



# **Optical Line System**

Applications, Planning, and Ordering Guide

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This document was developed by the Customer Training and Information Products organization.

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# Contents

---

<b>About This Document</b>	xxi
■ Intended Audience	xxi
■ How to Use This Document	xxi
■ Related Documentation	xxiii
Drawings	xxiv
Documentation for Related Equipment and Software	xxv
■ Electronic Documentation	xxvi
■ How to Order Documents	xxvii
■ Training	xxviii
■ How to Comment on This Document	xxx

---

<b>1</b>	<b>Introduction</b>	
	■ Introduction to OLS	1-1
	■ What is OLS?	1-2
	■ OLS Features Release Plan	1-6

---

<b>2</b>	<b>Features</b>	
	■ OLS: Basic Functions	2-1
	OLS and OT: Extended Functions	2-2
	■ Basic Benefits of OLS	2-2
	■ Dense Wave Division Multiplexing	2-3
	■ Optical Amplifier	2-3
	■ Flexible Network Applications	2-4
	■ Easy Installation and Self-Tests	2-5
	■ Multiple Maintenance Features	2-6
	Maintenance	2-6
	Operations Interface Flexibility	2-7
	Single-Ended Operations	2-8

---

## Contents

Access Domains	2-9
Remote Login	2-10
Inventorying Capabilities	2-10
Remote NE Status (Through DCC)	2-10
Local and Remote Software Copy/Upgrades	2-10
Directory Service Network Element (DS-NE)	2-11
Continuous Performance Monitoring	2-11
Protection Switching for DCC Signal	2-11
Original Value Provisioning and User-Selectable Thresholds	2-11
Security	2-12
■ Physical Features	2-13
Front Access	2-13
Physical Compactness	2-14
On-Board Power Modules	2-17

---

### 3

#### Applications

■ Optically Amplified Transmission	3-1
■ OLS Optical Transmission Elements	3-2
OLS End Terminal and OLS Repeater Shelves	3-4
■ OLS Basic Configuration	3-6
■ Dual Network Elements versus 4 Bidirectional Line Network Elements	3-7
Optical Translator Features	3-8
■ Point-to-Point Applications with FT-2000 OC-48 LCT, Generic SONET ADMs and OT	3-9
■ Ring Applications with FT-2000 LCT and the Optical Translator	3-10
■ Span Capacity Growth Scenario	3-15

---

# Contents

---

<b>4</b>	<b>Product Description</b>	
	■ Introduction	4-1
	■ System Control Architecture	4-2
	■ Physical Design	4-4
	OLS Cabinet	4-4
	1A-TX and 1A-RCV	4-8
	End Terminal for 4 Bidirectional Optical Lines	4-8
	Repeater for 4 Bidirectional Optical Lines	4-10
	Dual Repeater	4-11
	Dual End Terminal	4-12
	End Terminal and Repeater	4-13
	Shelf Descriptions for OLS	4-14
	■ Miscellaneously Mounted Shelf	4-25
	■ Transmission	4-27
	OLS End Terminal	4-27
	OLS Repeater	4-29
	Supervisory Signal	4-30
	■ Transmission Circuit Packs and Units	4-31
	Optical Amplifier (OA)	4-31
	Transmission	4-32
	Optical Multiplexer Unit (OMU)	4-34
	Optical Demultiplexer Unit (ODU)	4-34
	Telemetry (TLM)	4-34
	Drop Side Signal Requirements	4-36
	■ Control Circuit Packs	4-36
	System Controller (SYSCTL)	4-36
	System Memory (SYSMEM)	4-37
	Tributary Overhead Controller (TOHCTL)	4-37
	■ DCC Channel Protection Switching	4-37
	■ Power	4-37
	Power Distribution for the OLS Cabinet	4-38

---

# Contents

Power Cables	4-40
Shelf-Level Power Distribution	4-40

---

## 5 Operations, Administration, Maintenance, and Provisioning

■ Operations	5-1
General Description	5-1
Indicator Strip	5-1
Operations Interfaces	5-6
Data Communications Channel	5-8
■ Administration	5-12
Version Recognition	5-12
Security	5-12
Equipment Inventory	5-14
System Start-up	5-14
■ Maintenance	5-14
Maintenance Philosophy	5-14
Remote Maintenance Philosophy	5-15
Local and Remote Software Copy/Upgrades	5-17
Analog Transmission Maintenance	5-17
DCC Protection Switching	5-18
Automatic Detection of Facility Failures	5-18
Performance Monitoring	5-20
Provisioning Consistency Audits	5-24
Reports	5-24
Orderwire	5-26
■ Provisioning	5-27
Original Value Provisioning	5-27
Local or Remote Provisioning	5-28
Preprovisioning Circuit Packs	5-28
Provisioning on Circuit Pack Replacement	5-28
Provisionable Parameters Summary	5-28

---

# Contents

Network Element Configuration	5-29
End Terminal Provisioning	5-29

---

## 6 System Planning and Engineering

■ Planning Considerations	6-1
■ Customer Maintenance Signal Synchronization	6-2
■ Protection Switching	6-2
■ Capacity	6-3
■ Engineering Rules	6-5
Use of LBOs	6-5
Network Topologies	6-5
Dispersion	6-5
OLS/OT Interworking	6-6
Engineering Rules for OA Applications	6-7
■ Floor Plan Layout	6-8
■ Equipment Interconnection	6-10
■ Cabling	6-10
■ Environmental Considerations	6-13
■ Power Planning	6-14

---

## 7 Ordering

■ How to Order Optical Line System Equipment	7-2
Ordering Lightguide Office Cable	7-2
■ Worksheets	7-3
■ Ordering Guidelines	7-30
Ordering OLS	7-30
Package Descriptions	7-32
Related Software and Documentation	7-33
■ Conversion Kit	7-35

---

## Contents

■ Cables	7-36
Intraoffice Electrical Nontransmission Cable Descriptions	7-36
■ Ordering Spare Circuit Packs/Units and Fuses	7-39
Circuit Pack/Unit Descriptions	7-40
■ Circuit Pack/Unit Sparing Guidelines	7-41
Lead Time	7-41
Sparing Examples	7-41
■ Related Framework	7-46
■ Related Products	7-47
Ordering Cleaning Materials	7-47
Ordering METRAL Backplane Replacement Pins	7-47
Ordering the External Miscellaneous Discrete Unit	7-49
DANTEL Orderwire Shelf	7-50
■ Software Compatibility	7-51

---

## 8 Product Support

■ Engineering and Installation Services	8-1
■ Technical Support	8-2
■ Documentation Support	8-6
■ Training Support	8-6
■ Warranty Support	8-6
■ Account Executive Support	8-6

---

## 9 Reliability and Quality

■ Overview	9-1
■ Reliability Specifications	9-2
■ Maintainability Specifications	9-4
■ Warranty	9-4

---

# Contents

---

<b>10</b>	<b>Technical Specifications</b>	
	■ Optical Connector Interfaces	10-1
	■ Transmission Medium	10-1
	■ Lightguide Jumpers	10-1
	■ Optical Safety (BRH Classification)	10-2
	■ Operating Wavelength	10-2
	■ Optical Dispersion	10-2
	■ Optical Return Loss	10-2
	■ Optical Reflections Tolerance	10-2
	■ Optical Line Rate	10-2
	■ Optical Amplifier Output Power	10-2
	■ Outside Plant Loss	10-4
	■ Capacity	10-4
	■ Transmission Standards Compliance	10-4
	■ Cable Access	10-5
	■ Power Specifications	10-5
	■ Dimensions	10-7
	Circuit Pack/Unit Dimensions	10-8
	■ Floor Loading Specifications	10-9
	■ Environmental Specifications	10-11
	■ Handling and Transportation	10-12
	■ Reliability Specifications	10-13
	■ Hardware Unavailability	10-14
	■ Silent failure unavailability	10-15
	■ Mean Time Between Maintenance Activities	10-15
	■ Input Power	10-15
	■ Tone Frequencies	10-16
	■ Optical Signal to Noise Ratio (SNR)	10-17
	■ Customer Maintenance Signal	10-18
	■ Engineering Rules	10-19
	Use of LBOs	10-19
	Network Topologies	10-19

---

## Contents

Dispersion	10-20
OLS/OT Interworking	10-20
Engineering Rules for OA Applications	10-21

---

<b>Glossary</b>	<b>GL-1</b>
-----------------	-------------

---

<b>Index</b>	<b>IN-1</b>
--------------	-------------

---

# Figures

---

## 1

- 1-1. OLS End Terminals for 4 Bidirectional Optical Lines 1-5
- 

## 2

- 2-1. OLS Cabinet with Doors Closed 2-15  
2-2. Miscellaneously Mounted Shelf with Front Covers 2-16
- 

## 3

- 3-1. OLS Transmission 3-3  
3-2. OLS Transmission from the FT-2000 OC-48 LCT Showing Service and Protection Fibers 3-4  
3-3. OLS End Terminal Shelves 3-5  
3-4. OLS Repeater Shelf 3-6  
3-5. Three-Span Configuration with OLS End Terminals and Repeaters 3-7  
3-6. OLS Transmission with OT Supporting Signal Regeneration and Wavelength Add/Drop 3-8  
3-7. OT as Interface between OLS and Generic SONET OC-48 Terminals 3-8  
3-8. Dual 1x1 End Terminal Application (Equipped with 4 Optical Lines) 3-9  
3-9. An FT-2000 OC-48 LCT Ring with OLS Systems Connected by an Optical Translator 3-11  
3-10. FT-2000 OC-48 LCT Rings Sharing an OLS System 3-12  
3-11. 4-Fiber Ring Application 3-13  
3-12. Large Ring Application Using Optical Translators for WA/D 3-15  
3-13. Span Capacity Growth Scenario 3-17

---

## Figures

---

### 4

4-1.	System Control Architecture for the Optical Line System (OLS)	4-3
4-2.	Indicator Strip for Dual End Terminal and Dual Repeater Cabinets	4-5
4-3.	Indicator Strip for Cabinets for OLS End Terminal and Repeater for 4 Bidirectional Optical Lines	4-5
4-4.	OLS Cabinet	4-7
4-5.	OLS End Terminals for 4 Bidirectional Optical Lines	4-9
4-6.	OLS Repeater for 4 Bidirectional Optical Lines	4-10
4-7.	OLS Dual Repeater	4-11
4-8.	OLS Dual End Terminals	4-12
4-9.	OLS End Terminal and Repeater	4-13
4-10.	OLS End Terminal Shelves	4-14
4-11.	OLS Shelf Fiber/Cable Dressing and EMC/ESD Design	4-16
4-12.	OLS Repeater Shelf	4-17
4-13.	Interconnection Panel Diagram	4-18
4-14.	Fuse Panel	4-20
4-15.	Miscellaneously Mounted Shelf with Front Covers	4-25
4-16.	User Panel for the Miscellaneously Mounted Shelf	4-26
4-17.	OLS End Terminal Transmission Block Diagram	4-28
4-18.	OLS Repeater Transmission Block Diagram	4-30
4-19.	OLS Overall Power Distribution in Cabinet	4-39
4-20.	OLS Shelf Level Power Distribution	4-41

---

### 5

5-1.	Indicator Strip (Dual End Terminal, Dual Repeater, End Terminal and Repeater)	5-2
5-2.	Indicator Strip (4 Bidirectional Line)	5-3
5-3.	Fuse Panel	5-4

---

## Figures

5-4.	Miscellaneously Mounted Shelf User Panel	5-5
5-5.	CIT Access Domain	5-9
5-6.	OLS Network Elements	5-30

---

## 6

6-1.	Span and Line Distances for 3-Span (Standard Reach) Systems	6-4
6-2.	Span and Line Distances for 7- and 8-Span (Long Reach) Systems	6-4
6-3.	OLS OA System	6-7
6-4.	Floor Plan Layout	6-9
6-5.	ST-Type Build-Out Assembly	6-11
6-6.	FC Type Build-Out Assembly	6-11
6-7.	SC-Type Build-Out Assembly	6-12
6-8.	D-Subminiature Connector	6-13

---

## 7

7-1.	Sparing Chart -- 10-Day Lead Time	7-44
7-2.	Circuit Pack Sparing Chart -- 64-Day Lead Time	7-45

---

## 8

8-1.	Product Support	8-4
------	-----------------	-----

---

## 10

10-1.	OLS OA System	10-21
-------	---------------	-------

---

## Figures

---

## Tables

---

### 4

Table 4-1. Indicators for OLS	4-5
Table 4-2. OLS Wavelengths and Associated Tone Frequencies	4-33
Table 4-3. Power Cable Color Codes	4-40

---

### 6

Table 6-1. Engineering Rules for OLS/OT Interworking	6-6
Table 6-2. Engineering Rules for OLS R2.0 (OC-48/STM-16 for Standard Single Mode Fiber)	6-8
Table 6-3. OLS Power Planning	6-15

---

### 7

Table 7-1.4 Bidirectional Line End Terminal Worksheet	7-4
Table 7-2. Dual End Terminal Worksheet	7-6
Table 7-3.4 Bidirectional Line Repeater Worksheet	7-9
Table 7-4. Dual Repeater Worksheet	7-12
Table 7-5. End Terminal/Repeater Worksheet	7-15
Table 7-6. Miscellaneously Mounted Shelf - End Terminal	7-19
Table 7-7. Miscellaneously Mounted Shelf - Repeater	7-22
Table 7-8.4 Line End Terminal-to-Dual End Terminal Conversion Worksheet (J68982C-1)	7-24
Table 7-9.4 Line Repeater-to-Dual Repeater Conversion Worksheet (J68982C-1)	7-27
Table 7-10. OLS J68982C-1 Equipment Shipped Separately	7-30
Table 7-11. OLS J68982CS-1 Software and Documentation Shipped with or Separately from Equipment	7-33
Table 7-12. Ordering Additional Copies of Software and Documentation	7-34
Table 7-13. Conversion Kit (L310, 4 Line-to-Dual)	7-35
Table 7-14. Intraoffice Electrical Nontransmission Cables (Associated with OLS)	7-36

---

## Tables

Table 7-15.Power Cables (associated with OLS)	7-37
Table 7-16.Circuit Pack/Unit Comcodes	7-39
Table 7-18.CP/Unit FIT Rates for OLS	7-43
Table 7-19.Related Cabinet Hardware	7-46
Table 7-20.Cleaning Materials for Optical Fiber Connectors	7-47
Table 7-21.METRAL Pin Ordering Information	7-47
Table 7-22.OLS Equipment Locations and Pin Types	7-48
Table 7-23.Ordering METRAL Pin Kit/Pin Tool Kit	7-49
Table 7-24.Ordering Information for External Miscellaneous Discrete Unit (EMDU)	7-50
Table 7-25.OLS Slot/Circuit Pack/ Software Compatibility of 3)	7-51

---

## 9

Table 9-1.OC-48 Channel Unavailability (min/year/channel)	9-2
Table 9-2.Telemetry Channel Unavailability (min/year/channel)	9-3
Table 9-3.Silent Failure Unavailability	9-3
Table 9-4.Mean Time Between Maintenance Activities	9-3
Table 9-5.Product Infant Mortality and Design Life	9-3
Table 9-6.CP/Unit FIT Rates per Bellcore RPP	9-4

---

## 10

Table 10-1.OA Output Power	10-3
Table 10-2.Plant Loss Between OA Sites	10-4
Table 10-3.Minimum and Maximum OA Spacing for OLS	10-5
Table 10-4.OLS Power Planning	10-6
Table 10-5.OLS Power Specifications	10-7
Table 10-6.OLS Physical Dimensions	10-8
Table 10-7.OLS Circuit Pack/Unit Dimensions	10-9
Table 10-8.OLS Floor Loads	10-10

---

## Tables

Table 10-9.Operating Temperature/Humidity Values	10-11
Table 10-10.Handling and Transportation Tolerance Ranges	10-12
Table 10-11.CP/Unit FIT Rates per Bellcore RPP	10-13
Table 10-12.Channel Unavailability (min/year/channel)	10-14
Table 10-13.Telemetry Channel Unavailability	10-15
Table 10-14.Mean Time Between Maintenance Activities	10-15
Table 10-15.Input Power Specifications	10-16
Table 10-16.OLS Tone Frequencies	10-17
Table 10-17.OLS Optical SNR	10-17
Table 10-18.Optical Interface Specifications	10-18
Table 10-19.IS-3 Interface Distance Limitations	10-19
Table 10-20.Engineering Rules for OLS/OT Interworking	10-20
Table 10-21.Engineering Rules for OLS R2.0 (OC-48/STM-16 for Standard Single Mode Fiber)	10-22

---

# Tables

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# About This Document

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This guide provides information about the Lucent Technologies Optical Line System (OLS).

## **Intended Audience**

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This book is written primarily for network planners and engineers, as well as for anyone who needs information about the features, applications, operation, engineering, and ordering of the OLS.

## **How to Use This Document**

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For general product and release information, refer to Chapters 1, 2, 4, and 5. For information about applications planning, refer to Chapters 2, 3, 4, and 6. Persons engineering a system should refer to Chapters 4 and 6. Those responsible for ordering equipment should refer to Chapters 4, 6, and 7.

