET DCC exists that allows for DCC connectivity above and beyond that provided by optical interfaces. This extension is the Intra-Office Local Area Network (IAO LAN). The IAO LAN is the only means by which DCC connectivity can be extended to ITM SNC.

DDM-2000 OC-3 and OC-12 support an IAO LAN interface for operations data communications. The IAO LAN is necessary to support the following ITM SNC R5.0 (and later) features:

1. ITM SNC as the TL1-GNE for DDM-2000, FT-2000 and *TITAN 5500/S*
2. ITM SNC software download to DDM-2000 and FT-2000

Because the IAO LAN is effectively an extension of the SONET DCC, the IAO LAN may also be used to join multiple, otherwise separate subnetworks. All NE-NE OI features that are supported by PF-2000 over the DCC are also supported over the IAO LAN. DDM-2000 FiberReach and FT-2000 do not support direct IAO LAN interfaces, but their OI features are supported indirectly via DDM-2000, WaveStar, or another-vendor (such as *TITAN 5500/S*) NE's IAO LAN interface.

Establishing the IAO LAN

The IAO LAN interface is a software-only enhancement to DDM-2000 OC-3 R13.0/R15.0 and OC-12 R7.0. The DDM-2000 OC-3 J50 and DDM-2000 OC-12 J74 backplane connectors support the IAO LAN interface via an RJ45 connector, although, DDM-2000 OC-3 requires an IAO LAN adapter cable (ED8C724-22) to accept an RJ45.

DDM-2000's IAO LAN interface is dependent on user provisioning to enable communications (**com**) (CIT **set-fecom**, TL1 **ENT-FECOM**). The DDM-2000 default value is *Enabled*. The same DDM-2000 commands can be used to reset DDM-2000's IAO LAN interface. The CIT command **test-iaolan** is available to test DDM-2000's IAO LAN connection to an IAO LAN hub.

ITM SNC's IAO LAN interface provides an alternate, higher bandwidth communications path to the NEs (instead of X.25). This improves performance by migrating TL1-GNE processing from the NEs to the EMS, by providing multiple ITM SNC to NE communication paths over the IAO LAN, and by supporting fast remote software downloads to the NEs over the IAO LAN.

(Continued on next page)

Data Communications Channel (DCC) (Continued)

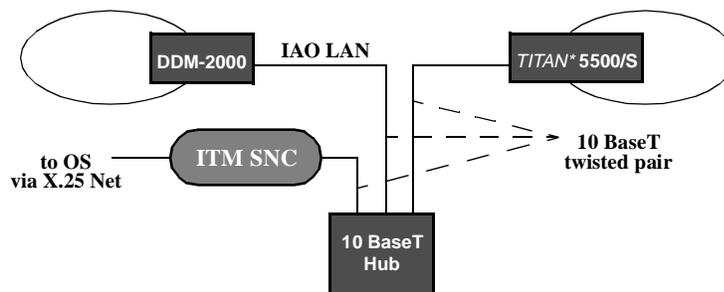
IAO LAN compatibility

The IAO LAN interface is compatible with 10 BaseT Ethernet Hubs operating at 10 Mb/s over four-wire twisted pair cables (per Bellcore GR-253, ANSI/IEEE 802.2 [ISO 8802-2] and ANSI/IEEE 802.3 [ISO 8802-3]). For example, Lucent IAO LAN testing was performed with CentreCOM 3012T Hubs, and ITM SNC testing was performed with Applied Innovation 2524 Router. Other NEs may connect to the same IAO LAN via another port on the hub. The hub may connect to other IAO LAN segments via an Attachment Unit Interface (AUI) interface.

The IAO LAN capability is contained within the data link layer of the OSI protocol stack. To the network layer above it, the IAO LAN is simply another communication "link," just like the DCC on optical interfaces.

IAO LAN sample illustration

Figure 2-1 shows an example configuration of NEs (DDM-2000 OC-3 or OC-12 or *TITAN* 5500/S) that are equipped with IAO LAN interfaces.



* Registered trademark of Tellabs Operations, Inc.

Figure 2-1. IAO LAN Interface Example

(Continued on next page)

Data Communications Channel (DCC) (Continued)

High-Speed DCCs The number of high-speed (HS) optical DCCs supported simultaneously by a PF-2000 NE depends on the product type, the product's software release, and the DCC type (bidirectional line-switched ring [BLSR] or unidirectional path-switched ring [UPSR]). These limits are summarized in Table 2-3.

Table 2-3. High-Speed DCC Types Supported

Product Type	Software Release	Max. No. Simultaneous HS - DCCs	DCC type
FT-2000 OC-48	R8.1 / R9.0 / R9.1	1 pair	Protected BLSR OC-48
DDM-2000 OC-12	R7.0	1 pair	Protected Ring OC-12
DDM-2000 OC-3 (and SLC[®]-2000 Access System)	R13.0 / R13.5 / R15.0	1 pair	Protected Ring OC-3
		1 pair	Protected Ring OC-12
DDM-2000 FiberReach	R3.0 / R3.1	1 pair	Protected Ring OC-1
	R3.1 / R4.0	1 pair	Protected Ring OC-3
	R4.0	1 pair	Protected Ring OC-12

(Continued on next page)

Data Communications Channel (DCC) (Continued)

Low-Speed DCCs The number of low-speed (LS) optical DCCs supported simultaneously by a PF-2000 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 2-4.

Table 2-4. Low-Speed DCC Types Supported

Product Type	Software Release	Max. No. Simultaneous LS - DCCs	DCC type
FT-2000 OC-48	R8.1 / R9.0 / R9.1	8	Linear (1+1) OC-3
		4 pairs	Linear-to-Ring OC-3
			Protected Ring (0x1) OC-3
		8	Unprotected Ring (0x1) OC-3
		2 pairs	Linear (1+1) OC-12
			Linear-to-Ring OC-12
4	Protected Ring (0x1) OC-12		
DDM-2000 OC-12	R7.0	4	Unprotected Ring (0x1) OC-12
		4 pairs	Linear (1+1) OC-3
		8	Protected Ring (0x1) OC-3
DDM-2000 OC-3	R13.0 / R15.0	3	Unprotected Ring (0x1) OC-3
		6 pairs	Linear (1+1) OC-3
		12	Protected Ring (0x1) OC-1
	R13.5	None (5ESS Switch NCT or NCT2 only)	
SLC[®]-2000 Access System	R3.3 / R4.4 — R4.7 with DDM-2000 OC-3 R13.0 / R15.0	2	Unprotected Ring (0x1) OC-1
		2 pairs	Linear (1+1) OC-3
		4	Protected Ring (0x1) OC-1

(Continued on next page)

Data Communications Channel (DCC) (Continued)

Low-Speed DCCs (continued)

For FT-2000 to access the low-speed DCC, one or more OC-3 or OC-12 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 (but the FT-2000 low-speed transmission slots are physically limited to four OC-12 circuit packs).

DDM-2000 FiberReach does not support DCC on low-speed optical interfaces.

(Continued on next page)

Data Communications Channel (DCC) (Continued)

Optical Rates

Optical interfaces that support DCC communications and compatibility among the interfaces are summarized in Table 2-5:

Table 2-5. Optical Interfaces Supporting DCC Communication

	FT-2000 OC-48	DDM-2000 OC-12	DDM-2000 OC-3	DDM-2000 FiberReach*
FT-2000	OC-48 OC-12 OC-3/IS-3	OC-12 OC-3/IS-3	OC-12 OC-3/IS-3	OC-12 (IS-3) OC-3 (IS-3)
DDM-2000 OC-12	OC-12 OC-3/IS-3	OC-12 OC-3/IS-3	OC-12 OC-3/IS-3	OC-12 (IS-3) OC-3 (IS-3)
DDM-2000 OC-3	OC-12 OC-3/IS-3	OC-12 OC-3/IS-3	OC-12 OC-3/IS-3	OC-12 (IS-3) OC-3 (IS-3) OC-1
DDM-2000 FiberReach*	OC-12 (IS-3) OC-3 (IS-3)	OC-12 (IS-3) OC-3 (IS-3)	OC-12 (IS-3) OC-3 (IS-3) OC-1	OC-12 (IS-3) OC-3 (IS-3) OC-1
WaveStar BWM	OC-48 OC-12 OC-3	OC-12 OC-3	OC-12 OC-3	OC-3
WaveStar 2.5G	OC-48 OC-12 OC-3	OC-12 OC-3	OC-12 OC-3	OC-3
WaveStar 10G	OC-48 OC-12 OC-3	OC-12 OC-3	OC-12 OC-3	OC-3
TITAN† 5500/S	OC-12 OC-3/IS-3	OC-12 OC-3/IS-3	OC-12 OC-3/IS-3	OC-3 (IS-3)

* DDM-2000 FiberReach R3.1 supports OC-3 ring (0x1) interfaces. FiberReach R3.1 does not support an IS-3 interface itself, but FiberReach's OC-3 interface is compatible with IS-3 interfaces.

DDM-2000 FiberReach R4.0 supports OC-3 and OC-12 ring (0x1) and identical (1+1) interfaces. FiberReach R4.0 does not support IS-3 interface itself, but FiberReach's OC-3 and OC-12 interfaces are compatible with IS-3 interfaces.

† Registered trademark of Tellabs Operations, Inc.



NOTE:

TITAN 5500/S supports OC-3 ring (0x1), OC-12 ring (0x1), and OC-3 linear (1+1) interfaces to DDM-2000 and FT-2000. *TITAN 5500/S* supports OC-12 linear (1+1) interfaces to FT-2000, also.

DCC Protection

Sample Illustration

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

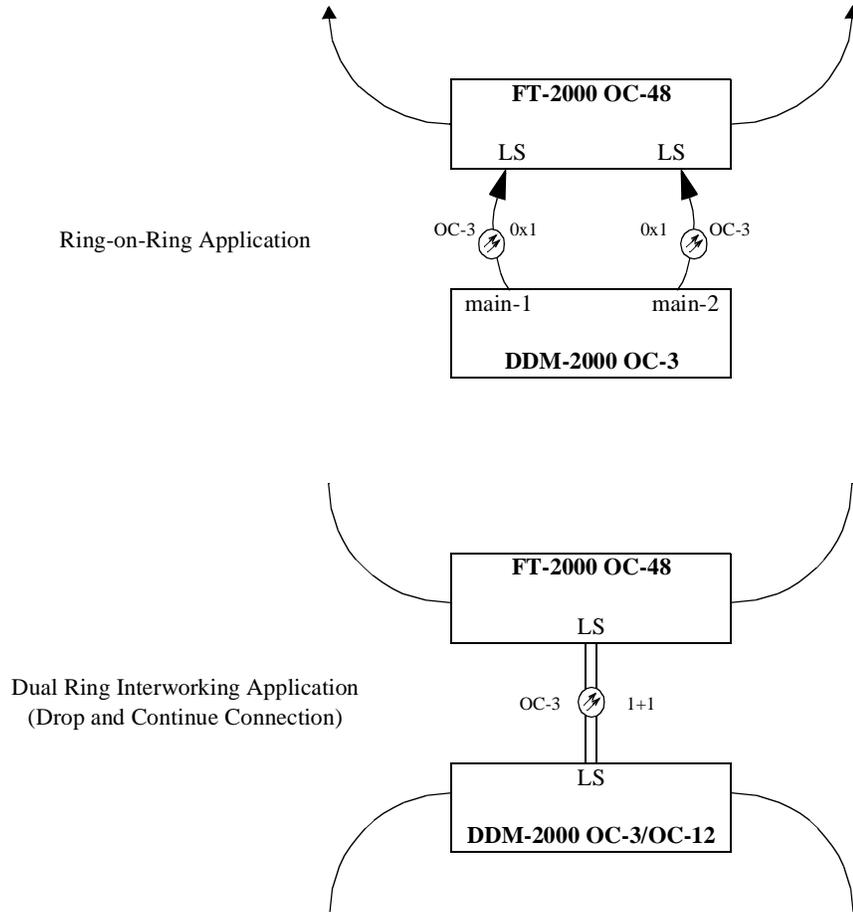


Figure 2-2. DCC Protection Guidelines for Interworking Rings

(Continued on next page)

DCC Protection (Continued)

Protection Guidelines

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 support 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 support ring (0x1) protection mode, therefore, no protection mode provisioning is necessary (refer to Table 2-4). 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 Lucent NEs are fixed and cannot be changed in all references except OC-3 R15.0 and OC-1 R4.0.
2. When the main interfaces of a DDM-2000 OC-3 PSR or OC-3 optics on a FiberReach shelf (or a *TITAN* 5500/S 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 unless R15.0 or R4.0 is being used. In this case, the high-speed OC-3 optics and the interconnected low-speed OC-3 optics of the OC-12 can also be provisioned for 1+1 identical protection mode.

(Continued on next page)

DCC Protection (Continued)

Protection Guidelines (continued)

3. When the main interfaces of a DDM-2000 OC-3 PSR or OC-3 optics on a FiberReach shelf (or a *TITAN 5500/S* 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. Alternatively, the DDM-2000 OC-3 PSR and OC-3 optics on a FiberReach shelf can interconnect with (1+1) low-speed interfaces on an FT-2000 using the special procedure described in Circuit Order NTP-018, "Establish Cross-Connection Between FT-2000 (1+1) OC-3/OC-12 Interface and DDM-2000 OC-3/OC-12 Interface," in the *FT-2000 OC-48 Lightwave System User/Service Manual*, 365-575-103. In cases where OC-3 R15.0 and OC-1 R4.0 are being used, the high-speed OC-3 optics can also be provisioned for 1+1 identical protection mode.

When the main interfaces of a DDM-2000 OC-12 PSR or OC-12 Optics on a DDM-2000 OC-3 Shelf or OC-12 optics on a FiberReach shelf (or a *TITAN 5500/S* OC-12 PSR) interconnect to low-speed OC-12 interfaces of an FT-2000, those low-speed interfaces of the FT-2000 must be provisioned for ring (0x1) protection mode. Alternatively, the DDM-2000 OC-12 PSR can interconnect with (1+1) low-speed interfaces on an FT-2000 using the special procedure described in Circuit Order NTP-018, "Establish Cross-Connection Between FT-2000 (1+1) OC-3/OC-12 Interface and DDM-2000 OC-3/OC-12 Interface," in the *FT-2000 OC-48 Lightwave System User/Service Manual*, 365-575-103.

In cases where OC-3 R15.0 and OC-1 R4.0 are being used, the high-speed OC-12 optics can also be provisioned for 1+1 identical mode.

4. When the low-speed linear interfaces of a DDM-2000 OC-3 PSR or an FT-2000 (or *TITAN 5500/S* OC-3 linear interfaces) 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 *TITAN 5500/S* OC-3 linear interfaces) 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.
6. When the *TITAN 5500/S* OC-12 linear interfaces interconnect to low-speed OC-12 interfaces of an FT-2000, those low-speed interfaces of the FT-2000 must be provisioned for linear (1+1) protection mode.

(Continued on next page)

DCC Protection (Continued)

FT-2000 to WaveStar Connectivity

The following examples show three types of supported DCC interfaces:

Example One

Figure 2-3 uses a BLSR OC-48 high-speed interface:

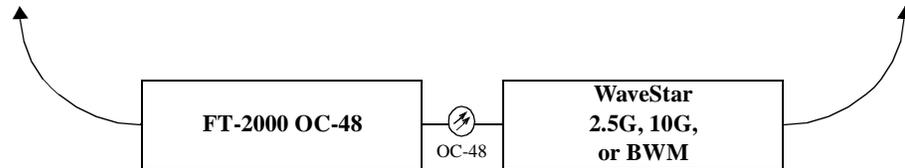
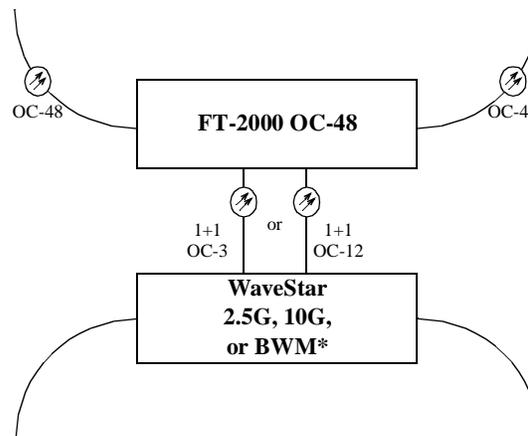


Figure 2-3. FT-2000 to WaveStar Connectivity Using a BLSR OC-48 High-Speed Interface

Example Two

Figure 2-4 uses a 1+1 OC-3 or OC-12 low-speed interface:



* BWM R3 does not support 1+1 DCC.

Figure 2-4. FT-2000 to WaveStar Connectivity Using a 1+1 OC-3 or OC-12 Low-Speed Interface

(Continued on next page)

DCC Protection (Continued)

FT-2000 to WaveStar Connectivity (Continued)

Example Three

Figure 2-5 uses a 0x1 OC-3 or OC-12 low-speed interface:

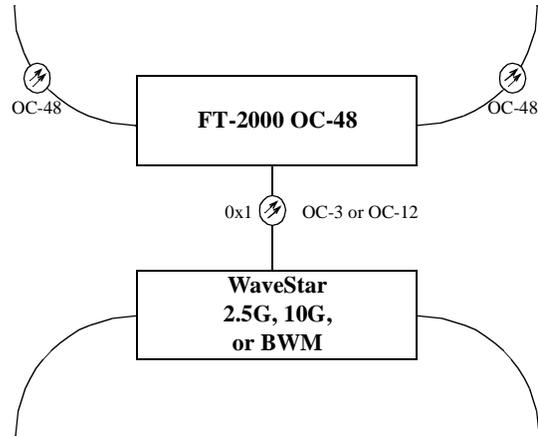


Figure 2-5. FT-2000 to WaveStar Connectivity Using a 0x1 OC-3 or OC-12 Low-Speed Interface

(Continued on next page)

DCC Protection (Continued)

DDM-2000 OC-3 or OC-12 Ring (Dual 0x1) Interfaces to WaveStar BWM 2.5G/10G Linear (1+1) Interfaces

None of the DDM-2000 OC-3 (or OC-12) TARP Releases that support OI with WaveStar BWM 2.5G/10G supports *high-speed* OC-3 (or OC-12) *linear* (1+1) interfaces. However, applications that require a DDM-2000 OC-3 shelf to multiplex low-speed DS1 traffic onto an OC-3 (or OC-12) interface are still supported as shown in Figure 2-6.

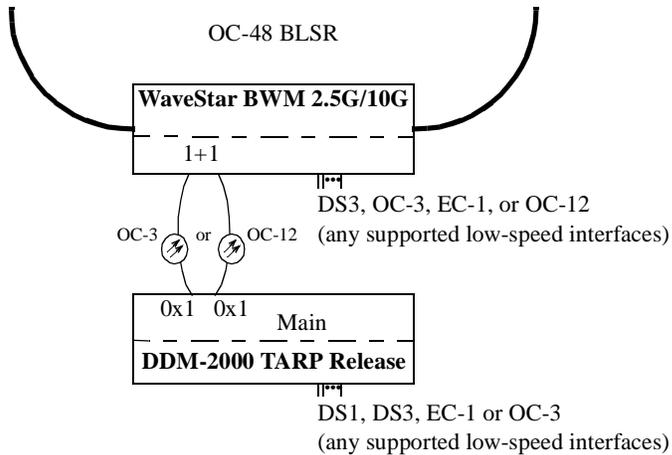


Figure 2-6. DDM-2000 to WaveStar Connectivity

NOTE:
 This application is *neither* path-on-line applications *nor* WaveStar BWM 2.5G/10G Unidirectional Path-Switched Ring (UPSR) termination. WaveStar BWM 2.5G/10G supports path-on-line applications.

(Continued on next page)

DCC Protection (Continued)

DDM-2000 OC-3 or OC-12 Ring (Dual 0x1) Interfaces to WaveStar BWM 2.5G/10G Linear (1+1) Interfaces (Continued)

In the subject application, DDM-2000 operates as a UPSR ring node, with low-speed DS1 (or DS3 or EC1 or OC-3) interfaces and dual 0x1 high-speed OC-3 (or OC-12) ring interfaces. The DDM-2000 dual 0x1 OC-3 (or OC-12) fiber pairs are connected to WaveStar BWM 2.5G/10G, but those WaveStar BWM 2.5G/10G ports are provisioned as a linear (1+1) protection group. The STS-1 paths on such linear (1+1) interfaces can be cross-connected to any other port (OC-48, OC-12, OC-3, EC-1, or DS3) on the WaveStar BWM 2.5G/10G.

**NOTE:**

Multiple DDM-2000s can be connected to a WaveStar BWM 2.5G/10G in this same way, but each DDM-2000 must be in its own separate *single*-node UPSR for this application.

Defaults

DDM-2000 supports DCC on both of its dual 0x1 ring interfaces by default. The WaveStar 2.5G is provisioned to support DCC on *each* of the two ports in the connected linear (1+1) protection group. That assignment of WaveStar BWM 2.5G/10G DCC is unique for this application, in particular. For all other WaveStar BWM 2.5G/10G linear (1+1) protection groups, only one DCC is assigned to a linear (1+1) protection group (by default and standard practice).

Identical DCC

When available, DDM-2000 OC-3 R15 can be provisioned to support "identical DCC" on its high-speed ring (dual 0x1) OC-3 (or OC-12) interface. Because DDM-2000's "identical DCC" feature mimics linear (1+1) DCC, WaveStar BWM 2.5G/10G's default DCC assignment for a linear (1+1) protection group will suffice for the subject application, too. The DDM-2000 "identical DCC" feature is not compatible with BWM releases without 1+1 DCC (BWM R3).

(Continued on next page)

DCC Protection (Continued)

Protection Guidelines for PF-2000 Optical Interfaces

Table 2-6 shows the DCC protection modes available per optical interface as described in the previous section:

Table 2-6. DCC Protection Modes for PF-2000 Optical Interfaces

		FT-2000			DDM-2000 OC-12		DDM-2000 OC-3			DDM-2000 FiberReach			
		OC-3/IS-3 LS	OC-12 LS	OC-48 HS	OC-3/IS-3 LS	OC-12 HS	OC-1 LS	OC-3/IS-3 LS	OC-3/IS-3 HS	OC-12 HS	OC-1 HS	OC-3 HS R3.1 and R4.0 only	OC-12 HS R4.0 only
FT-2000	OC-3/IS-3 Low-Speed	0x1 1+1			0x1 1+1			1+1	0x1 1+1			0x1 1+1	
	OC-12 Low-Speed		0x1 1+1			0x1				0x1 1+1			0x1 1+1
	OC-48 High-Speed			BLSR									
DDM-2000 OC-12	OC-3/IS-3 Low-Speed				0x1 1+1			1+1	0x1 1+1			0x1 1+1	
	OC-12 High-Speed					0x1				0x1			0x1
DDM-2000 OC-3	OC-1 Low-Speed										0x1		
	OC-3/IS-3 Low-Speed							1+1					
	OC-3/IS-3 High-Speed								0x1 1+1			0x1 1+1	
	OC-12 High-Speed									0x1 1+1			0x1 1+1
DDM-2000 FiberReach	OC-1 High-Speed										0x1		
	OC-3 High-Speed (R3.1/R4.0)											0x1	
	OC-12 High-Speed (R4.0)												0x1

(Continued on next page)

DCC Protection (Continued)

Protection Guidelines for PF-2000 Multi-Product / Multi-Vendor Optical Interfaces

Table 2-7 shows the DCC protection modes available per optical interface as described in the previous section:

Table 2-7. DCC Protection Modes for PF-2000 Multi-Product / Multi-Vendor Optical Interfaces

		FT-2000			DDM-2000 OC-12		DDM-2000 OC-3			DDM-2000 FiberReach			
		OC-3/IS-3 LS	OC-12 LS	OC-48 HS	OC-3/IS-3 LS	OC-12 HS	OC-1 LS	OC-3/IS-3 LS	OC-3/IS-3 HS	OC-12 HS	OC-1 HS	OC-3 HS R3.1 and R4.0 only	OC-12 HS R4.0 only
WaveStar BandWidth Manager*	OC-3	0x1 1+1			0x1 1+1			0x1 1+1	0x1 1+1			0x1 1+1	
	OC-12		0x1 1+1			0x1				0x1 1+1†			0x1 1+1
	OC-48			2F BLSR									
WaveStar 2.5G/10G	OC-3	0x1 1+1			0x1 1+1			0x1 1+1	0x1 1+1†			0x1 1+1‡	
	OC-12		0x1 1+1			0x1				0x1 1+1†			0x1 1+1‡
	OC-48			2F BLSR									
TITAN 5500/S	OC-3/IS-3	0x1 1+1			0x1 1+1			1+1	0x1 1+1			0x1 1+1	
	OC-12		0x1 1+1			0x1				0x1 1+1			0x1 1+1

* BWM R3.0 does not support 1+1 DCC, but does support linear (1+1) transmission protection group support with dual 0x1 DCC. DDM-2000 "identical DCC" feature is not compatible with BWM releases without 1+1 DCC.

† DDM-2000 OC-3 R15 "identical DCC" feature is required.

‡ DDM-2000 FiberReach R4 "identical DCC" feature is required.

Directory Services

TARP Replaces Lucent Directory Services (LDS)

PF-2000 supports OSI seven-layer protocol stack architecture over the SONET DCC. This architecture requires network layer 3 addresses (NSAPs), while users at remote OSs and at NE CITs use application layer 7 names (TIDs).

Therefore, it is essential that a system be available that provides translations between NE names (TIDs) and addresses (NSAPs).

In the Pre-TARP Releases, this function was provided by LDS. In Pre-TARP Release Lucent-only subnetworks, the NE that maintains the directory of translations between TIDs and NSAPs for all NEs in the subnetwork is called the directory services network element (DSNE). There is no DSNE in the TARP Releases.

In the TARP Releases, the translation function supports multi-vendor OI compatibility. For more information about TARP, refer to Chapter 5 of this document.

OI features that are supported by LDS in Pre-TARP Releases but *not* by TARP include:

- Duplicate TID alarms
- Remote NE product type identification
- Remote NE communication status (exceptions are R15.0 and R4.0)
- Remote NE status (exceptions are R15.0 and R4.0)
(Refer to "Remote NE Status" in Chapter 3 for further elaboration.)

(Continued on next page)

Directory Services (Continued)

**Target Identifier
(TID)**

Each NE in a subnetwork must be user provisioned with a unique TID (CIT **set-ne**, TL1 **ENT-SYS** or **SET-SID**). DDM-2000's default TID is *LT-DDM-2000*, and FT-2000's default TID is *LT-FT-2000*. WaveStar's default TID is *LUCENT-WAVESTAR-NE*.

**NOTE:**

Some other-vendor NEs may require that *all* TIDs in a subnetwork adhere to specific rules, e.g., that each TID start with an alphabetic character and/or that each TID consist of at least 6-7 characters.

**Network Service
Access Point
(NSAP)**

NSAP (area address) provisioning is described in Chapter 6 of this document.

Maximum Subnetwork Size

Subnetwork Size Guidelines

The maximum subnetwork size supported by PF-2000 NEs within a single Level 1 area only (i.e., a subnetwork with no Level 2 ISs) is 50 NEs. However, by partitioning a subnetwork into multiple areas and provisioning Level 2 ISs, subnetwork sizes of up to 256 NEs are supported. Refer to "Maximum Subnetwork Sizes" in Chapter 6 for additional information.

**NOTE:**

The subnetwork size limits apply to all NEs in the same DCC domain. If DCC domains are split (e.g., by disabling the DCC between such domains of NEs), larger transmission networks are possible.

Contents

■ Introduction	2
■ Remote Craft Access	3
■ Remote Operations System Access	4
■ X.25 Virtual Circuits	13
■ TL1 Autonomous Message Routing	15
■ TL1-GNE Reporting for TL1-RNEs	18
■ TL1/X.25 Message Volume	19
■ Remote NE Status	21
■ Remote Software Download	26
■ Remote Time and Date Synchronization	28
■ OI Features Summary	30

Introduction

Overview

Operations Interworking (OI) provides the capability to access, operate, provision, and administer remote PF-2000 NEs from any site in a SONET subnetwork or from a centralized operations system (OS).

This OI Guide deals with interworking at the “application” level. To interwork at this level, PF-2000 NEs must be capable of performing the following end-to-end applications:

- Remote Login
- Configuration Management
- Fault Management
- Software Management.