The guide is organized as follows:

- “About This Document” describes the purpose, intended audiences, reason for reissue, and the organization of this document. This section also references other related documentation and explains how to order and make comments or recommendations for changes to the document.
- Chapter 1, “Introduction,” presents a summary description of the OLS and related products.
- Chapter 2, “Features,” describes the major features of the OLS. The features are further described in Chapter 3, “Applications,” Chapter 4, “Product Description,” and Chapter 5, “Operations, Administration, Maintenance, and Provisioning.”
- Chapter 3, “Applications,” describes how the OLS handles point-to-point, Dual End Terminal, and 4 fiber rings.
- Chapter 4, “Product Description,” describes the OLS architecture. After introducing the various OLS packages, Chapter 4 describes the system control, physical design, transmission, synchronization, protection, and powering down to the circuit pack level.
- Chapter 5, “Operations, Administration, Maintenance, and Provisioning,” discusses the features available for monitoring and maintaining the OLS.
- Chapter 6, “System Planning and Engineering,” summarizes descriptive information used with applications information to plan procurement and deployment of the OLS.
- Chapter 7, “Ordering,” contains equipment ordering information for the OLS.
- Chapter 8, “Product Support,” describes how Lucent Technologies supports the OLS. This includes information about engineering and installation services, technical support, documentation support, and training.
- Chapter 9, “Reliability and Quality,” contains the Lucent Technologies quality policy and describes the reliability program.
- Chapter 10, “Technical Specifications,” lists the technical specifications for the OLS.
- The Glossary defines many terms used in this guide
- The Index provides page numbers for key words and subject names.

## **Related Documentation**

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The following documents provide information about the OLS:

- Number: 365-575-301  
Title: *Optical Line System (OLS) User/Service Manual*  
Audience: End user maintenance personnel  
Content: Detailed system description, technical specifications, operation and maintenance, and user interface descriptive/tutorial information
- Number: 365-575-310  
Title: *Optical Line System (OLS) Installation Manual*  
Audience: Customers planning to install the OLS  
Content: Customer installation instructions
- Number: 365-575-315\* (Comcode: 107584468)  
Title: *Optical Line System (OLS) Software Release Description*  
Audience: End user maintenance personnel  
Content: Status of fixed and known problems for Release 2 of the OLS software, along with features and installation procedures
- Number: 824-102-176  
Title: *Optical Line System (OLS) Operations Systems Engineering Guide*  
Audience: End user maintenance personnel  
Content: Operations Systems software commands, messages, and other information
- Number: 365-575-211  
Title: *Optical Line System/Large Capacity Terminal (LCT) Integration Manual*  
Audience: End user maintenance personnel  
Content: Instructions on how to integrate OLS with the LCT

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\* This document is shipped with the OLS software. It is also available on CD-ROM. For ordering information, see the "Electronic Documentation" section later in this document.

- Number: 5088TS  
Title: *Optical Line System (OLS) Technical Specifications*  
Audience: Engineers responsible for system planning, use, or maintenance  
Content: Technical specifications on all system components
- Number: 2492C  
Title: *Lucent Technologies Fiber Optic Products*  
Audience: Line engineers and technical consultants responsible for system planning and ordering  
Content: Ordering information for fiber optic products.

## **Drawings**

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The following drawings, which are shipped with the product, provide information about the OLS. These drawings are needed for the installation process.

J68982C-1	Optical Line System Cabinet (Equipment and Circuit Packs Ordered with Equipment)
J68982CS-1	Optical Line System Cabinet Software and Documentation
SD-5G276-01	Optical Line System Application Schematic
T5G276-33	Optical Line System Interconnection Circuit
ED7G033-30	Optical Line System Cabinet Framework
ED7G028-20	OLS Cable Assembly
ED7G028-22	OLS Intercabinet Cable Assembly
ED7G028-30	Optical Line System Shelf Assembly
ED7G027-30	OLS User/Fuse Panel/Power Indicating Assembly
FPD 804-604-161	Optical Line System Cabinet (Floor Plan Data Sheets)

The following drawings are available from the Customer Information Center (CIC) at 1-888-582-3688. They contain valuable product information, but are not needed for product installation. Therefore, they are not shipped with the product.

T5G276-30	Optical Line System Circuit
T5G273-30	Optical Line System Shelf Circuit

For more information, see “How to Order Documents,” later in this chapter.

### **Documentation for Related Equipment and Software**

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The following Lucent Technologies documentation provides information about related hardware and software:

365-575-200	<i>FT-2000 OC-48 Large Capacity Terminal Applications, Planning, and Ordering Guide</i>
365-575-215	<i>FT-2000 OC-48 Large Capacity Terminal Software Release Description</i>
365-575-201	<i>FT-2000 OC-48 Large Capacity Terminal User/Service Manual</i>
365-575-211	<i>FT-2000 OC-48 Large Capacity Terminal Integration Manual</i>
365-575-210	<i>FT-2000 OC-48 Large Capacity Terminal Installation Manual</i>
824-102-175	<i>FT-2000 OC-48 Large Capacity Terminal Operations Systems Engineering Guide</i>
5089TS	<i>FT-2000 OC-48 Large Capacity Terminal Technical Specifications</i>
365-575-212	<i>FT-2000 OC-48 Large Capacity Terminal Implementation Procedures</i>
365-575-200	<i>FT-2000 OC-48 Lightwave System, Applications, Planning, and Ordering Guide</i>

365-575-101	<i>FT2000 OC-48 Lightwave System, Quick Reference Guide</i>
365-575-102	<i>FT-2000 OC-48 Lightwave System, User/Service Manual</i>
365-575-115	<i>FT-2000 OC-48 Lightwave System, Installation Manual</i>
824-102-147	<i>Lucent Technologies 2000 Product Family Operations Interworking Guide</i>
365-099-142TS	<i>FT-2000 OC-48 Lightwave System Technical Specifications</i>
824-102-148	<i>2000 Family of Products Systems Engineering Guide</i>
365-575-400	<i>Optical Translator Applications, Planning, and Ordering Guide</i>
365-575-401	<i>Optical Translator User/Service Manual</i>
365-575-410	<i>Optical Translator Installation Manual</i>

## **Electronic Documentation**

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Documentation on CD-ROM has many advantages over traditional paper documentation, including cost savings, search and retrieve capability, and the assurance of having current information.

The CD-ROM containing the OLS documentation is part of the FT-2000 CD-ROM family. The CD-ROM comcode is 10977143; its select code is: 300-100-016. To order the CD-ROM, call the Lucent CIC telephone number: 1-888-LUCENT-8 (1-888-582-3688).

For pricing information and a list of all documents available on CD-ROM, contact your Lucent Technologies account executive or the Lucent Technologies Customer Training and Information Products hotline (1-800-334-0404).

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No product offering is complete without a formal training package. Suitcasing of these courses is also available. Contact your account executive to enroll in training classes or to arrange suitcase sessions.

The following courses are provided:

- Number: LW2200

Title: Optical Networking Overview (with FT-2000 OC-48 and Optical Line System)

Audience: This course is primarily intended for network planners, product managers, product evaluation/selection managers, equipment engineers, and sales personnel. In general, the course will be helpful to anyone needing a high-level description of networking components

Content: This course provides an introduction to the products offered by Lucent Technologies for optical networking, that is, building high-capacity transmission networks to transport optical signals

Prerequisites: None. However, the student must have a basic understanding of digital fundamentals and lightwave transmission systems

- Number: LW2253

Title: FT-2000 OC-48 Large Capacity Terminal (LCT) Applications, Architecture, Planning, and Ordering

**Audience:** This course is primarily intended for network planners, product managers, equipment engineers, technical consultants, and account representatives. In general, the course will be helpful to anyone needing a high-level description of the equipment

**Content:** This course provides instruction on the product applications, features and architecture, as well as the office and network planning needed for implementation. Included in the last session is instruction and practice on ordering the equipment. The course is based on the *Applications, Planning, and Ordering Guide*

**Prerequisites:** The student should have a basic understanding of digital fundamentals and lightwave transmission systems. Unless the student already has experience on a lightwave transmission assignment, the following course is a prerequisite:

- LW2200, Optical Networking Overview
- TR0510, Transmission Principles, self paced

■ **Number:** LW2653

**Title:** FT-2000 OC-48 Large Capacity Terminal (LCT) Operation and Maintenance (Hands-on)

**Audience:** This course is primarily intended for technicians responsible for the operation and maintenance of the equipment, but will be useful to technical support people and anyone needing a working knowledge of the equipment

**Content:** This course prepares the student for operation and maintenance of the LCT. The course provides in-depth description of the equipment and how it is used with other lightwave equipment. The course is based on the *User Service Manual*

**Prerequisites:** The student should have a basic understanding of digital fundamentals and lightwave transmission systems. Unless the student already has experience on a lightwave transmission assignment, the following course is a prerequisite:

- LW2200, Optical Networking Overview

- Number: LW2450

Title: FT-2000 OC-48 LCT and OLS Installation

Audience: Technicians, installers, maintenance engineers, technical support personnel, product evaluators, and anyone desiring installation information on the FT-2000 OC-48 LCT and OLS

Content: Self-paced course covering the installation differences between FT-2000 Lightwave Systems and FT-2000 OC-48 LCT and OLS systems.

Prerequisites: TR2448 or equivalent knowledge

- Number: LW2455

Title: FT-2000 OC-48 Large Capacity Terminal Installation (Self-paced)

Audience: This course is primarily intended for personnel responsible for the installation of the LCT equipment

Content: This course provides instruction on the equipment architecture, the installation methods and tests, and the content of the *Installation Manual*

Prerequisites: TR2448, FT-2000 OC-48 Installation (Hands-on).

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

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# Introduction

# 1

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■ Introduction to OLS	1-1
■ What is OLS?	1-2
■ OLS Features Release Plan	1-6



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# Introduction

# 1

---

This chapter presents a brief overview of the Optical Line System (OLS).

## Introduction to OLS

Lucent Technologies offers the industry's widest range of transmission systems and related services in order to provide total network solutions. The Optical Line System (OLS) is a point-to-point analog system that can be used in a variety of network applications.

Designed to help telecommunications service providers enter a new century of advanced services and revenue generating capabilities, OLS provides a higher capacity per fiber over longer distances than previously possible.

When used with Lucent Technologies new Optical Translator (OT), OLS provides Long Reach wavelength add/drop and multi-vendor compatibility, as well as concatenation of multiple OLS terminals. This functionality increases the flexibility and cost-effectiveness of OLS, especially for use in large ring networks.

The Lucent Technologies 2000 Product Family is comprised of compatible lightwave systems.

The FT-2000 OC-48 Large Capacity Terminal (FT-2000 OC-48 LCT) was designed to operate with OLS. The FT-2000 LCT also operates with other FT-2000 family products such as the DDM-2000 Multiplexers, the DACS III-2000 Cross-Connect System, the DACS IV-2000 Cross-Connect System, the *DACScan*<sup>TM</sup>-2000 Controller, the *SLC*<sup>®</sup>-2000 Access System, and the BRT-2000 Access System.

When used with Optical Translator (OT), OLS is compatible with the FT-2000 OC-48 Add Drop Rings Terminal (FT-2000 OC-48 ADR) and with the OC-48/STM-16 systems of other vendors. In 1997, OLS-compatible optics will be available on the FT-2000 OC-48 ADR system.

The 2000 Product Family provides significant elements of the Lucent Technologies Service Net-2000 Architecture. The Service Net-2000 Architecture supports increased network capabilities with standard interfaces, increased bandwidth, faster provisioning, and more robust networks.

## What is OLS?

---

OLS systems provide the following functions:

- The OLS end terminal provides dense wave division multiplexing (DWDM) of up to 8 OC-48 lines onto one optical fiber.
- The OLS repeater terminal provides signal amplification to allow transmission distances of:
  - approximately 120 km per span in Standard Reach 3-span (3x33dB) OLS systems (see Figure 6-1) for a total distance of approximately 360 km.
  - approximately 80 km per span in Long Reach seven-span (7x25dB) and eight-span (8x24dB) OLS systems (see Figure 6-2) for total distances of approximately 560 km and 640 km, respectively.
- Repeater sites between OLS end terminals support each span.
- 384 DS3 equivalents (258,048 two way voice circuits per fiber pair). Up to 4 fiber pairs per cabinet.

DWDM permits up to 20 Gb/s of traffic onto one optical line.

OLS transmits over two types of optical fiber:

- standard, single-mode fiber
- Truewave™ non-zero dispersion fiber

On either type of fiber, a Standard Reach OLS system supports a maximum distance of 360 km (or three spans) before requiring signal regeneration, while a Long Reach OLS system supports a length of 560 km (seven spans) or 640 km (eight spans) on any type of fiber.

The OLS optical amplifiers (OAs) amplify signals of different wavelengths in the 1.5  $\mu\text{m}$  wavelength region that have been optically multiplexed onto one fiber. A single OA can amplify up to eight wavelengths simultaneously.

The high optical power provided by the OAs allows significantly longer optical sections than previously used, making it possible to skip some of the intermediate sites required for traditional electronic repeaters in spans between lightwave terminals.

OLS includes telemetry circuit packs (TLMs) for performance monitoring. The TLMs collect data for fault isolation and preventive maintenance and pass the data to a special supervisory channel.

OLS supports applications that need to grow in order to accommodate increasing amounts of information. It allows wavelength growth, span growth, and, when used with the OT, a highly flexible form of wavelength add/drop.

In wavelength growth, up to eight wavelengths can be added to a single fiber. Wavelength growth increases capacity and decreases the need for fibers, which is especially useful in cases of fiber exhaust.

Span growth adds fibers that use the same frequency. With span growth, the first wavelength is equipped on the protection line and on each service line before the second wavelength is added. Span growth requires fewer transmitters and spares and could be cost effective on short spans when there are fibers to spare.

With wavelength add/drop, some wavelengths can be added/dropped at an OLS end terminal, while other wavelengths are expressed to/from other OLS systems. Wavelength add/drop is supported on OLS by use of the OT, which regenerates express wavelengths at add/drop sites. This makes it unnecessary for the express wavelengths to pass through an LCT

terminal, thus providing significant savings in equipment costs and office space.

Release 2.0 is available in the following equipment packages:

- OLS End Terminal for 4 Bidirectional Optical Lines
- OLS Repeater for 4 Bidirectional Optical Lines
- OLS Dual End Terminal
- OLS Dual Repeater
- OLS End Terminal and Repeater
- OLS End Terminal Shelf (Miscellaneously Mounted End Terminal Shelf)
- OLS Repeater Shelf (Miscellaneously Mounted Repeater Shelf)

The OLS end terminal packages include optical amplifiers as well as optical multiplexer and demultiplexer units that provide dense wavelength division multiplexing of up to eight wavelengths per fiber. The OLS repeaters use optical amplifiers and do not require multiplexers.

The dual end terminal requires two independent sets of control circuit packs for handling crossing-route applications. The packages for 4 bidirectional optical lines require only one set of control circuit packs.

The optical multiplexer units (OMUs) and optical demultiplexer units (ODUs) are placed in a different order at each end of an OLS system. On one end of the system, all OA "A" lines are used as transmitters. On the other end, all OA "A" lines are used as receivers. For that reason, one end terminal of the OLS system is referred to as 1A-TX, and the other end terminal is referred to as 1A-RCV.

Figure 1-1 shows the equipment package for the OLS End Terminals for four Bidirectional Optical Lines. For more information about the equipment packages, refer to Chapter 4, "Product Description."

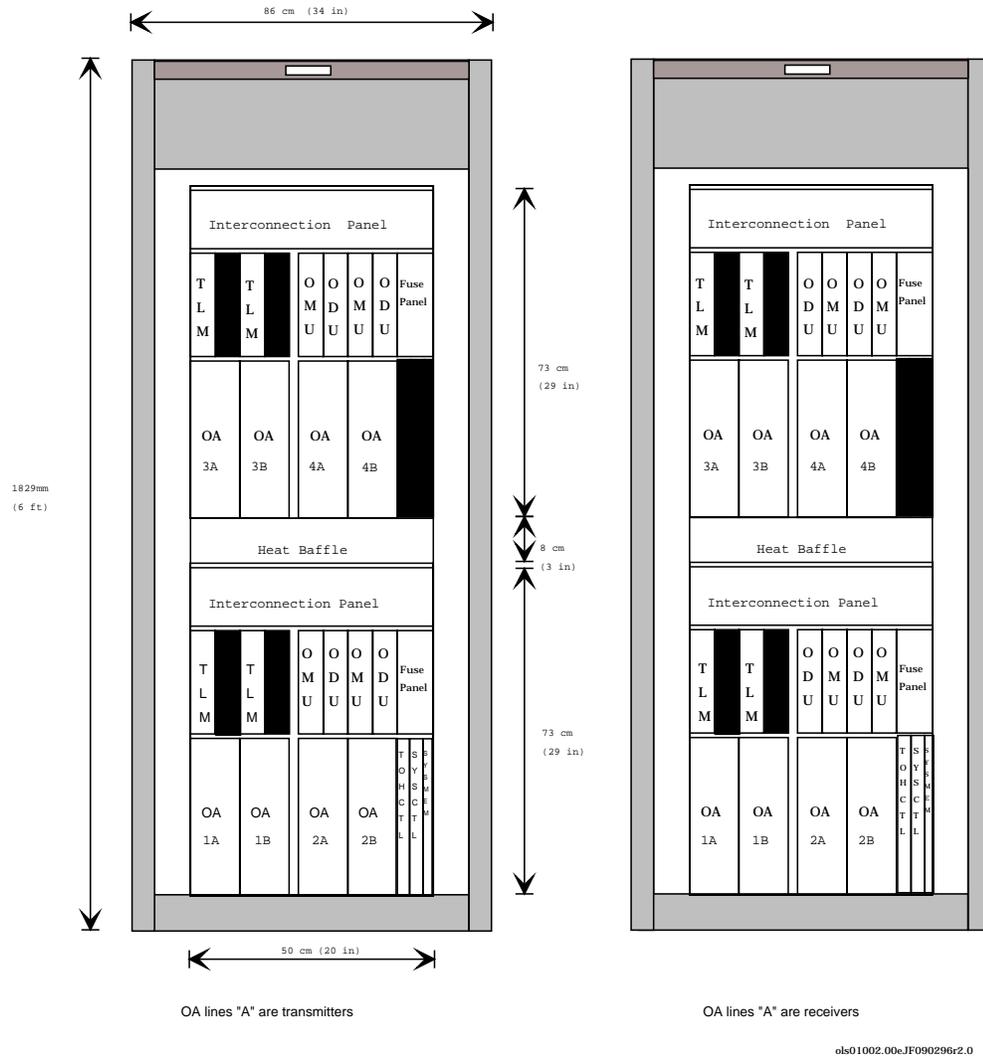


Figure 1-1. OLS End Terminals for 4 Bidirectional Optical Lines

## **OLS Features Release Plan**

---

Release 2 is the second of a series of phased releases for OLS. Each release provides a new set of features. Release 2 will be available in Spring 1997.