This section describes the individual OI features. It also provides application information and guidance that must be considered to use the OI features of PF-2000 NEs effectively. Considerations for Multi-Product (PF-2000/PF-3000) OI are also discussed.

Remote Craft Access

CIT Remote Login This feature allows a craftperson who is logged into a local PF-2000 NE via an ASCII craft interface terminal (CIT) to establish a remote login session with another PF-2000 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 PF-2000 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.

**NOTE:**

In a multi-vendor subnetwork, remote craft access is limited to PF-2000-to-PF-2000 sessions. However, connections may be established through other-vendor's NEs or through PF-3000 NEs in Multi-Product subnetworks. The WaveStar CIT provides a TL1 cut-through mode to login to PF-2000 NEs and enter TL1 commands.

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

Remote Operations System Access

TL1/X.25 Gateway Network Elements (TL1-GNEs)

Through this feature, one or more TL1/X.25 OS interfaces may be used to provide OS access to all the PF-2000 and PF-3000 NEs in a subnetwork. The NE providing the OS interface is called the TL1/X.25 Gateway Network Element (TL1-GNE) because it forwards TL1 messages received from OSs to remote NEs via an X.25 interface, and vice versa. FiberReach does not support a directly connected X.25 interface but supports remote OS access via any of the other PF-2000 TL1-GNEs.

DDM-2000 OC-3 and OC-12 can now serve as the TL1-GNE for FT-2000 TL1-RNEs (as an alternative to FT-2000's existing capability to serve as the TL1-GNE for DDM-2000 TL1-RNEs). ITM SNC can also serve as the TL1-GNE for PF-2000 TL1-RNEs (refer to "ITM SNC as TL1-GNE" in Chapter 4).

FT-2000 R9.1 enables the FT-2000 to serve as the TL1-GNE for *TITAN* 5500/S as well as WaveStar 2.5G and 10G. DDM-2000 and FT-2000 may also serve as the TL1-RNE for WaveStar BWM, 2.5G, and 10G. NCC provides the GNE functionality for the WaveStar products.

Other-vendor NEs such as *TITAN* 5500/S may also be the TL1-GNE for PF-2000 TL1-RNEs. The reverse of that is not necessarily supported, in particular, some PF-2000 NEs cannot serve as the TL1-GNE for *TITAN* 5500/S R5.0. DDM-2000 OC-3 R15, FiberReach R4 (TL1 over CIT), and FT-2000 R9.1 provide limited TL1-GNE service for non-Lucent NEs (up to five logins).

(Continued on next page)

Remote Operations System Access (Continued)

TL1-GNE vs. TL1-RNE

Table 3-1 summarizes TL1-RNEs supported by each TL1-GNE in TARP Release subnetworks:

Table 3-1. TL1-RNEs Supported by TL1-GNEs

TL1-GNE	Supported TL1-RNEs					
	FT-2000	DDM-2000 OC-12	DDM-2000 OC-3	DDM-2000 FiberReach	WaveStar 2.5G/10G	TITAN 5500/S
FT-2000	✓	✓	✓	✓	✓	✓
DDM-2000 OC-12	✓	✓	✓	✓	—	—
DDM-2000 OC-3	✓	✓	✓	✓	—	—
DDM-2000 FiberReach	—	—	—	—	—	—
WaveStar	✓	✓	✓	✓	✓	—
TITAN† 5500/S	✓	✓	✓	✓	✓	✓
ITM SNC	✓	✓	✓	✓	—	✓

* FT-2000 R9.1 and later.

† Registered trademark of Tellabs Operations, Inc.

Multiple TL1-GNEs

One or more NEs may be used as TL1-GNEs in a subnetwork. 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 NE may be used as the TL1-GNE for a small 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 TL1-RNEs than a single TL1-GNE can support. More than one TL1-GNE can contact the same TL1-RNEs at the same time.

(Continued on next page)

Remote Operations System Access (Continued)

TL1-GNE Selection

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

- PF-2000 TL1-GNE selection is simpler in the TARP Releases; any PF-2000 NE with X.25 access (except FiberReach) can serve as the TL1-GNE for any other PF-2000 NEs in the subnetwork.
- If a *TITAN 5500/S* with X.25 access is present, *TITAN 5500/S* must serve as the TL1-GNE for any *TITAN 5500/S* DCSs (or NEs) in the subnetwork. *TITAN 5500/S* can serve as the TL1-GNE for any PF-2000 NEs in the subnetwork, also.
- Alternatively, if an IAO LAN and ITM SNC are available, ITM SNC can serve as the TL1-GNE for all PF-2000 NEs and *TITAN 5500/S*s in the subnetwork (refer to “ITM SNC as TL1-GNE” in Chapter 4).
- When choosing an OC-3 R15.0 NE as a GNE, it is recommended that the GNE not be an AGNE.

Each subnetwork may have more than one TL1-GNE, as described in the previous subsection. All TL1-GNEs are subject to limitations with respect to the number of TL1 logins and/or TL1-RNEs supported. The limitations for TL1-GNEs are covered in “Maximum number of TL1 logins per PF-2000 TL1-GNE” later in this chapter.

A PF-2000 NE becomes a TL1-GNE automatically when the OS X.25 connection is made.

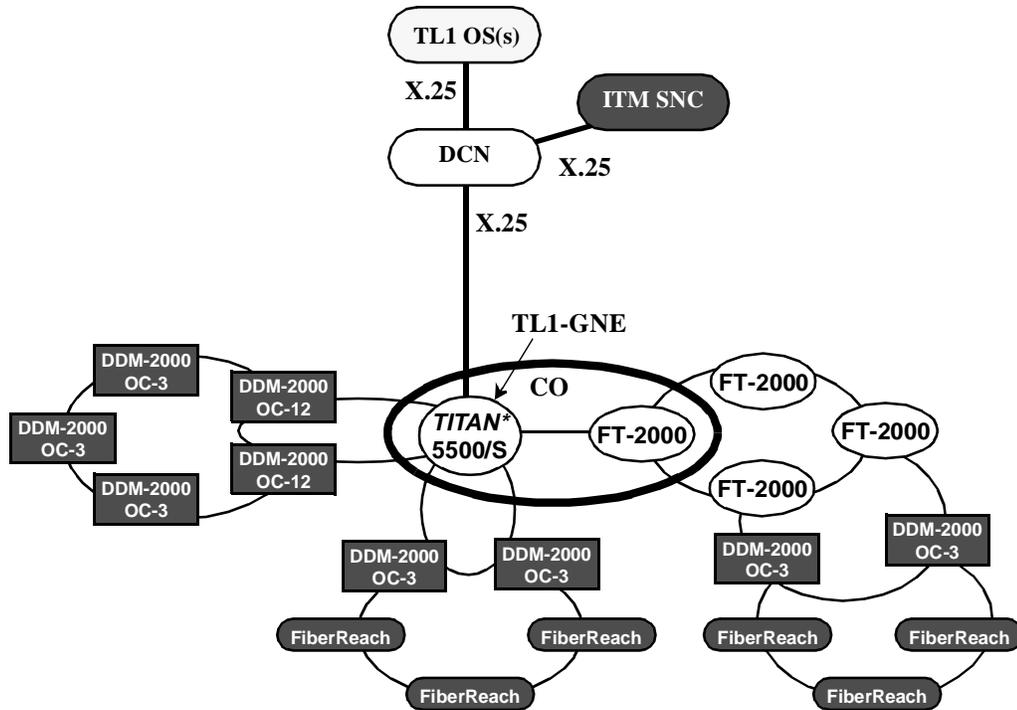
The TL1-GNE's X.25 packet size is adjustable via automatic negotiation to assure compatibility with the maximum X.25 packet sizes supported by the OSs and X.25 DCN (DDM-2000 CIT `set-x25`, FT-2000 CIT `set-ne`, and TL1 `ENT-sys`). The default value is 256 bytes.

Remote Operations System Access (Continued)

Examples

The following figures illustrate examples of OS access in multi-vendor subnetworks.

Figure 3-1 illustrates OS access with *TITAN 5500/S* serving as the TL1-GNE.



* Registered trademark of Tellabs Operations, Inc.

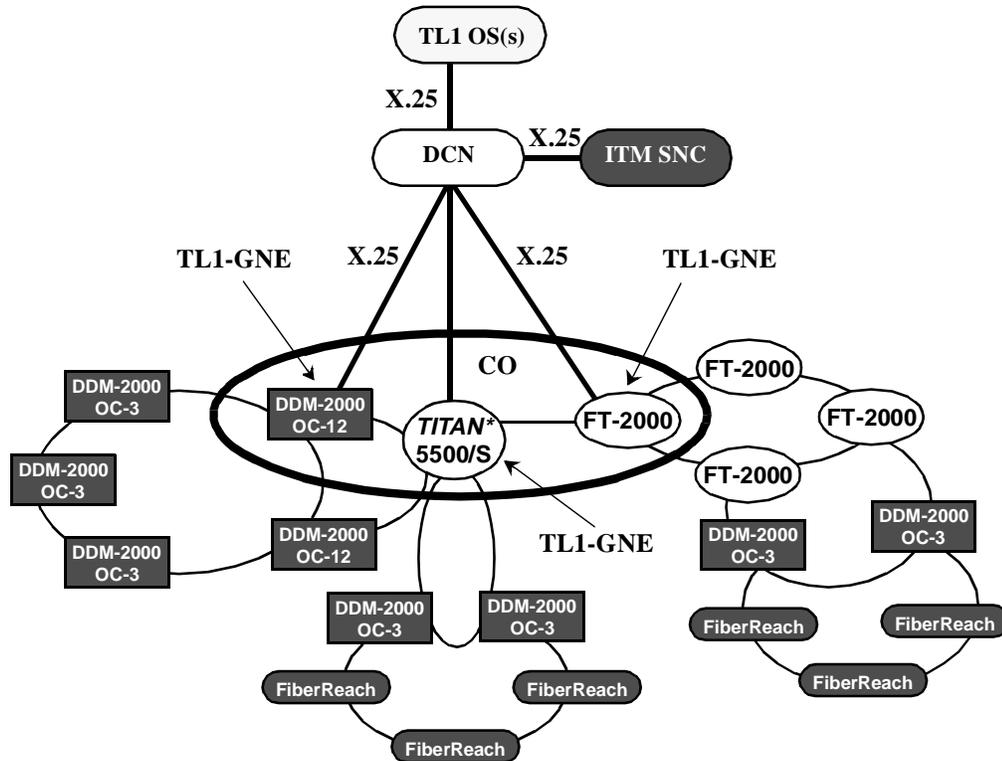
Figure 3-1. OS Access via the *TITAN 5500/S* X.25 Port

(Continued on next page)

Remote Operations System Access (Continued)

Examples (Continued)

Figure 3-2 illustrates OS access with DDM-2000, FT-2000, and *TITAN* 5500/S serving as multiple TL1-GNEs (*NOTE: DDM-2000 and FT-2000 R8.1/R9.0 cannot serve as TL1-GNE for TITAN 5500/S*).



* Registered trademark of Tellabs Operations, Inc.

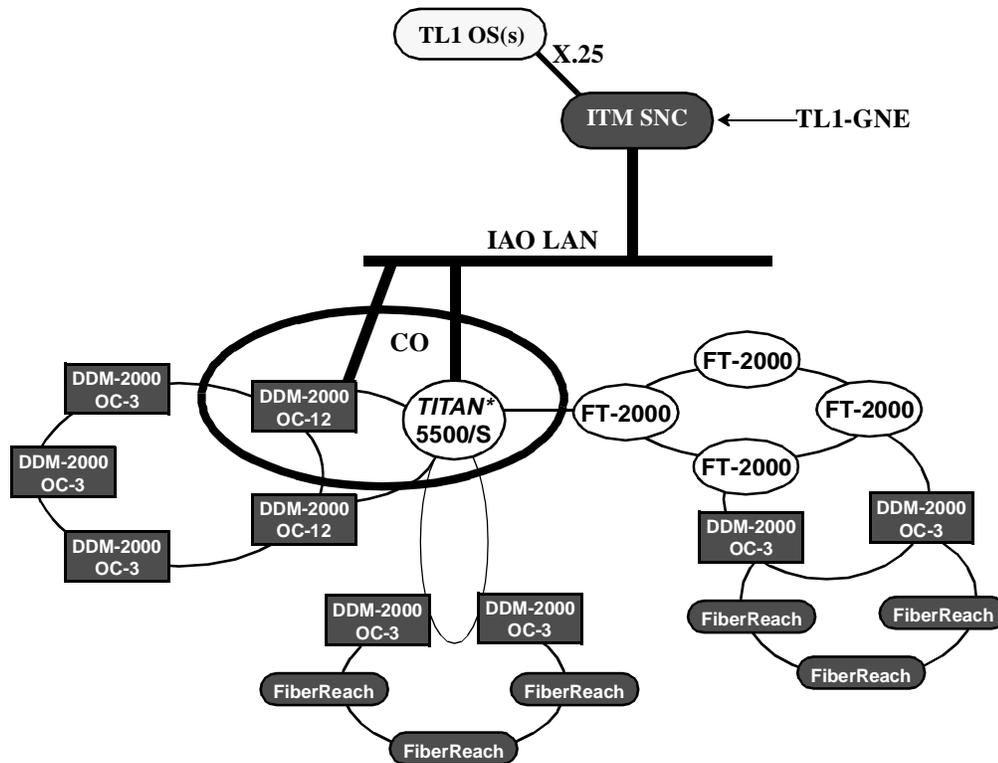
Figure 3-2. Multiple TL1-GNE OS Access

(Continued on next page)

Remote Operations System Access (Continued)

**Examples
 (Continued)**

Figure 3-3 illustrates OS access via IAO LAN with ITM SNC serving as the TL1-GNE and supporting the Northbound TL1/X.25 OS interface to other TL1 OSs.



* Registered trademark of Tellabs Operations, Inc.

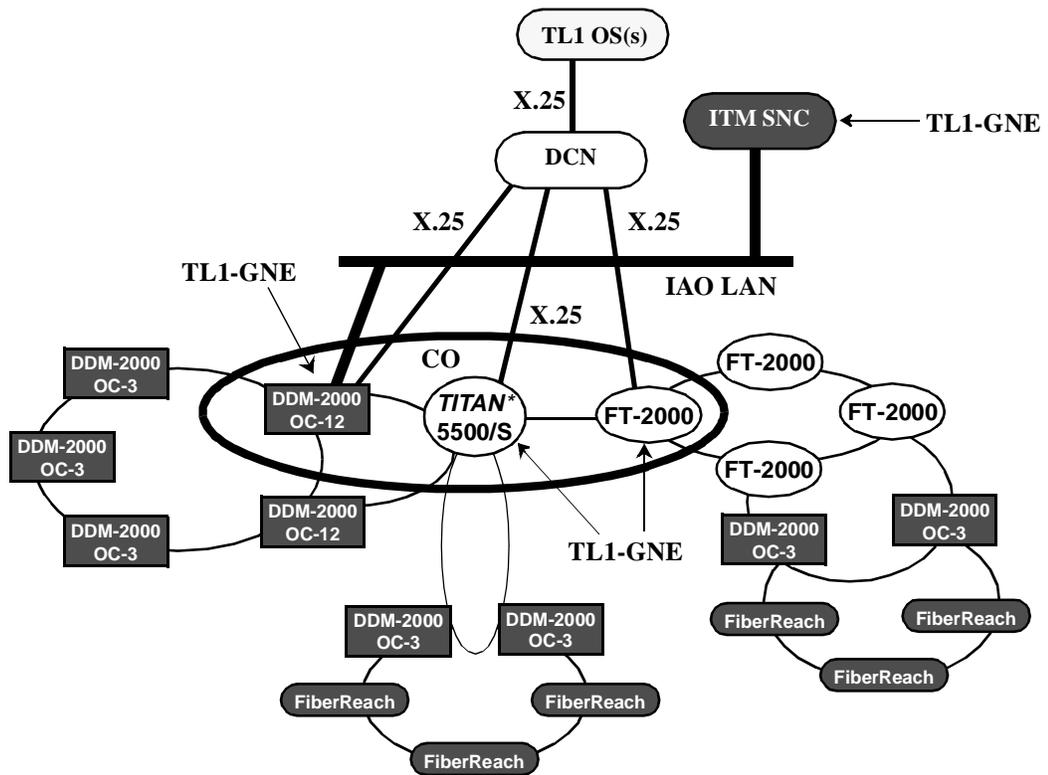
Figure 3-3. OS Access Via IAO LAN

(Continued on next page)

Remote Operations System Access (Continued)

Examples (Continued)

Figure 3-4 illustrates OS access via IAO LAN with ITM SNC serving as a TL1-GNE (as in Figure 3-3) and DDM-2000, FT-2000, and *TITAN* 5500/S serving as multiple TL1-GNEs at the same time (as in Figure 3-2). (NOTE: DDM-2000 and FT-2000 R8.1/R9.0 cannot serve as TL1-GNE for *TITAN* 5500/S). This example is also intended to demonstrate that DDM-2000 can support an IAO LAN and TL1/X.25 interface simultaneously.



* Registered trademark of Tellabs Operations, Inc.

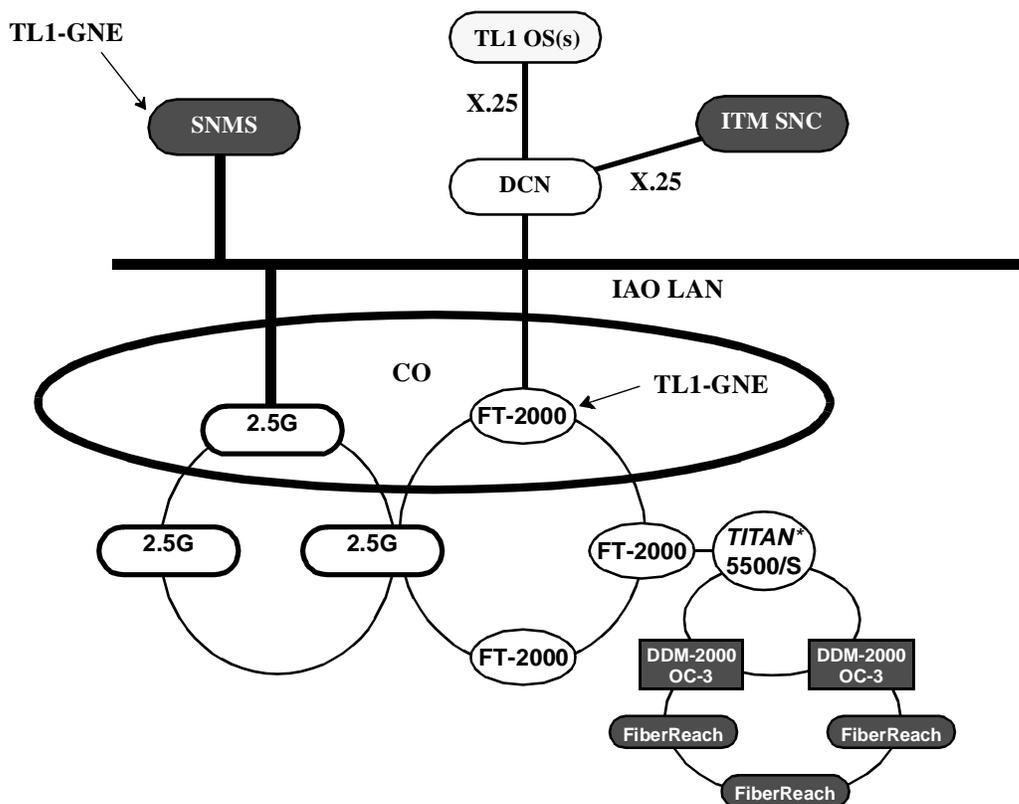
Figure 3-4. OS Access Via IAO LAN and Multiple TL1-GNEs

(Continued on next page)

Remote Operations System Access (Continued)

Examples (Continued)

Figure 3-5 illustrates OS access via IAO LAN with SNMS serving as the TL1-GNE for WaveStar 2.5G. OS access via X.25 is also shown with FT-2000 serving as the TL1-GNE for FT-2000, DDM-2000, TITAN 5500/S, and WaveStar 2.5G. (NOTE: DDM-2000 and FT-2000 R8.1/R9.0 cannot serve as TL1-GNE for TITAN 5500/S). In this example, the PF-2000 NEs are managed by ITM SNC. The PF-3000 NEs are managed by Subnetwork Management System (SNMS) which provides network control without an X.25 connection.



* Registered trademark of Tellabs Operations, Inc.

Figure 3-5. OS Access Via IAO LAN and X.25 in a Multi-Product/Multi-Vendor Network

(Continued on next page)

Remote Operations System Access (Continued)

**Maximum number
of TL1 logins per
PF-2000 TL1-GNE****Maximum number of TL1 logins per PF-2000 TL1-GNE**

Any PF-2000 NE serving as a TL1-GNE has a maximum of 105 outgoing TL1 logins it can support to other PF-2000 TL1-RNEs. This is the number of TL1-RNEs a TL1-GNE can support when there is only one TL1 login to each TL1-RNE. The maximum number of remote NEs decreases if multiple TL1 logins through the TL1-GNE to each TL1-RNE are used (for example, two different OSs accessing the same set of TL1-RNEs through the same TL1-GNE).

Maximum number of TL1 logins per PF-2000 TL1-RNEs

PF-2000 TL1-RNEs support a maximum of eight simultaneous incoming TL1 logins. This number is independent of the TL1-GNE(s) being used, e.g., PF-2000, ITM SNC, and/or other-vendor TL1-GNE(s).

X.25 Virtual Circuits

PF-2000 TL1-GNE Each PF-2000 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 3-2.

Table 3-2. X.25 Virtual Circuit Capacities

TL1-GNE	Number of SVCs	Number of PVCs
DDM-2000 OC-3 DDM-2000 OC-12	9 Total (in any combination)	
FT-2000	6	2

DDM-2000 OC-3 and OC-12 TL1-GNE X.25 VC default assignments are shown in Table 3-3.

Table 3-3. 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	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

All PF-2000 TL1-GNE X.25 VCs support TL1 command/response messages, and TL1 autonomous message reporting is provisionable for each VC. Refer to "TL1 Autonomous Message Routing" in this chapter.

(Continued on next page)

X.25 Virtual Circuits (Continued)

PF-2000 TL1-GNE (continued) FT-2000 TL1-GNE X.25 VC default assignments are shown in Table 3-4:

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

PVC ID	SVC ID	Logical Group	Logical Channel	Default Use
1		0	1	Autonomous Maintenance Messages, User Definable
2		0	2	User Definable
	1	0	3	User Definable
	2	0	4	User Definable
	3	0	5	User Definable
	4	0	6	User Definable
	5	0	7	User Definable
	6	0	8	User Definable

TL1 Autonomous Message Routing

Overview

A PF-2000 TL1-GNE establishes an OSI association with a TL1-RNE when an OS sends the TL1-GNE a TL1 login command with a target identifier (TID) matching that of the TL1-RNE. Part of the association setup is the exchange of information regarding the Application Context ID (ACID) (DDM-2000) or the OS type (FT-2000) that is requesting access to the TL1-RNE so the TL1-RNE will know which TL1 autonomous message types to output to the OS. If the TL1-RNE 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 TL1-RNE and TL1 command responses from the TL1-RNE to the OS. If, based on the OS type transmitted to the TL1-RNE by the TL1-GNE, the TL1-RNE generates autonomous TL1 messages, the TL1-GNE will forward them, as well, from the TL1-RNE to the OS.

All PF-2000 TL1-GNE VCs support TL1 command/response messages. The ACID/OS type assigned affects only TL1 autonomous message routing and can be provisioned on a per X.25 VC basis. DDM-2000 also has the capability to provision the set of autonomous messages that are output for a particular ACID/OS type. By default, the autonomous maintenance messages are all TL1 autonomous messages except **REPT DBCHG**.

Four ACID/OS types are specified as standard by Bellcore (in GR-253), and therefore appropriate for use in multi-vendor subnetworks. The four standard ACID/OS types are the first four ACID/OS types listed for DDM-2000 and FT-2000 in Table 3-5. PF-2000 TL1-GNEs use only standard ACID/OS types by default, but additional ACID/OS types are also available. For example, the special ACID/OS type **tl1Other1** (DDM-2000) and **Other** (FT-2000) may be used to route *all* PF-2000 TL1 autonomous message types to ITM SNC. (*Note: DDM-2000 **REPT PM** is not assigned to **tl1Other1** by default.*)

(Continued on next page)

TL1 Autonomous Message Routing (Continued)

TL1 Autonomous Message Routing in DDM-2000

If the default assignments in Tables 3-3 and 3-4 do not meet the user's OS needs, DDM-2000 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 (i.e., **REPT ALM**, **REPT ALM ENV**, **REPT COND**, **REPT DBCHG**, **REPT EVT**, **REPT PM**, and **REPT SW**, etc.) can be mapped to ACID/OS types (using the **ent-t11msgmap** command at every DDM-2000 (including FiberReach) TL1-GNE and TL1-RNE. Refer to the **ent-t11msgmap** command pages for the default mapping.
2. Each ACID/OS type can be mapped to any of the VCs (using the DDM-2000 [not FiberReach] **ent-osacmap** command at the TL1-GNE). Refer to the **ent-osacmap** command pages or Table 3-3 for the default mapping.

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

TL1 Autonomous Message Routing in FT-2000

FT-2000 functions similarly, but FT-2000 has fixed assignments of TL1 autonomous message types (i.e., **REPT ALM**, **REPT ALM ENV**, **REPT COND**, **REPT DBCHG**, **REPT EVT**, and **REPT SW**) to ACID/OS types. Refer to the CIT **set-secu-port** or TL1 **ENT-CID-SECU** command pages for the fixed assignments.

Each ACID/OS type can be mapped to any of the VCs (using the FT-2000 CIT **set-secu-port** or TL1 **ENT-CID-SECU** at the TL1-GNE). Refer to those command pages or Table 3-4 for the default mapping.

(Continued on next page)

TL1 Autonomous Message Routing (Continued)

ACID/OS Types The ACID/OS types for FT-2000 and DDM-2000, and the mappings between them, are listed in Table 3-5:

Table 3-5. ACID/OS Types

FT-2000 OS Type		DDM-2000 ACID
MT	↔	tl1Maintenance
MA (Provisioning)	↔	tl1MemoryAdministration
TEST	↔	tl1Test
CMDR or NONE	↔	tl1PeerComm
OTHR	↔	tl1Other1
—	↔	tl1Other2
—	↔	tl1CR

The special ACID/OS type OTHR (FT-2000) and tl1Other1 (DDM-2000) may be used to route *all* PF-2000 TL1 autonomous message types to ITM SNC.

ACID/OS Summary Example

The following example, *based on default values*, summarizes some of the preceding information about X.25 VCs, ACID/OS types, and TL1 autonomous message routing:

If an FT-2000 TL1-GNE receives a valid TL1 login request (**ACT-USER**) from an OS via X.25 PVC #1, and the TID addresses a DDM-2000 TL1-RNE, the FT-2000 TL1-GNE sets up a TL1 OSI association with the DDM-2000 TL1-RNE using ACID/OS type "MT." The DDM-2000 TL1-RNE recognizes that as ACID/OS type "tl1Maintenance" and reports TL1 autonomous maintenance messages to that OS.

TL1-GNE Reporting for TL1-RNEs

OS Communication Failure Messages

If a PF-2000 TL1-GNE detects an abnormal termination of the TL1 login(s) to a TL1-RNE, the TL1-GNE notifies the OS via a TL1 autonomous OS communication failure message. For example, 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), the TL1-GNE transmits a **REPT EVT** message.

The PF-2000 TL1-GNE does not report OS communication failure messages in the following cases, although each may involve terminated TL1 logins:

- X.25 failures, including X.25 VC resets (also TL1-GNE X.25 packet size changes)
- normal PF-2000 TL1-RNE logout (**CANC-USER**)
- PF-2000 TL1-RNE TID change, which causes all TL1 logins to the PF-2000 TL1-RNE to be terminated.

Error Responses

The PF-2000 TL1-GNE responds with some TL1 error responses on behalf of PF-2000 TL1-RNEs, 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 Lightwave System Operations Engineering Guide*, 824-102-148.

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 TL1-RNEs 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-RNEs in the same subnetwork.
3. The same TL1 autonomous message should be routed to no more than three OSs.

(Continued on next page)

TL1/X.25 Message Volume (Continued)

Considerations (Continued)

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 PF-2000 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-RNE, and among the TL1-RNEs 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-RNE before sending another command to the same TL1-RNE. This is the NMA option recommended by Bellcore (SR-1665, NMA OS Generic Transport NE Interface Support, Issue 5, December 1995).
-

Remote NE Status

Centralized Operations

Initial PF-2000 TARP Releases were intended to facilitate OS based centralized operations and because TL1/X.25 OS access is the standardized multi-vendor OI application, the following Remote NE Status features were not supported in the first generation TARP Releases of FT-2000 R8.1/R9.0/R9.1, DDM-2000 OC-3 R13.0, DDM-2000 OC-12 R7.0, and FiberReach R3.0/R3.1:

- Remote Office Alarms
- Remote CIT Alarm Reports
- Remote user panel indications (except FT-2000's FE ACTY LED indicator when an OC-48 protection switch is active at another FT-2000 in the same OC-48 ring)
- TBOS

The second generation TARP releases of DDM-2000 OC-3 R15.0 and FiberReach R4.0 once again support the Remote NE Status feature and all of the above with the exception of TBOS.

All of the above features depend on the proprietary exchange of information among PF-2000 NEs in a subnetwork, specifically the communication of each remote NE's alarm status to other NEs. Although the Remote NE Status features were supported in previous releases of PF-2000, such Lucent-only operations features in multi-vendor subnetworks would not include other-vendor NEs, due to the lack of applicable standards, and thus would be incomplete.



NOTE:

Although the remote reporting and control of miscellaneous discretes via parallel telemetry and TBOS is no longer supported in the initial TARP Releases, PF-2000 remote reporting and control of miscellaneous discretes is still supported via TL1.

The appropriate processing of DDM-2000's miscellaneous discretes as alarm/status inputs or control outputs is determined by DDM-2000's central office (CO)/remote terminal (RT) setting (CIT `set-ne`, TL1 `ENT-sys`). DDM-2000's default value of RT should suffice for TL1 in the TARP Releases. The only exception that is expected to require a user provisioned value of CO to support *local CO* miscellaneous discrete outputs is for *MegaStar** applications.

(Continued on next page)

* MegaStar is a registered trademark of Harris Corporation.

Remote NE Status (Continued)

Network Maps

Because the TARP Releases do not support Lucent Directory Services (LDS) or Remote NE Status features, the following information about remote NEs is no longer reported in the CIT and TL1 `rtrv-map-neighbor` and `rtrv-map-network` command responses:

- Alarm Group Number
- Communications Status
- NE Type (e.g., DSNE)
- Product Type (e.g., DDM-2000 OC-3).

The NE to which `rtrv-map-neighbor` and `rtrv-map-network` commands are addressed continues to report its product type. The `rtrv-map-neighbor` and `rtrv-map-network` reports include other-vendor remote NEs, also. The NSAP and TID, if available from TARP, is reported for each NE, local or remote, included in the reports. Refer to "Subnetwork Partitioning Confirmation" in Chapter 7 for more information about `rtrv-map-neighbor` and `rtrv-map-network` (and FT-2000's `rtrv-map-ring`) enhancements to support subnetwork partitioning. The Communications Status information is reported in the `rtrv-map-neighbor` command response for FT-2000 R9.1.

**NOTE:**

As noted in Chapter 2, with TARP replacing LDS, duplicate TID alarms are no longer feasible. The `rtrv-map-network` command (addressed to at least one PF-2000 NE in each area, if the subnetwork is partitioned) is recommended to assure all TIDs in a subnetwork are unique.

(Continued on next page)

Remote NE Status (Continued)

Eliminated Provisioning

Initial TARP Releases do not support LDS or Remote NE Status features, the following OI-related provisioning is no longer necessary:

- AGNE
- Alarm Group Number
- DSNE
- DSNE `dlt-tadrmapi` (DDM-2000 only CIT and TL1 command)
- NE Number (DDM-2000 only)
- Site Number (DDM-2000 only)
- TBOS Parameters.

Remote Communication Failures

With TARP, either a remote NE is reachable from a TL1-GNE or local NE and TID-NSAP information is available for the remote NE, or a remote NE is unreachable and there is no further knowledge of such an isolated remote NE. Thus, TL1-GNE remote OS communication failure notifications to report isolated remote NEs are now transient conditions instead of standing conditions. Similarly, remote communication failure error responses from TL1-GNEs and local NEs on behalf of isolated remote NEs are no longer feasible, instead *TL1-GNE unknown TID* and *TID not found* (or *Association Setup Failure*) error responses are returned. Also, all DCC failures are reported as minor alarms (DDM-2000 can no longer escalate DCC failures that cause communication failure(s) to be reported as major alarms).

(Continued on next page)

Remote NE Status (Continued)

Provisionable Remote NE Status

The second generation of TARP releases (DDM-2000 OC-3 R15.0 and FiberReach R4.0) now have a provisionable Remote NE Status parameter. The default value is Remote NE Status = *disabled*; and the NE behaves in an identical unsupported manner to the initial TARP releases. The CIT **set-ne** or TL1 **ent-sys** commands allow the user to set Remote NE Status = *enabled*; and now, the NE can be given an Alarm Group number and set as an AGNE.

Enabling Remote NE Status will now allow an NE to report all Alarm Group alarms via a CIT **rtrv-alm** or a TL1 **rtrv-alm-netwk**. Enabling Remote NE Status provides the following features:

- Remote Office Alarms
- Remote CIT Reports
- Parallel Telemetry
- User Panel Status whereby the highest level alarm of the Alarm Group is displayed along with near-end and/or far-end activity.

It is highly recommended that no more than 2 AGNEs are established in each Alarm Group; and no AGNE is a GNE. Violation of these guidelines may lead to poor network performance.

(Continued on next page)

Remote NE Status (Continued)

Establishing/ Maintaining Alarm Group(s)

When establishing or maintaining Alarm Group(s), the following guidelines are strongly recommended:

1. Provision the NEs with their Alarm Group numbers.
2. When the Alarm Group provisioning is completed, enable the AGNE.



NOTE:

If more than one AGNE needs to be defined (for the same or a different Alarm Group), allow a waiting period of 30 seconds before provisioning the next AGNE.



NOTE:

The TARP Data Cache (TDC) should always be enabled at each PF-2000 NE prior to establishing Alarm Groups.

If an already established Alarm Group needs to be divided further into two or more Alarm Groups, the following guidelines are recommended:

1. Do not change the current AGNE(s) provisioning.
2. Change the Alarm Group numbering on the NE(s) to be moved to a new Alarm Group.
3. When the new Alarm Group(s) provisioning is completed, enable the new AGNE(s). Refer again to the notes above.

Remote Software Download

Introduction

Remote Software Download was supported in the PF-2000 Pre-TARP Releases and is still supported between PF-2000 TARP Release NEs, even in multi-vendor subnetworks. 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 PF-2000 NE is being upgraded throughout a subnetwork.

**NOTE:**

The PF-2000 TARP Releases are not compatible with previous PF-2000 releases, thus care should be taken to avoid isolating NEs that have not yet been upgraded to the TARP Release when upgrading a subnetwork. Refer to Chapter 8, "Subnetwork Software Upgrade (Pre-TARP Releases to TARP Releases)," for additional information.

(Continued on next page)

Remote Software Download (Continued)

How It Works

FT-2000, DDM-2000 OC-3, and DDM-2000 OC-12 accept the download or copy of compressed dormant software. Software *cannot* be downloaded or copied in dormant form to FiberReach (FT-2000 and DDM-2000 OC-3 and OC-12 TARP Releases accept dormant software [in all cases except DDM-2000 *forced* local downloads]) without any disruption of subnetwork communications (i.e., no controller resets). The dormant software is not activated immediately. FT-2000 activates the dormant software copy when the FT-2000 controllers are reset using CIT **reset** or TL1 (R7.1 and later) **INIT-SYS** (phase = 3). DDM-2000 OC-3 and OC-12 accept a CIT or TL1 **apply** command that activates the dormant software at any time the user specifies. This reduces the time that incompatible NEs would be isolated during cut-over to a new software release such as the TARP Release, and reduces the total time required to upgrade a subnetwork.

**NOTE:**

PF-2000 software cannot be downloaded or copied directly to WaveStar NEs, but will pass through WaveStar NEs in mixed FT-2000/WaveStar Rings.

ITM SNC R5.0 (and later) supports remote software download to PF-2000 TARP Release NEs. This feature will be useful when upgrading *from* the PF-2000 TARP Releases *to* later releases. Refer to "ITM SNC NE Software Management" in Chapter 4 for additional information.

Remote Time and Date Synchronization

Introduction Synchronizing the time and date among all NEs in a subnetwork is useful to correlate events reported by different NEs.

Considerations In a new installation, it is recommended that the time and date be manually provisioned in at least the first PF-2000 NE in each ring (CIT command **set-date** or TL1 command **ED-DAT**). Each subsequent PF-2000 NE that is added to the subnetwork tries to learn the current time and date from one of the existing PF-2000 NEs automatically.

After start-up (or any subsequent controller resets), the PF-2000 NE's time and date revert back to the original time *00:00:00* and date *70-01-01*. PF-2000 NEs wait 5 minutes, in case other NEs are also resetting (e.g., as part of a subnetwork software upgrade), before starting to check with other NEs for the current time and date. DDM-2000 checks with all, if necessary, remote NEs that it's aware of (i.e., all remote NEs included in CIT and TL1 **rtrv-map-network** responses) for the current time and date. FT-2000 checks with all, if necessary, of its immediate DCC neighbors (i.e., all remote NEs included in CIT and TL1 **rtrv-map-neighbor** responses) for the current time and date.

(Continued on next page)

Remote Time and Date Synchronization (Continued)

How It Works

PF-2000 NEs allow up to 2 minutes for each remote NE to respond before checking with the next remote NE for the current time and date, and keep checking until a valid current time and date is found.

DDM-2000 accepts a provisioned time and date value or any remote NE date later than 97-01-01 as a valid current time and date. FT-2000 accepts a provisioned time and date value or any remote NE value later than the original date 70-01-01 as a valid current time and date.



NOTE:

The automatic remote NE-NE time and date synchronization described above is intended to achieve time and date synchronization among PF-2000 NEs within each subnetwork, but such synchronization can not be guaranteed at start-up for all subnetwork configurations or over the course of time.

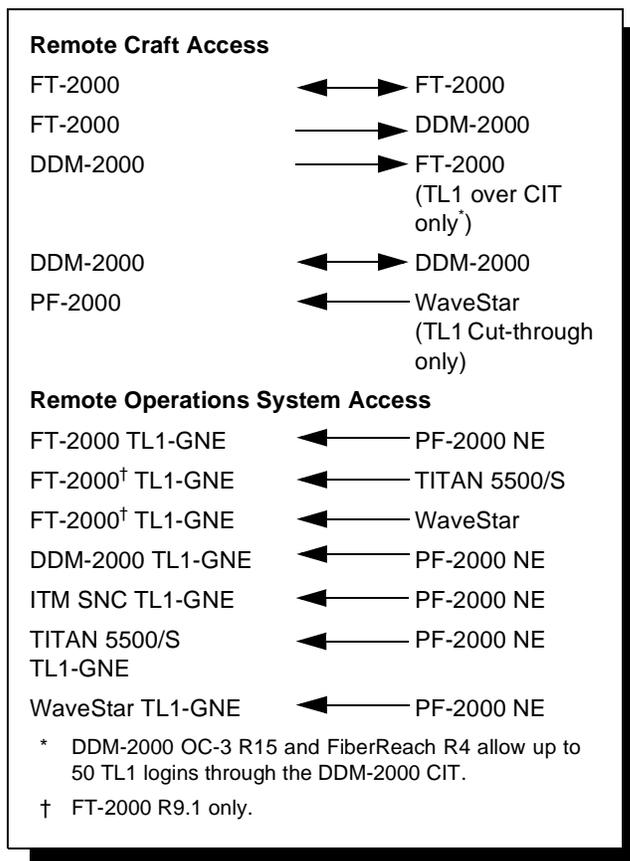
Command Responses

CIT and TL1 command responses include a PF-2000 NE's current time and date. As an alternative to manually provisioning and confirming the current time and date in each PF-2000 NE in a subnetwork, ITM SNC can do that automatically, periodically or on-demand.

OI Features Summary

Direction of operation for features

Figure 3-6 lists the OI features and indicates their direction of operation. Table 3-6 lists the provisionable OI parameters and the CIT and TL1 commands used to provision the parameters.



Note: This summary does not address all of the qualifications that apply to PF-2000 OI compatibility; any qualifications are specified earlier in this chapter. The OI features operate only between the NEs (or ITM SNC) noted but are supported through other-vendor NEs in multi-vendor subnetworks, over the IAO LAN as well as the DCC, and across areas in partitioned subnetworks.

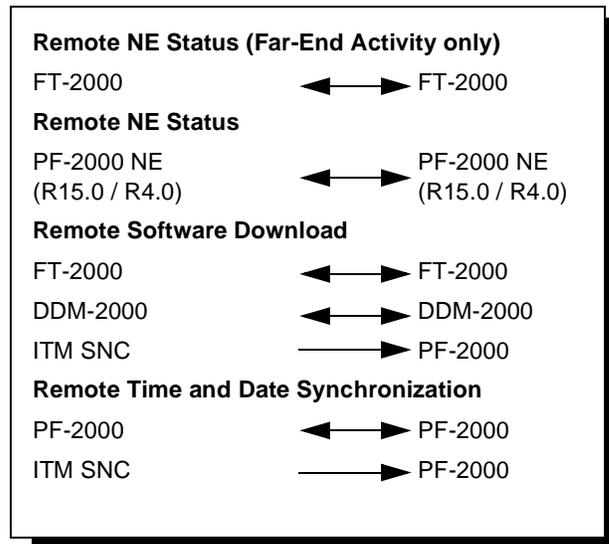
Figure 3-6. 2000 Product Family OI Compatibility Summary (Sheet 1 of 2)

(Continued on next page)

OI Features Summary (Continued)

Direction of operation for features (Continued)

This is the continuation of Figure 3-6.



Note: This summary does not address all of the qualifications that apply to PF-2000 OI compatibility; any qualifications are specified earlier in this chapter. The OI features operate only between the NEs (or ITM SNC) noted but are supported through other-vendor NEs in multi-vendor subnetworks, over the IA0 LAN as well as the DCC, and across areas in partitioned subnetworks.

Figure 3-6. 2000 Product Family OI Compatibility Summary (Sheet 2 of 2)

(Continued on next page)

OI Features Summary (Continued)

CIT and TL1 Provisioning Parameters

Table 3-6 lists the provisionable OI parameters and the CIT and TL1 commands used to provision the parameters shown in Figure 3-6.

Table 3-6. OI Parameters Provisioning

Parameter	CIT		TL1		Defaults
	DDM-2000	FT-2000	DDM-2000	FT-2000	
CO/RT Setting	set-ne	N/A	ENT-SYS	N/A	RT
DCC (IAO LAN) Enable/Disable	set-fecom	ent-asgnmt-dcc	ENT-FECOM	ENT-ASGNMT-DCC	Enabled (DDM-2000)
		dlt-asgnmt-dcc		DLT-ASGNMT-DCC	Disabled (FT-2000)
DCC User Side/Network Side	set-fecom	ent-asgnmt-dcc	ENT-FECOM	ENT-ASGNMT-DCC	See Command Pages (DDM-2000)
		dlt-asgnmt-dcc		DLT-ASGNMT-DCC	Network (FT-2000)
Remote Craft Port Access	N/A	set-secu-port	N/A	ENT-CID-SECU	Enabled
Subnetwork Partitioning: NSAP Organization ID	ent-ulsdcc-13	set-ulsdcc-13	ENT-ULSDCC-L3		00000
Subnetwork Partitioning: NSAP Reserved	ent-ulsdcc-13	N/A	ENT-ULSDCC-L3		0000
Subnetwork Partitioning: NSAP Routing Domain	ent-ulsdcc-13	set-ulsdcc-13	ENT-ULSDCC-L3		0000
Subnetwork Partitioning: NSAP Area	ent-ulsdcc-13	set-ulsdcc-13	ENT-ULSDCC-L3		0000

Table 3-6. OI Parameters Provisioning (Contd)

Parameter (Contd)	CIT		TL1		Defaults
	DDM-2000	FT-2000	DDM-2000	FT-2000	
Subnetwork Partitioning: Level 2 IS	ent-ulsdcc-13	set-ulsdcc-13	ENT-ULSDCC-L3		Disable
Target Identifier (TID)	set-ne		ENT-SYS or SET-SID		LT-DDM-2000 (DDM-2000) LT-FT-2000 (FT-2000)
TARP Lifetime Parameter	ent-ulsdcc-14	N/A	ENT-ULSDCC-L4		100
TARP Manual Adjacency	ent-ulsdcc-14 dlt-ulsdcc-14	N/A	ENT-ULSDCC-L4 DLT-ULSDCC-L4		See Command Pages
TARP Timer T1	ent-ulsdcc-14	N/A	ENT-ULSDCC-L4		15 seconds
TARP Timer T2	ent-ulsdcc-14	N/A	ENT-ULSDCC-L4		25 seconds
TARP Timer T3	ent-ulsdcc-14	N/A	ENT-ULSDCC-L4		40 seconds
TARP Timer T4	ent-ulsdcc-14	N/A	ENT-ULSDCC-L4		20 seconds
TARP Loop Detection Buffer (LDB) Flush Timer	ent-ulsdcc-14	N/A	ENT-ULSDCC-L4		5 minutes
TARP Data Cache (TDC) Enable/Disable	ent-ulsdcc-14	set-ulsdcc-14	ENT-ULSDCC-L4		Enable
TARP Data Cache (TDC) TID-NSAP Entries	ent-ulsdcc-14 dlt-ulsdcc-14	N/A	ENT-ULSDCC-L4 DLT-ULSDCC-L4		See Command Pages

Table 3-6. OI Parameters Provisioning (Contd)

Parameter (Contd)	CIT		TL1		Defaults
	DDM-2000	FT-2000	DDM-2000	FT-2000	
Time and Date	set-date		ED-DAT		00:00:00 (Time) 70-01-01 (Date)
TL1/X.25 ACID/OS Type	ent-osacmap ent-tl1msgmap	set-secu-port	ENT-OSACMAP ENT-TL1MSGMAP	ENT-CID-SECU	See Command Pages and Table 3-5
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		256
X.25 VCs	ent-osacmap dlt-osacmap	set-secu-port	ENT-OSACMAP DLT-OSACMAP	ENT-CID-SECU	See Command Pages or Table 3-3 (DDM-2000) Table 3-4 (FT-2000)
All FT-2000 DCC references are to FT-2000's low-speed OC-3 and/or OC-12 DCC interfaces.					

(Continued on next page)

OI Features Summary (Continued)

New TARP Release Provisionable OI Parameter Guidelines

The following guidelines should be considered when provisioning the new TARP Release OI parameters (i.e., specifically, the subnetwork partitioning and TARP parameters in Table 3-6). Note that “area addresses” refers to the NE’s primary area address (the term “multiple area addresses” is used when another vendor’s NE in the subnetwork is provisioned with any extra addresses in addition to that NE’s primary area address).

1. In subnetworks that consist of a single Level 1 area-only:

The default area address suffices (unless another-vendor’s NE in the same subnetwork uses a different area address).

The default TARP T2 and T4 Timer values are recommended because during peak TARP propagation loads, TARP Type 2 queries may succeed to another NE in the same Level 1 area (even though the TARP Type 1 query timed out).

In PF-2000 TARP Releases, users may be tempted to provision both the TARP T2 Timer and the T4 Timer to 1 (the value 0 is not allowed and would not avoid the origination and propagation of TARP Type 2 queries in either case). Although not recommended, this would reduce the “Unknown TID” error response delay for several OI applications from the default of about 85 seconds to about 18 seconds (the latter being based on the 15-second TARP T1 Timer default + T2 + T4 + T2 = 18 seconds). The affected OI applications are TL1 logins, remote CIT logins, and remote software downloads and copies.

2. In partitioned subnetworks, i.e., subnetworks that consist of multiple Level 1 areas:

The area address of NEs to be included in areas other than the default area address need to be changed. This effort should be coordinated with the provisioning of appropriate NEs as Level 2 ISs and the area addresses of those Level 2 ISs. Refer to Chapter 6, “Subnetwork Partitioning Guidelines,” for additional engineering guidelines.

NOTE: Only the L3AREA field of the NSAP should be changed, not any of the other provisionable fields of the NSAP.

(Continued on next page)

OI Features Summary (Continued)

3. In subnetworks that include another-vendor's NE that supports OSI Network Layer Routing but not TARP Propagation:

In DDM-2000 OC-3 and OC-12 (and ITM SNC) with IAO LAN interfaces, provisioning of TARP Manual Adjacencies may also be necessary if generic LAN routers (with their own NSAPs) are deployed between ITM SNC and DDM-2000 or between DDM-2000 NEs that are intended to be part of the same subnetwork. Refer to "TARP Manual Adjacency" in Chapter 5.

4. In PF-2000 TARP Release subnetworks that include non-TARP nodes or another-vendor's NE provisioned with multiple area addresses:

Users may want to provision the TARP T3 Timer to 10 seconds. Although not required, this would reduce the delay for individual TL1 and CIT **rtrv-map-network** and **rtrv-map-neighbor** command responses from the default TARP T3 Timer of about 40 seconds to about 10 seconds.

The original value (default) for any subnetwork partitioning or TARP provisionable parameter not mentioned above suffices, e.g., the TARP TDC will typically be *enabled* and manual TDC entries will be the exception, not the norm, thus the TDC is not mentioned here. Refer to "TARP Data Cache (TDC)" and "TDC Accuracy," respectively, in Chapter 5.

Contents

■ Overview	2
■ ITM SNC as TL1-GNE	3
■ ITM SNC NE Software Management	6
■ ITM SNC Backup and Restore	9
■ ITM SNC Automatic Subnetwork Discovery	13

Overview

The Integrated Transport Management Subnetwork Controller (TM SNC) is an element management system (EMS) that supports SONET NEs. ITM SNC provides fault, provisioning, configuration, and security management functions via a graphical user interface (GUI). Through these functions, ITM SNC is able to support communications multiplexing or concentration, to guarantee network security, and to record all database changes. ITM SNC also provides a cut-through capability, allowing the ITM SNC user to access an NE through TL1 commands.

In the TARP Releases, the interface between ITM SNC and the NEs may be an IAO LAN which can be directly connected to DDM-2000 OC-3 or OC-12 or another-vendor NE (such as *TITAN* 5500/S). ITM SNC continues to support TL1/X.25 interfaces to PF-2000 TL1-GNEs as in previous releases or to another-vendor NE (such as *TITAN* 5500/S).

This chapter provides high-level descriptions of the following ITM SNC OI features:

- ITM SNC as a TL1-GNE
- ITM SNC software management
- ITM SNC backup and restore
- ITM SNC automatic subnetwork discovery.

The ITM SNC also provides the capability to synchronize the time and date settings of up to 20 NEs simultaneously. This feature may be performed automatically, periodically, or manually, and allows for daylight savings time and leap years.

Many ITM SNC capacity requirements are dependent on the size of the host processor. Processor/capacity requirements are specified in the *Integrated Transport Management SubNetwork Controller (ITM SNC) System Administration Guide*, 107-564-288.

For additional information on Release 5.0 (the TARP Release) of ITM SNC, refer to the *Integrated Transport Management (ITM) Subnetwork Controller (SNC) User Guide*, 107-564-270, Release 5.0.

* Registered trademark of Tellabs Operations, Inc.

ITM SNC as TL1-GNE

Introduction to Northbound/Southbound OS Interfaces

ITM SNC forwards commands generated by external OS(s) to TL1-RNEs, and in like manner, routes TL1 command responses and autonomous messages generated by TL1-RNEs to external OSs. Figure 3-3 and Figure 3-4 illustrate examples of ITM SNC serving as a TL1-GNE.

The interface between ITM SNC and external OS(s) is called the Northbound OS interface. The interface between ITM SNC and TL1-RNEs is called the Southbound OS interface. Figure 4-1 illustrates that ITM SNC's Northbound OS interface is the same in Pre-TARP and TARP Releases, and independent of the Southbound OS interface.

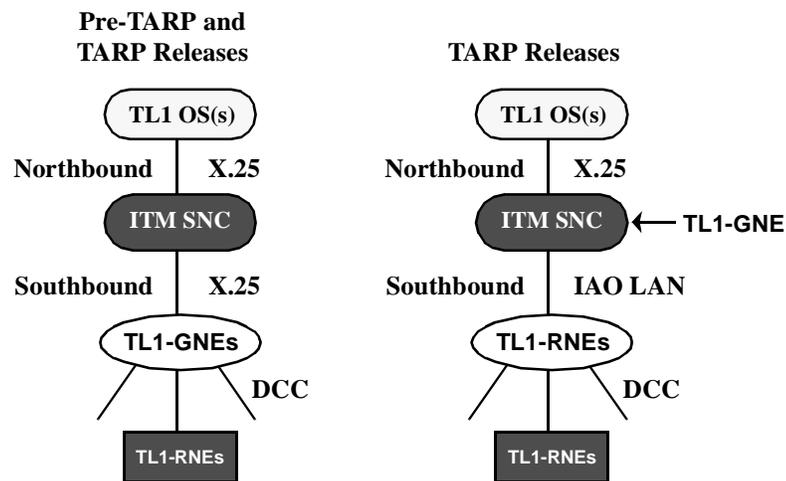


Figure 4-1. ITM SNC Northbound/Southbound OS Message Concentrator

(Continued on next page)

ITM SNC as TL1-GNE (Continued)

Southbound OS Interface

The ITM SNC R5.0 Southbound OS interface is the same as in the Pre-TARP Releases, a TL1/X.25 interface to TL1-GNE(s) and indirectly to TL1-RNEs. ITM SNC R5.0 supports an additional Southbound OS interface alternative in the TARP Releases. When ITM SNC R5.0 is connected to TARP Release PF-2000 NEs via an IAO LAN, ITM SNC automatically assumes the TL1-GNE role. This Southbound OS interface from ITM SNC to one or more of the TL1-RNEs is via TL1/Open Systems Interconnection (OSI) over an IAO LAN. TL1/OSI routing and session establishment is managed by ITM SNC and is separate from the Northbound OS interface.

ITM SNC uses TARP-like PF-2000 TL1-GNEs to translate provisioned or automatically discovered NE TIDs into TL1-RNE NSAP addresses and route TL1 login commands to the addressed TL1-RNEs.

Communications hardware and path redundancy may be provided by the ITM SNC platform through the use of redundant TL1/X.25 and/or IAO LAN ports.

Northbound OS Interface

ITM SNC's Northbound OS interface can be used to provide TL1 OS message concentration. The ITM SNC R5.0 Northbound OS interface is the same as in Pre-TARP Releases, a TL1/X.25 interface that provides bidirectional communication of transport surveillance, monitoring, and provisioning messages between ITM SNC and external OS(s) via standard TL1 message formats.

ITM SNC responds to some TL1 commands, e.g., TL1 login commands from external OSs on behalf of the TL1-RNEs. For other TL1 commands from external OSs, ITM SNC parses incoming TL1 commands, extracts the TID, and passes the TID and TL1 command to the Southbound OS interface.

(Continued on next page)

ITM SNC as TL1-GNE (Continued)

TL1 Logins

ITM SNC as a TL1-GNE supports up to three (two by default) simultaneous TL1 logins to each TL1-RNE.

The ACID/OS types supported by ITM SNC include the following:

- tl1Maintenance (default)
- tl1MemoryAdministration (default)
- tl1Test
- tl1PeerComm
- tl1Other1.

Refer to “TL1 Autonomous Message Routing” in Chapter 3 for explanations of ACID/OS types.

Maximum Subnetwork Size

The maximum number of TL1-RNEs per subnetwork supported by ITM SNC depends on the number of loaded node units supported by each ITM SNC host processor (not to exceed the PF-2000 NE Maximum Subnetwork Size specified in Chapter 2 and Chapter 6 in any case).

ITM SNC NE Software Management

Overview

Software download from the ITM SNC to PF-2000 NEs is provided via an IAO LAN using DDM-2000 and FT-2000 specific file transfer protocols. This feature will be useful when upgrading from the PF-2000 TARP Releases to later releases. Also, NE-to-NE Software Copy and NE Software Activation in PF-2000 NEs are supported by ITM SNC's GUI.



NOTE:

NE software management requires Privileged/Super User status by the user (usually restricted to ITM SNC system administrators).