OLS Release 1 includes the following features:

- 8 wavelength-ready
- double-pumped optical amplifiers
- support for four bidirectional optical lines
- Craft Interface Terminal (CIT)
- Transaction Language 1 (TL1) operations system interface
- orderwire
- parallel telemetry
- automatic fault detection and isolation
- 155 Mb/s customer maintenance signal
- Gateway Network Element (GNE) operation
- Alarm Gateway Network Element (AGNE) support
- optical signal performance monitoring
- pump performance monitoring
- Threshold Crossing Alert (TCA) reporting
- automatic and CIT provisioning
- user software download
- multi-level security
- login and password aging

OLS Release 2.0, available in 1997, offers these additional features:

- support for use of the Optical Translator (OT), which increases the flexibility and applicability of OLS, especially in ring applications
- support for FT-2000 OC-48 Large Capacity Terminal Release 1.0 and Release 2.0

- Long Reach systems supporting up to eight fiber spans, each approximately 80 km in length, covering a total distance of up to 640 km
- an increased number of user-settable inputs and outputs on the Extended Miscellaneous Discrete Unit
- enhanced set of TL1 messages

Chapter 2, "Features," briefly describes OLS product features. The remainder of this guide discusses these features in more detail.



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# Features

# 2

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■ OLS: Basic Functions	2-1
OLS and OT: Extended Functions	2-2
■ Basic Benefits of OLS	2-2
■ Dense Wave Division Multiplexing	2-3
■ Optical Amplifier	2-3
■ Flexible Network Applications	2-4
■ Easy Installation and Self-Tests	2-5
■ Multiple Maintenance Features	2-6
Maintenance	2-6
Operations Interface Flexibility	2-7
Single-Ended Operations	2-8
Access Domains	2-9
Remote Login	2-10
Inventorying Capabilities	2-10
Remote NE Status (Through DCC)	2-10
Local and Remote Software Copy/Upgrades	2-10
Directory Service Network Element (DS-NE)	2-11
Continuous Performance Monitoring	2-11
Protection Switching for DCC Signal	2-11
Original Value Provisioning and User-Selectable Thresholds	2-11
Security	2-12
■ Physical Features	2-13
Front Access	2-13
Physical Compactness	2-14
On-Board Power Modules	2-17



This chapter summarizes the main features of the Optical Line System (OLS).

## **OLS: Basic Functions**

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OLS performs the following basic functions:

- supports bidirectional transmission
- receives up to eight SONET OC-48 optical signals of different, specific wavelengths from compatible optical transmitters
- optically multiplexes the signals together with another signal that is used for maintenance purposes by using dense wave division multiplexing (DWDM)
- amplifies the resulting signal using an erbium-doped fiber optical amplifier (OA)
- transmits the amplified signal over one standard single-mode or Truewave™ non-zero dispersion fiber
- uses OLS repeater terminals to optically amplify the signal
- in Standard Reach configurations, supports a maximum distance of 360 km (three spans, up to two OLS repeaters) on standard or Truewave™ fiber

- in Long Reach configurations, supports up to eight spans, with a maximum optical line length of 640 km
- optically demultiplexes the signals at the other end of the optical line and passes them on to compatible optical receivers

### **OLS and OT: Extended Functions**

When used with the Optical Translator (OT), OLS provides these additional functions:

- transmission of generic SONET OC-48/SDH STM-16 signals
- compatibility with the FT-2000 ADR system and with other vendors' OC-48/STM-16 systems
- use of a highly flexible form of wavelength add/drop, for savings in equipment costs and office space
- concatenation of multiple point-to-point OLS systems into a very Long Reach subnetwork
- wavelength interchange at network interfaces

### **Basic Benefits of OLS**

OLS provides the following basic benefits:

- handles more capacity on a single fiber (up to 20 Gb/s)
- provides a cost-effective solution to fiber-exhaust situations (no need to add more fiber)
- via use of the Optical Translator (OT), wavelength sections can be extended to thousands of kilometers
- permits a choice between adding more wavelengths (for long distances where there is fiber exhaust) or adding more spans (for short distances where there is fiber to spare)
- supports overall lengths of up to 640 km on Long Reach systems
- applicable in a variety of topologies, such as point-to-point and ring configurations
- provides for user-settable alarms and control of equipment co-located with OLS

- is bit-rate independent, making it easier to upgrade to higher performance systems
- provides for performance monitoring, fault isolation, and preventive maintenance

## **Dense Wave Division Multiplexing**

---

In **Dense Wave Division Multiplexing** ( DWDM), different optical wavelengths in the same transmission band are combined onto a single fiber. OLS supports up to 8 wavelengths in the 1.5  $\mu\text{m}$  band. The channels can be equipped in any order.

The optical multiplexer unit (OMU) multiplexes the signals together using a passive optical coupler. Since it is possible to connect the same wavelength to two different inputs, thus corrupting both signals, the wavelength inputs are carefully labeled to match the outputs on the associated transmitters. Labels indicating the specific, required wavelength are supplied for each fiber jumper. Additional safeguards at the transmitter prevent optical powering up of mismatched connections.

The optical demultiplexer unit (ODU) demultiplexes the signals by using a fixed frequency filter device called a splitter module. The splitter module takes a combined optical input signal and separates it into the eight separate wavelength signals on each of eight optical outputs.

## **Optical Amplifier**

---

The OLS optical amplifier (OA) is an erbium-doped fiber amplifier (EDFA). Working in conjunction with the transmitters, the OAs generate high optical power. This high optical power supports longer optical sections and lines between lightwave terminals than traditional lightwave applications.

OLS uses two OAs at each end terminal site. One OA is a power amplifier for the transmitter and the other is a pre-amplifier for the receiver. At the OLS repeater sites, an OA acts as an optical repeater. Each OA can amplify signals of different wavelengths that have been optically multiplexed onto one fiber. A single OA amplifies up to eight wavelengths simultaneously.

The optical amplifiers operate in the 1.5  $\mu\text{m}$  wavelength region. The main components of the OAs are as follows:

- **pump lasers:** Two high power optical pump lasers operating at a wavelength of 980 nm provide power, which is then combined with the 1.5  $\mu\text{m}$  signal onto a piece of erbium-doped fiber, where the actual gain takes place.
- **filter:** In the middle of the OA, a filter separates the light at 1532 nm from the rest of the 1.5  $\mu\text{m}$  band. This filtering separates the supervisory channel from the optical (signal) channels and reduces noise.
- **optical splitter:** An optical splitter in the OA splits off a small amount of light for monitoring purposes.
- **optical isolators:** Optical isolators prevent optical reflections from degrading system performance.

Used with compatible transmitters, Standard Reach OLS systems support a loss budget of up to 33dB per span and have a total of three spans between transmitters.

Long Reach OLS systems provide a loss budget of 25dB per span, with up to seven spans, or of 24dB per span, with up to eight spans between transmitters. For details on span length and network topologies, see the “Engineering Rules” section of Chapter 6, “System Planning and Engineering.” Table 6-1 presents a straightforward description of the Engineering Rules used in building OLS networks and subnetworks.

## **Flexible Network Applications**

---

OLS is a point-to-point system that supports a variety of network topologies. It supports high capacity loop, inter-office, outstate, and long haul applications with maximum economy and efficiency. These network topologies (described in Chapter 3, “Applications”) include the following FT-2000 OC-48 LCT-based applications:

- 1x1 end terminal
- dual 1x1 end terminal
- open or closed rings, dual rings, and 4-fiber rings

The Long Reach feature, optimized for a standard repeater spacing of up to 80 km using either 7x25 dB or 8x24 dB engineering rules, supports some additional application aspects:

- large circumference ring architectures with maximum ring sizes of 8960 km (7x25 dB, 7 spansx16 end terminal nodes) and 10240 km (8x24dB, 8 spansx16 end terminal nodes) when FT-2000 OC-48, compatible Lightwave Terminals, or OT, are used as electrical regenerators.
- six or seven repeaters between OLS end terminals (allowing longer distances before electrical regeneration by an LCT is needed)
- works over standard single mode and Truwave® fibers

The variety of topologies is further increased by use of the Optical Translator (OT), which provides wavelength add/drop. The OT electrically regenerates the signal, permitting it to use express wavelength routes that bypass intermediate offices and terminals. The availability of wavelength add/drop promises significant equipment savings as well as decreased office congestion.

OT serves as an interface between OLS and the FT-2000 Add/Drop Rings Terminal and to other vendors' OC48/STM-16 systems. Eventually, OT will allow OLS to carry other SONET/SDH and non-SONET/SDH bit rates.

## **Easy Installation and Self-Tests**

---

OLS minimizes installation time with "one box" product deliveries, connectorized cabling with commercially available connectors, and simplified procedures. The "one box" product delivery concept ensures that all product components arrive at the installation site at the same time in a small number of containers. The use of connectorized cabling with commercially available connectors also saves installation time. In addition to original value provisioning, a set of automatic turnup tests is available. These tests verify installation cabling to and from the telemetry (TLM) and the optical amplifier (OA) circuit packs for each optical line. In addition, a manual local test verifies that the optical multiplexer unit (OMU) and the optical demultiplexer unit (ODU) are working properly. Since test signal generators and detectors are integrated into the system, external test equipment is not needed.

## **Multiple Maintenance Features**

---

OLS provides multiple maintenance features that are similar to and compatible with those of other Lucent Technologies 2000 family products. The following sections summarize the major features. Chapter 5, "Operations, Administration, Maintenance, and Provisioning," describes these features in more detail.

### **Maintenance**

---

OLS maintenance features provide a wide range of system information and control, from summary-level status information to detailed reporting.

#### **Indicator Strip/User Panel**

The indicator strip at the top of the cabinet provides system-level information. The user panel provides this information for the miscellaneous mounted shelf.

The indicator strip/user panel displays system-level alarm and status information. This strip contains one or two independent sets of indicators, depending on the number of sets of system controllers in the cabinet. A dual end terminal or dual repeater cabinet contains two sets of indicators, while an end terminal or repeater cabinet for four bidirectional optical lines requires only one.

The indicators consist of colored light-emitting diodes (LEDs) that indicate:

- power (PWR ON UP SHELF, PWR ON LOW SHELF)
- critical (CR), major (MJ), and minor (MN) problems/alarms
- abnormal conditions (ABN)
- near end activity (NE ACTY)
- far end activity (FE ACTY)

An alarm cut-off button (ACO), when pressed, silences audible office alarms and lights up to indicate that it is suppressing audible alarms.

The user panel on the miscellaneous mounted shelf also contains two fuse indicators (A and B feeds), an electrostatic discharge jack connected to frame ground, and a Craft Interface Terminal (CIT) port.

## Craft Interface Terminal (CIT)

Operators use the system's Craft Interface Terminal (CIT) to retrieve detailed reports about performance monitoring, alarms and status, and system configuration. The CIT terminals can be used as remote or local terminals.

The CIT-PC (personal computer), lets you get detailed information to control the system and support the following activities:

- provisioning
- maintenance
- configuration
- administration
- performance monitoring

The CIT-PC runs menu-driven CIT-PC software under the *MS-DOS*<sup>1</sup> operating system. The CIT-PC also provides extensive on-line help and security against unauthorized access.

The CIT-TL1 is a local operations system (OS) interface that was designed for machine-to-machine language communications. It is possible to enter both local and remote TL1 commands manually by using an ASCII terminal; to do so, you should be an experienced TL1 user. For more information about the use of TL1 commands through the CIT, refer to the *2000 Family of Products Operations Systems Engineering Guide* (824-102-148).

For more information about the CIT-PC or CIT-TL1, refer to Chapter 5, "Operations, Administration, Maintenance, and Provisioning."

## Operations Interface Flexibility

---

OLS offers a variety of operations interfaces to meet the needs of an evolving operations system (OS) network. The operations interfaces include the following:

- **office alarms interface:** provides a set of discrete relays that control office audible and visible alarms.

---

1. Registered trademark of Microsoft Corporation.

- **parallel telemetry interface:** provides a minimum set of alarm and status information to an operations center.
- **miscellaneous discrete interface:** provides a total of 144 miscellaneous discrete input points and 36 miscellaneous discrete output points. Miscellaneous discrete inputs can monitor conditions like open doors or high temperatures, and miscellaneous discrete outputs can control equipment like fans and generators. Miscellaneous discrete inputs can be used to read status conditions of the OT.
- **X.25 interface:** uses X.25 protocol to provide communications with a message-based operations system through Transaction Language 1 (TL1) operations messages. A message-based operations system can access local and remote OLS network elements in a maintenance OLS system using the gateway network element (GNE) capability.

### **Single-Ended Operations**

---

An OLS system consists of two OLS end terminals and two OLS repeaters in the same optical line. Operations, Administration, Maintenance, and Provisioning (OAM&P) operations for OLS can take place only within an OLS system.

The single-ended operations capability allows control of an OLS system from a single network element in an OLS system. With this capability, you can perform operations, administration, maintenance, and provisioning on a centralized basis, saving travel time and money. Both the craft interface terminals and the operations interfaces can access the network elements (NEs). The NEs can be:

- OLS end terminals
- OLS repeaters

Single-ended operations (operations interworking) capabilities include:

- GNE (remote TL1 operations system access)
- remote login (remote craft access)
- remote NE status (remote alarming, alarm groups, Alarm Gateway Network Element, status of remote alarms, remote office alarms, and parallel telemetry)
- remote software copy

## Gateway Network Element (GNE)

You can use one or more OLS network elements as a gateway network element. The gateway network element (GNE) serves as a single interface to the X.25 message-based operations system of these network elements:

- all OLS terminals in the same OLS system
- all OLS repeaters in the same OLS system

The GNE receives operations information from these network elements through the digital communications channel (DCC) and reports that information and its own information to the operations system. The operations information is in the form of TL1 messages. Through the GNE, the operations system can send TL1 commands to any network elements in the OLS system.

The number of GNEs you use depends on your application and operations needs. For example, to reduce the number of operations data communication links between the OLS system and the operations system, you might choose to use one OLS network element as the GNE. If you need redundancy, you might choose to use two network elements as GNEs.

To communicate remote status information efficiently, you must provision each network element with an alarm group parameter. Members of the alarm group exchange remote NE status information through one or more Alarm Gateway Network Elements (AGNEs) that are defined in the same alarm group.

## Access Domains

---

OLS network elements and the signal transmitter network elements (such as the FT-2000 OC-48 LCT) operate as separate and independent systems. There is no communication (DCC connectivity) between the two types of network elements.

OLS network elements can communicate only with other OLS NEs in the same OLS system.

For more information about access domains, see Chapter 5, "Operations, Administration, Maintenance, and Provisioning."

## **Remote Login**

---

You can log in remotely from one OLS network element to another OLS network element when they are in the same OLS system.

## **Inventorying Capabilities**

---

OLS provides automatic version recognition of all hardware and software installed in the system. Circuit pack types, circuit pack CLEI<sup>1</sup> codes, and serial numbers are accessible via the CIT. These capabilities greatly simplify troubleshooting, dispatch decisions, and inventory audits.

## **Remote NE Status (Through DCC)**

---

Through the DCC Supervisory Channel interface, an OLS network element can receive and transport summary alarm and status information from remote network elements in the same OLS system. A far-end activity LED on the local OLS terminal indicates whether any condition is present in an OLS network element elsewhere in the OLS system. Relays connected to the office audible and visual alarm indicators (CR, MJ, and MN) announce any local and remote alarm conditions. If the ACO (Alarm Cut-off) button is pressed, audible alarms are suppressed. Visual alarms are not affected by pressing the ACO button.

If there are multiple alarms, only the highest level alarm is indicated. When the highest level alarm is cleared, the office alarm panel displays the next highest alarm, and so on, until all alarms are cleared.

## **Local and Remote Software Copy/Upgrades**

---

You can upgrade OLS software within an OLS system in-service without changing any control circuit packs. The transmission system monitoring and control are fully functional during the software download.

Use the Craft Interface Terminal (CIT) to download/upgrade software locally. The software can then be copied to a remote terminal over the DCC.