(Continued on next page)

ITM SNC NE Software Management (Continued)

Software Download

Before downloading NE software from the ITM SNC, the NE software must be loaded into the ITM SNC application file system. (This is supported in ITM SNC by providing GUI access to transfer NE software to the ITM SNC file system.) NE software is provided by the NE Software Distribution Organizations on a Digital Access Tape (DAT) that can be read by the ITM SNC host processors.

Multiple releases of NE software may be stored in the ITM SNC filing system, depending on the size of the ITM SNC host processor (refer to Table 4-1).

Table 4-1. Maximum Number of NE Software Copies Stored on ITM SNC

Host Processor	Number of NE Software Release Copies Per NE Type
K460	3
K420	3
K220	2
I70	2
C100	1

If the appropriate limit would be exceeded, the GUI informs the user to delete some of the existing software releases to make room for the new releases.

(Continued on next page)

ITM SNC NE Software Management (Continued)

Simultaneous NE Software Management Tasks

In addition to supporting software download to the NEs, ITM SNC's GUI provides software management support of NE-to-NE software copies and NE software activation. ITM SNC supports simultaneous NE software management tasks to multiple NEs. However, only one software download or one software activation request is executed at a time for each NE. If a software download is in progress to an NE, a software activation request is not permitted to the same NE. Table 4-2 specifies the maximum number of software management tasks allowed for various ITM SNC host processors.

Table 4-2. Maximum Number of Simultaneous Software Management Tasks

Host Processor	NE Software Transfers to ITM SNC	ITM SNC to NE Software Downloads	NE-to-NE Software Copies per Source FT-2000	NE-to-NE Software Copies per Source DDM-2000	NE Software Activations*
K460	1	6	15	1	512
K420	1	6	15	1	256
K220	1	4	15	1	128
I70	1	6	15	1	256
C100	1	2	15	1	50

* Equal to the maximum number of loaded node units each ITM SNC host processor supports.

While a particular software management task (e.g., NE-to-NE Software Copy) is being executed, another task of that same type (e.g., NE-to-NE Software Copy) is permitted if the number of in-progress tasks of that type is at least one less than the maximum number as specified above.

ITM SNC Backup and Restore

Overview

One of the main functions of ITM SNC is to provide network configuration management capabilities that include setting various provisioning parameters in the NE including system, user security, communication setup, ports, and cross connections. Both backup and restore are accomplished via TL1 provisioning command exchanges between ITM SNC and the NEs.

Because of the complexity and time involved in setting up the various provisioning parameters in the NE, it is highly desirable to backup the NE periodically, so that in the event of a catastrophic failure at an NE site, this data can be restored from ITM SNC with minimal user intervention. ITM SNC backs up most (but not all) provisionable parameter values, including:

- System Parameters
- Synchronization Parameters
- Alarm and Control Data
- Security Parameters
- Line, channel and port options
- PM Thresholds and start time
- Cross Connections
- Communication Data (*X.25 packet size is set under this category.*)
- Feature Data
- Switch settable parameters (DDM-2000 OC-3 and DDM-2000 OC-12 only)

(Continued on next page)

ITM SNC Backup and Restore (Continued)

Overview (continued)

Backup can be done on demand or on a scheduled basis from the ITM SNC GUI. The user can easily schedule backup for several NEs on a periodic or non-periodic basis. If any scheduled attempt fails, ITM SNC will retry zero-to-four times (the number of retries is user specified via the enhanced scheduler with one additional try being the default value). A complete log of activities is kept for the user to verify the status for all scheduled operations.

ITM SNC R5.0 (and later)'s Backup and Restore capabilities have been enhanced to backup only NEs that have reported provisioning changes since the last backup, and to retry backups if backup failures occur. Also, ITM SNC R5.0 (and later) only restores parameter values that don't match an NE's default value, therefore reducing the time to restore an NE.

ITM SNC can store up to seven backup files for each NE. Any of the seven backups may be used by the restore function. If seven backups are stored and another backup is added, the oldest of the original seven is deleted.

ITM SNC R5.0 (and later) provides Intelligent Backup and Restore features that build on the existing backup and restore features from Pre-TARP Releases of ITM SNC.

(Continued on next page)

ITM SNC Backup and Restore (Continued)

Intelligent Backup Feature

The Intelligent Backup feature keeps track of all the NE events. If there was not an event that changed the NE parameters since the last backup, the user will be notified and will have a choice to continue or skip backup. This will help the user save precious time when managing the network. This enhanced backup feature is most useful for networks with large number of NEs and can be set on a scheduled basis as well.

If alarms are present, the backup is not performed.

Intelligent Restore Feature

The Intelligent Restore feature checks for NE default settings in the ITM SNC data base, and if any parameter setting in the backup file is identical to the NE default setting for that parameter, ITM SNC will skip restoral of that parameter, thus decreasing the restore time. Note that NEs automatically revert to default settings upon initialization (CIT or TL1 `init-sys` command). Therefore, Intelligent Restore is most useful when an NE has just been re-initialized after a catastrophic failure.

If a protection switch alarm condition appears on FT-2000, the restore is not performed.

Other New Backup and Restore Features

These additional backup and restore features are provided by the TARP Release ITM SNC:

- Feature availability via either TL1/X.25 or IAO LAN interfaces to a subnetwork.
 - During a backup or restore operation, no further provisioning is allowed by ITM SNC.
-

(Continued on next page)

ITM SNC Backup and Restore (Continued)

Simultaneous Backups

The user can demand or schedule simultaneous backups for several NEs. The number of different NEs that can be simultaneously backed up depends on the ITM SNC host processor and is defined in Table 4-3.

Table 4-3. Maximum Number of Simultaneous Backups

Host Processor	NE Simultaneous Backups
K460	6
K420	6
K220	4
I70	4
C100	2

ITM SNC Automatic Subnetwork Discovery

ITM SNC Automatic Subnetwork Discovery functions in the TARP Release as it did for the Pre-TARP Releases; however, it has been enhanced to operate in large partitioned, multi-vendor subnetworks (with multiple TL1/X.25 GNEs or with ITM SNC as the TL1-GNE).

ITM SNC provides a subnetwork discovery feature that automatically discover all NEs in a subnetwork as well as the trails between NEs. As a result, the subnetwork topology (NEs and trails) are automatically displayed on the ITM SNC network map as soon as it is discovered. This feature is supported in ITM SNC R5.0 for TARP Release PF-2000 NEs and *TITAN 5500/S*.

The ITM SNC Automatic Subnetwork Discovery feature is a part of the ITM SNC Dynamic Network Operations (DNO) feature. In addition to discovering subnetworks, the DNO feature also synchronizes the ITM SNC database with current configuration data from the NEs. The DNO feature can be configured by the user to work in three modes:

- **Automatic** - By default, Discovery/Synchronization is executed whenever ITM SNC receives a "communication up" event message and DNO has not been executed on the connecting NE(s). This most likely happens when communications are first established as the system administrator configures an NE for X.25 or IAO LAN connection. Users also have the option of activating automatic DNO whenever there is a communication link up, even if DNO has already been executed on the connecting NE(s).
 - **Manual** - Discovery/Synchronization is executed once whenever the user requests it. A manual DNO can be executed for a single NE or for an aggregate. When a manual DNO for an aggregate is requested, DNO is executed for all nodes in the aggregate. When the Automatic Subnetwork Discovery feature is executed on a per-NE basis, the neighbors of the target NE are discovered, too.
 - **Scheduled** - The ITM SNC system administrator can schedule DNO requests on a per-NE basis.
-

TID Address Resolution Protocol (TARP)

5

Contents

■ Overview	2
■ TARP Translations	3
■ TARP Data Cache (TDC)	5
■ TARP Provisioning	6
■ TARP Manual Adjacency	7

Overview

Introduction

Users at remote OSs and at PF-2000 and PF-3000 NE local CITs access remote NEs using the remote NE's TID (or name) but remote NEs are addressed on the DCC using NSAPs. Therefore, a method to provide TID-to-NSAP (name-to-address) and NSAP-to-TID (address-to-name) translations is necessary. TARP provides this capability.

For SONET NEs that support TL1/X.25 OS interfaces (DDM-2000, FT-2000, *TITAN* 5500/S, etc.), TARP is the directory services standard to support multi-vendor OI compatibility. TARP is specified in Bellcore GR-253-CORE, SONET Transport Systems: Common Criteria.

FT-2000 exchanges information with all other FT-2000 NEs in the same OC-48 ring. The exchanged information is called the FT-2000 Ring Directory Information Database (DIB) and includes each NE's TID and NSAP (plus additional information). This exchange within an FT-2000 OC-48 ring is completely independent of TARP. FT-2000 uses its Ring DIB to respond to CIT and TL1 rtrv-map-ring commands. Also, whenever FT-2000 needs a TID-to-NSAP translation, FT-2000 checks its Ring DIB first but uses TARP if the required TID-to-NSAP translation is not available in its Ring DIB.

* Registered trademark of Tellabs Operations, Inc.

TARP Translations

TID-to-NSAP Translations

The three OI applications that depend on TARP TID-to-NSAP translations are:

1. Remote OS Access
2. Remote CIT Login
3. Remote Software Download/Copy.

When a TL1-GNE receives a TL1 login request for a TL1-RNE, the TL1 login request includes the TL1-RNE's TID. The TL1-GNE relies on TARP to determine the TL1-RNE's NSAP. The TL1-GNE needs the NSAP to establish a DCC OSI association with the remote NE to provide remote OS access.

The local PF-2000 and PF-3000 NE uses TARP in a similar manner whenever a user requests a remote CIT login or remote software download/copy.

TARP Propagation

The first time a TL1-GNE or local NE requires a TARP TID-to-NSAP translation for each remote NE, the TL1-GNE or local NE originates a TARP query. The TARP query is propagated to all NEs in the same area, and if no response is received from within the area, up to two additional TARP queries are propagated throughout the subnetwork. TARP queries are forwarded to each neighbor (i.e., adjacency) of an NE, except the neighbor from which the TARP query was received.

When the TARP query reaches the remote NE with the requested TID, that remote NE responds to the originating NE with the remote NE's NSAP. If there is no response to any of the TARP queries for a TID, after the third query times out, an error response (e.g., *TL1-GNE unknown TID* or *TID not found*) is returned to the OS or user.

(Continued on next page)

TARP Translations (Continued)

NSAP-to-TID Translations

The two CIT and TL1 commands that depend on TARP NSAP-to-TID translations are:

1. `rtrv-map-neighbor`
2. `rtrv-map-network`.

In these cases, the PF-2000 NE that receives these commands knows the NSAPs of the remote NEs to be included in the responses but relies on TARP to determine the corresponding TIDs.

To ensure that the responses to these commands always include the most up-to-date subnetwork information, real-time TARP queries are originated instead of relying on the TARP Data Cache (TDC — see page 5-5) although the TDC is updated, as appropriate, based on the responses to these NSAP-to-TID queries.

Because the NSAPs are known, these TARP queries are addressed directly to each remote NE (TARP propagation is not necessary). Each remote NE responds to the originating NE with the remote NE's TID.

In FT-2000 TL1-RNE R8.1 and later, CIT `retrieve-active-user` and TL1 `RTRV-CID-SECU` responses include the TL1-GNE's TID. The FT-2000 TL1-RNE knows the TL1-GNE's NSAP and uses TARP to report the TL1-GNE's TID (both the TL1-GNE's NSAP and TID are determined when the TL1 login is established, using a real-time TARP query for the TL1-GNE's TID).

TARP Data Cache (TDC)

Introduction

Each NE maintains its own TDC, independently. The TDC consists of TID-NSAP translations. PF-2000 and PF-3000 automatically update their own TDCs based on the responses to their previous TARP queries. The TDC may also be updated upon receipt of an unsolicited, automatic notification from another NE in the subnetwork of a TID or NSAP change.

Why it is used

In order to reduce the frequency of TARP propagation, and to improve the performance of the affected OI application, PF-2000 NEs support a TDC option. The TDC is enabled (default) or disabled by user provisioning (DDM-2000 CIT or TL1 `ent-u1sdcc-14` [or FT-2000 CIT `set-u1sdcc-14`]).

PF-2000 check their TDC to see if they already have a requested TID-to-NSAP translation before originating a TARP query to the subnetwork. If a translation is not found in the TDC, the response to that TARP query is used to update the originating NE's TDC. PF-2000 NEs assure that their TDC maintains only one TID-NSAP translation for each unique TID. PF-2000 NEs support TDC sizes of up to 110 TID-NSAP translations. The contents of the TDC are reported in response to CIT (DDM-2000 only) and TL1 command `rtrv-u1sdcc-14`. If the TDC is disabled or an NE's controllers are reset, the contents of the TDC are deleted.

TDC Accuracy

In the unlikely event that a TDC includes an inaccurate TID-to-NSAP translation, PF-2000 and PF-3000 NEs confirm that both the NSAP and TID of the remote NE are correct before a remote OI application proceeds. If there is a mismatch, an error response (e.g., *TL1-RNE unknown TID* or *Inconsistent TID* [or *Association Setup Failure*]) is returned to the OS or user.

To correct such a situation, the user uses the CIT (DDM-2000 only) or TL1 `dlt-u1sdcc-14` to delete the subject TID (L4tdctid) from the TL1-GNE or local PF-2000 NE's TDC, then re-requests the remote OI application for the subject TID. The subsequent TARP query results in an accurate TID-to-NSAP translation, and the TDC is updated accordingly. A broader solution is to disable and re-enable the TL1-GNE or local NE's TDC (DDM-2000 CIT or TL1 `ent-u1sdcc-14` [or FT-2000 CIT `set-u1sdcc-14`]) in which case *all* TDC entries are deleted.

TARP Provisioning

What is allowed

Although TARP functions automatically, using standard default values, without any user provisioning, PF-2000 NEs allow provisioning of the following TARP parameters. All TARP parameters are provisioned by the CIT (DDM-2000 only) and TL1 **ent-ulsdcc-14** command:

1. Lifetime
2. Manual Adjacency
3. Timers
4. Loop Detection Buffer (LDB) Flush Timer
5. TDC Enable/Disable (FT-2000 CIT **set-ulsdcc-14** supports, also)
6. TDC **TID-NSAP** Entries (CIT [DDM-2000 only] and TL1 **dlt-ulsdcc-14** is used to *delete* an individual entry).

Default Values

It is recommended that the TARP default values always be used, with the possible exceptions of Manual Adjacency (see "TARP Manual Adjacency" later in this chapter) and the TDC parameters (see "TDC Accuracy" earlier in this chapter).

TARP Manual Adjacency

What is it?

TARP Manual Adjacencies are used to assure TARP propagation from any TARP NE in the subnetwork will reach all other TARP NEs in the subnetwork. TARP Manual Adjacencies are necessary if DCC connectivity between some TARP NEs and other TARP NEs in the same subnetwork is available, but only via NEs (or generic LAN routers with their own NSAPs) that don't support TARP propagation. TARP Manual Adjacencies are used to bridge the gap between such islands of otherwise isolated TARP NEs, thus assuring complete TARP propagation throughout the subnetwork via the combination of both actual TARP Adjacencies (i.e., neighbors) and provisioned TARP Manual Adjacencies.

Provisioning

TARP Manual Adjacencies should be provisioned such that each island of TARP NEs has at least one, preferably two (for redundancy and better performance), TARP Manual Adjacencies. Note, most TARP NEs may not have any TARP Manual Adjacencies provisioned; but typically the TARP NEs that serve as the "gateways" to/from the islands of TARP NEs will need to have TARP Manual Adjacencies provisioned to reach the next island of TARP NEs. The best example is the creation of a "virtual ring" of islands of TARP NEs connected logically via TARP Manual Adjacencies. If necessary, TARP Manual Adjacencies are provisioned using the CIT (DDM-2000 only) or TL1 `ent-u1sdcc-14` command.

Subnetwork Partitioning Guidelines

6

Contents

■ Introduction	2
■ Advantages of Subnetwork Partitioning	4
■ Area Address Assignment	5
■ Level 2 IS Assignment	7
■ Maximum Subnetwork Sizes	8
■ Engineering Rules and Guidelines	10

Introduction

Hierarchical routing makes it possible to increase the size of the Open Systems Interconnection (OSI) management network in TARP Release subnetworks. This is achieved through the use of subnetwork partitioning.

Partitioning involves the division of subnetworks into multiple areas. Areas are connected by Level 2 Intermediate Systems (ISs) which maintains DCC connectivity throughout the partitioned subnetwork. The assignment of PF-2000 NEs to areas or to serve as Level 2 ISs is accomplished by NE provisioning (refer to "Area Address Assignment" and "Level 2 IS Assignment," respectively, in this chapter).

In this chapter, *guidelines* are established for partitioning subnetworks. In Chapter 7 of this document, *procedures* are provided to partition subnetworks under various circumstances. Refer to the DDM-2000 and FT-2000 User Manuals for the CIT command specifics or the DDM-2000 and FT-2000 OS Engineering Guides for the TL1 command specifics.

Figure 6-1 lists the symbols that are used within this chapter's examples:

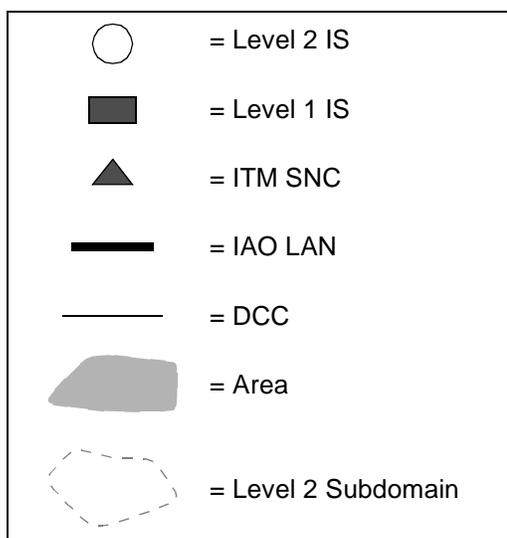


Figure 6-1. Subnetwork Partitioning List of Symbols

(Continued on next page)

Introduction (Continued)

Figure 6-2 illustrates a subnetwork that has been partitioned into multiple areas connected by Level 2 ISs.

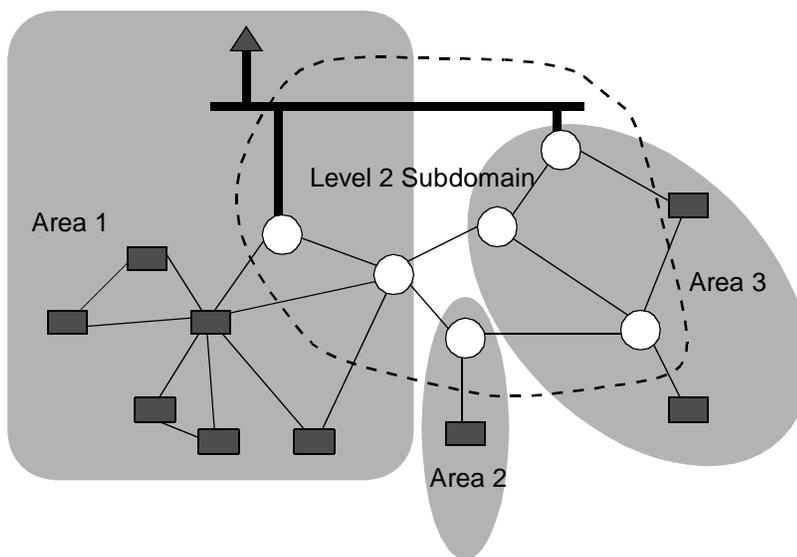


Figure 6-2. Subnetwork Partitioning

Advantages of Subnetwork Partitioning

The primary advantages of subnetwork partitioning are performance improvements and the ability to have much larger networks (50 NEs are allowed in one area). Subnetwork partitioning limits the DCC routing information that must be maintained by each NE in a subnetwork. Each NE within an area maintains routing tables to route DCC messages to the other NEs in the same area. If an NE needs to route a DCC message to an NE in a different area, the NE relies on a Level 2 IS in its own area to route the message to a Level 2 IS in the target area and from that Level 2 IS to the target NE within that area.

The Level 2 ISs route DCC messages between NEs in different areas. The DCC messages include all of the NE-NE (and ITM SNC-NE) communications necessary to support the OI applications described in Chapter 3 and Chapter 4 of this document, for example, a TL1 login message from a TL1-GNE to a TL1-RNE.

In addition to maintaining a routing table to route DCC messages to other NEs in the same area, Level 2 ISs need to maintain routing information for the Level 2 ISs in all other areas (but not for all NEs within each of these other areas).

Area Address Assignment

Area Address

The area address is the first 26 characters of each NE's NSAP. The first eight characters of all PF-2000 NSAPs are the same and can't be changed. The remaining 18 characters of the NSAP area address are provisionable but *only* the Area field should be changed to assign an NE to a different area. The remainder of the NSAP includes the System Identifier field, which is unique to each NE, and the Selector field. Table 6-1 identifies the components of the NSAP:

Table 6-1. NSAP Structure

NSAP Field:	AFI	IDI	IDI PAD	DFI	Organization ID	RES	RD	Area	System Identifier	SEL
Bytes:	1	2		1	3	2	2	2	6	1
Default Value: (hex)	39	840	F	80	000000	0000	0000	0000	none	00
	not provisionable				user provisionable			not provisionable		

A subnetwork is partitioned by changing the NSAP Area field to a specific value that is the same for all NEs that will be within a single planned area. The entire NSAP area address must be identical for all NEs in an area and different from the NSAP area addresses for all other areas.

If more than one separate area with the same area address exists, routing to these areas from other areas would not be predictable and couldn't be expected to function properly.

Area Field

The Area field consists of four hexadecimal characters, with a default value of 0000 (hex). The Area field is user-provisionable using CIT (DDM-2000) or TL1 command **ent-ulsdcc-13** (or FT-2000 CIT command **set-ulsdcc-13**). The DDM-2000 and FT-2000 OS Engineering Guides specify the TL1 **ENT-ULSDCC-L3** in detail.

(Continued on next page)

Area Address Assignment (Continued)

Area Terminology Despite the technical differences between the area address and the Area field described previously, the term area address is commonly used to refer to the Area field value. Thus, for convenience, the term area address is used throughout this document.

Multiple Area Addresses Multiple Area Addressing is the capability for an NE to be assigned more than one area address. The provisioning of multiple area addresses is not supported on PF-2000 NEs, directly. However, if multiple area addresses are provisioned in another-vendor's NE(s) in a multi-vendor subnetwork, PF-2000 NEs will recognize their own primary area address plus up to two other area addresses.

Level 2 IS Assignment

DCC message routing is supported within a subnetwork which may consist of a single area, or multiple areas. Level 1 ISs provide interconnectivity between NEs in an area (all PF-2000 NEs are Level 1 ISs). Level 2 ISs provide connectivity between areas.

In a partitioned subnetwork, each area must contain at least one Level 2 IS. An area without a Level 2 IS would be isolated from the rest of a partitioned subnetwork. The adjacent set of Level 2 ISs form the Level 2 subdomain. For proper network layer routing, every Level 2 IS should have at least one neighbor (via DCC or IAO LAN) that is also a Level 2 IS. At least one of the Level 2 ISs in an area must be adjacent to a Level 2 IS in another area, otherwise, the former area would be isolated from the rest of the subnetwork.

Each PF-2000 NE is *not* a Level 2 IS by default. Any PF-2000 NE (except FiberReach) may be provisioned to be a Level 2 IS using CIT (DDM-2000) or TL1 command **ent-ulsdcc-13** (or FT-2000 CIT command **set-ulsdcc-13**).

Maximum Subnetwork Sizes

The total number of NEs within an area cannot exceed 50. Whenever a PF-2000 NE is a Level 2 IS, the 50 NE maximum is reduced one-for-one by the number of Level 2 ISs within the subnetwork.

Table 6-2 illustrates the relationship between the number of Level 2 ISs in a subnetwork and the maximum number of NEs allowed per area. The maximum subnetwork size is determined by multiplying the number of Level 2 ISs by the maximum number of NEs per area, *up to a maximum of 256*.

Table 6-2. Maximum Area and Subnetwork Sizes per Number of Level 2 ISs

Number of Level 2 ISs per Subnetwork	Maximum Number of NEs Allowed per Area	Maximum Subnetwork Size*
0	50	50
2	48	96*
3	47	141*
4	46	184*
5	45	225*
6	44	256
7	43	256
8	42	256
9	41	256
10	40	256
11	39	256
12	38	256
13	37	256
14	36	256
15	35	256
16	34	256
17	33	256
18	32	256
19	31	256
20	30	256
21	29	256
22	28	256
23	27	256
24	26	256
25	25	256
26	24	256

Table 6-2. Maximum Area and Subnetwork Sizes per Number of Level 2 ISs (Contd)

Number of Level 2 ISs per Subnetwork	Maximum Number of NEs Allowed per Area	Maximum Subnetwork Size *
27	23	256
28	22	256
29	21	256
30	20	256
31	19	256
32	18	256
33	17	256
34	16	256
35	15	256
36	14	256
37	13	256
38	12	256
39	11	256
40	10	256
41	9	256
42	8	256
43	7	256
44	6	256
45	5	225*
46	4	184*
47	3	141*
48	2	96*
49	1	49*

* These are theoretical maximum subnetwork sizes, assuming the number of Level 2 ISs equals the number of areas in the subnetwork (that is, one Level 2 IS per area) and each area includes the maximum number of NEs allowed per area.

Engineering Rules and Guidelines

Introduction

To use subnetwork partitioning, the user must plan and engineer the provisioning of Level 2 ISs and area addresses in the subnetwork.

The goal is to create a subnetwork where all NEs have DCC connectivity with each other, and management of the NEs can be done from any point in the subnetwork.

Rules must be followed to assure DCC message routing. Guidelines are recommendations that add survivability in the event of a DCC or IAO LAN failure. Rules *must* be followed. Guidelines *should* be followed. There may be customer subnetwork applications that cannot adhere to all the guidelines. In these special cases, the user should be aware of the vulnerabilities that exist as a result of not following the guidelines.

(Continued on next page)

Engineering Rules and Guidelines (Continued)

Rule: DCC Connectivity Within An Area

All NEs in an area must have DCC connectivity *within the area* to all other NEs in the same area. Otherwise, the area would be segmented and DCC routing could not be expected to function properly.

Figure 6-3 illustrates a correct and an incorrect example of assigning a Level 2 subdomain:

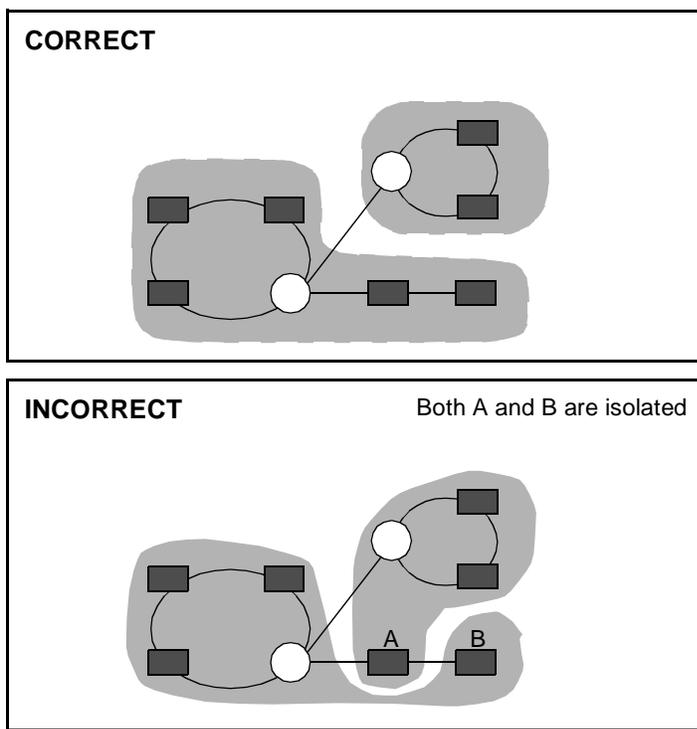


Figure 6-3. DCC Connectivity Between NEs in an Area

(Continued on next page)

Engineering Rules and Guidelines (Continued)

Rule: Single Level 2 Subdomain

All Level 2 ISs must have DCC connectivity, either directly or indirectly via other Level 2 ISs, to all other Level 2 ISs in the subnetwork to form a single Level 2 subdomain that provides connectivity to all areas. If more than one Level 2 subdomain is used, it will segment the network and routing cannot be expected to function properly.