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1. COMMON LANGUAGE is a registered trademark and CLEI, CLLI, CLCI, and CLFI are trademarks of Bell Communications Research, Inc.

### **Directory Service Network Element (DS-NE)**

Any one node in an OLS system can be designated the Directory Service Network Element (DS-NE). The DS-NE provides a centralized database that maps terminal names (TIDs) to addresses (Network Service Access Points [NSAPs]). The NSAPs are used internally for routing information within the OLS system. No provisioning is required for the DS-NE; the mapping is configured automatically.

### **Continuous Performance Monitoring**

Continuous performance monitoring allows OLS to detect OLS system problems before they affect service. OLS monitors analog performance on each channel of an optical line. OLS receives digital performance information on the supervisory channel. Thresholds for each parameter can be provisioned, depending on customer needs.

You can specify a single start time for measuring all 24-hour performance monitoring parameters. The start time can be the beginning of any hour (the default is midnight). The performance monitoring parameters for each day are collected separately, beginning at the specified time. OLS keeps information for the current day and the previous 6 days. OLS also records performance data at 15 minute intervals, storing data from the previous 8 hours.

### **Protection Switching for DCC Signal**

OLS provides automatic protection for the DCC signal. The supervisory channel on optical line 1 is designated as the service DCC; the supervisory channel on optical line 2 is designated as the protection DCC. The DCC is the only protected part of the signal on the primary supervisory channel. DCC protection is implemented on an optical span basis (between 2 adjacent OLS NEs). The DCC protection switching is bidirectional, revertive, and 1x1.

### **Original Value Provisioning and User-Selectable Thresholds**

OLS offers provisioning capabilities that allow you to set the following conditions:

- alarm thresholds for OLS performance monitoring attributes

- date
- far end communications
- login information
- performance monitoring baselines and thresholds
- security information
- optical pump power (LEA7 only) to accommodate Long Reach

To minimize provisioning, an original value is assigned to each parameter by the software. The values assigned by the software can be changed easily with the CIT.

## **Security**

---

OLS provides three tiers of security against unauthorized access to the CIT and OS functions (for example, provisioning). The three tiers are Port Security, Network Element Login Security, and User Login Security.

### **Port Security**

This feature controls access to the system through a per-port enable/disable mechanism and inactivity time outs.

### **Network Element Login Security**

This feature controls access to the system through a lockout mechanism to disable all but administrative logins.

### **User Login Security**

This feature controls access to the system on an individual user basis including

- **Login ID and password assignment:** Requires the user to enter a valid login ID and password to access the system. OLS allows up to 100 login IDs and passwords. Two of these login IDs are expert/privileged and the balance are reports only and general.
- **User authorization levels:** Provides four levels of access on a per login session basis:

- **Expert:** Provides access to all commands and options. Expert users are privileged users who have gained this authorization level in one of two ways: They acquire it automatically by logging in through a TL1 interface (either X.25/TL1 or CIT-TL1 interface). They provide a special option as they log in from a CIT-PC.
  - **Privileged:** Provides access to all commands and options except those that may affect all service at once, for example, TEST AUTO-TURNUP.
  - **General:** Provides access to all commands except those relating to security and system access.
  - **Reports Only:** Provides access only to reports OPR-ACO and TEST-LED.
- **Login aging:** Enables a privileged user to set individual logins to be deleted if unused for a certain number of days or on a particular date (for example, for a visitor or for temporary access during installation).
  - **Password aging:** Enables a privileged user to require each user to change his or her password periodically.
  - **Autonomous indications and history log records:** Provides autonomous indications and history log records of successful and unsuccessful logins and intrusion attempts for security auditing.

## **Physical Features**

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OLS packaging is designed for ease of use and adaptability. The following sections highlight some of these features. For more details, see Chapter 4, "Product Description."

### **Front Access**

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You can access all operation, maintenance, and installation activities from the front of the OLS system. Front access provides greater flexibility, permitting placement of the equipment in physically restricted locations.

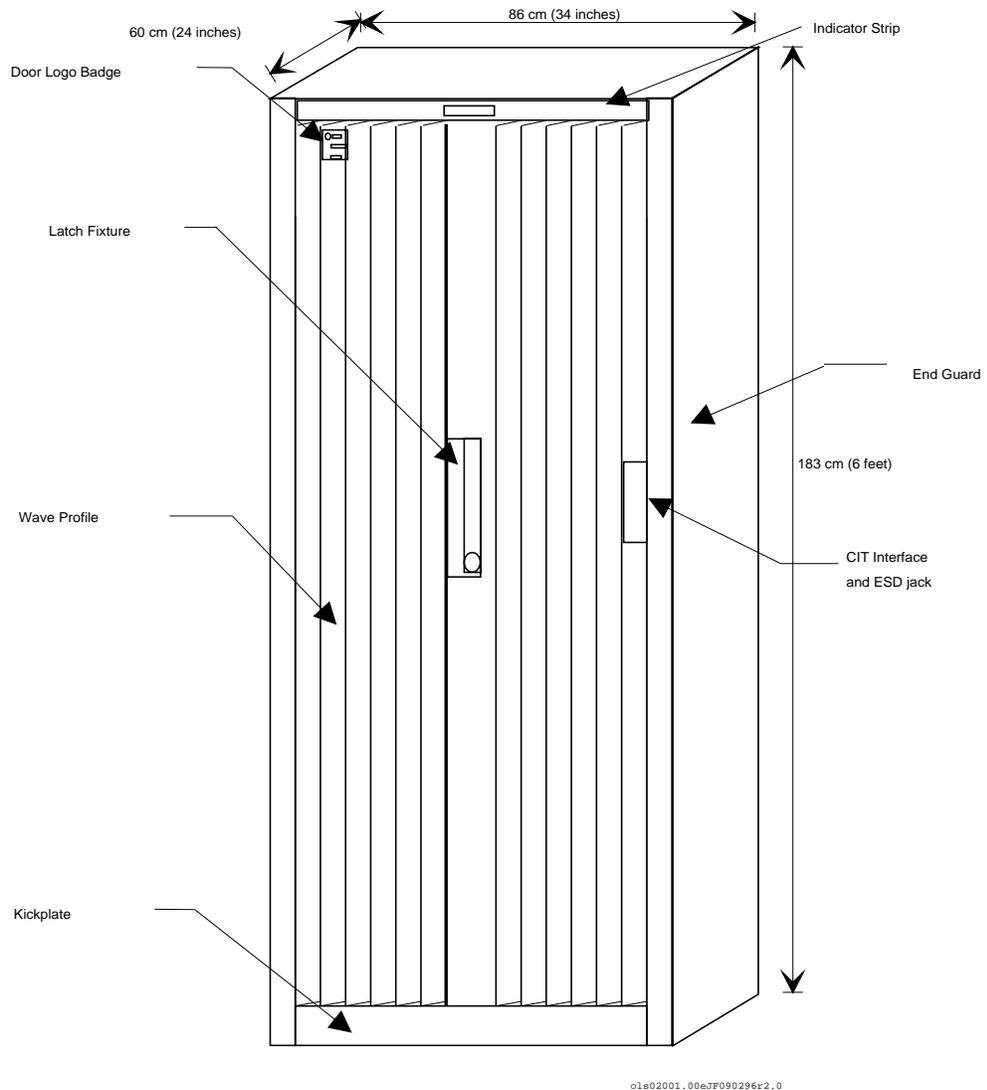
An indicator strip at the top of the cabinet header contains system indicators.

### **Physical Compactness**

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OLS components are housed in compact cabinet or mounted shelf packages. Each cabinet is 183 cm (6 feet) high, 86 cm (34 inches) wide, and 60 cm (24 inches) deep. Each cabinet houses two shelves, each containing a maximum of two bidirectional optical lines or four bidirectional optical lines.

Figure 2-1 is a diagram of the cabinet with the doors closed.



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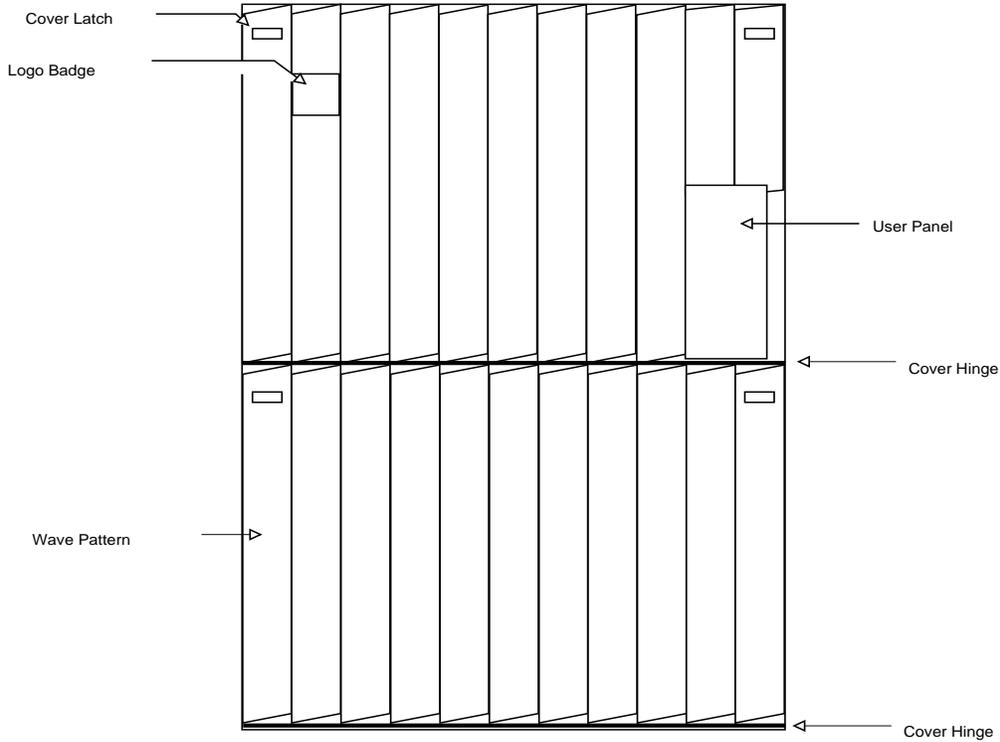
**Figure 2-1. OLS Cabinet with Doors Closed**

The cabinets accept cabling from, either or both, overhead arrangements and through-floor routing.

The shelves are designed so that they can operate on a stand-alone basis in the miscellaneous mounted shelf as well as in the cabinet. This feature provides for flexibility for future deployment and relocation of systems.

The miscellaneous mounted shelf is 31 inches (80 cm) high, 12 inches (30 cm) deep, and 20 inches (50 cm) wide.

Figure 2-2 shows a diagram of the miscellaneous mounted shelf with front covers.



---

**Figure 2-2. Miscellaneous Mounted Shelf with Front Covers**

### **On-Board Power Modules**

OLS distributes power uniformly across the system. Circuit packs contain converters that change the voltages to those required. Distributing power improves system reliability by dissipating heat uniformly across the system, avoiding "hot spots."

Each cabinet uses two -48V 8-gauge power cables (feeders A and B) that branch into two 10-gauge power cables (one for each shelf). These power cables terminate directly onto the shelves. Each branch connects to an overcurrent limiter located on the shelves. The power is then filtered and terminated on the backplane with power buses that distribute the -48V power to each circuit pack residing in the shelf.



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# Applications

# 3

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■	Optically Amplified Transmission	3-1
■	OLS Optical Transmission Elements	3-2
	OLS End Terminal and OLS Repeater Shelves	3-4
■	OLS Basic Configuration	3-6
■	Dual Network Elements versus 4 Bidirectional Line Network Elements	3-7
	Optical Translator Features	3-8
■	Point-to-Point Applications with FT-2000 OC-48 LCT, Generic SONET ADMs and OT	3-9
■	Ring Applications with FT-2000 LCT and the Optical Translator	3-10
■	Span Capacity Growth Scenario	3-15



This chapter describes the basics of Optical Line System (OLS) transmission technology, transmission elements, and configurations as well as OLS applications. These applications use FT-2000 OC-48 Large Capacity Terminals (FT-2000 OC-48 LCTs) as well as FT-2000 OC-48 ADR Terminals (FT-2000 ADR), provided OLS is using an Optical Translator.

For a basic description of OLS and its available packages, see Chapter 1. For a list of OLS features, see Chapter 2. For more information about the physical components of OLS, see Chapter 4, "Product Description."

For information about the components of the FT-2000 OC-48 LCT and FT-2000 OC-48 ADR, see the documents referred to in the section, "Documentation for Related Equipment and Software" in "About This Document."

## **Optically Amplified Transmission**

Fiber optics technology has been proven to be the best technology for long-distance high capacity transmission. The use of erbium-doped fiber amplifiers (EDFAs) and dense wave division multiplexing (DWDM) extends the reach and capacity of fiber transmission systems. The EDFA uses the photoluminescent properties of the rare-earth element erbium to amplify an incoming optical signal. When light at 980 nm wavelength is inserted into a piece of erbium-doped fiber, the photons change state and

emit light at 1.5 micrometers (also called microns or  $\mu\text{m}$ ). If this emission is combined with a 1.5  $\mu\text{m}$  optical signal, the 1.5  $\mu\text{m}$  signal is amplified. The 980 nm light comes from high powered lasers called pump lasers. The light from the pump lasers is combined with the 1.5  $\mu\text{m}$  transmission onto the erbium-doped fiber using special couplers.

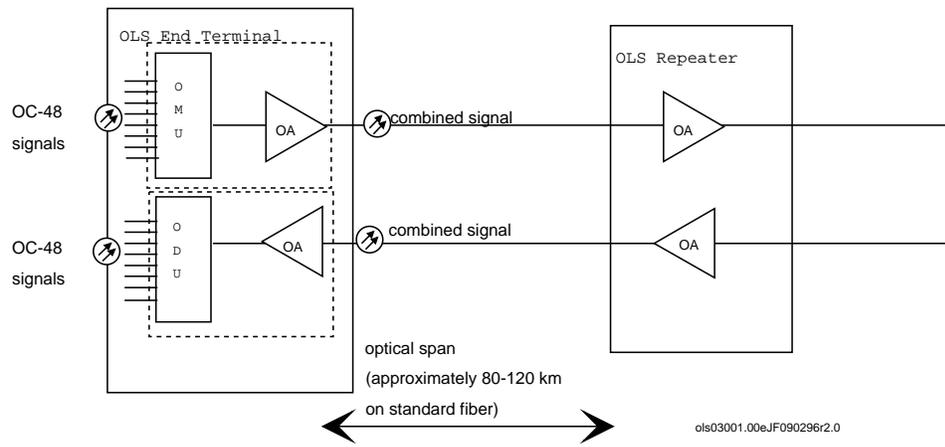
OLS uses EDFA technology in its optical amplifiers (OAs). OLS uses dense wave division multiplexers to combine up to eight optical signals (channels) in the 1.5  $\mu\text{m}$  bandwidth on the same fiber. One EDFA can amplify the combined signals together, unlike a traditional system, where the individual optical signals are amplified separately. One EDFA replaces several traditional amplifiers.

## **OLS Optical Transmission Elements**

OLS is a bit-rate-independent, point-to-point optical system usable in a variety of applications. This section describes the basic OLS transmission elements. The next section shows basic OLS configurations that use these elements.

OLS uses optical amplifiers (OAs), optical multiplexer units (OMUs), and optical demultiplexer units (ODUs) as its basic components. See Chapter 4, “Physical Description” for a description of these components.

Figure 3-1 is a block diagram of the basic OLS transmission elements. This diagram shows the transmission on one bidirectional optical section between an OLS end terminal and an OLS repeater. (For an introduction to OLS end terminals and repeaters, see Chapter 1.) The transmission shown in Figure 3-1 requires two optical fibers, one for each direction. The end terminal uses two OAs, an OMU, and an ODU for the transmission and reception of the signals. The repeater uses two OAs and requires no multiplexers or demultiplexers.

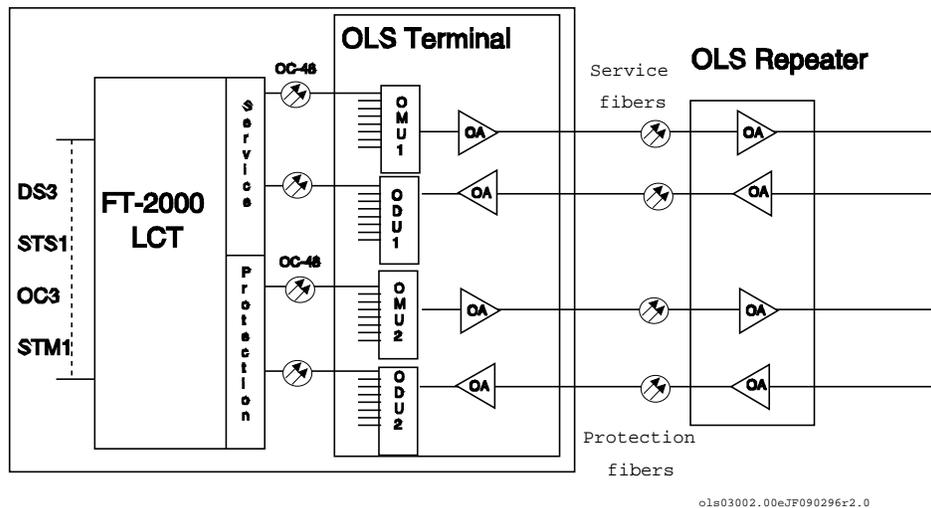


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**Figure 3-1. OLS Transmission**

OC-48 optical signals enter the multiplexer from a compatible lightwave transmission terminal. At the other end of the transmission, optical signals are demultiplexed and sent on to another compatible lightwave transmission terminal.

Figure 3-2 is a block diagram of an FT-2000 OC-48 LCT connected to an OLS end terminal and repeater. The transmission illustrated shows service and protection lines (four fibers) for one shelf of a 1x1 end terminal. Two fibers are used for transmission in each direction.



**Figure 3-2. OLS Transmission from the FT-2000 OC-48 LCT Showing Service and Protection Fibers**

A fully-equipped OLS cabinet containing two shelves, supports four optical lines (eight fibers). (For an explanation of optical lines and sections, see “What is OLS?” in Chapter 1, “Introduction.”)

Protection for traffic on the optical lines is handled by the FT-2000 OC-48 LCT. OLS provides protection for the OLS DCC channel only. For information about OLS protection, see “Protection Switching” in Chapter 6, “System Planning and Engineering.”

### **OLS End Terminal and OLS Repeater Shelves**

Although the physical shelf for the OLS end terminal and repeater is the same, the equipage of the two types of shelves is different.

The OLS end terminal shelves each contain two OMUs and two ODUs, each of which uses an OA. (The shelves also contain telemetry [TLM] and system controller circuit packs, which are described in Chapter 4, “Product Description.”) Figure 3-3 shows a diagram of the end terminal shelf associated with the transmission shown in Figure 3-2.

The OLS repeater shelves can contain four TLMs and four OAs, one for each fiber. Figure 3-4 shows the repeater shelf associated with the transmission that is shown in Figure 3-2.

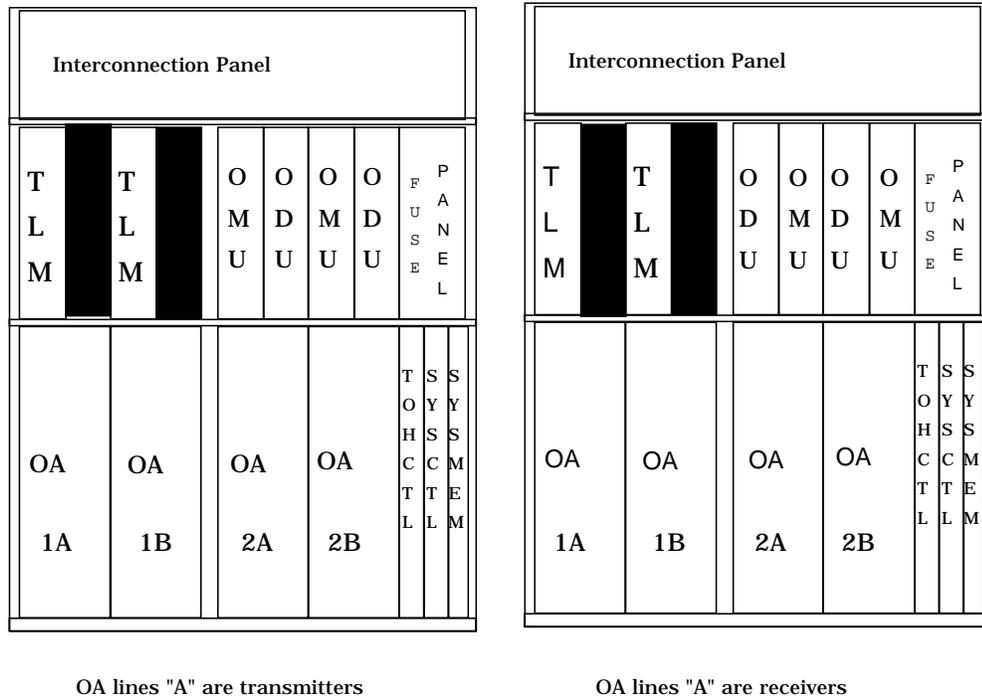
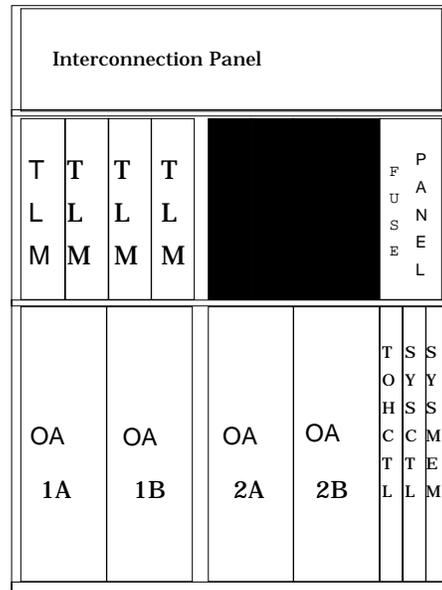


Figure 3-3. OLS End Terminal Shelves



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**Figure 3-4. OLS Repeater Shelf**

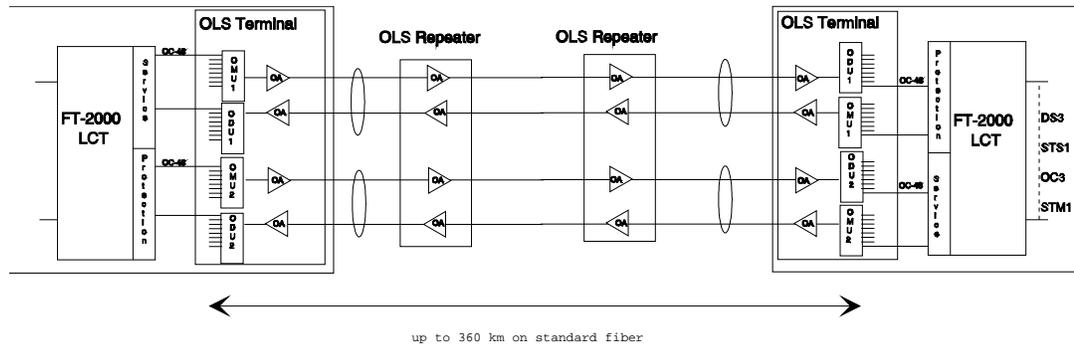
### **OLS Basic Configuration**

The OLS can be configured in a variety of ways--ranging from single span, two-terminal systems to complex multispan systems involving multiple repeater terminals and end terminals.

The most basic configuration is two OLS end terminals. If the distance between the end terminals exceeds 120 km on standard fiber, an OLS repeater terminal is needed to amplify the signal between the two end terminals.

In two and three-span configurations, each optical line on standard fiber supports up to two OLS repeaters between end terminals. See Table 6-1 in the "Engineering Rules" section of Chapter 6 for specific guidelines on spacing and topologies. Up to 33dB (approximately 120 km) of spacing between the two OLS network elements is possible. After 33dB of loss, the

signal must be amplified, either at an OLS repeater terminal or at the other OLS end terminal. Figure 3-5 shows a 3-span configuration with two end terminals and two repeaters. The figure shows only one OLS shelf. Note that an OLS cabinet contains twice the capacity shown.



**Figure 3-5. Three-Span Configuration with OLS End Terminals and Repeaters**

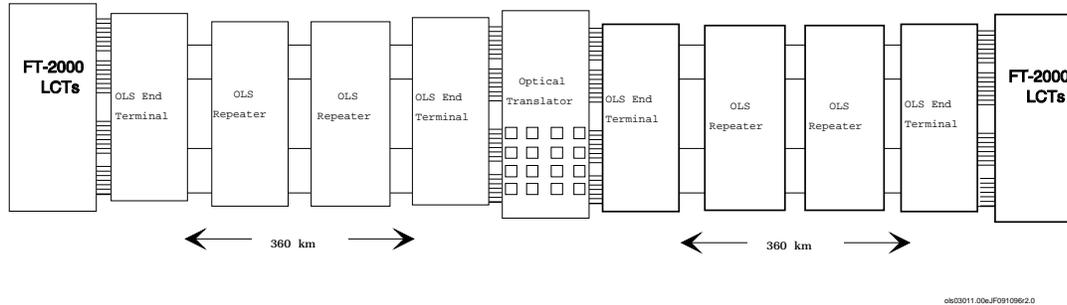
In configurations of more than three spans, up to 80 km of spacing between network elements is supported. In Long Reach configurations, after 24 dB (8x24dB) or 25 dB (7x25dB) of loss the signal must be amplified, either at an OLS repeater or at the other end terminal. OLS now supports Long Reach configurations of up to seven and eight spans; the total distances covered by such configurations are 560km and 640 km, respectively. Refer to Chapter 6 for definitions and engineering rules in the section "Engineering Rules".

## **Dual Network Elements versus 4 Bidirectional Line Network Elements**

The decision whether to use 4 bidirectional network elements or dual network elements depends on your requirements. If you plan to route all traffic through an OLS network element to a single office, use end terminals and repeaters. To route traffic to two locations, use dual network elements. The dual elements provide DCC connectivity to both sites, ensuring that remote operations are possible at both locations. See Chapter 4, "Product Description" for information on equipment packages.

### Optical Translator Features

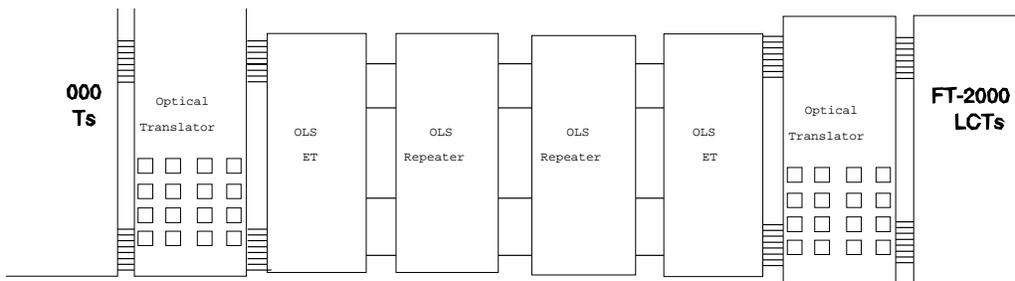
For target distances greater than 640 km with standard fiber, an Optical Translator (OT) provides regeneration, permitting the signal to overcome the limitations of all-optical transmission.



**Figure 3-6. OLS Transmission with OT Supporting Signal Regeneration and Wavelength Add/Drop**

Figure 3-6 shows an OLS transmission with OTs performing signal regeneration. Regeneration allows the OT to support wavelength add/drop at OLS, as shown in Figure 3-6.

OT can serve as an interface between OLS and generic SONET OC-48/SDH STM-16 terminals, as shown in Figure 3-7.



**Figure 3-7. OT as Interface between OLS and Generic SONET OC-48 Terminals**

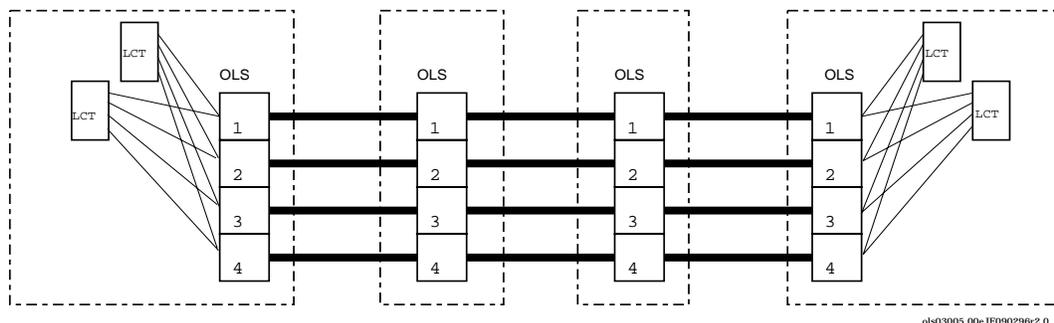
## Point-to-Point Applications with FT-2000 OC-48 LCT, Generic SONET ADMs and OT

---

OLS can be configured to operate with the FT-2000 OC-48 LCT in any LCT application. This feature is useful when more than one OC-48 signal per fiber is required. Figure 3-8 shows OLS used in an LCT application. See *FT-2000 OC-48 Large Capacity Terminal Applications, Planning, and Ordering Guide*, Chapter 3 “Applications” for other LCT applications.

Figure 3-8 shows a dual 1x1 end terminal application with one OLS end terminal consisting of two shelves (one cabinet) at each end. Up to two OLS repeaters between the end terminals contain two shelves (one cabinet) each. This application uses four optical lines (eight fibers). Two lines are used for service and two for protection. Remember that this is an LCT application with OLS used to increase fiber capacity and/or transmission distance. The term “dual” is part of the application name and does not refer to OLS dual end terminals or dual repeaters.

OTs can be used with OLS to extend wavelength sections beyond 360 km or 640 km.



**Figure 3-8. Dual 1x1 End Terminal Application (Equipped with 4 Optical Lines)**

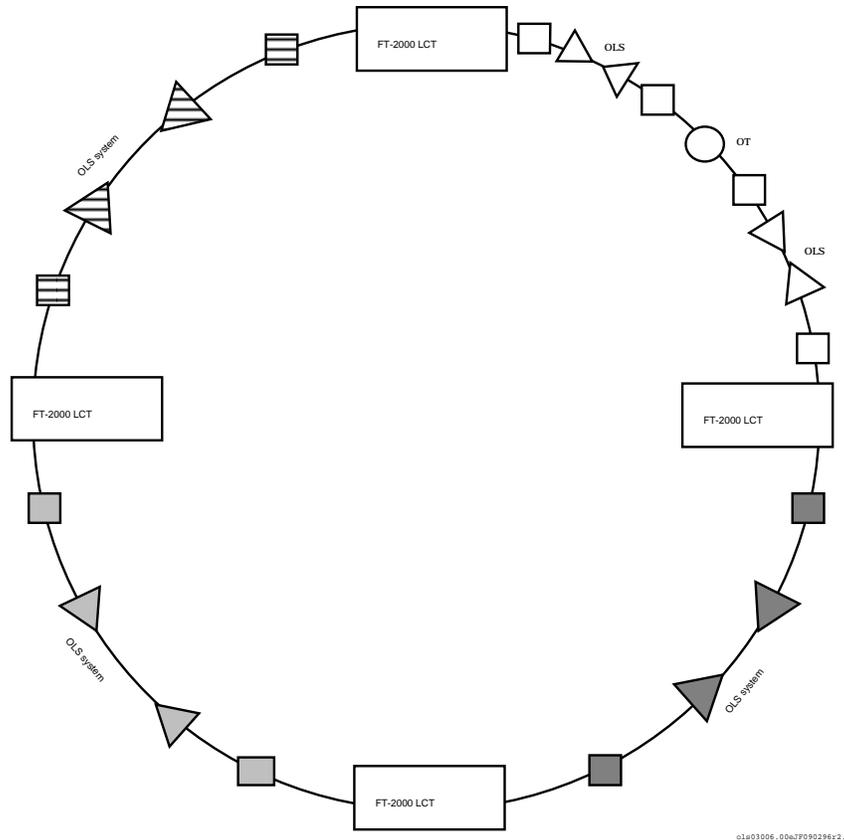
## **Ring Applications with FT-2000 LCT and the Optical Translator**

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OLS can be used in either open or closed ring applications to increase the distance between transmission terminals, increase span capacity, and relieve fiber exhaust. The multispans OLS system(s) can consist of up to seven 80-km spans with 25 dB loss or eight 80-km spans with 24 dB loss each. Each OLS system in the ring can be custom-sized to meet the needs of the application. OLS allows the OC-48 capacity of 2.5 Gb/s per fiber to be expanded up to 20 Gb/s per fiber. A fully equipped OLS system uses four lines, consisting of eight fibers, each of which can support 20 Gb/s.

In an OLS ring application, a separate OLS system is used between each pair of adjacent nodes (span). This can be an open or a closed ring.

Figure 3-9 shows a ring of four FT-2000 OC-48 LCTs connected to five OLS systems. Two of the five OLS systems are connected by OTs, creating a subnetwork between adjacent LCTs. In this ring configuration, the OT extends the length of wavelength sections and additionally provides wavelength add/drop. The same benefits can be achieved with the use of the OT in generic SONET OC-48/SDH STM-16 ADM rings.

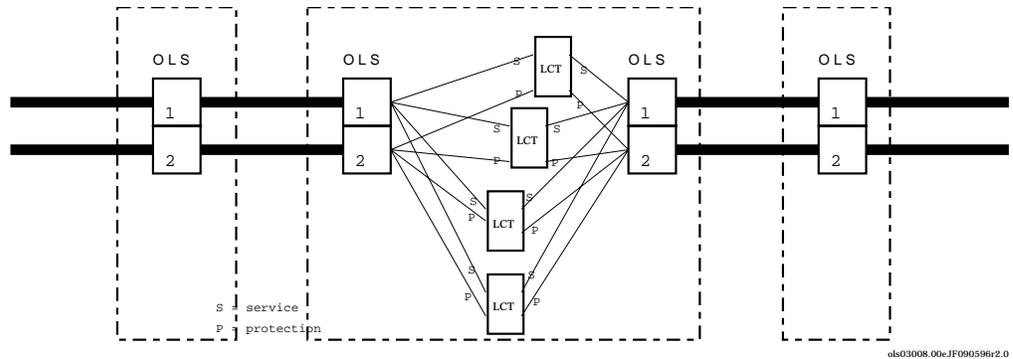


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**Figure 3-9. An FT-2000 OC-48 LCT Ring with OLS Systems Connected by an Optical Translator**

Different drop side signals in an OLS system can come from different FT-2000 OC-48 LCT topologies. Some drop side signals may drop at a given office, while others may go express.