Figure 6-4 illustrates a correct and an incorrect example of assigning a Level 2 subdomain:

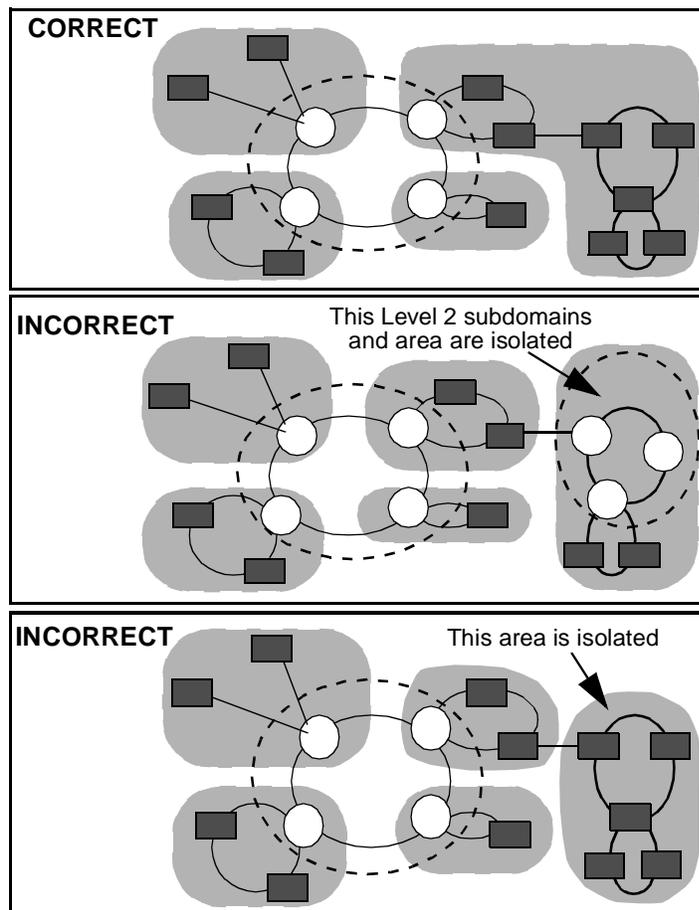


Figure 6-4. Single Level 2 Subdomain

(Continued on next page)

Engineering Rules and Guidelines (Continued)

Guideline: Redundant Routes in Level 2 Subdomain

When practical, redundant routes in the Level 2 subdomain should be available between all Level 2 ISs to ensure that proper routing will occur in the event of a single DCC failure. To satisfy this guideline, every Level 2 IS has at least two neighboring Level 2 ISs.

Figure 6-5 illustrates a recommended and a non-recommended example of protection path routing through the Level 2 subdomain:

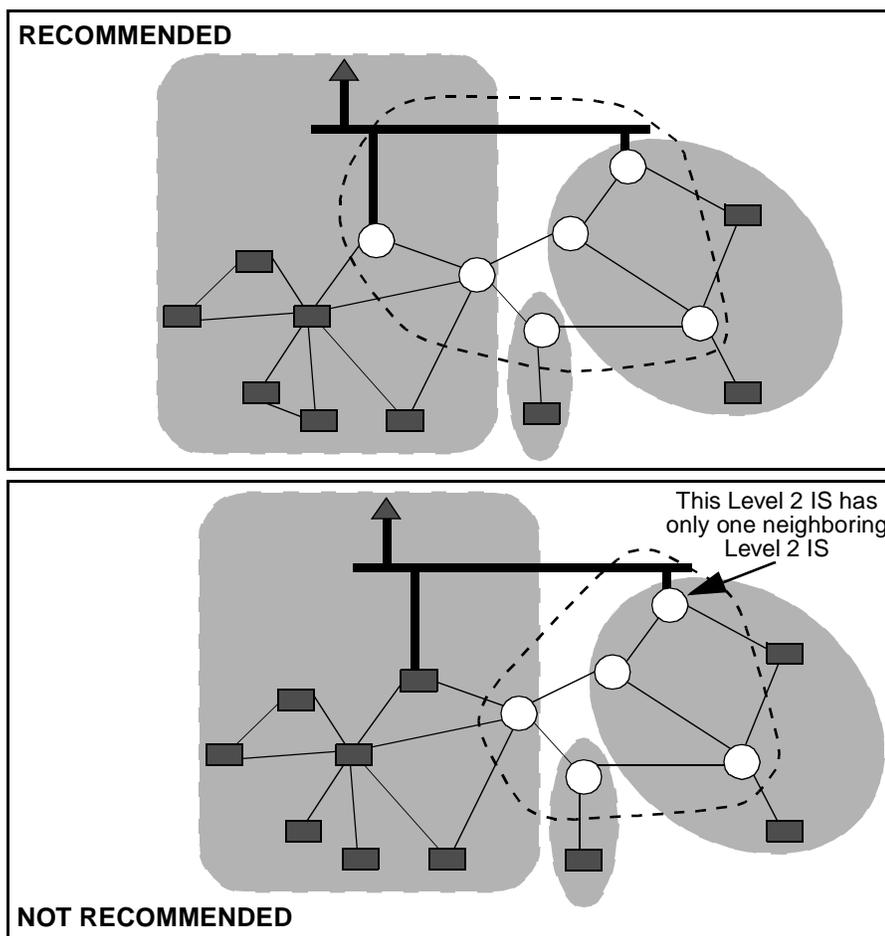


Figure 6-5. Redundant Routes in the Level 2 Subdomain

(Continued on next page)

Engineering Rules and Guidelines (Continued)

Guideline: Level 2 ISs in a Ring

The possible number of Level 2 ISs in a ring is:

- None, or
- One, or
- All NEs in the ring, or
- Two; for example, when dual-homing or dual ring interworking (DRI) is used.

Figure 6-6 illustrates examples of ISs in various ring configurations:

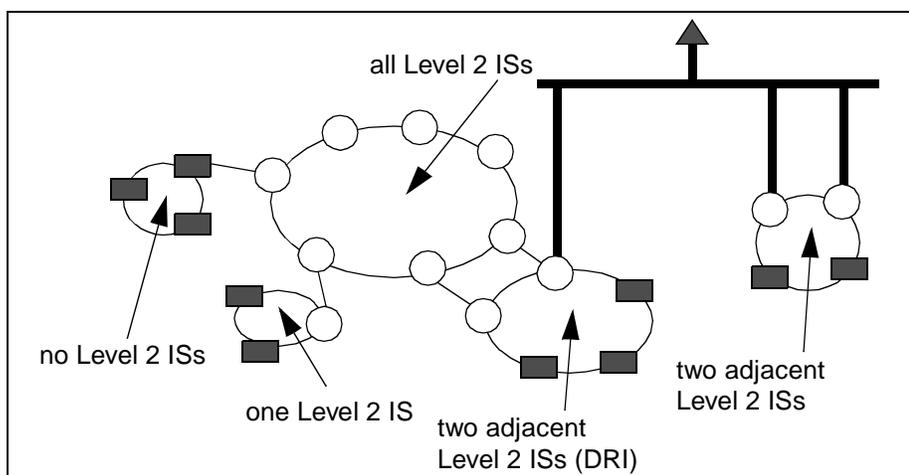


Figure 6-6. Number of Level 2 ISs in a Ring

(Continued on next page)

Engineering Rules and Guidelines (Continued)

Guideline: Level 2 IS Ring Area Topologies

For a ring of Level 2 ISs, three valid area topologies exist:

- All Level 2 ISs are part of the same area.
- Each Level 2 IS is part of a different area.
- A pair of adjacent Level 2 ISs are in the same area (for example, with dual-homing or DRI), with either the other Level 2 ISs similarly paired off or individually in different areas.

Figure 6-7 illustrates the three valid area topologies:

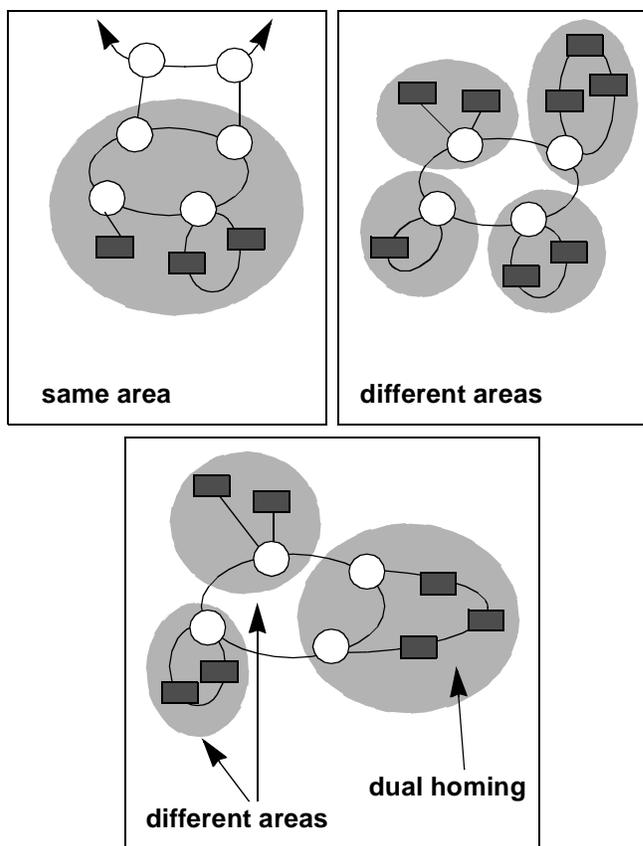


Figure 6-7. Defining Level 2 IS Ring Area Topologies

(Continued on next page)

Engineering Rules and Guidelines (Continued)

Guideline: Adjacent Level 2 ISs within an Area

It is recommended that dual Level 2 ISs in an area be adjacent to each other and have a redundant route within the area. Failure to meet this guideline will result in some messages not being routed properly in the event of a single DCC failure that divides an area into two islands.

Figure 6-8 illustrates a recommended and two non-recommended examples of dual Level 2 ISs in an area:

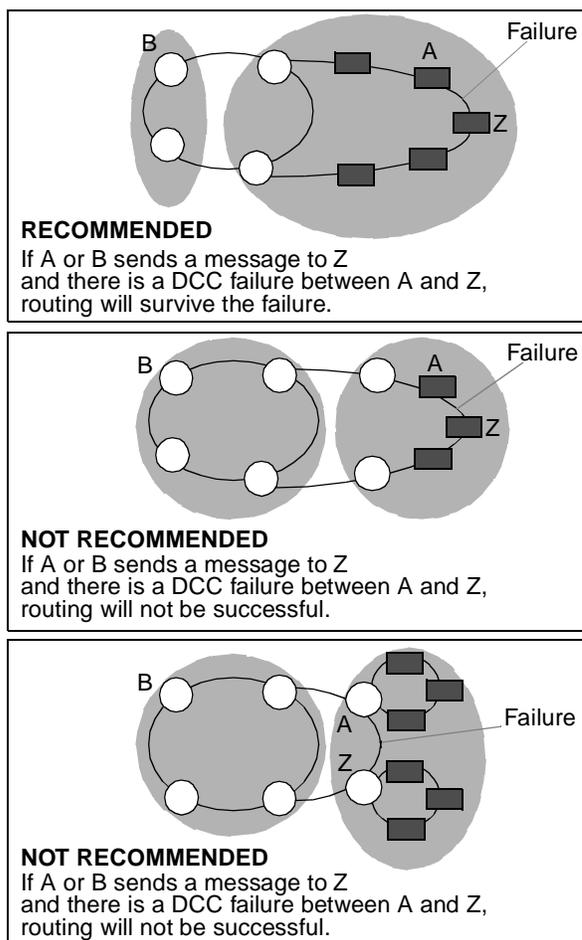


Figure 6-8. Adjacent Level 2 ISs within an Area

(Continued on next page)

Engineering Rules and Guidelines (Continued)

Rule: ITM SNC's Area Address

At least one of the NEs on the IAO LAN must have the same area address as ITM SNC when ITM SNC is connected to the subnetwork via an IAO LAN (instead of TL1/X.25). This is because ITM SNC is not expected to be a Level 2 IS itself. If this condition is not met, the rest of the subnetwork will not be aware of ITM SNC, and will not route to or from ITM SNC.

Figure 6-9 illustrates a correct and an incorrect example of area addressing for ITM SNC:

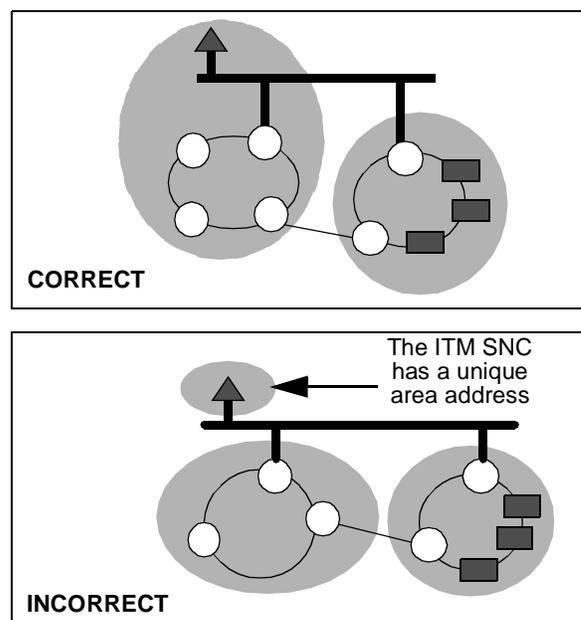


Figure 6-9. ITM SNC's Area Address

(Continued on next page)

Engineering Rules and Guidelines (Continued)

**Rule: Level 2 ISs
on the IAO LAN**

If an IAO LAN is used to connect between areas, then at least one NE in each area on the IAO LAN must be provisioned to be a Level 2 IS. Otherwise, the areas won't route to each other via the IAO LAN.

Figure 6-10 illustrates a correct and an incorrect example of Level 2 IS placement on the IAO LAN:

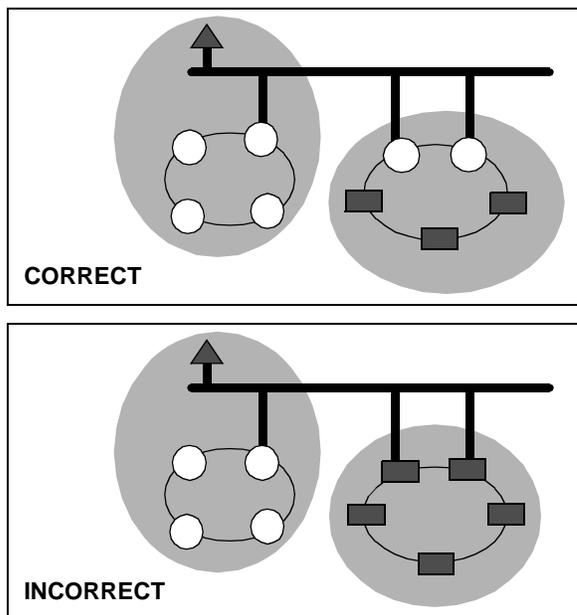


Figure 6-10. Level 2 ISs on the IAO LAN

(Continued on next page)

Engineering Rules and Guidelines (Continued)

Guideline: IAO LAN Redundancy

If an IAO LAN is the only method of connecting between areas, then at least two Level 2 ISs directly connected to the IAO LAN for each area are recommended for redundancy purposes. A second IAO LAN hub would provide additional redundancy.

Figure 6-11 illustrates two recommended methods of providing redundancy between areas connected solely by IAO LANs:

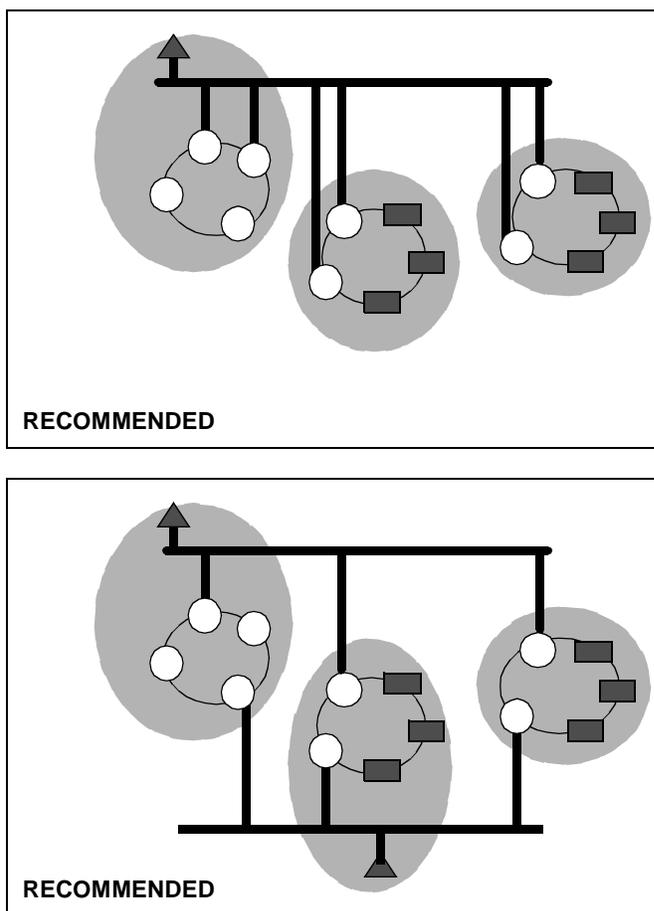


Figure 6-11. IAO LAN Redundancy

Contents

■ Overview	2
■ Redefining a Subnetwork	3
■ Subnetwork Partitioning Sequence	4
■ Subnetwork Partitioning Confirmation	7
■ Single-Homed Subnetworks	8
■ Single-Homed Subnetwork via ITM SNC IAO LAN	11
■ Dual-Homed Subnetworks	16
■ IAO LAN-Connected Subnetwork	19

Overview

Introduction

In Chapter 6 of this document, *guidelines* are established for partitioning subnetworks. In this chapter, *procedures* are provided for partitioning subnetworks under various circumstances. Refer to the DDM-2000 and FT-2000 User Manuals for the CIT command specifics or the DDM-2000 and FT-2000 OS Engineering Guides for the TL1 command specifics.

Default

Prior to partitioning an existing subnetwork, all NEs in the subnetwork are in the same area (typically, the default area address is "0" [zero]). A **rtrv-map-network** command to the local NE or TL1-GNE reports all NEs in the subnetwork and confirms the current area address. The same command also assures that the local NE's TDC is up to date, providing efficient subsequent CIT remote logins to remote NEs.

Redefining a Subnetwork

Adding New Network Elements

Adding new NEs to an existing subnetwork can result in the single area limits being exceeded. When this occurs, the subnetwork must be partitioned (or further partitioned) into separate areas before the new NE is added.

When expanding a subnetwork with new NEs, each new NE's area and Level 2 IS can be provisioned prior to the NE being installed in the subnetwork and before it is carrying any traffic. Therefore, subnetwork DCC disruption is avoided.

Combining Existing Subnetworks

Combining existing subnetworks which were previously separate may require that the NEs in one or more of the subnetworks be provisioned with a different area address and/or as Level 2 ISs prior to connecting the subnetworks.

In such cases, the CIT and TL1 command **rtrv-map-network** is recommended to confirm the uniqueness of NSAP area addresses *before* combining existing subnetworks. As noted in Chapters 2 and 3, adherence to other-vendor TID restrictions and uniqueness of TIDs for all NEs should be confirmed in a similar manner *before* combining existing subnetworks. Refer to "Network Maps" in Chapter 3 and "Subnetwork Partitioning Confirmation" in this chapter for more information about the **rtrv-map-network** command.

Subnetwork Partitioning Sequence

Avoid Isolating NEs

An important goal is to partition the subnetwork in such a way that NEs are not isolated. Isolating an NE may require craft dispatch to the isolated NE to recover. To avoid isolating NEs, the sequence for provisioning new Area field values is established with respect to the local NE to which the CIT is connected or the TL1-GNE through which ITM SNC is connected. Typically, the local NE or TL1-GNE is provisioned to be a Level 2 IS first, but its area address is not changed initially, if at all. As demonstrated in the examples that follow, this general sequence can be modified in subnetworks with redundant DCC or IAO LAN connectivity between and within areas.

1. The NEs and sub-tending rings that are furthest away from this local NE or TL1-GNE are provisioned first.
2. Work back toward the local NE or TL1-GNE's sub-tending ring.
3. Provision the local NE or TL1-GNE's sub-tending ring, if the address must be changed.
4. Provision the local NE or TL1-GNE last, if the address must be changed.

If ITM SNC is part of the subnetwork via an IAO LAN interface, provision the area address for the ITM SNC last if the address must be changed. However, it is recommended that the area address of the ITM SNC not be changed.



NOTE:

Before partitioning a subnetwork, be sure no alarms exist, especially no **DCC failure** alarms; otherwise, even the recommended partitioning sequence might result in isolated NEs. To confirm the alarm status of TARP release subnetworks, it is recommended that a centralized maintenance center with TL1 OS support be consulted.

(Continued on next page)

Subnetwork Partitioning Sequence (Continued)

Provisioning Sub-tending Rings

Always provision new Area field values for a sub-tending ring by starting with an NE that is adjacent to the NE that connects this sub-tending ring to the rest of the subnetwork, and then provisioning new Area field values to each sequential adjacent NE going around the sub-tending ring. Provision the new Area field value of the connecting NE last.

For single-homed sub-tending rings, provision the NE that will be the Level 2 IS node last; otherwise, NEs in its area could be isolated. For dual-homed rings, provision one of the NEs that will be Level 2 IS first, so that DCC connectivity is established with upgraded NEs as soon as they complete their resets.

As one NE is undergoing a reset in an area, the next adjacent NE should be provisioned to minimize the overall time required to provision the NEs in an area and minimize the time that DCC communications with the NEs in the area are lost.

Consistent with established FT-2000 OC-48 ring upgrade precedent, it is recommended that the partitioning sequence proceed in an East-to-West direction around an FT-2000 OC-48 ring. The FT-2000 CIT and TL1 command **rtrv-map-ring** is recommended to confirm the FT-2000 OC-48 ring configuration.

Minimizing DCC Subnetwork Disruption

Another important goal is to partition the subnetwork in such a way that subnetwork DCC disruption is minimized. Changing an NE's area address and/or enabling an NE as a Level 2 IS causes the NE to reset its controllers. The reset is immediate and is part of the completion of the command. In addition to temporarily disrupting DCC communications, NE resets temporarily disable automatic transmission protection switching.

Changing an NE's area address and enabling an NE as a Level 2 IS, if appropriate, should usually both be done with a single command per NE. Such provisioning is a sequential process in a subnetwork.

(Continued on next page)

Subnetwork Partitioning Sequence (Continued)

Selecting a Local NE for CIT Remote Login

If there are DDM-2000 and FT-2000 NEs in the subnetwork to be partitioned, and if partitioning will be via Remote Login from a CIT, the CIT must be connected to an FT-2000 NE (FT-2000 NEs can remotely login to a DDM-2000, but the reverse is not supported).

Termination of CIT Remote Logins

When provisioning remote NEs via CIT remote login, the remote login session is not terminated immediately when the remote NE resets but may take up to 10 minutes to time out. Until the remote login session times out and control is returned to the local CIT, the CIT cannot be used to log into another remote NE. FT-2000's CIT Function Key 4 can be used to drop the remote login session more quickly.

Termination of ITM SNC TL1 Logins

If partitioning is done from ITM SNC, the TL1 logins are dropped between ITM SNC and an NE that is reset. Independent of the previous NE's reset, ITM SNC maintains immediate access to the next NE via its existing TL1 logins to each NE still in the same area as the TL1-GNE.

Subnetwork Partitioning Confirmation

A successfully partitioned subnetwork supports DCC message routing among all NEs in the subnetwork. While it may be impractical to test DCC communications between all possible pair-wise combinations of NEs, the PF-2000 CIT and TL1 commands **rtrv-map-neighbor**, **rtrv-map-network** and **rtrv-map-ring** (FT-2000 only) have been enhanced to support subnetwork partitioning (refer to "Network Maps" in Chapter 3, also). All three commands report the complete NSAP of each NE included in the response. Thus, the NSAP area address for multiple NEs may be confirmed.

The default **rtrv-map-network** report includes all reachable NEs (including Level 2 ISs) in the same area. If the addressed NE is a Level 2 IS, the **rtrv-map-network** report may include all reachable Level 2 ISs in the subnetwork. Thus, successive **rtrv-map-network** commands can identify all NEs in a partitioned subnetwork. One **rtrv-map-network** command at a time per area should suffice and is recommended to avoid unnecessarily burdening the subnetwork with many redundant TARP queries.

Both **rtrv-map-neighbor** and **rtrv-map-network** reports also include indications as to whether each listed NE is a Level 2 IS. The primary exception is when DDM-2000 is not a Level 2 IS itself, DDM-2000 can identify the default Level 2 IS in its area but not any additional Level 2 ISs that may be in its area. (The default Level 2 IS is the NE DDM-2000 would rely on to route a DCC message outside DDM-2000's own area. When there are multiple Level 2 ISs in the same area, not all DDM-2000 NEs in the area would identify the same default Level 2 IS typically.) If subnetwork partitioning involves disabling an NE's Level 2 IS functionality, it may take up to 20 minutes for that change to be reflected in the **rtrv-map-neighbor** and **rtrv-map-network** reports.

In the initial TARP Releases, if a subnetwork is *not* partitioned (i.e., all NEs in a subnetwork are in the same area), DDM-2000 cannot identify *any* remote Level 2 ISs in the area (FT-2000 accurately identifies all Level 2 ISs in the same case).

There is no standing alarm or status condition at a PF-2000 NE with Level 2 IS functionality enabled or disabled. There is no automatic means of determining whether the area address is consistent with the rest of the subnetwork. The user must ensure that all subnetwork partitioning rules have been followed.

If subnetwork partitioning rules have not been followed, there is no guarantee that the subnetwork will successfully route DCC messages.

Single-Homed Subnetworks

Introduction

Figure 7-1 illustrates a subnetwork consisting of an FT-2000 backbone ring with DDM-2000 and FiberReach NEs comprising the sub-tending rings in each area. FT-2000 1 is the local NE for CIT remote login and/or the TL1-GNE for ITM SNC.

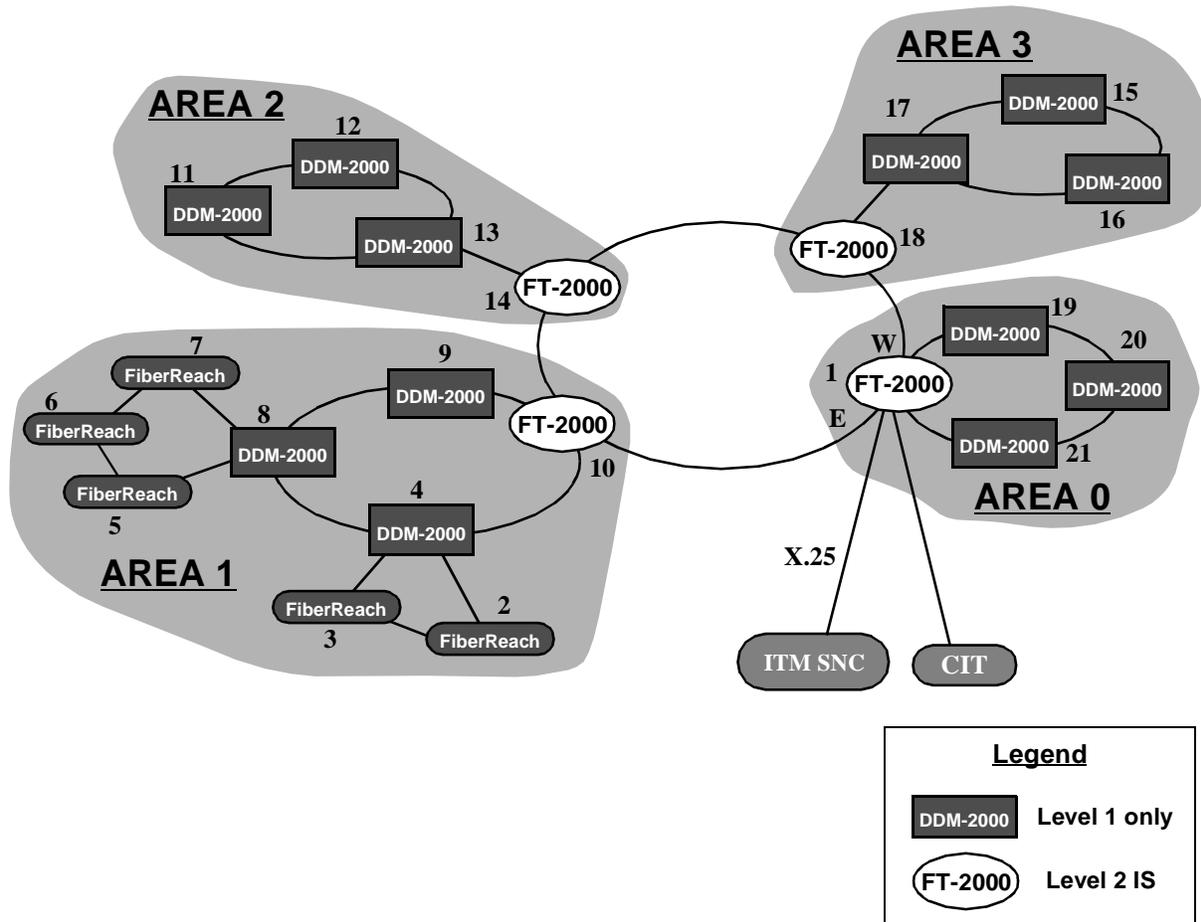


Figure 7-1. Single-Homed Subnetwork

(Continued on next page)

Single-Homed Subnetworks (Continued)

Provisioning Sequence

The provisioning sequence is the same whether provisioning remote NEs from the CIT via Remote Login commands or from ITM SNC.

In Figure 7-1, the area address of the NEs in Area 0 don't need to be changed from default area address 0. If Area 0's address did need to be changed, the area addresses for Area 0 would be provisioned last.

The following table shows the provisioning sequence and considerations that apply for this example:

NE	Area Address	Level 2 IS	Consideration	
FT 1		enable	Provision FT 1 to be a Level 2 IS to have connectivity with other NEs as the subnetwork is partitioned	
FiberReach 2	1		Outermost sub-tending ring NE adjacent to a connecting NE (DDM 4) First sub-tending ring in backbone FT ring, adjacent to and EAST of FT 1	
FiberReach 3			Next adjacent NE in outer sub-tending ring	
DDM 4			NE connecting outer sub-tending ring to inner sub-tending ring	
FiberReach 5			Next outermost sub-tending ring NE adjacent to a connecting NE (DDM 8)	
FiberReach 6			Next adjacent NE in outer sub-tending ring	
FiberReach 7			Next adjacent NE in outer sub-tending ring	
DDM 8			NE connecting outer sub-tending ring to inner sub-tending ring	
DDM 9			Next adjacent NE in inner sub-tending ring	
FT10			enable	NE connecting inner sub-tending ring to backbone ring Level 2 IS for Area 1

NE (Contd)	Area Address	Level 2 IS	Consideration
DDM 11	2		NE adjacent to a connecting NE (DDM 13) in next sub-tending ring
DDM 12			Next adjacent NE in sub-tending ring
DDM 13			NE connecting sub-tending ring to the FT in the backbone ring
FT14		enable	NE connecting the sub-tending ring to backbone ring Level 2 IS for Area 2
DDM 15	3		NE adjacent to a connecting NE (DDM 17) in next sub-tending ring
DDM 16			Next adjacent NE in sub-tending ring
DDM 17			NE connecting sub-tending ring to the FT in the backbone ring
FT18		enable	NE connecting the sub-tending ring to backbone ring Level 2 IS for Area 3 NOTE: At this point, the subnetwork is partitioned into four areas. However, if the area address of the NEs in Area 0 need to be changed, the sequence would be as follows:
DDM 19	0 (if needed)		NE adjacent to the local NE and/or TL1-GNE connecting the sub-tending ring to the backbone ring NE (FT 1)
DDM 20			Next adjacent NE in sub-tending ring
DDM 21			Next adjacent NE in sub-tending ring
FT1		(previously enabled)	Local NE and/or TL1-GNE connecting the sub-tending ring to backbone ring Level 2 IS for Area 0

Single-Homed Subnetwork via ITM SNC IAO LAN

Introduction

The IAO LAN in the subnetwork presents some additional considerations:

- Since FT-2000 does not support an IAO LAN interface directly, the IAO LAN is connected to DDM-2000 NEs. Thus, the NE around which the partitioning sequence is designed is not an FT-2000 in the backbone ring but a DDM-2000 with an IAO LAN interface to ITM SNC in a sub-tending ring.
- When connected to a subnetwork via an IAO LAN, ITM SNC has to be the same area as at least one of the NEs on the IAO LAN. All NEs on an IAO LAN are essentially adjacent, therefore, any of these NEs could be considered to be the key NE for the subnetwork partitioning procedure. The partitioning procedure takes advantage of these facts by first provisioning the Level 2 IS NEs that will be in the same area as ITM SNC, then while they are undergoing resets, the area address of NEs that will be in different areas are provisioned through the other NE(s) on the IAO LAN.
- When an IAO LAN connects different areas, at least one NE in each area on the IAO LAN must be a Level 2 IS.

(Continued on next page)

Single-Homed Subnetwork via ITM SNC IAO LAN (Continued)

Introduction (continued)

Figure 7-2 shows the same subnetwork as in Figure 7-1, with ITM SNC connected via an IAO LAN, to two DDM-2000 NEs that will be in different areas in the partitioned subnetwork:

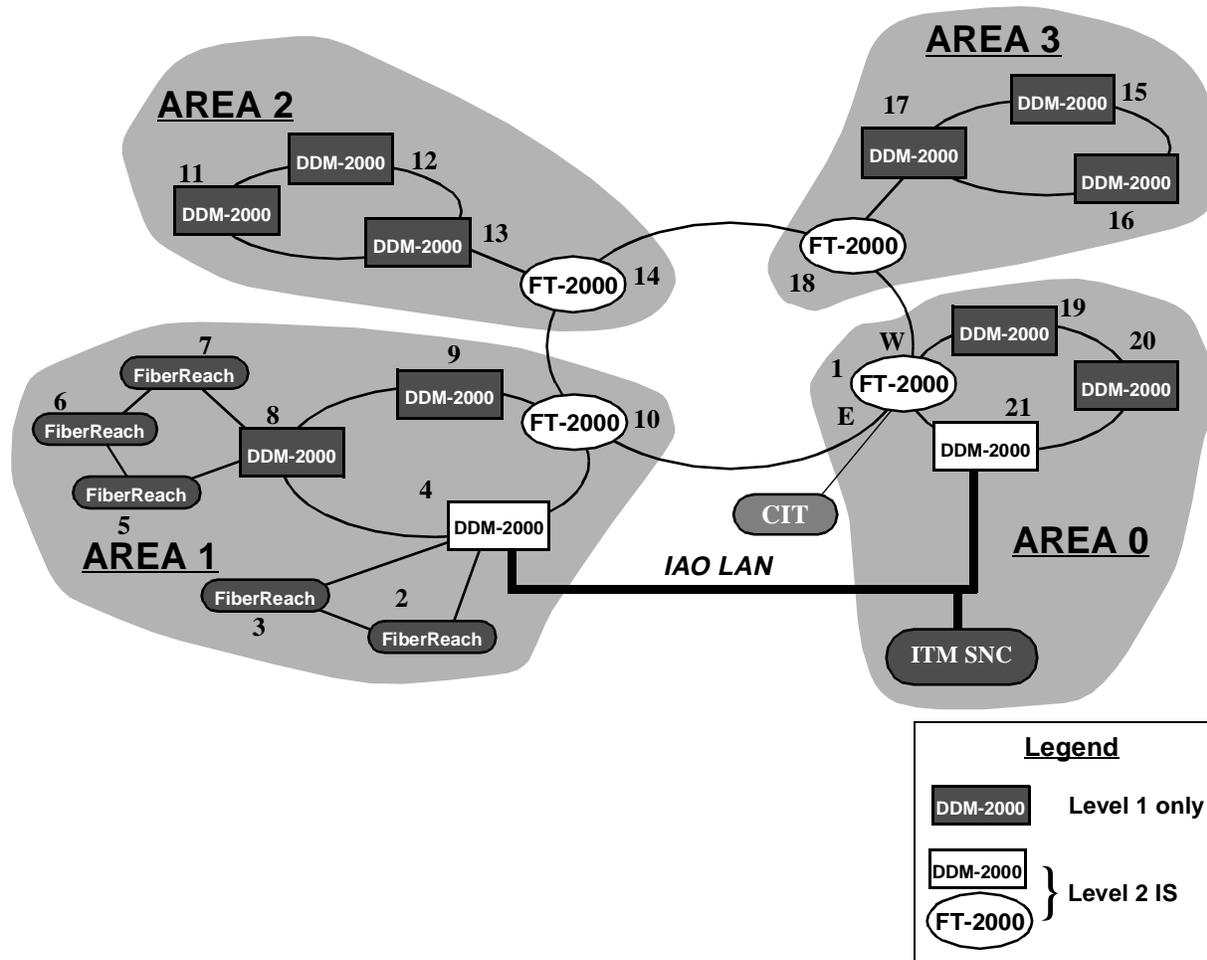


Figure 7-2. Single-Homed Subnetwork, ITM SNC On IAO LAN

(Continued on next page)

Single-Homed Subnetwork via ITM SNC IAO LAN (Continued)

Provisioning Sequence

The procedure to partition this type of subnetwork is similar to partitioning a subnetwork from ITM SNC over an X.25 link or from a CIT, except, the IAO LAN provides a separate, redundant communications path between some of the NEs that will be partitioned into different areas, and thus provides procedural opportunities that do not exist in the subnetwork in the previous example.

The following table shows the provisioning sequence and considerations that apply for this example:

NE	Area Address	Level 2 IS	Consideration
FT 1		enable	Provision FT 1 to be a Level 2 IS to have connectivity with other NEs as the subnetwork is partitioned
DDM 21		enable	Provision DDM 21 to be a Level 2 IS to have connectivity via the IAO LAN with other NEs as the subnetwork is partitioned

NE (Contd)	Area Address	Level 2 IS	Consideration
FiberReach 2	1		Outermost sub-tending ring NE adjacent to a connecting NE (DDM 4) connected via IAO LAN. DDM 4 provides access to the subnetwork while FT 1 and DDM 21 are resetting. First sub-tending ring in backbone FT ring, adjacent to and EAST of FT 1, in an area that will be provisioned as a different area than ITM SNC
FiberReach 3			Next adjacent NE in outer sub-tending ring
FiberReach 5			Next outermost sub-tending ring NE adjacent to a connecting NE (DDM 8)
FiberReach 6			Next adjacent NE in outer sub-tending ring
FiberReach 7			Next adjacent NE in outer sub-tending ring
DDM 8			NE connecting outer sub-tending ring to inner sub-tending ring
DDM 9			Next adjacent NE in inner sub-tending ring
FT 10		enable	NE connecting inner sub-tending ring to backbone ring Level 2 IS for Area 1
DDM 4		enable	NE connecting outer sub-tending ring to inner sub-tending ring Level 2 IS on the IAO LAN for Area 1
			NOTE: At this point, DDM 21 and FT 1 should have completed resetting and can serve as the communication path to the other NEs to be provisioned
DDM 11	2		NE adjacent to a connecting NE (DDM 13) in next sub-tending ring
DDM 12			Next adjacent NE in sub-tending ring
DDM 13			NE connecting sub-tending ring to the FT in the backbone ring
FT 14		enable	NE connecting the sub-tending ring to backbone ring Level 2 IS for Area 2

NE (Contd)	Area Address	Level 2 IS	Consideration
DDM 15	3		NE adjacent to a connecting NE (DDM 17) in next sub-tending ring
DDM 16			Next adjacent NE in sub-tending ring
DDM 17			NE connecting sub-tending ring to the FT in the backbone ring
FT 18		enable	NE connecting the sub-tending ring to backbone ring Level 2 IS for Area 3 NOTE: At this point, the subnetwork is partitioned into four areas. However, if the area address of the NEs in Area 0 need to be changed, the sequence would be as follows:
DDM 19	0 (if needed)		NE adjacent to the FT connecting the sub-tending ring to the backbone ring NE (FT 1)
DDM 20			Next adjacent NE in sub-tending ring
FT 1		(previously enabled)	NE connecting inner sub-tending ring to backbone ring Level 2 IS for Area 0
DDM 21		(previously enabled)	Next adjacent NE in sub-tending ring Level 2 IS on the IAO LAN for Area 0
ITM SNC			ITM SNC must be assigned to the same area as at least one of the NEs on the IAO LAN

Dual-Homed Subnetworks

Introduction

Partitioning a dual-homed subnetwork, in which each area has two Level 2 ISs in the backbone ring, also provides procedural opportunities that do not exist in the subnetwork in the first example. The primary difference is that in each area, one of the Level 2 ISs can have its area address provisioned to the new area and Level 2 IS functionality enabled first. Then, as other NEs in the area are provisioned to the new area, they will have DCC communication via the previously provisioned Level 2 IS for that area. DCC communication is disrupted only during the time that NE is undergoing a reset.

Figure 7-3 illustrates a subnetwork consisting of an FT-2000 backbone ring with DDM-2000 NEs comprising the dual-homed sub-tending rings (and FiberReach NEs comprising a single-homed sub-tending ring) in each area. FT-2000 1 is the local NE for CIT remote login and/or the TL1-GNE for ITM SNC.

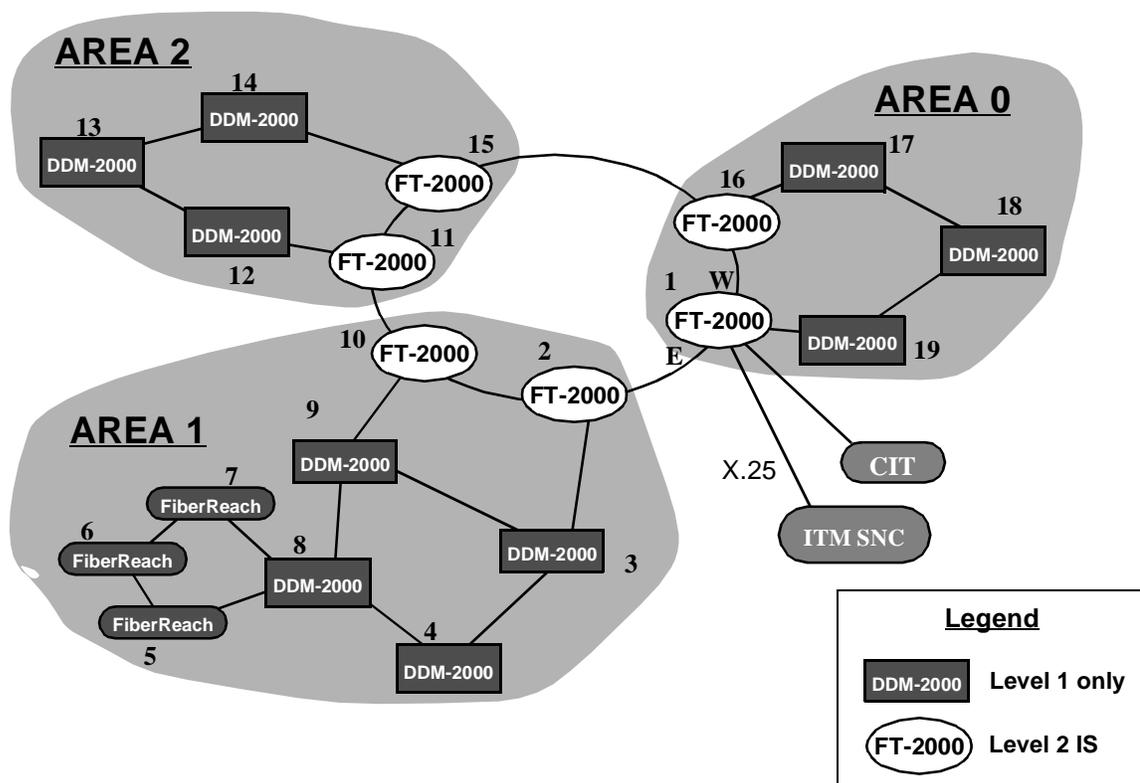


Figure 7-3. Dual-Homed Subnetwork

(Continued on next page)

Dual-Homed Subnetworks (Continued)

Provisioning Sequence

The following table shows the provisioning sequence and considerations that apply for this example:

NE	Area Address	Level 2 IS	Consideration	
FT 1		enable	Provision FT 1 to be a Level 2 IS having connectivity with other NEs as the subnetwork is partitioned	
FT 2	1	enable	Provision FT 2, adjacent to and East of FT 1 in Area 1, to be one of the Level 2 ISs having connectivity with other NEs as the subnetwork is partitioned	
DDM 3			Next adjacent NE in sub-tending ring	
DDM 4			Next adjacent NE in sub-tending ring	
FiberReach 5			Outermost sub-tending ring NE adjacent to a connecting NE (DDM 8)	
FiberReach 6			Next adjacent NE in outer sub-tending ring	
FiberReach 7			Next adjacent NE in outer sub-tending ring	
DDM 8			NE connecting outer sub-tending ring to inner sub-tending ring	
DDM 9			Next adjacent NE in inner sub-tending ring	
FT 10			enable	NE connecting inner sub-tending ring to backbone ring Second Level 2 IS for Area 1
FT 11		2	enable	Provision FT 11 to be one of the Level 2 ISs in Area 2, having connectivity with other NEs as the subnetwork is partitioned
DDM 12			Next adjacent NE in sub-tending ring	
DDM 13			Next adjacent NE in sub-tending ring	
DDM 14			Next adjacent NE in sub-tending ring	
FT 15	enable		NE connecting the sub-tending ring to backbone ring Second Level 2 IS for Area 2	
			NOTE: At this point, the subnetwork is partitioned into three areas except for enabling FT 16 as the second Level 2 IS in Area 0. If the area address of the NEs in Area 0 need to be changed, the sequence would be as follows:	

NE (Contd)	Area Address	Level 2 IS	Consideration
FT 16	0 (if needed)	enable	NE connecting the sub-tending ring to backbone ring Second Level 2 IS for Area 0
DDM 17			Next adjacent NE in sub-tending ring
DDM 18			Next adjacent NE in sub-tending ring
DDM 19			Next adjacent NE in sub-tending ring
FT 1		(previously enabled)	Local NE and/or TL1-GNE connecting the sub-tending ring to backbone ring One of the Level 2 ISs for Area 0

IAO LAN-Connected Subnetwork

Introduction

When an IAO LAN in the *only* method of connecting different areas, it is recommended that at least two NEs on the IAO LAN in each area be Level 2 ISs for redundancy purposes. Therefore, since each area will be effectively dual-homed on the IAO LAN, this subnetwork is partitioned following the same general approach as when upgrading a dual-homed subnetwork.

Figure 7-4 is a subnetwork with redundant IAO LAN interfaces between each area and to ITM SNC. There is no DCC connectivity, other than the IAO LAN, between the NEs that will be in different areas.

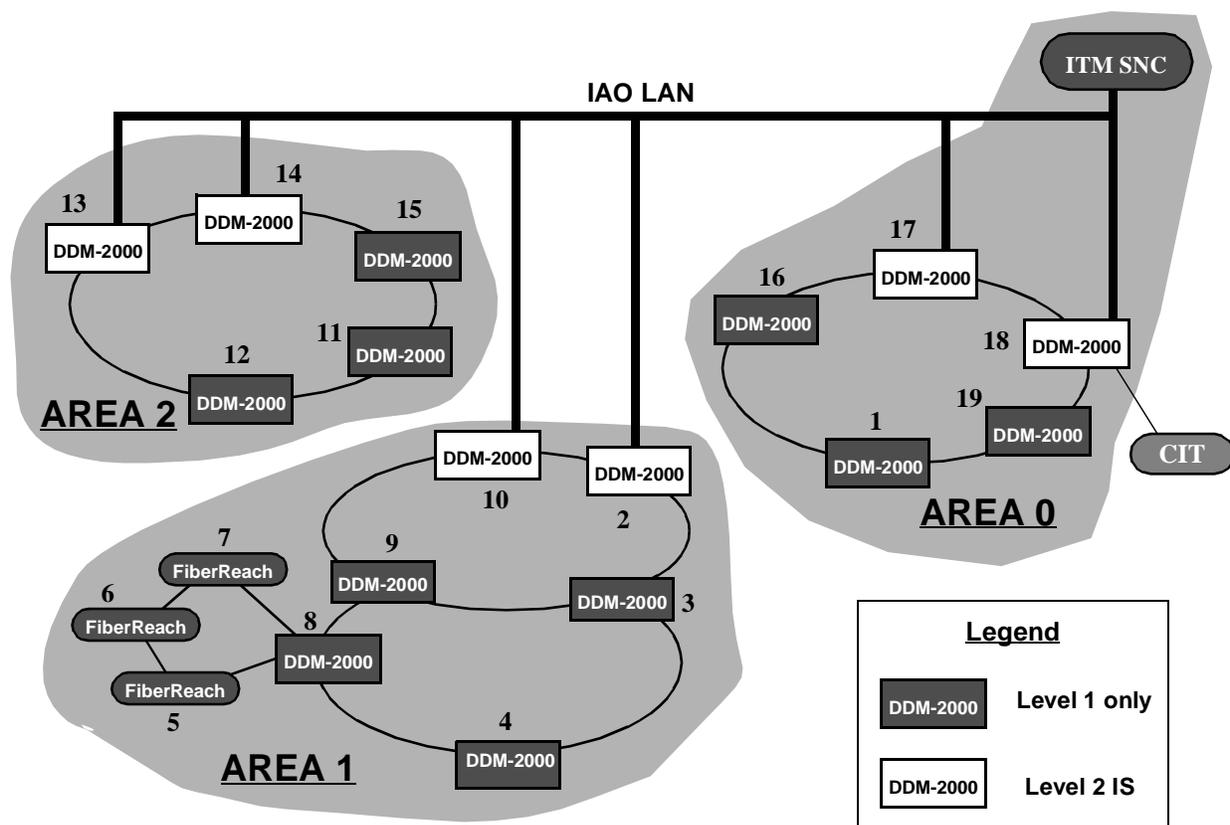


Figure 7-4. IAO LAN-Connected Subnetwork, ITM SNC On IAO LAN

(Continued on next page)

IAO LAN-Connected Subnetwork (Continued)

Provisioning Sequence

The following table shows the provisioning sequence and considerations that apply for this example:

NE	Area Address	Level 2 IS	Consideration	
DDM 18		enable	Provision DDM 18 to be a Level 2 IS to have connectivity over the IAO LAN with other NEs as the subnetwork is partitioned	
DDM 2	1	enable	Provision DDM 2 to be one of the Level 2 ISs in Area 1, having connectivity with other NEs as the subnetwork is partitioned	
DDM 3			Next adjacent NE in sub-tending ring	
DDM 4			Next adjacent NE in sub-tending ring	
FiberReach 5			Outermost sub-tending ring NE adjacent to a connecting NE (DDM 8)	
FiberReach 6			Next adjacent NE in outer sub-tending ring	
FiberReach 7			Next adjacent NE in outer sub-tending ring	
DDM 8			NE connecting outer sub-tending ring to inner sub-tending ring	
DDM 9			Next adjacent NE in inner sub-tending ring	
DDM 10			enable	Second Level 2 IS connecting Area 1 to the IAO LAN

NE (Contd)	Area Address	Level 2 IS	Consideration
DDM 14	2	enable	Provision DDM 14 to be one of the Level 2 ISs in Area 2 to have connectivity with other NEs as the subnetwork is partitioned
DDM 15			Next adjacent NE in sub-tending ring
DDM 11			Next adjacent NE in sub-tending ring
DDM 12			Next adjacent NE in sub-tending ring
DDM 13		enable	Second Level 2 IS connecting Area 2 to the IAO LAN NOTE: At this point, the subnetwork is partitioned into three areas except for enabling DDM 17 as the second Level 2 IS in Area 0. If the area address of the NEs in Area 0 need to be changed, the sequence would be as follows:
DDM 17	0 (if needed)	enable	Second Level 2 IS connecting Area 0 to the IAO LAN
DDM 19			Next adjacent NE in sub-tending ring
DDM 1			Next adjacent NE in sub-tending ring
DDM 16			Next adjacent NE in sub-tending ring
DDM 18		(previously enabled)	One of the Level 2 ISs connecting Area 0 to the IAO LAN
ITM SNC			ITM SNC must be assigned to the same area as at least one of the NEs on the IAO LAN.

Subnetwork Software Upgrade (Pre-TARP Releases to TARP Releases)

8

Contents

■ Overview	2
■ Considerations	3
■ Software Download and Copy	4
■ Remote Operations Guidelines	8
■ Subnetwork Software Upgrade Sequence	15
■ Subnetwork Software Upgrade Example: Pre-TARP Releases to TARP Releases	18

Overview

Introduction

Beginning with the TARP Releases, PF-2000 NEs use a different OSI protocol stack. Therefore, NEs that have not been upgraded to TARP Release will not share DCC communications with NEs that have been upgraded.

Upgrading to the TARP Release software on an NE or ITM SNC includes the steps of loading the software on the NE and making it the active software. FT-2000 and DDM-2000 OC-3 R9.1 and OC-12 R5.1 (and later) store two copies of software. For these NEs, newly loaded software does not become the active software until the FT-2000's overhead controllers are reset or until an **apply** command is executed for DDM-2000 OC-3 and OC-12. FiberReach and DDM-2000 OC-3 R9.0 and OC-12 R5.0 (and earlier) store only a single copy of the software, thus newly loaded software becomes the active software immediately upon the completion of the download.

Subnetworks require careful sequencing of software downloads and activation to avoid isolating non-upgraded NEs. Refer to "Subnetwork Software Upgrade Sequence" later in this chapter for information on establishing the sequence.

Considerations

Software Upgrade Compatibility

PF-2000 NEs support local or remote software downloads from several previous software releases to the TARP Releases. TARP Release OI is a software-only enhancement to PF-2000 NEs.



NOTE:

Upgrades from some of the older FT-2000 and DDM-2000 Pre-TARP Releases to the TARP Releases may require an upgrade procedure with on-site equipment/fiber changes. Refer to the "Software Upgrades" sections of *FT-2000 OC-48 Lightwave System User/Service Manual*, 365-575-103, *DDM-2000 OC-12 Multiplexer User/Service Manual*, 363-206-295, *DDM-2000 OC-3 Multiplexer User/Service Manual*, 363-206-285, and *DDM-2000 FiberReach User/Service Manual*, 363-206-301.

Upgrade the ITM SNC

If ITM SNC is used, it needs to be upgraded to its TARP Release (R5.0), also, to be compatible with the PF-2000 NE TARP Releases.



NOTE:

The ITM SNC capability to download software to PF-2000 NEs is not useful until software upgrades from the TARP Releases to subsequent releases are needed.

When using ITM SNC to control the subnetwork software upgrade, the ITM SNC itself should typically be upgraded to the TARP Release *before* all the NEs in the subnetwork have been upgraded, to assure ongoing TL1/X.25 access to all the non-upgraded NEs.

Software Download and Copy

Definitions

Destination NE

An NE *to* which the generic software is downloaded or copied.

Dormant Software

Generic software stored in FT-2000 and DDM-2000 OC-3 R9.1 and OC-12 R5.1 (and later) that has not yet been activated. FiberReach does not support Dormant Software.



NOTE:

After the new (dormant) software is downloaded/copied to a DDM-2000 OC-3 or OC-12 or FT-2000 NE, the NE will have two different versions of their respective software and hence will report code mismatch conditions:

- a minor alarm for FT-2000
- a status condition for DDM-2000 OC-3 and OC-12.

Remote Software Download

Loading generic software from a PC directly connected to a local DDM-2000 to a remote NE of either the same type or a different type (DDM-2000 OC-3, OC-12, or FiberReach). When upgrading a subnetwork to the TARP Releases, this is the only practical method to upgrade FiberReach NEs from a centralized location. This procedure is also called a "Remote Install Program".

Software Activation

Initiating the Dormant Software.

- FT-2000 CIT **reset** or TL1 (R7.1 [and later]) **INIT-SYS** (phase = 3)
- DDM-2000 OC-3 R9.1 and OC-12 (R5.1 [and later]) CIT or TL1 **apply**.



NOTE:

Because FiberReach does not support Dormant Software, Software Download/Copy immediately activates the new generic software in FiberReach.