For example, Figure 3-10 shows separate FT-2000 OC-48 LCT rings sharing an OLS system.

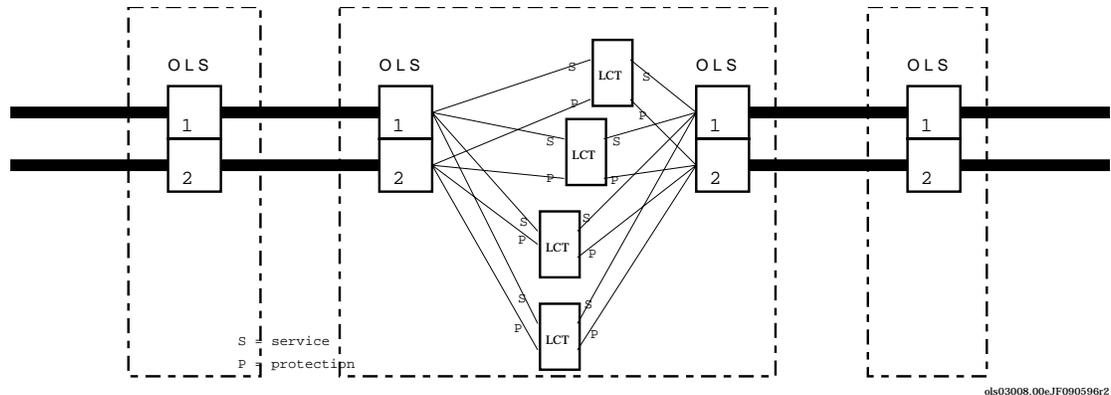


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**Figure 3-10. FT-2000 OC-48 LCT Rings Sharing an OLS System**

A 4-fiber ring application can be configured with either two or four optical lines. When four optical lines are used, the OLS end terminals and OLS repeaters each use one set of three system control circuit packs: system controller, system memory, and tributary overhead controller (SYSCTL, SYSMEM, and TOHCTL).

Figure 3-11 shows a 4-fiber ring application in which four FT-2000 OC-48 LCTs share OLS systems. In a 4-fiber ring application, for each ring, the service and protection can use the same wavelength over different optical lines in each direction.



---

**Figure 3-11. 4-Fiber Ring Application**

When used with the Optical Translator (OT), OLS can dramatically extend the distances between LCT terminals, providing maximum flexibility in ring applications and lowering the overall cost of equipment.

Designed for use with OLS, the OT offers:

- wavelength add/drop capability
- concatenation of multiple OLS systems
- long-span transmission for FT-2000 LCT systems
- compatibility with FT-2000 ADR systems and other vendors' SONET OC-48/SDH STM-16 equipment

Through electrical regeneration of the signal, the OT permits concatenation of multiple point-to-point OLS systems, thus increasing the distance and overall length of the network.

The OT can interface OLS with other vendors' OC-48/STM-16 Add/Drop Multiplexer systems. The OT is designed to support express OC-48 traffic and to serve as an interface between OLS and SONET/SDH and non-SDH terminals.

With the OT, OLS can be used to create very large ring networks, where express wavelengths bypass intermediate offices without going through an LCT (see Figure 3-12). Such networks offer heightened flexibility, lower equipment costs, and lessened office congestion.



2000 OC-48 LCT supports four bidirectional OC-48 lines, or eight fibers. As shown in Figure 3-2, one line is used for service and one line for protection.

When OLS is added to the application, one fiber supports eight times the capacity of one OC-48 fiber from the FT-2000 OC-48 LCT. One fully-equipped OLS cabinet, containing two fully-equipped OLS shelves, supports sixteen fully-equipped and fully-protected FT-2000 OC-48 LCTs.

Figure 3-13 shows a scenario in which each central office (CO) has 16 FT-2000 OC-48 LCTs. Before OLS is added, 64 fibers are required to transmit the OC-48 service and protection channels. After OLS is added, one OLS cabinet is used to transmit the FT-2000 OC-48 LCT traffic at 20 Gb/s over four lines (eight fibers, four in each direction). Two lines are used for service and two for protection.

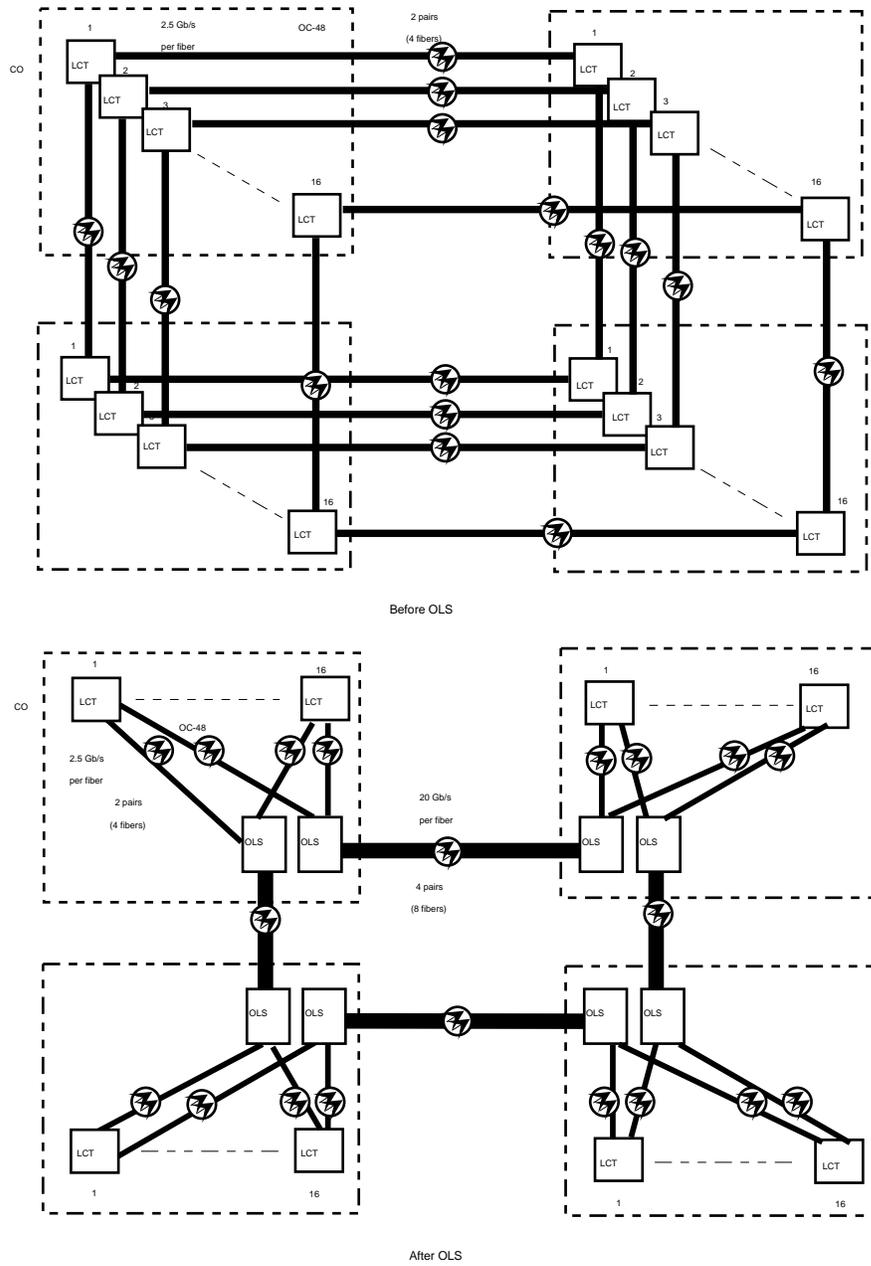


Figure 3-13. Span Capacity Growth Scenario



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# Product Description

# 4

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■ Introduction	4-1
■ System Control Architecture	4-2
■ Physical Design	4-4
OLS Cabinet	4-4
1A-TX and 1A-RCV	4-8
End Terminal for 4 Bidirectional Optical Lines	4-8
Repeater for 4 Bidirectional Optical Lines	4-10
Dual Repeater	4-11
Dual End Terminal	4-12
End Terminal and Repeater	4-13
Shelf Descriptions for OLS	4-14
■ Miscellaneously Mounted Shelf	4-25
■ Transmission	4-27
OLS End Terminal	4-27
OLS Repeater	4-29
Supervisory Signal	4-30
■ Transmission Circuit Packs and Units	4-31
Optical Amplifier (OA)	4-31
Transmission	4-32
Optical Multiplexer Unit (OMU)	4-34
Optical Demultiplexer Unit (ODU)	4-34
Telemetry (TLM)	4-34
Drop Side Signal Requirements	4-36
■ Control Circuit Packs	4-36
System Controller (SYSCTL)	4-36
System Memory (SYSMEM)	4-37

Tributary Overhead Controller (TOHCTL)	4-37
■ DCC Channel Protection Switching	4-37
■ Power	4-37
Power Distribution for the OLS Cabinet	4-38
Power Cables	4-40
Shelf-Level Power Distribution	4-40

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# Product Description

# 4

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This chapter describes the Optical Line System (OLS) architecture and features, and including the OLS packages, system control, physical design, transmission, protection, and powering.

## Introduction

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OLS is available in the following equipment packages:

- OLS End Terminal for 4 Bidirectional Optical Lines
- OLS Repeater for 4 Bidirectional Optical Lines
- OLS Dual End Terminal
- OLS Dual Repeater
- OLS End Terminal and Repeater
- OLS End Terminal Shelf (Miscellaneously Mounted)
- OLS Repeater Shelf (Miscellaneously Mounted)

OLS shelves are designed to be housed in Lucent Technologies Newlook 2000 cabinets, mounted in European Telecommunications Standard Institute (ETSI) compatible racks, or mounted in a Network System Bay Framework (800 or 801 type).

The cabinets used for OLS systems have the following dimensions:

- 183 cm (6 ft) high
- 86 cm (34 in) wide
- 60 cm (24 in) deep

A cabinet houses two shelves, each containing a maximum of two bidirectional optical lines for a maximum of four bidirectional optical lines per cabinet.

The OLS interconnection cabling is completely connectorized (no wire wrap or solder) using industry standard connectors, such as ST, SC, and FC optical connectors, with ST as the standard connector.

OLS offers complete front access. All operation, maintenance, and installation activities take place in front of the equipment.

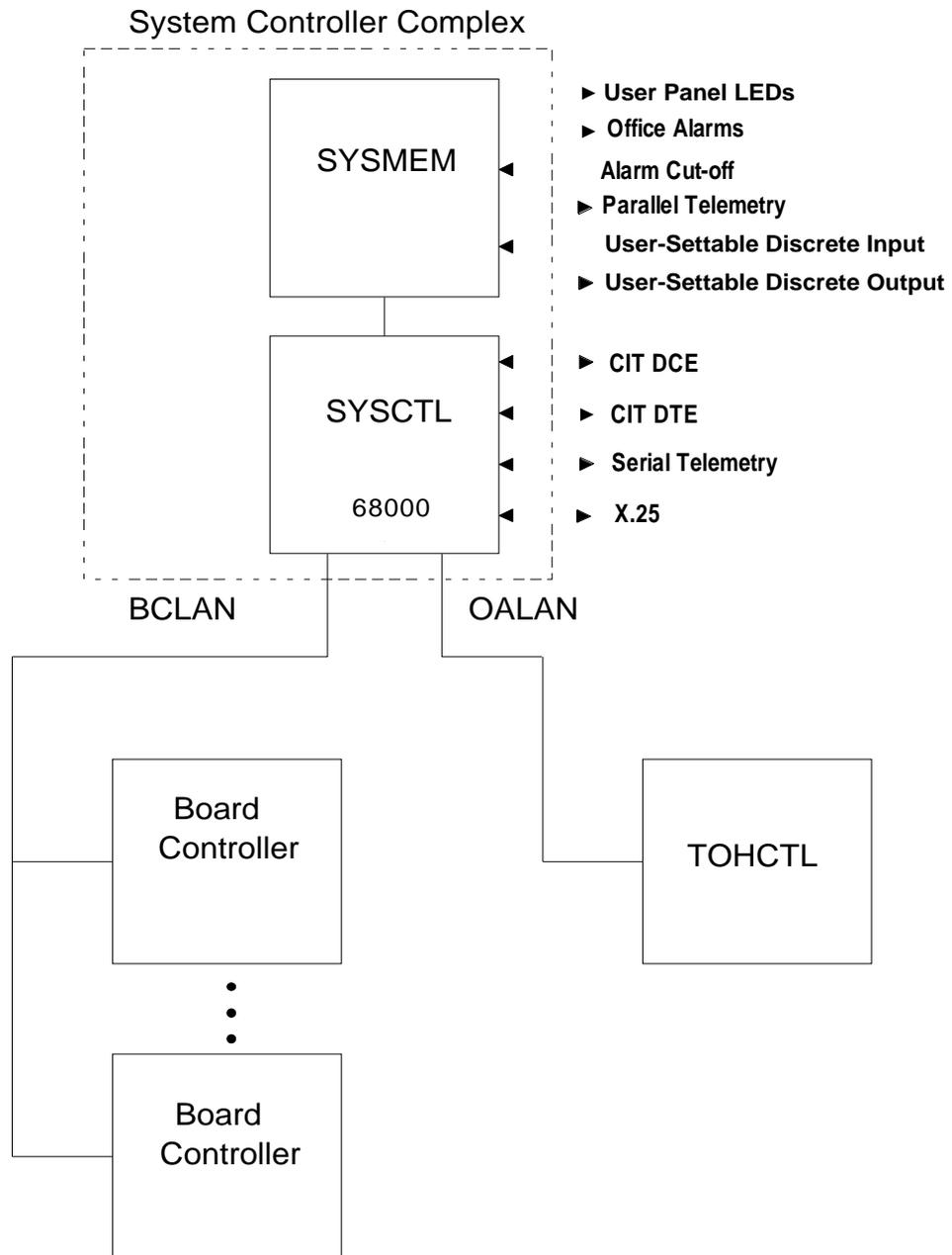
Using the OLS software, you can enable different maintenance and operational features and upgrade with new features as they become available.

## **System Control Architecture**

OLS uses a hierarchical control architecture. The hierarchy consists of a 2-level control system, in which the system controller complex functions as the higher level of control and the board controller, residing on the optical amplifier (OA) and telemetry (TLM) circuit packs, serve as the lower level of control. Figure 4-1 shows the OLS system control architecture.

The system controller complex is responsible for system-wide computations and system user interface functions. The complex is physically partitioned into two separate circuit packs referred to as the system controller (SYSCTL) and system memory (SYSMEM) circuit packs respectively. The board controller local area network (BCLAN) connects these two control levels. The system controller complex also plays a major role in providing the operations, administration, maintenance, and provisioning functions.

A single system controller complex controls up to four bidirectional optical lines. Applications involving crossing routes require two controller complexes in a single cabinet; in this case, each controller is independent of the other, and each controller controls two bidirectional optical lines.



---

Figure 4-1. System Control Architecture for the Optical Line System (OLS)

The board controller contains a microcontroller with supporting circuitry. This controller monitors and controls the OA and TLM circuit packs, isolates faults at the pack level, controls the circuit pack FAULT LEDs, calculates the signal quality factor (SQF), controls hardware provisioning data, maintains a sanity timer, and provides debugging functions.

The tributary overhead controller (TOHCTL) performs SONET Section Data Communications Channel (DCC) processing functions.

The controllers communicate among the various levels of the system using internal local area networks (LANs). The board controllers communicate using the board controller local area network (BCLAN). The TOHCTL circuit pack and the system controller complex communicate using the overhead access local area network (OALAN).

The OLS control features are available to the operator through several craft and operations system (OS) interfaces. In addition to accessing the local terminal, the craft and OS interfaces can reach a remote terminal using the DCC in the OC-48 signal. These functions are provided by the SYSCTL, SYSMEM, and TOHCTL circuit packs. For more information about craft and operations system interfaces, refer to Chapter 5, "Operations, Administration, Maintenance, and Provisioning."

## **Physical Design**

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OLS shelves are designed to be placed in a cabinet or in a rack or framework.

### **OLS Cabinet**

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Each OLS cabinet has an indicator strip located at the top front of the cabinet. Connectorized cabling connects the shelves to this indicator strip. Figure 4-2 shows the indicator strip for the OLS Dual End Terminal and OLS Dual Repeater cabinet, and Figure 4-3 shows the indicator strip for the OLS End Terminal and OLS Repeater for four Bidirectional Optical Lines. Table 4-1 lists the indicators.

The OLS cabinet is shown with its doors closed in Figure 4-4.