(Continued on next page)

Software Download and Copy (Continued)

Definitions (continued)

Software Copy

Copying generic software from an NE to another NE of the same type (FT-2000, DDM-2000 OC-12, DDM-2000 OC-3, or DDM-2000 FiberReach) in the subnetwork. The software being copied should typically be dormant (FT-2000 and DDM-2000 OC-12 and OC-3 default) but may be active (FiberReach does not support Dormant Software).

Software Download

Loading generic software from a PC to a local PF-2000 NE via a direct connection. This procedure is also called a "Local Install Program" or simply an "Install Program".

⇒ **NOTE:**
The PC may be an FT-2000 PC-Craft Interface Terminal (PC-CIT), but for simplification, it will hereafter be referred to as a PC.

Software Upgrade

The completion of Software Download/Copy *and* Software Activation in an NE.

Source NE

The NE *from* which the software is copied during Software Copy.

The *initial* Source NE is the NE of each type to which software is first locally or remotely downloaded, and in turn, first copied to other NEs of the same type in the subnetwork. One of the initial Source NEs, typically an FT-2000, is expected to be the local NE for CIT remote logins and/or the TL1-GNE for ITM SNC TL1/X.25 access.

⇒ **NOTE:**
Because the Source NEs must have DCC communications with NEs that have not as yet been upgraded during Software Copy, the TARP Release software must be dormant in the Source NEs until all Destination NEs have been upgraded.

(Continued on next page)

Software Download and Copy (Continued)

Recommended Procedures

The recommended procedure for upgrading a subnetwork to TARP Release may be described as a high-level concept as follows, but see “Subnetwork Software Upgrade Sequence” and “Subnetwork Software Upgrade Example: Pre-TARP Releases to TARP Releases” in this chapter for the specific steps and sequence.

Step	Action	Notes
1	Download software to convenient initial Source NEs of each NE type (DDM-2000 OC-3 and OC-12 and FT-2000) in the subnetwork.	Recommended initial Source NEs are located in the Central Office (CO).
2	Use Software Copy to all other NEs of those types in the subnetwork.	Assuming DDM-2000 OC-3 R9.1 and OC-12 R5.1 (and later) in the subnetwork.
3	Use Remote Software Downloads to each FiberReach NE.	The NE <i>sequence</i> for Steps 3 and 4 is important to avoid isolating non-upgraded NEs.
4	Activate the Dormant Software in each DDM-2000 OC-3 and OC-12 and FT-2000.	

(Continued on next page)

Software Download and Copy (Continued)

Recommended Procedures (continued)

The following factors should be considered to determine an upgrade sequence for any specific subnetwork.

Typical times required to copy software from one NE to another may be on the order of 10 to 20 minutes depending on the type of NE and may increase depending on the number of intervening intermediate DCC spans ("hops"). Downloading software from a PC could take up to 5 times as long as copying software from one NE to another and generally can only be done to one NE at a time. Because of the length of time required to complete remote software download to each FiberReach, upgrading a subnetwork that includes many FiberReach NEs is likely to be a lengthy process.

Once TARP Release software is loaded on several DDM-2000 NEs (but not activated), it can be copied simultaneously from these DDM-2000 NEs to other DDM-2000 NEs of the same type. Software activation times for DDM-2000 are on the order of 5 minutes.

For FT-2000, new software can be copied from the same FT-2000 to up to 15 other FT-2000 NEs simultaneously. Software activation for FT-2000 is on the order of 15 minutes.

Remote Operations Guidelines

General Considerations

When upgrading to the TARP Releases, the initial download of TARP Release software to the initial source FT-2000 and DDM-2000 OC-3 and OC-12 NEs, can only be done from a PC. Copying software from one NE to another, and activating the software on the NE can be done through a CIT (either locally or remotely) or from ITM SNC.

When software has been downloaded or copied to several NEs, it can be copied simultaneously from these NEs to others.

Selecting a Local NE for CIT Remote Login

If there are DDM-2000 and FT-2000 NEs in the subnetwork to be upgraded, and if software copy or software activation will be initiated via CIT remote login, the local CIT must be connected to an FT-2000 (FT-2000 supports CIT remote login to DDM-2000, but not vice versa).

(Continued on next page)

Remote Operations Guidelines (Continued)

Termination of CIT Remote Logins

If activating software immediately in remote NEs via CIT remote login (e.g., using an FT-2000 **reset** command), the remote login session is terminated immediately and control is returned to the local CIT. The CIT can then be used to log into another remote NE (unlike the subnetwork partitioning procedure in Chapter 7).

Termination of ITM SNC TL1 Logins

When activating software from ITM SNC, the TL1 logins are dropped between ITM SNC and an NE that is reset. Independent of the previous remote NE's reset, ITM SNC maintains immediate access to the next NE via its TL1 login to each non-upgraded NE.

When the TL1-GNE (to ITM SNC) is reset, communication to the entire subnetwork is temporarily lost. When the TL1-GNE completes its reset, ITM SNC reestablishes its TL1 logins to the entire subnetwork.

(Continued on next page)

Remote Operations Guidelines (Continued)

Obsolete Pre-TARP Release OI Parameters

The Pre-TARP Release provisionable parameters that do not apply to the TARP Releases (such as DSNE and AGNE) should be left "as is" to support subnetwork software upgrades from Pre-TARP to TARP Releases. The obsolete parameters are simply ignored as the subnetwork is upgraded to the TARP Releases (obsolete parameters will not appear in any TARP Release reports).

If TARP Release software is downloaded or copied to a DDM-2000 that resets upon receipt of dormant software (refer to DDM-2000 OC-3 and OC-12 Specifics or Table 8-1), all other NEs in the subnetwork will experience temporary *communication failure* status condition(s). If the DDM-2000 that resets is the Pre-TARP Release DSNE or AGNE, all other NEs in the subnetwork will experience a temporary *DSNE not reachable* or DDM-2000 *AGNE communication failure* or FT-2000 *NE status com failure* condition(s). Similar temporary conditions occur as a result of the resets that are part of software activation for both DDM-2000 and FT-2000, also.

(Continued on next page)

Remote Operations Guidelines (Continued)

FT-2000 Specifics

FT-2000 supports local software download and software copy but not remote software download. FT-2000 software copy is initiated via CIT command **copy-program** or TL1 command **CPY-PRGM**. FT-2000 accepts dormant software without any disruption of subnetwork communications (i.e., no controller resets).

To activate software on an FT-2000 after the new software has been downloaded or copied into its dormant area, a user can use the CIT **reset** command. Alternatively, the FT-2000 R7.1 (and later) TL1 **INIT-SYS** (phase = 3) command can be used from ITM SNC.



WARNING:

*An unintentional FT-2000 **reset** would also activate the dormant software, possibly resulting in loss of DCC communications with non-upgraded NEs. In this case, craft dispatch may be necessary to complete the subnetwork upgrade.*

(Continued on next page)

Remote Operations Guidelines (Continued)

DDM-2000 OC-3 and OC-12 Specifics

DDM-2000 OC-3 and OC-12 support local and remote software download and software copy. DDM-2000 software download is initiated via PC command **ins-prog**. DDM-2000 software copy is initiated via CIT command **cpy-prog** or TL1 command **CPY-PRGM**.

Software that is downloaded or copied to DDM-2000 OC-3 and OC-12 becomes a dormant copy until the software is activated by a user. This is the case for DDM-2000 OC-3 R9.1 and OC-12 R5.1 (and later), but not for earlier releases. Therefore, it is recommended that DDM-2000 upgrades to the TARP Releases be done from DDM-2000 OC-3 R9.1 and OC-12 R5.1 (or later). Otherwise, the special considerations needed to upgrade FiberReach NEs to the TARP Release will also apply to DDM-2000 OC-3 and OC-12 NEs.



NOTE:

DDM-2000 OC-3 R9.0 and OC-12 R5.0 (and earlier) NEs don't support Remote Software Download or Software Copy of TARP Release software to themselves.

DDM-2000 OC-3 R9.1 and OC-12 R5.1 and R5.2 reset when new software is downloaded or copied to them (even as a dormant software copy), therefore, temporary DCC disruption occurs. DDM-2000 OC-3 R11.0 only resets when software is downloaded locally, *not* remote software downloads or copies. DDM-2000 OC-3 and OC-12 TARP Releases do not reset in any of the above-mentioned cases.

To activate software on a DDM-2000 OC-3 and OC-12 after the new software has been downloaded or copied into its dormant area, a user may use the CIT **apply** command. Alternatively, the DDM-2000 OC-3 and OC-12 TL1 **apply** command can be issued from ITM SNC. The DDM-2000 OC-3 R9.1 and OC-12 R5.1 and R5.2 **apply** command has a fixed 30 minute delay before the software activation begins. The DDM-2000 OC-3 R11.0 and OC-12 R7.0 (and later) **apply** command software activation can be scheduled by the user (with a default delay of 15 minutes). The **apply** can be cancelled prior to the delayed or scheduled software activation. In any case, DDM-2000 OC-3 and OC-12 resets do *not* activate the dormant software.

(Continued on next page)

Remote Operations Guidelines (Continued)

FiberReach Specifics

FiberReach supports local and remote software download and software copy, but remote software download in particular is recommended to upgrade FiberReach to the TARP Release. FiberReach remote software download is initiated via PC command `ins-prog`. To go physically to each FiberReach in a subnetwork and upgrade each, via a local software download, may not be practical and is therefore not recommended.

Because FiberReach cannot store two copies of software simultaneously, downloading (or copying) software also activates it. When TARP Release software is downloaded to FiberReach, FiberReach loses DCC communications to non-upgraded NEs. Therefore, a FiberReach NE that has been upgraded cannot communicate with other non-upgraded FiberReach NEs, and thus cannot be used as a source NE to copy the new software to non-upgraded FiberReach NEs.

(Continued on next page)

Remote Operations Guidelines (Continued)

PF-2000 NE Software Upgrade Summary Table 8-1 summarizes some of the software upgrade information described in the previous paragraphs:

Table 8-1. PF-2000 NE Software Upgrade Summary

PF-2000 Software Generic Currently Active	Activates Software Immediately Upon Receipt	Accepts Dormant Software	Resets Upon Receipt of Dormant Software			apply Command to Activate Dormant Software	Reset Activates Dormant Software
			Local Software Download	Remote Software Download	Software Copy		
FT-2000 R6.0	—	✓	—	N/A	—	—	✓
FT-2000 R7.x	—	✓	—	N/A	—	—	✓
FT-2000 R8.0	—	✓	—	N/A	—	—	✓
DDM-2000 OC-12 R5.0	✓	—	N/A	N/A	N/A	N/A	N/A
DDM-2000 OC-12 R5.1, DDM-2000 OC-12 R5.2	—	✓	✓	✓	✓	Fixed 30 minutes	—
DDM-2000 OC-12 R7.0	—	✓	—	—	—	Scheduled	—
DDM-2000 OC-3 R7.2*	✓	—	N/A	N/A	N/A	N/A	N/A
DDM-2000 OC-3 R9.0†	✓	—	N/A	N/A	N/A	N/A	N/A
DDM-2000 OC-3 R9.1	—	✓	✓	✓	✓	Fixed 30 minutes	—
DDM-2000 OC-3 R11.0	—	✓	✓	—	—	Scheduled	—
DDM-2000 OC-3 R13.0	—	✓	—	—	—	Scheduled	—
DDM-2000 FiberReach R2.1	✓	—	N/A	N/A	N/A	N/A	—
DDM-2000 FiberReach R3.0	✓	—	N/A	N/A	N/A	N/A	—

* Requires new controller circuit packs to upgrade to any later DDM-2000 OC-3 release.

† Does not accept remote software download or software copy.

Subnetwork Software Upgrade Sequence



CAUTION:

Subnetwork software upgrades should take place during off-peak hours.

Minimize Subnetwork DCC Disruption

During the process of upgrading a subnetwork to the TARP Releases, there will be periods of time when subnetwork DCC communications are disrupted and isolated NEs are unable to report any alarms that might occur to the OS. In addition to temporarily disrupting DCC communications, NE resets temporarily disable automatic transmission protection switching. Once an NE has been upgraded, it will not have DCC communications to non-upgraded NEs, including the initial source NE. If the initial source NE is also the only TL1-GNE to ITM SNC, upgraded NEs will have no TL1 communications to ITM SNC until all NEs are upgraded, including the initial source NE.

To avoid unreported alarm conditions, TARP Release software should first be downloaded and copied, but not activated, on all FT-2000 and DDM-2000 OC-3 and OC-12 NEs. Then, the software should be activated on all these NEs in as much of a simultaneous manner as possible. This minimizes the total length of time in which the subnetwork loses DCC communications.

Upgrade FiberReach First

Because FiberReach immediately activates downloaded (or copied) software, when upgrading a subnetwork that includes FiberReach NEs using remote software downloads, all FiberReach NEs should be upgraded before any of the intervening DDM-2000 OC-3 and OC-12 and FT-2000 NEs. DCC communications will be lost to the upgraded FiberReach NEs until the remainder of the subnetwork is upgraded.

DDM-2000 OC-3 and OC-12 and FT-2000 Software Copies

When copying software from a source DDM-2000 OC-3 or OC-12 or FT-2000 to the other DDM-2000 OC-3 and OC-12 NEs and FT-2000 NEs in the subnetwork, generally, software should be copied to the NEs that are in sub-tending rings that are further away from the source NE first. However, this rule should be modified by copying to an intermediate NE and then copying from the intermediate NE to the further away NEs to reduce the total number of copy hops (i.e., the number of DCC spans between the source and destination NEs) and thus reduce the total copy time.

(Continued on next page)

Subnetwork Software Upgrade Sequence (Continued)

Avoid Isolating NEs

To avoid isolating non-upgraded NEs, any NE that acts to connect a sub-tending ring to the remainder of the subnetwork containing the local NE or TL1-GNE should be upgraded only after all of the other NEs in it's sub-tending ring have been upgraded.

When upgrading a sub-tending ring:

1. If the connecting NE is:
 - an FT-2000, the NE to the East of the connecting FT-2000 is upgraded first.
 - a DDM-2000, then *either* of the adjacent NEs in the sub-tending ring is upgraded first.
2. Then, other NEs in the sub-tending ring are upgraded in order around the ring sequentially upgrading the next adjacent NE.
 - The connecting NE is not upgraded when the NEs in its sub-tending ring are upgraded.
 - The outermost sub-tending rings are upgraded first, not including the connecting NE, then the next inner sub-tending ring is upgraded, again going around the ring in order.
 - This would then include the upgrading of the connecting NE to the outer ring.

(Continued on next page)

Subnetwork Software Upgrade Sequence (Continued)

Avoid Isolating NEs (continued)

3. Finally, the backbone or sub-tending ring which contains the local NE or TL1-GNE is sequentially upgraded,
 - starting with the NE to the East of the local NE or TL1-GNE if the local NE or TL1-GNE is an FT-2000,
 - starting with *either* of the adjacent NEs if the local NE or TL1-GNE is a DDM-2000,and upgrading the local NE or TL1-GNE last.

This sequence focuses on TARP Release software activation with the primary goal being to avoid isolating any non-upgraded NEs. The sequence to download initially (except FiberReach) and copy software throughout a subnetwork is less important.



NOTE:

Before upgrading a subnetwork, be sure no alarms exist, especially *DCC failure* alarms; otherwise, even the recommended upgrade sequence might result in isolated NEs.

Subnetwork Software Upgrade Example: Pre-TARP Releases to TARP Releases

Introduction

Figure 8-1 shows a hypothetical subnetwork consisting of an FT-2000 backbone ring, an FT-2000 sub-tending ring, two DDM-2000 sub-tending rings and three FiberReach sub-tending rings.

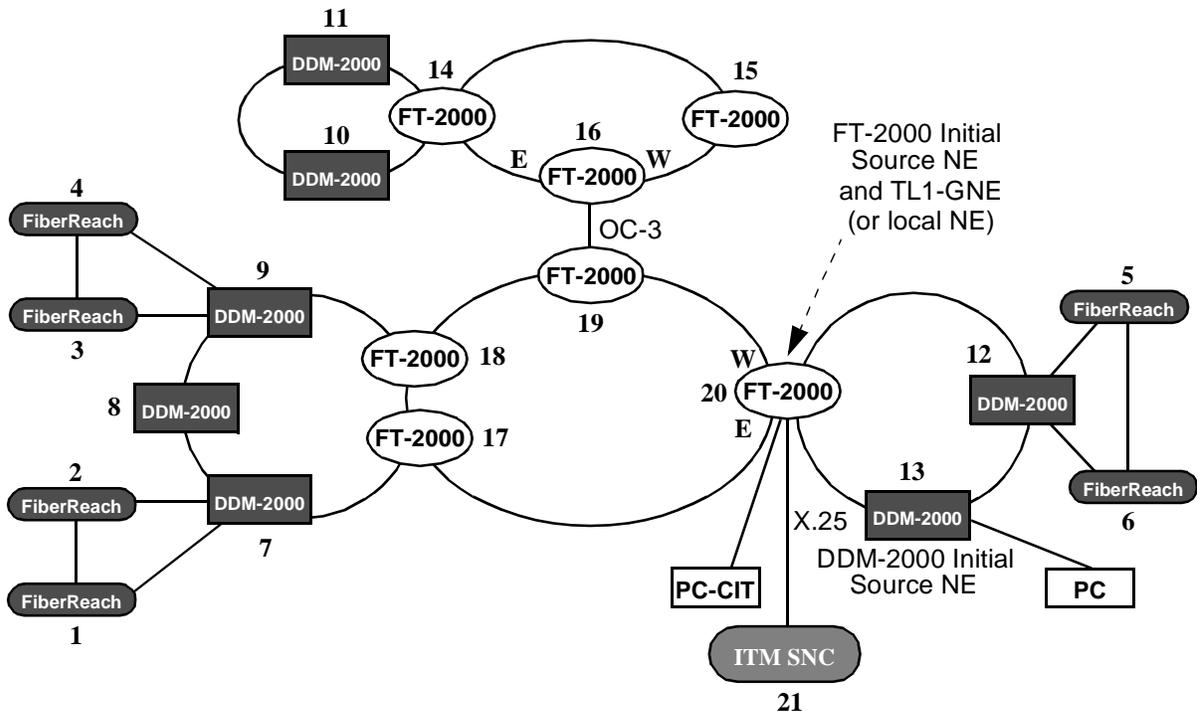


Figure 8-1. Example: Subnetwork Software Upgrade (Pre-TARP Releases to TARP Releases)

(Continued on next page)

Subnetwork Software Upgrade Example: Pre-TARP Releases to TARP Releases (Continued)

Subnetwork Software Upgrade Assumptions

In this example (Figure 8-1), the following assumptions are made:

- all DDM-2000 NEs are of the same type, i.e., DDM-2000 OC-3. Hence, one DDM-2000 serves as the initial source NE to copy the software to all other DDM-2000 NEs.

In a subnetwork with both DDM-2000 OC-3 and OC-12 NEs, one DDM-2000 OC-3 and one DDM-2000 OC-12 would need to serve as the source NE for the other DDM-2000 OC-3 and OC-12 NEs, respectively.

- NE 20 is the FT-2000 initial source NE and NE 13 is the DDM-2000 initial source NE. These two NEs would ideally be in the same CO.
- NE 13 is also the DDM-2000 through which the FiberReach software is downloaded using remote software downloads.

NE 20 is the FT-2000 TL1-GNE or local NE through which the FT-2000 and DDM-2000 OC-3 software copies and software activations are controlled.

(Continued on next page)

Subnetwork Software Upgrade

Example: Pre-TARP Releases to TARP Releases (Continued)

Recommended Subnetwork Software Upgrade Sequence

Referring to Figure 8-1, the recommended upgrade sequence is:

Step	Action
1	Upgrade ITM SNC to the TARP Release software.
2	Connect a PC to DDM-2000 13 to locally download the TARP Release software to DDM-2000 13 as a dormant copy.
3	Copy the TARP Release DDM-2000 software from DDM-2000 13 to the other DDM-2000 NEs (7-12), as dormant copies, directly and indirectly: <ol style="list-style-type: none"> a. Copy the software from DDM-2000 13 to DDM-2000 7. b. Copy the software from DDM-2000 7 to DDM-2000 8. c. Copy the software from DDM-2000 8 to DDM-2000 9. d. Copy the software from DDM-2000 13 to DDM-2000 10. e. Copy the software from DDM-2000 10 to DDM-2000 11. f. Copy the software from DDM-2000 13 to DDM-2000 12.
4	Connect a PC to FT-2000 20 to locally download the TARP Release software to FT-2000 20 as a dormant copy.
5	Copy the TARP Release FT-2000 software from FT-2000 20 to the other FT-2000 NEs (14-19), as dormant copies, directly and indirectly: <ol style="list-style-type: none"> a. Copy the software from FT-2000 20 to FT-2000 14. b. Copy the software from FT-2000 14 to FT-2000 15 and 16, simultaneously. c. Copy the software from FT-2000 20 to FT-2000 17. d. Copy the software from FT-2000 17 to FT-2000 18 and 19, simultaneously.

Step	Action
6	Upgrade the FiberReach NEs: Connect a PC to DDM-2000 13 to remotely download the TARP Release software sequentially to each FiberReach (1-6) in ascending numbered order starting with FiberReach 1.
7	Activate the TARP Release software sequentially in each DDM-2000 (7-13) in the same ascending numbered order that was used to copy software to the DDM-2000 NEs, starting with DDM-2000 7. Activate the TARP Release software last in DDM-2000 13, the DDM-2000 initial source NE. For DDM-2000 OC-3 R11, schedule all DDM-2000 (7-13) software activations to occur simultaneously.
8	After all DDM-2000 NEs have been upgraded, sequentially reset each of the FT-2000 NEs (14-20) in ascending numbered order, starting with FT-2000 14. Reset FT-2000 20 (the FT-2000 TL1-GNE or local NE) last.

An Introduction To SONET



A SONET Overview

The Basic Purpose of SONET

The basic purpose of Synchronous Optical Network (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.

A SONET Overview (Continued)

The History of SONET

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.

A SONET Overview (Continued)

SONET Definitions

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 following SONET parameters are defined under the American National Standard:

- 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).
-

* Registered trademark of America National Standards Institute

SONET Signal Hierarchy (Continued)

STS-1 Signal Rate Each STS-1 frame consists of 810 bytes and each byte has 8 bits; therefore, each frame contains 6480 bits (8 X 810).

Each STS-1 frame has a reoccurring rate of 8000 frames per second; therefore, each STS-1 frame has a bandwidth of 125 microseconds (1 / 0.000125).

The STS-1 signal rate is equal to the total bits per frame multiplied by the total frames per second (6480 X 8000) or **51,840,000 bits a second**.

STS-1 Payload and Overhead

Columns 4 through 90 of the STS-1 frame are 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).

Columns one through three in each of the nine rows carry the SECTION and LINE overhead bytes. Collectively, these 27 bytes are referred to as transport overhead.

SONET Layers

Divisions

SONET divides its processing functions into three layers (section, line, and path). These three layers are associated with equipment that reflects the natural divisions in network spans.

Figure A-2 illustrates the three defined layers in a signal path:

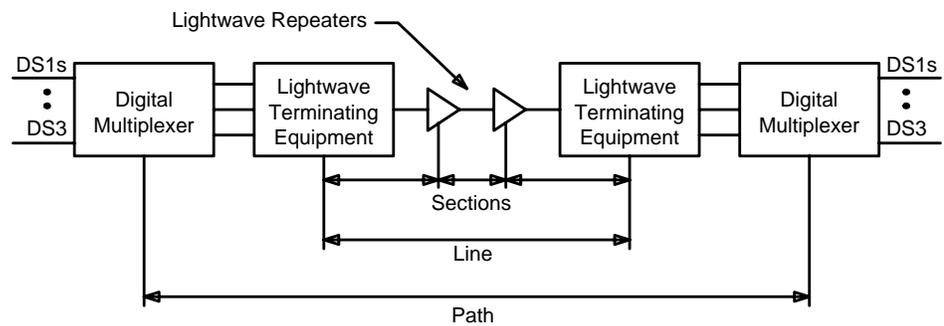


Figure A-2. Section, Line, and Path Definitions

SONET Layers (Continued)

Sections **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 **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.

Path **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.

SONET Layers (Continued)

Overhead

Each SONET layer has a set of overhead bytes that carry information used by various network elements.

Figure A-3 illustrates the SONET framing format:

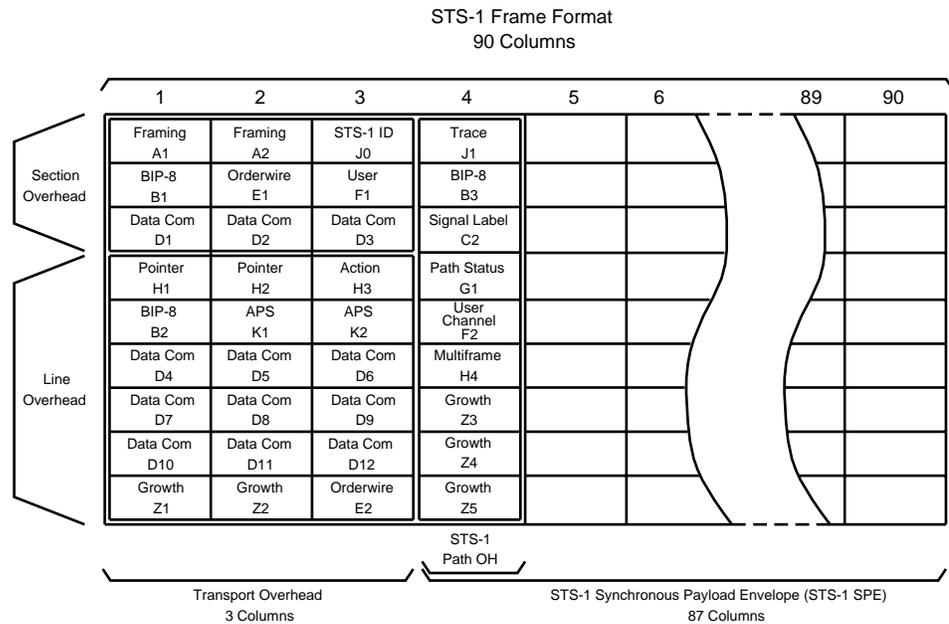


Figure A-3. SONET Frame Format

SONET Layers (Continued)

Overhead Components

The following list simplifies the contents of the three SONET layer overheads and identifies the network elements serviced by each:

- **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.
-

SONET Frame Structures

Section Overhead Table A-1 provides more detailed information on the function of the overhead bytes for the Section layer:

Table A-1. Section Layer Overhead Bytes

Overhead Bytes	Function
Framing (A1, A2)	Provides framing for each STS-1.
STS-1 ID (J0)	Provides the order of appearance in a byte-interleaved STS- <i>N</i> 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- <i>N</i> 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- <i>N</i> frame. Defined only for STS-1 #1 of an STS- <i>N</i> 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- <i>N</i> signal.
Section User Channel (F1)	Set aside for the user's purpose. Defined only for STS-1 #1 of an STS- <i>N</i> 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- <i>N</i> signal.

SONET Frame Structures (Continued)

Line Overhead

Table A-2 provides more detailed information on the function of the overhead bytes for the Line layer:

Table A-2. Line Layer Overhead Bytes

Overhead Bytes	Function
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- <i>N</i> 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- <i>N</i> 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- <i>N</i> signal.	One byte is allocated to be used as an express orderwire between line terminating equipment.

SONET Frame Structures (Continued)

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.

Table A-3 provides more detailed information on the function of the overhead bytes for the STS-1 Path layer:

Table A-3. Path Layer Overhead Bytes

Overhead Bytes	Function
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.

(Continued on next page)

SONET Frame Structures (Continued)

Path Overhead (continued)

VT Path Overhead

There is one byte of VT path overhead called V5 that occurs on every fourth frame; therefore, it occurs 2000 times a second (8000 / 4).

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 byte are specified in the following list:

- 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.

Figure A-4 illustrates the bit assignments of the VT path overhead byte::



VT Path Signal Label Coding:

0 0 0	Unequipped
0 0 1	Equipped-Nonspecific

Figure A-4. VT Path Overhead Byte

SONET Multiplexing

Which Signals are Allowed?

SONET has provisions for multiplexing the following:

- synchronous DS1s
 - asynchronous DS1s
 - asynchronous DS3s.
-

Procedures

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.

The following mapping hierarchy is used by the STS-1 frame:

- 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.