**Figure 4-2. Indicator Strip for Dual End Terminal and Dual Repeater Cabinets**



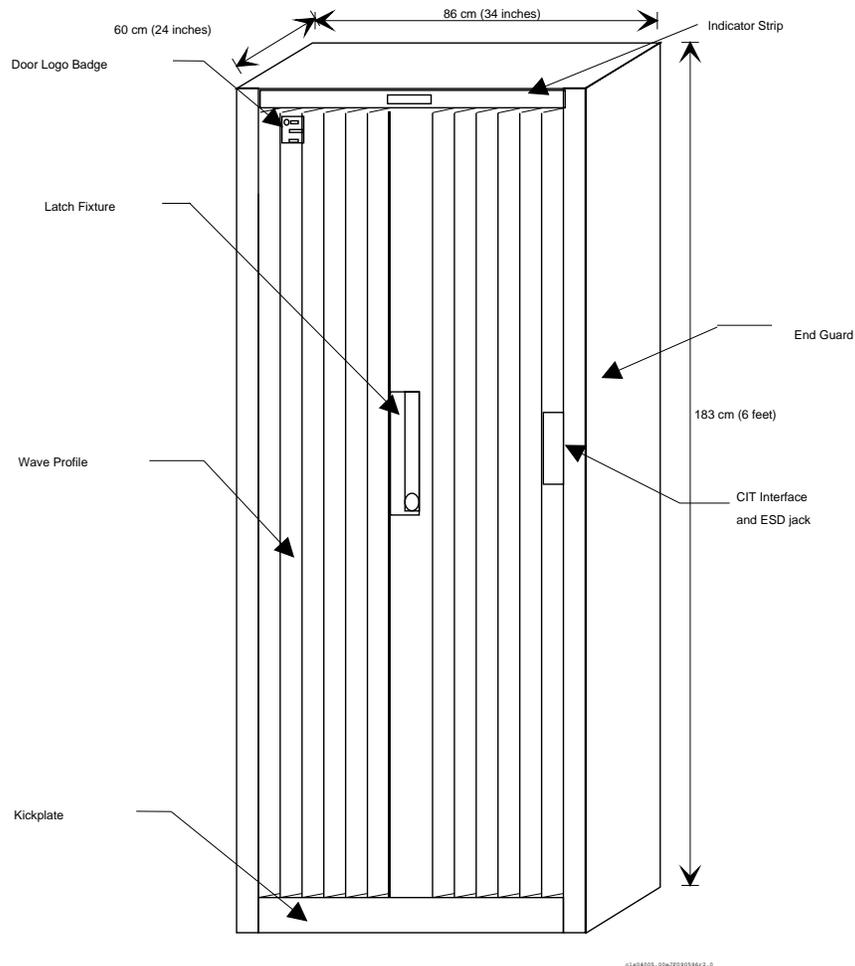
**Figure 4-3. Indicator Strip for Cabinets for OLS End Terminal and Repeater for 4 Bidirectional Optical Lines**

**Table 4-1. Indicators for OLS**

Indicator Name	Abbrev.	Type	Color	Description
Critical	CR	LED	Red	Indicates critical active alarm level
Major	MJ	LED	Red	Indicates major active alarm level
Minor	MN	LED	Yellow	Indicates minor active alarm level
Alarm Cut-off	ACO	SW/LED	Green	When depressed, silences active audible alarms
Abnormal	ABN	LED	Yellow	Indicates an abnormal condition
Near End Activity	NE ACTY	LED	Yellow	Indicates alarm or status conditions at the local equipment

**Table 4-1. Indicators for OLS**

<b>Indicator Name</b>	<b>Abbrev.</b>	<b>Type</b>	<b>Color</b>	<b>Description</b>
Far End Activity	FE ACTY	LED	Yellow	Indicates alarm or status conditions at the remote equipment
Power On (Lower Shelf)	PWR ON LOW SHELF	LED	Green	Indicates that lower shelf is receiving -48V power
Power On (Upper Shelf)	PWR ON UP SHELF	LED	Green	Indicates that upper shelf is receiving -48V power



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**Figure 4-4. OLS Cabinet**

Each cabinet contains two shelves, each of which contains circuit packs, label strips, a fuse panel, and an interconnection panel.

Each shelf provides two bidirectional optical lines and is designed according to the ETSI standards documented in ETS 300119-4, September 1993.

One heat baffle is located between the two shelves in each cabinet.

Each cabinet uses two -48V 8-gauge power cables (feeders A and B) that branch into two 10-gauge power cables (one for each shelf). These power cables terminate directly onto the shelves. Each branch connects to an overcurrent limiter located on the shelves.

All shelves use power filter units (with A and B feeds) and a fuse panel.

Connectorized cables provide alarming and CIT access on the outside of the cabinet.

OLS shelves, circuit packs, and cable treatment are designed to satisfy the requirements of Bellcore TA-NWT-001089, Issue 2, 1993. OLS is also designed to meet the electromagnetic compatibility requirements of FCC Title 47, Part 15, Subpart J for Class A equipment. An electrostatic discharge (ESD) jack in the cabinet is connected to frame ground. The cabinet contains no floating metal piece parts.

### **1A-TX and 1A-RCV**

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In the following sections, the terms 1A-TX (1A-transmit) and 1A-RCV (1A-receive) are used in reference to OLS end terminals. These terms indicate a different placement order of the OMU and ODU and a different provisioning between the ends of an OLS system. In dual end terminals, each OLS shelf can be independently configured as 1A-TX or 1A-RCV. For an OLS shelf provisioned as 1A-TX, both OA lines "A" in the shelf are used as transmitters. For an OLS shelf provisioned as 1A-RCV, both OA lines "A" in the shelf are used as receivers.

In a 4-line end terminal, both shelves are used as either 1A-TX or 1A-RCV. A 4-line end terminal that is provisioned as 1A-TX uses all OA lines "A" (1A- 4A) as transmitters. A 4-line end terminal that is provisioned as 1A-RCV uses all OA lines "A" (1A - 4A) as receivers. See "End Terminal Provisioning" in Chapter 5 for additional information.

### **End Terminal for 4 Bidirectional Optical Lines**

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The OLS End Terminal for 4 Bidirectional Optical Lines (Figure 4-5) consists of the cabinet containing two OLS end terminal shelves that are physically identical, except for the label strips. The lower shelf is equipped with all the control circuit packs (CPs); the upper shelf is *not* equipped

with control CPs. The OMU and ODU circuit packs in the end terminal for site 1A-TX (one end of the OLS system) are arranged in a different order than for the end terminal for site 1A-RCV (the other end of the OLS system).

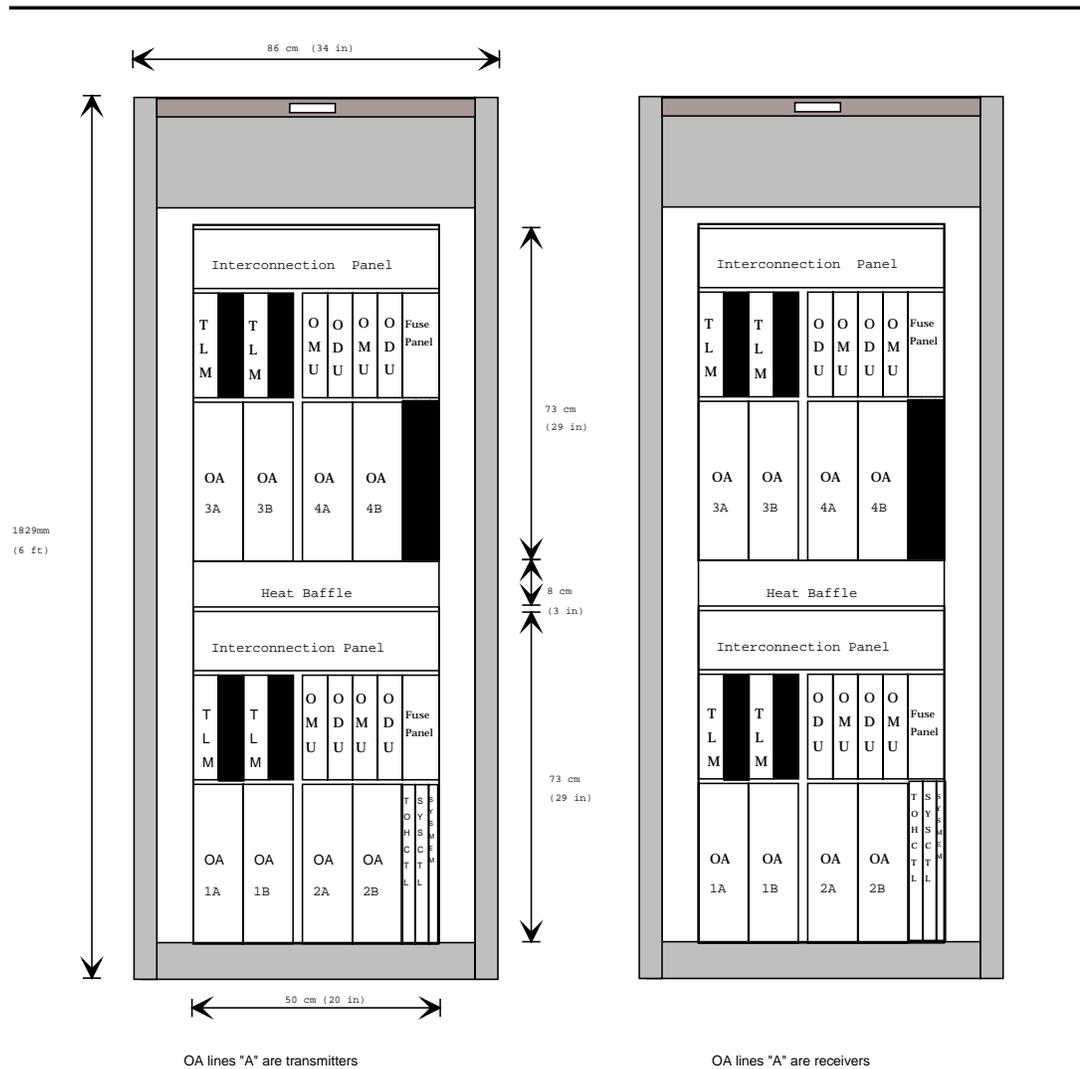
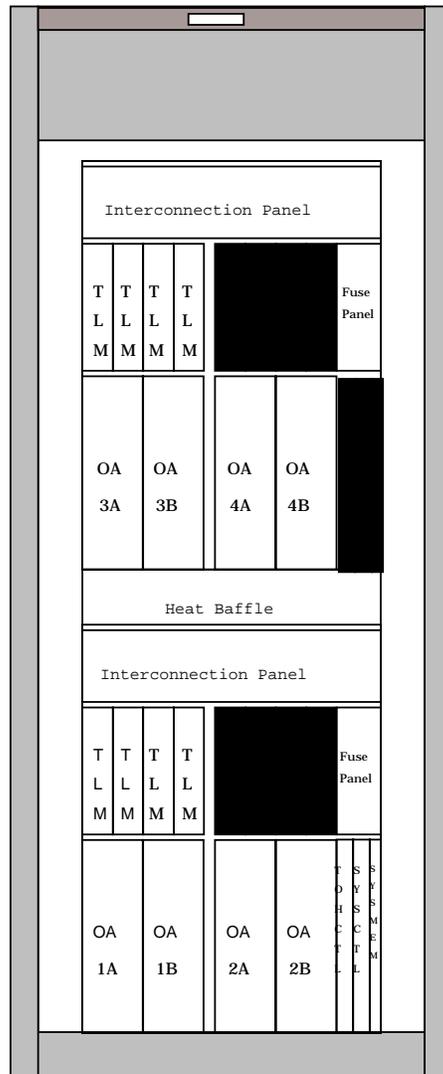


Figure 4-5. OLS End Terminals for 4 Bidirectional Optical Lines



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**Figure 4-6. OLS Repeater for 4 Bidirectional Optical Lines**

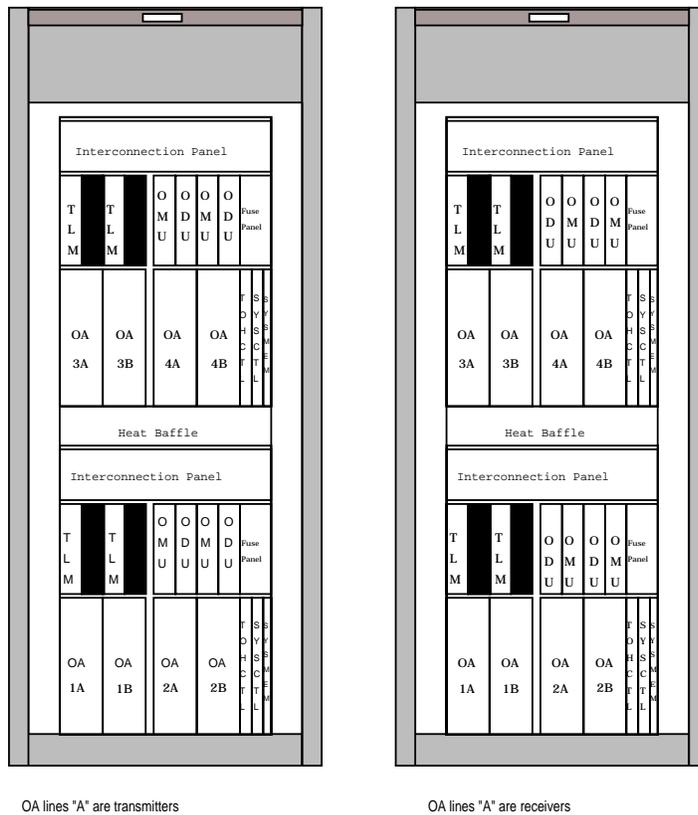
**Repeater for 4 Bidirectional Optical Lines**

The OLS Repeater for 4 Bidirectional Optical Lines (Figure 4-6) consists of a cabinet containing two OLS repeater shelves that are physically identical



**Dual End Terminal**

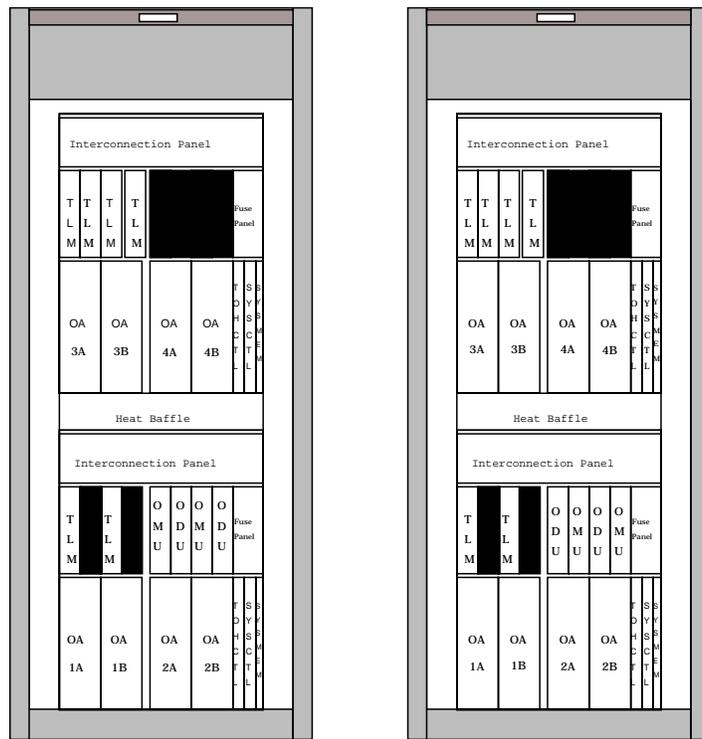
The OLS Dual End Terminal (Figure 4-8) consists of a cabinet containing two OLS end terminal shelves that are physically identical and that operate independently of each other. The shelves are equipped with control CPs. The OMU and ODU circuit packs are arranged in reverse order at site 1A-TX (one end of the OLS system) as at site 1A-RCV (the other end of the OLS system). OA lines in each shelf can be independently configured as transmitters or receivers. OA lines in each shelf can be independently configured as transmitters or receivers.



**Figure 4-8. OLS Dual End Terminals**

**End Terminal and Repeater**

The OLS End Terminal and Repeater (Figure 4-9) consists of the cabinet containing two shelves. The lower shelf is the OLS end terminal shelf and the upper shelf is the OLS repeater shelf. These shelves are physically identical except for the label strips. The optical multiplexer and demultiplexer units (OMUs and ODUs) mounted in the OLS end terminal shelf are *not* used in the OLS repeater shelf. The shelves operate independently of each other.



OA lines "A" are transmitters for end terminal shelf

OA lines "A" are receivers for end terminal shelf

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**Figure 4-9. OLS End Terminal and Repeater**

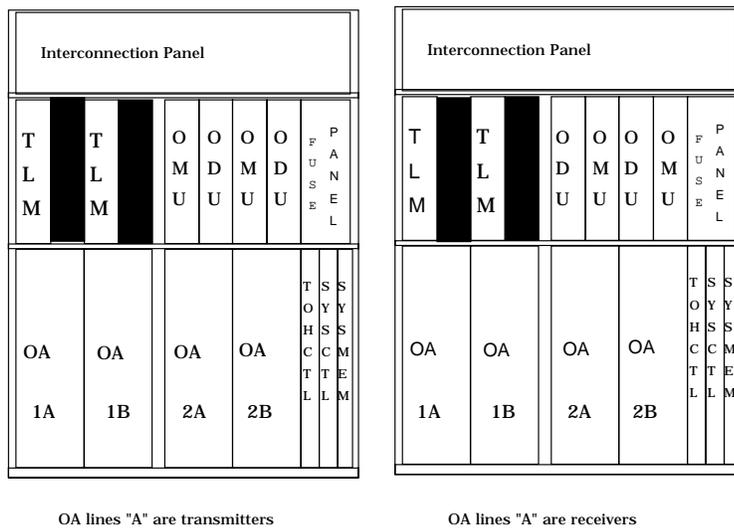
## Shelf Descriptions for OLS

The OLS shelves consist of the

- end terminal shelf
- repeater shelf

### End Terminal Shelf

Figure 4-10 shows the OLS end terminal shelf for site 1A-TX and site 1A-RCV. This shelf contains circuit packs and units for telemetry (TLMs), optical amplifiers (OAs), optical multiplexers (OMUs), optical demultiplexers (ODUs), and system control (TOHCTL, SYSCTL, and SYSTEM); label strips for the circuit pack slots; an interconnection panel; and a fuse panel. For the OLS Dual End Terminal configuration, each shelf has its own system control circuit packs. For the OLS 4 Bidirectional Optical Line End Terminal configuration, one system control is used for the entire terminal.