(Continued on next page)

SONET Multiplexing (Continued)

**Procedures
(continued)**

Figure A-5 illustrates the SONET multiplexing procedure that provides the scrambled STS-N signal to the optical conversion stage:

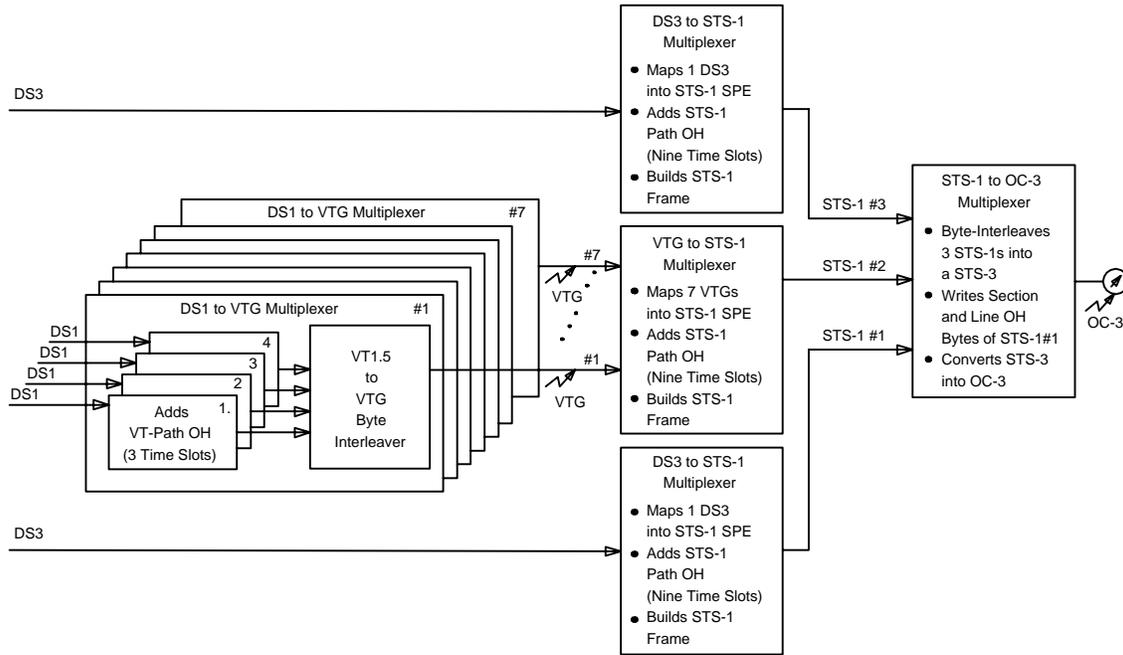


Figure A-5. SONET Multiplexing Procedure

SONET Demultiplexing

Procedures

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 illustrates the SONET demultiplexing procedure:

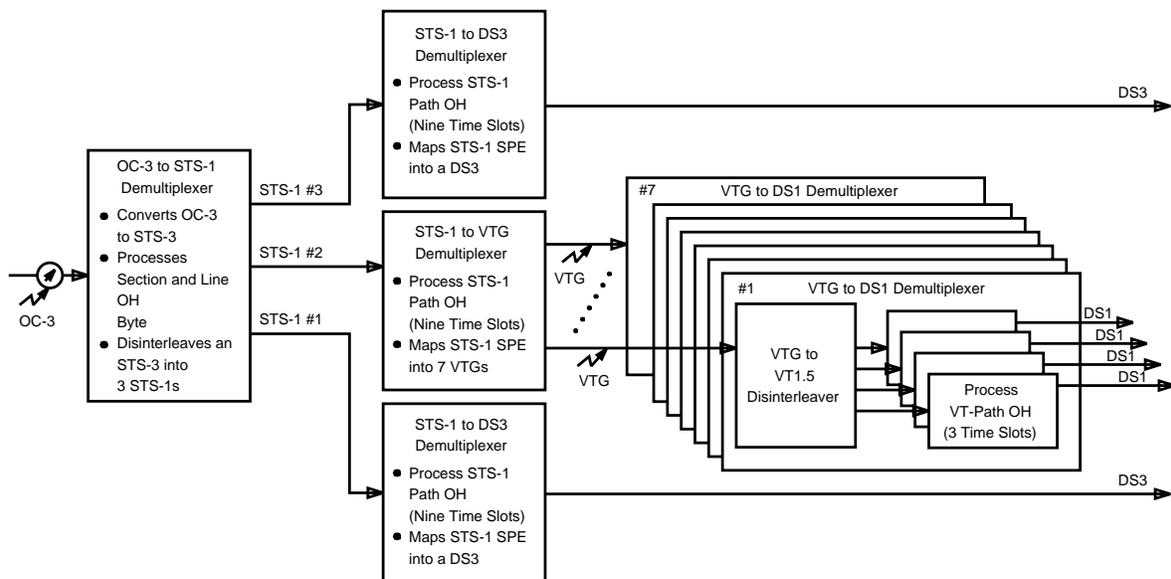


Figure A-6. SONET Demultiplexing Procedure

SONET Demultiplexing (Continued)

Key Points

Two key points should be noted at this time. First, the SONET frame is a fixed time (125 μ s) and no bit-stuffing is used. Second, 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- μ s frame boundary. SONET STS pointers are used to locate the SPE relative to the transport overhead.

SONET Demultiplexing (Continued)

STS-1 Synchronous Payload Envelope

Figure A-7 illustrates the STS-1 synchronous payload envelope used in the STS-1 frame:

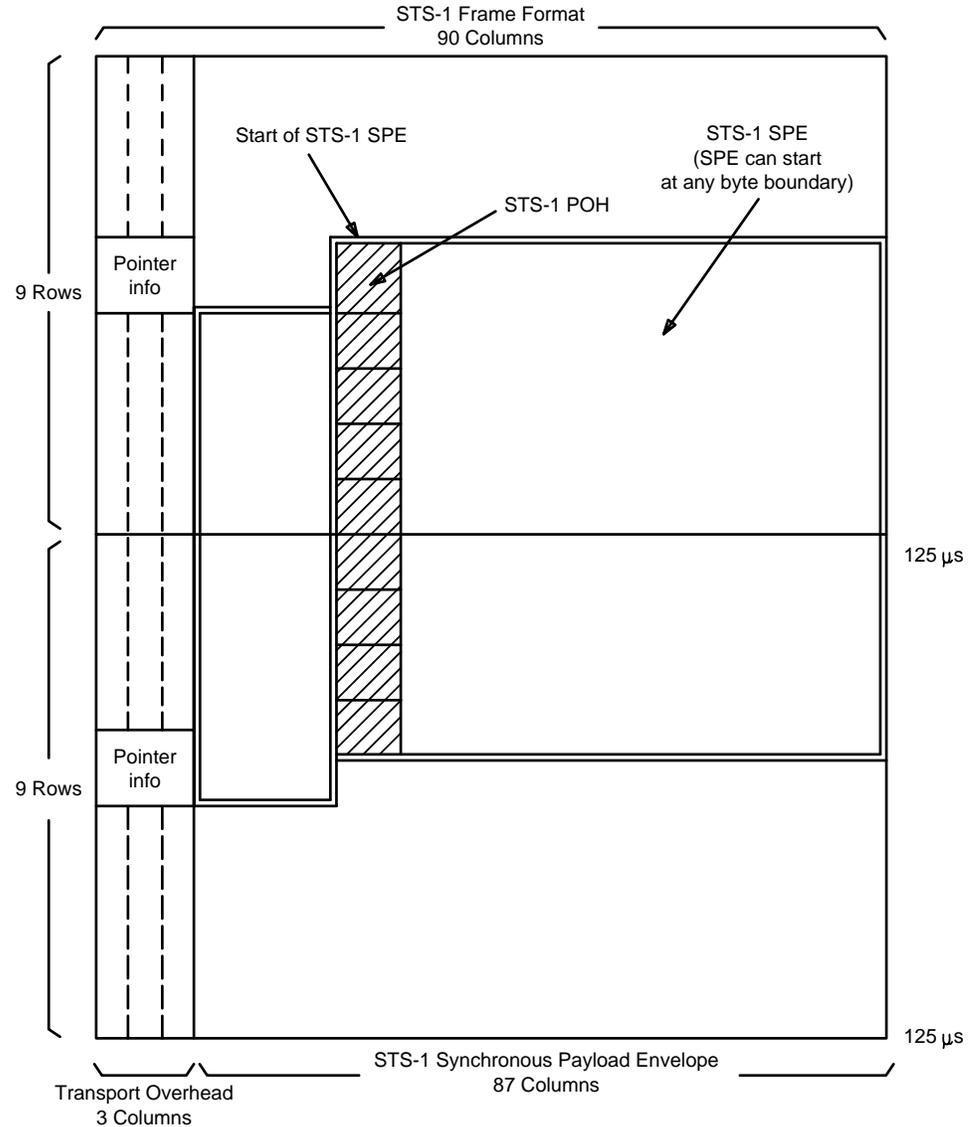


Figure A-7. STS-1 Synchronous Payload Envelope in Interior of STS-1 Frame

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.

Figure A-8 illustrates SONET Asynchronous Multiplexing:

- Bit Interleaving above DS1
- DS1 Not Observable above DS1
- No End-To-End Overhead Channel

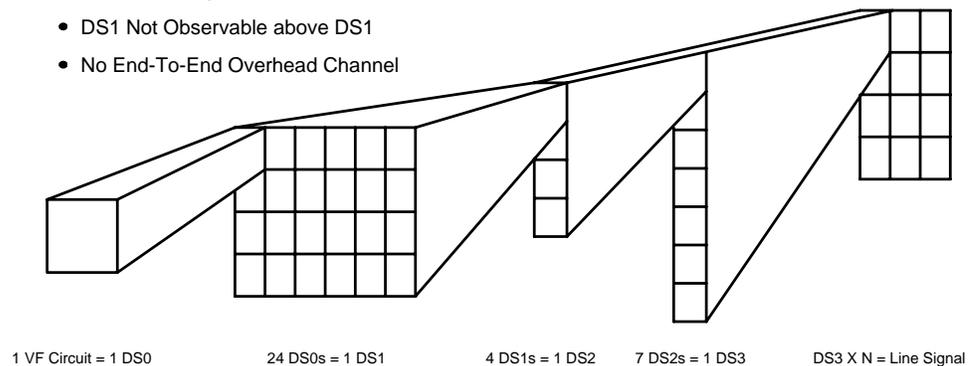


Figure A-8. Asynchronous Multiplexing

M13 Format

Typically, 28 DS1 signals are multiplexed into a DS3 signal, using an M13 format. 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.

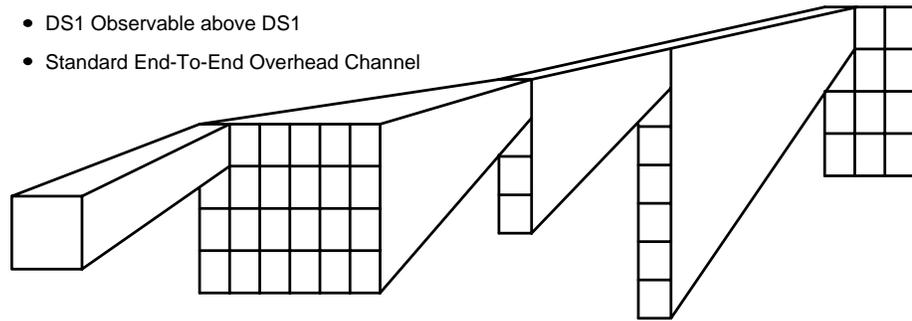
SONET Digital Multiplexing Schemes (Continued)

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.

Figure A-9 illustrates a single asynchronous DS3 signal being mapped into an STS-1 SPE:

- 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 Path OH
+ STS-1 Line OH
+ STS-1 Section OH

1 STS-1

STS-1 X N = OC-N

24 DS0s
+ 3 DS0s (VT OH)

1 VT1.5

Figure A-9. Synchronous Multiplexing

SONET Digital Multiplexing Schemes (Continued)

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-*Nc* (OC-*Nc*). STS-1 signals are mapped into an STS-*Nc* SPE and transported as a concatenated STS-*Nc* signal. This STS-*Nc* 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-*Nc* 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.

(Continued on next page)

SONET Digital Multiplexing Schemes (Continued)

Concatenated Mode (continued)

Figure A-10 illustrates an example of an STS-3c SPE:

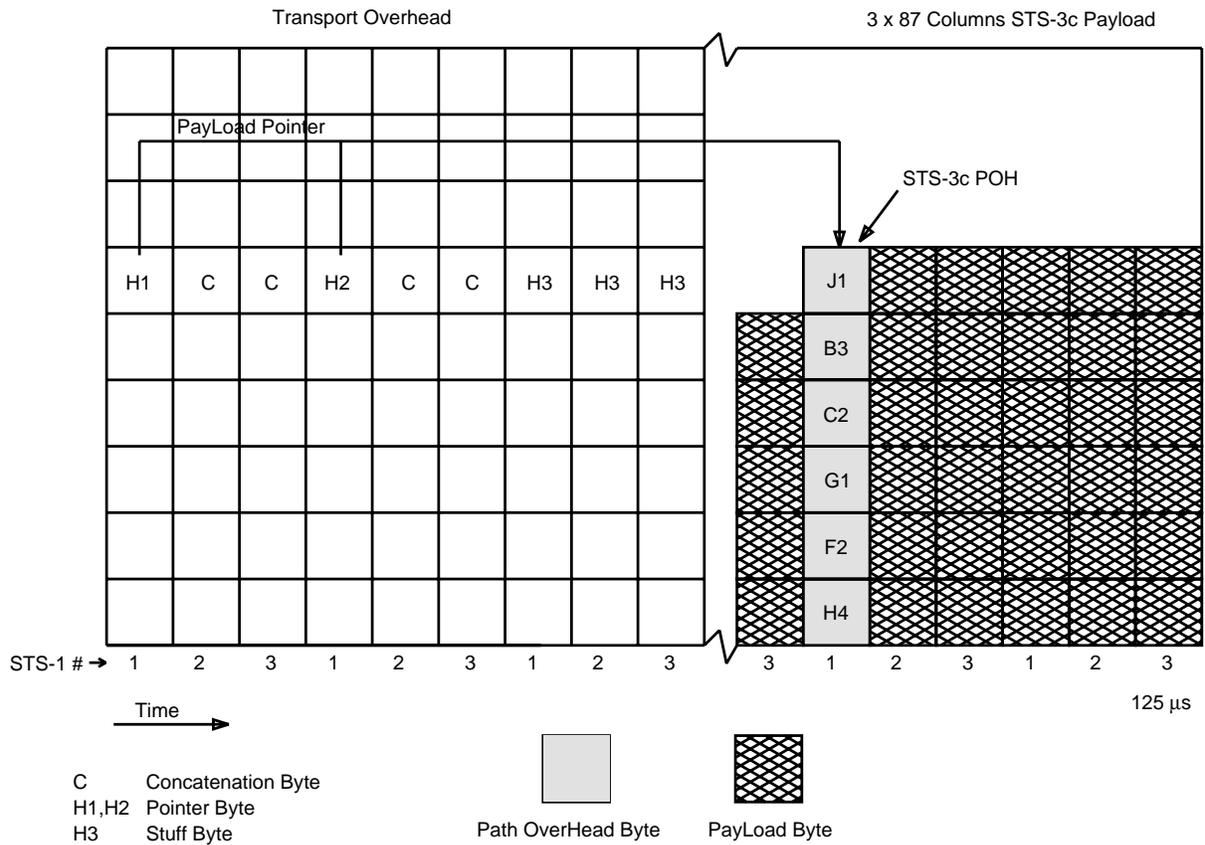


Figure A-10. STS-3c Concatenated Payload

The STS-3c in the previous figure consists of 3 x 87 columns and 9 rows of bytes. The order of transmission is row by row, from left to right.

SONET Interface

Overview

The SONET interface 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.

Figure A-11 illustrates the SONET interface:

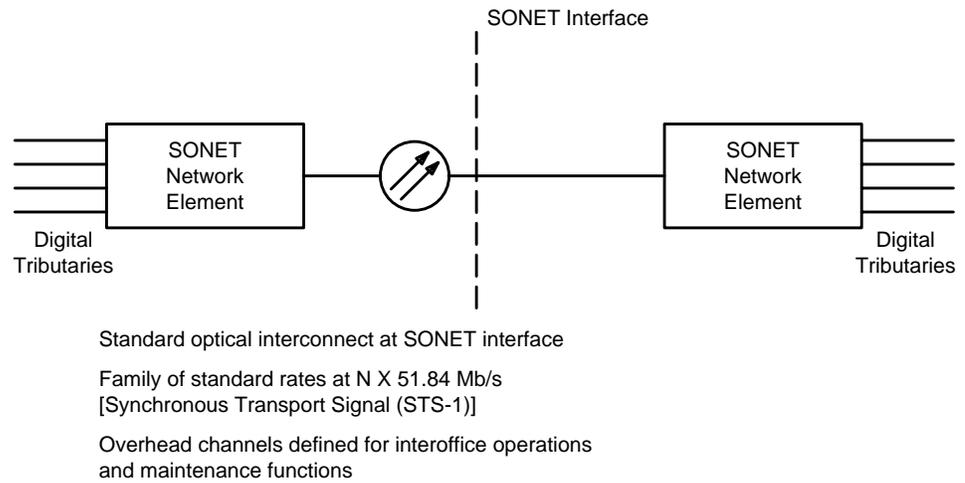


Figure A-11. SONET Interface

SONET Interface (Continued)

SONET Payloads Table A-4 shows the digital signals that can be transported as SONET payloads:

Table A-4. 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.

SONET Interface (Continued)

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.

Table A-5 shows the various SONET transport rates and the line rates and capacities of each:

Table A-5. 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

References

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.

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.•
-

Glossary

Numerics

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

ACID

Application Context ID

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 (not supported in Green Releases).

ANSI

American National Standards Institute

APS

Automatic Protection Switch

Area Address

The first 26 characters of each NE's NSAP

ASCII

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

AUI

Attachment Unit Interface — Interface connecting a 10 BaseT Ethernet Hub to other IAO LAN segments

Automatic Protection Switch

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

CMISE

Common Management Information Service Element

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.

DIB

Directory Information Database

Digital Multiplexer

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

Directory Services

TARP (or LDS in Pre-Green Releases)

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 subnetwork. (Not supported in Green Releases.)

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

EMS

Element Management System

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 user panel display on the faceplate of the SYSCTL circuit pack. (Not supported in Green Releases.)

FE ID

Far End Identifier — The identity of a remote DDM-2000 NE(s) reporting via parallel telemetry. (Not supported in Green Releases.)

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.

GR

Bellcore General Requirement

Green Releases

Software Releases: FT-2000 R8.0, DDM-2000 OC-12 R7.0, DDM-2000 OC-3 R13.0, DDM-2000 FiberReach R3.0, ITM SNC R5.0, CPro-2000 R7.0.

Group

The eight slots that may be equipped.

GUI

Graphical User Interface

H**HS**High-Speed

I**IAO LAN**

IntraOffice Local Area Network

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

IS

Intermediate System

ISDN

Integrated Services Digital Network

ISO

International Standards Organization (see OSI).

ITM SNCIntegrated Transport Management Subnetwork Controller.

L**LAN**

Local Area Network

LCN

Local Communications Network

LDS

Lucent Directory Services, replaced by TARP in Green Releases.

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.

Level 2 IS

Intermediate System that routes DCC messages between NEs in different areas of a partitioned subnetwork.

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

Mult

Multiplying. 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.

Multi-Product OI

Operations interworking between compatible Lucent PF-2000 and PF-3000 NEs.

Multi-Vendor OI

Operations interworking between compatible Lucent PF-2000 NEs and other-vender NEs (such as the TITAN 5500/S R5.0).

Multiplexing

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

MUX

Multiplex

N**NCT**

5ESS Switch Network Control and Timing.

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 NEs in a subnetwork 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

PF-2000

Product Family 2000 — DDM-2000 OC-3, OC-12 and FiberReach and FT-2000.

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).

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

Lucent 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. (Not supported in Green Releases.)

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

An 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.

SVC

Switched Virtual Circuit

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

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.

TDC

TARP Data Cache

TID

Target Identifier — An NE's 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

TRCU3

Transmission Rate Converter Unit 3

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.

UPSR

Unidirectional Path-Switch Ring

V**VC**

Virtual Circuit

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

Index

Numerics

10 BaseT Ethernet Hubs, [2-8](#)
5ESS® Switch TRCU3, [xxvi](#)

A

ACID, [3-15](#)
AGNE, [8-10](#)
Application Context ID
 see ACID
Area Address, [6-5](#)
Area Field, [6-5](#), [7-4](#)
Attachment Unit Interface
 see AUI
AUI, [2-8](#)

B

Backup and Restore, [1-9](#), [4-9](#)
Bellcore GR-253, [1-4](#)

C

CentreCOM 3012T Hubs, [2-8](#)
CIT, [2-22](#), [3-3](#)
CIT Remote Login, [8-8](#)
CMISE, [1-4](#)
Combining Existing Subnetworks, [7-3](#)
Conventions Used, [xxvi](#)
Craft Interface Terminal
 see CIT

D

DAT, [4-7](#)
Data Communications Channel
 see DCC

DCC, [1-5](#), [2-6](#), [6-4](#)
 Interface Requirements, [2-12](#)
 Topology Guidelines, [2-6](#)
DDM-2000, [xxvi](#), [8-12](#)
DDM-2000 FiberReach, [8-13](#)
DDM-2000 OC-3, [xxvi](#)
Destination NE, [8-4](#)
DIB, [5-2](#)
Directory Information Database
 see DIB
Directory Services, [2-22](#)
Directory Services Network Element
 see DSNE
Dormant Software, [8-4](#), [8-5](#)
DSNE, [1-4](#), [2-22](#), [8-10](#)
Dual-Homed Subnetworks, [7-16](#)

E

Element Management System
 see EMS
EMS, [2-5](#), [4-2](#)

F

FT-2000, [xxvi](#), [8-11](#)
FT-2000 OC-48 Add/Drop-Rings Terminals
 see FT-2000

G

Graphical User Interface
 see GUI
GUI, [2-5](#), [4-2](#)

I

IAO LAN, [1-5](#), [2-7](#), [4-6](#), [7-4](#)
IAO LAN Interface, [2-7](#)
IAO LAN-Connected Subnetwork, [7-19](#)
Integrated Transport Management Subnetwork
 Controller
 see ITM SNC
Intelligent Backup, [4-11](#)
Intelligent Restore, [4-11](#)
Intended Audiences, [xxv](#)

Interface Terminology, [xxvi](#)
 Intermediate System
 see IS
 IntraOffice LAN
 see IAO LAN
 Intra-Office Local Area Network
 see IAO LAN
 IS, [1-4](#), [6-2](#)
 Assignment, [6-7](#)
 Isolating NEs, [7-4](#), [8-16](#)
 ITM SNC, [8-3](#)
 Backup and Restore, [4-9](#)
 NE Software Management, [4-6](#)
 OI Features, [4-2](#)
 Software Download, [1-5](#), [4-6](#)
 ITM SNC as TL1-GNE, [4-4](#)

L

LDS, [1-4](#), [2-22](#), [3-22](#)
 Level 2 Intermediate Systems
 see ISs
 Lucent Directory Service
 see LDS

M

Maximum Subnetwork Size, [2-24](#), [6-8](#)
 MegaStar 2000 SONET Radio System, [xxvi](#)
 Multiple Area Addressing, [6-6](#)

N

NCT or NCT2, [1-6](#)
 Network Control and Timing
 see NCT
 Network Elements
 see NEs
 Network Maps, [3-22](#)
 Network Service Access Point
 see NSAP
 Northbound Interface, [4-4](#)
 NSAP, [1-4](#), [2-22](#), [3-22](#), [4-4](#), [5-2](#), [7-3](#)
 NSAP AREA, [6-5](#)

O

OI Features, [3-2](#)
 Summary, [3-30](#)
 Open Systems Interconnection
 see OSI
 Operations Systems
 see OS
 OS, [2-22](#), [5-2](#)
 OSI, [3-15](#), [4-4](#), [6-2](#)
 OSI Protocol Stack, [1-4](#), [2-2](#), [8-2](#)

P

Parallel Telemetry
 not supported, [1-7](#)
 Parameters, [3-36](#)
 Partitioning
 see Subnetwork Partitioning
 Permanent Virtual Circuits
 see PVCs
 Provisionable Parameters Guidelines, [3-36](#)
 Provisioning Tools, [2-5](#)
 PVCs, [3-13](#)

R

Redefining a Subnetwork
 Adding New NEs, [7-3](#)
 Combining Existing Subnetworks, [7-3](#)
 Related Documentation, [xxviii](#)
 DDM-2000 FiberReach, [xxxvii](#)
 DDM-2000 OC-12, [xxx](#)
 DDM-2000 OC-3, [xxxii](#)
 FT-2000 OC-48, [xxviii](#)
 SLC@-2000 Access System, [xxxiv](#)
 Remote CIT Alarm Reports
 not supported, [1-7](#)
 Remote Craft Access, [1-8](#), [3-3](#)
 Remote Login, [3-3](#)

Remote NE alarm status
not supported, [2-22](#)

Remote NE communication status
not supported, [2-22](#)

Remote NE product type identification
not supported, [2-22](#)

Remote NE Status
 Centralized Operations, [3-21](#)
 Network Maps, [3-22](#)

Remote NE-NE Software Copy, [3-26](#)

Remote Office Alarms
not supported, [1-7](#)

Remote Operations Guidelines, [8-8](#)

Remote Operations System Access, [3-4](#)

Remote OS Access, [1-8](#)

Remote Software Download, [1-9](#), [3-26](#), [8-4](#)

Remote User Panel Indications
not supported, [1-7](#)

Ring Directory Information Database
see DIB

S

Seven-Layer OSI Stack
see OSI Protocol Stack

Single-Homed Subnetworks, [7-8](#)

SLC®-2000 Access Systems, [xxvi](#)

Software Activation, [8-4](#)

Software Backup And Restore, [1-6](#)

Software Compatibility, [2-3](#)

Software Copy, [8-5](#)

Software Download, [8-5](#)

Software Upgrade, [8-5](#)
 Sequence, [8-15](#)

SONET
 Concatenated Mode, [A-21](#), [A-22](#)
 Interface, [A-23](#), [A-24](#), [A-25](#)
 Multiplexing Procedures, [A-19](#), [A-20](#), [A-21](#), [A-22](#)
 Section Orderwire, [A-10](#)

Source NE, [8-5](#)

Southbound Interface, [4-4](#)

Subnetwork Partitioning
 Advantages, [6-4](#)
 Confirmation, [7-7](#)
 Default Values, [7-2](#)
 Guidelines, [6-2](#)
 Procedures, [7-2](#)

Subnetwork Size Guidelines, [2-24](#)

SVCs, [3-13](#)

Switched Virtual Circuits
see SVCs

Synchronous Optical Network
see SONET

T

Target ID Address Resolution Protocol
see TARP

TARP, [1-4](#), [5-2](#)
 Parameters, [5-6](#)
 Propagation, [5-3](#)
 Provisioning, [5-6](#)
 Translations, [5-3](#)

TARP Data Cache
see TDC

TARP Manual Adjacency, [2-2](#), [5-7](#)

TARP Releases
 What Are The..., [1-3](#)

TBOS
not supported, [1-7](#)

TDC, [1-4](#), [5-5](#)
 Accuracy, [5-5](#)

Tellabs TITAN 5500/S DCS
see TITAN 5500/S

TID, [2-22](#), [3-15](#), [3-22](#), [4-4](#), [5-2](#)

TITAN 5500/S, [xxvi](#), [1-4](#), [2-3](#)

TL1
 Autonomous Message Routing, [3-15](#), [3-18](#)

TL1 Logins, [3-12](#)

TL1/X.25 Gateway Network Element
see TL1-GNE

TL1/X.25 Message Volume Considerations, [3-19](#)

TL1/X.25 OS Interfaces, [3-4](#), [4-2](#), [5-2](#)

TL1-GNE, [1-5](#), [3-4](#), [3-15](#)
 Multiple TL1-GNEs, [3-5](#)
 Selection, [3-6](#)

TL1-RNE, [3-5](#)

TOHCTL, [2-11](#)

Transaction Language 1 (TL1)/X.25 Gateway Network
 Element
see TL1-GNE

TRCU3, [xxvi](#), [1-6](#)

Tributary Overhead Controller
see TOHCTL

V

VCs, [3-13](#)
Virtual Circuits
see VCs

X

X.25 Virtual Circuits
see VCs