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Figure 4-10. OLS End Terminal Shelves

OC-48 optical signals enter the OLS end terminal from the FT-2000 OC-48 LCT transmitters. These signals are called **drop side signals**.

### **Cable Dressing**

To keep service and protection fiber and feeder A and feeder B power cables in separate places, the fiber and power feeder cables are dressed on different sides of the shelves.

All drop side optical fiber and electrical cables access each shelf from two cut-outs located on the left and right shelf side-plates above the shelf upper nest (interconnection area).

The drop side optical fibers for lines 1 or 3 access the shelf from a cutout located on the left side-plate. The drop side optical fibers for lines 2 or 4 access the shelf from a cutout located on the right side-plate. Fiber retainer clips are provided above the OMU and ODU units and along the edge above the shelf upper nest to support these fibers.

The OAM&P cables may access the shelf from either cutout, depending upon ease of access.

Shelf access for the A feeder of the power cable is from the left cutout and that for the B feeder is from the right cutout. These power feeders are terminated directly on the power connectors mounted inside the shelf on the right side above the shelf upper nest.

Fiber connections (eight maximum) between the TLM and OA circuit packs and between the OMU and ODU units and the OA circuit packs are dressed along the horizontal fiber track of the shelf upper nest. Fibers associated with lines 1 or 3 exit this track from the left side of the shelf, run along that side behind the left shelf mounting bracket, enter the fiber track of the lower nest from the left, and connect to the appropriate OA circuit packs. Fibers associated with lines 2 or 4 exit the upper nest track from the right side of the shelf, run along that side behind the right shelf mounting bracket, enter the fiber track of the lower nest from the right, and connect to the appropriate OA circuit packs. The fiber tracks in the shelves have cutouts with grommets beneath each optical circuit pack to allow fiber support for dressing between track and circuit pack. These cutouts are designed to support multiple fibers that run along the vertical line above the cutouts.

The wavelength division multiplexed signals are called the **optical line signals**. The optical line fibers for the OA circuit packs (8 maximum) are

dressed on the fiber track of the shelf lower nest. Fibers for lines 1 or 3 and for lines 2 or 4 access the lower nest fiber track from the left and right sides respectively. Customer maintenance (CM) fiber connections (8 maximum) are dressed on the fiber track of the shelf upper nest. Fibers for lines 1 or 3 and for lines 2 or 4 access the upper nest fiber track from the left and right sides respectively. Figure 4-11 shows how the cables are dressed for the end terminal shelf. The OLS repeater shelf follows the same dressing scheme except that the drop side optical fibers are not used.

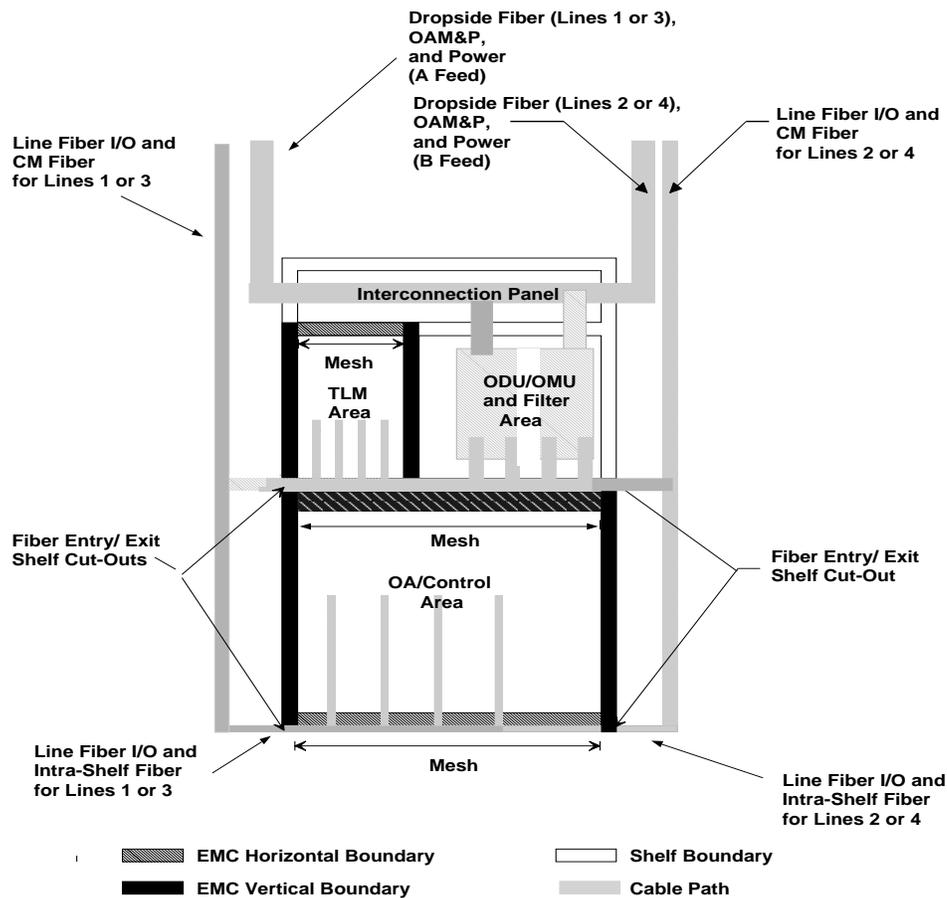


Figure 4-11. OLS Shelf Fiber/Cable Dressing and EMC/ESD Design

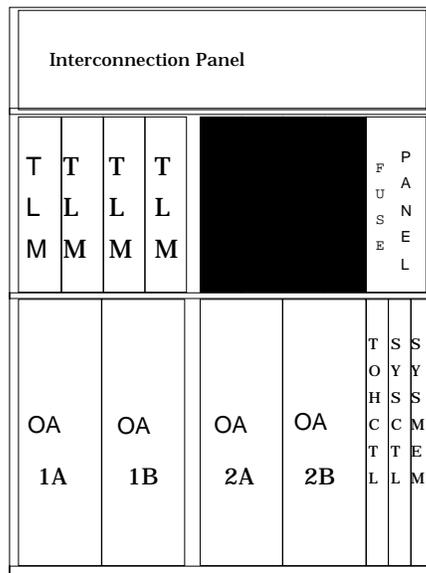
### Circuit Pack Placement

The location of the OMUs and ODUs in the shelf slots is not the same at the two OLS end terminals. One OLS end terminal is designated as site 1A-TX. In this system, the right-most circuit pack slot contains an ODU. To the left of that slot is an OMU, then another ODU, and then the second OMU. The other OLS end terminal (1A-RCV) must have the slots positioned in reverse order (see Figure 4-10).

### OLS Repeater Shelf

The OLS repeater shelf (Figure 4-12) is like the OLS end terminal shelf, except that it does *not* contain optical multiplexers or demultiplexers. The OLS repeater shelf contains optical amplifier (OA) circuit packs, associated system control and telemetry circuit packs, a fuse panel, and an interconnection panel.

The OLS repeater shelf and end terminal shelf use the same method of dressing the fibers, except the OLS repeater shelf does *not* have drop side optical fibers.



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Figure 4-12. OLS Repeater Shelf

### Interconnection Panel

The OLS shelf construction is double nested with a built-in interconnection area at the top for OAM&P connections. The backplane for each shelf provides intrashelf interconnection between all the circuit packs (CPs) used in the shelf as well as interconnection from the OAM&P interconnectors at the top of the shelf to the various CP connector pins on the backplane. A Craft Interface Terminal (CIT) access port is available from the interconnection panel. All access to the connections is from the front.

Figure 4-13 shows a diagram of the interconnection panel as seen from the front of the cabinet.

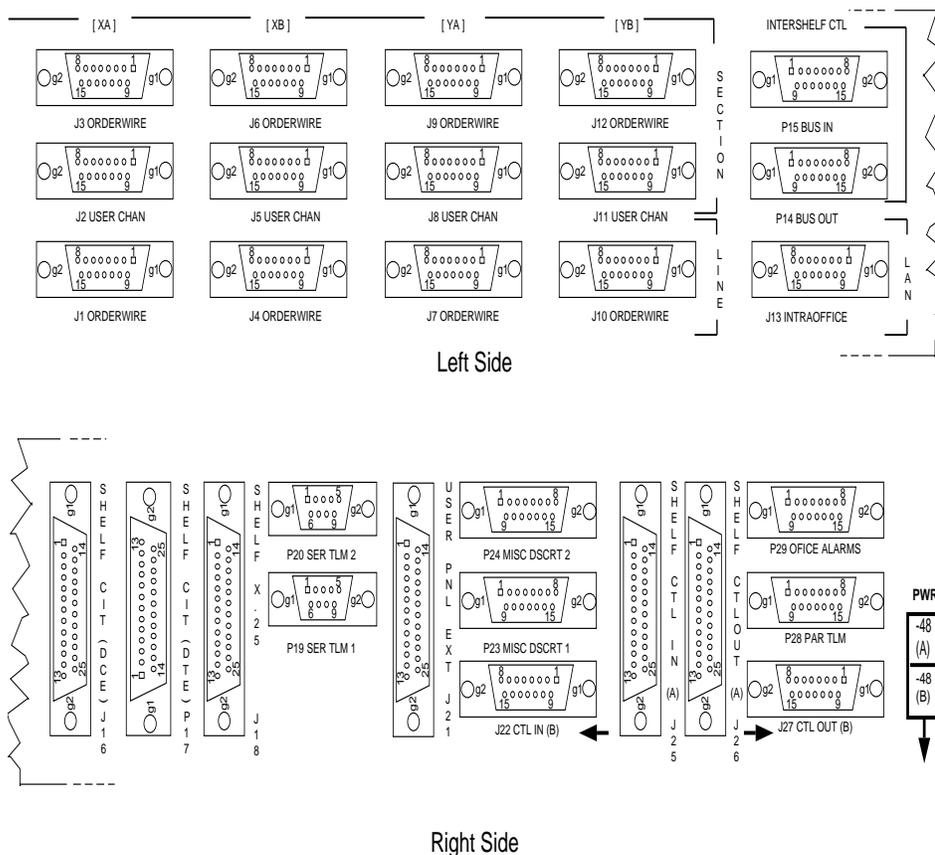


Figure 4-13. Interconnection Panel Diagram

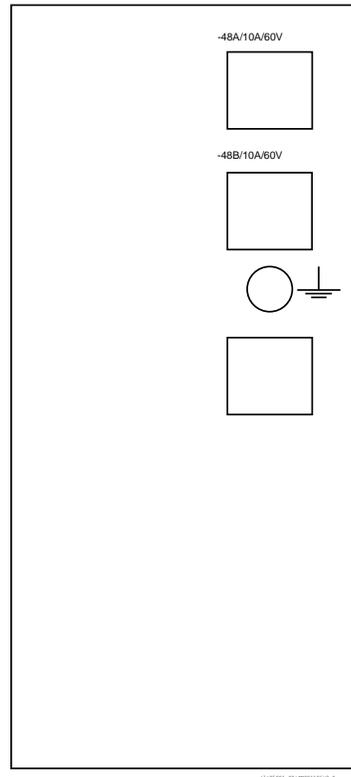
### **OMU and ODU Units**

The OMU and ODU units are mechanically fastened to the shelf with screw fasteners and are field replaceable. The shelf comes equipped with the screw fasteners. The shelf card guides enable proper alignment to the backplane. Eight optical input/output connectors for the drop side signals are mounted directly on the front plate of each unit at an angle normal to the vertical plane to allow for fiber access from the top and for better connector access. The optical line ST connector is mounted directly on the lower portion of the front plate of each unit at a similar angle to allow easy access to the connector.

As mentioned previously, the slot locations of the OMU and ODU units are reversed in the two end terminals. One end terminal is designated as site 1A-TX; the other end terminal is designated as site 1A-RCV. Site 1A-TX and site 1A-RCV must have the OMUs and ODUs in the reverse locations. Refer to Figure 4-10.

### **Fuse Panel**

The fuse panel displays the fuse indicators for overcurrent protection (A and B feeds) and provides an electrostatic discharge (ESD) jack that is connected to frame ground. To avoid interrupting the power while removing the fuse panel, neither the fuses nor the ESD jack are physically attached to the shelf. The fuse panel can be replaced in the field. Figure 4-14 shows a diagram of the fuse panel.



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**Figure 4-14. Fuse Panel**

### **Power Filtering**

Two units provide power filtering for the -48 V DC power feeds (A and B). One unit per feed is used, allowing replacement without interrupting the power supply to the shelf. These units are physically attached by removable fasteners to the shelf. The power filter units can be replaced in the field.

### Label Strips

Each OLS shelf has several label strips to aid the user during installation, operation, and maintenance. These strips are attached below the plugged-in circuit packs. Each shelf nest has a strip identifying each circuit pack. The following eight unique label strips identify shelf slot designations:

1.

TLM	TLM	TLM	TLM
3A/B	3B/A	4A/B	4B/A

2.

TLM	TLM
3A/B	4A/B

3.

OMU/ODU			
3A	3B	4A	4B

4.

TLM	TLM	TLM	TLM
1A/B	1B/A	2A/B	2B/A

5.

TLM	TLM
1A/B	2A/B

6.

OMU/ODU			
1A	1B	2A	2B

7.

OA	OA	OA	OA
3A	3B	4A	4B

8.

OA 1A	OA 1B	OA 2A	OA 2B	TOHCTL	SYSCTL	SYSTEMEM
----------	----------	----------	----------	--------	--------	----------

The labeling for the shelf slots is as follows:

- 4-Line End Terminal Application - Upper Shelf
- *Upper Nest*

LEFT		RIGHT			
TLM	TLM	OMU/ODU			
3A/B	4A/B	3A	3B	A	4B

- *Lower Nest*

OA 3A	OA 3B	OA 4A	OA 4B
----------	----------	----------	----------

- 4-Line End Terminal Application - Lower Shelf
- *Upper Nest*

LEFT		RIGHT			
TLM	TLM	OMU/ODU			
1A/B	2A/B	1A	1B	2A	2B

- *Lower Nest*

OA 1A	OA 1B	OA 2A	OA 2B	TOHCTL	SYSCTL	SYSTEMEM
----------	----------	----------	----------	--------	--------	----------

- Dual End Terminal Application - Upper Shelf
- *Upper Nest*

LEFT		RIGHT			
TLM	TLM	OMU/ODU			
1A/B	2A/B	1A	1B	2A	2B

— Lower Nest

OA	OA	OA	OA	TOHCTL	SYSCTL	SYSTEMEM
1A	1B	2A	2B			

■ Dual End Terminal Application - Lower Shelf

— Upper Nest

LEFT		RIGHT			
TLM	TLM	OMU/ODU			
1A/B	2A/B	1A	1B	2A	2B

— Lower Nest

OA	OA	OA	OA	TOHCTL	SYSCTL	SYSTEMEM
1A	1B	2A	2B			

■ 4-Line Repeater Application - Upper Shelf

— Upper Nest

LEFT

TLM	TLM	TLM	TLM
3A/B	3B/A	4A/B	4B/A

— Lower Nest

OA	OA	OA	OA
3A	3B	4A	4B

■ 4-Line Repeater Application - Lower Shelf

— Upper Nest

LEFT

TLM	TLM	TLM	TLM
1A/B	1B/A	2A/B	2B/A

— Lower Nest

OA 1A	OA 1B	OA 2A	OA 2B	TOHCTL	SYSCTL	SYSTEMEM
----------	----------	----------	----------	--------	--------	----------

■ Dual Repeater Application - Upper Shelf

— Upper Nest

LEFT

TLM	TLM	TLM	TLM
1A/B	1B/A	2A/B	2B/A

— Lower Nest

OA 1A	OA 1B	OA 2A	OA 2B	TOHCTL	SYSCTL	SYSTEMEM
----------	----------	----------	----------	--------	--------	----------

■ Dual Repeater Application - Lower Shelf

— Upper Nest

LEFT

TLM	TLM	TLM	TLM
1A/B	1B/A	2A/B	2B/A

— Lower Nest

OA 1A	OA 1B	OA 2A	OA 2B	TOHCTL	SYSCTL	SYSTEMEM
----------	----------	----------	----------	--------	--------	----------

**Circuit Pack Design**

The OLS circuit packs (CPs) in the lower shelf nest use two latch assemblies (top and bottom) per CP. All CPs used in the upper shelf nest use one top latch assembly. The ODU and OMU are fastened with screws that are provided on the shelf. All CP/unit assemblies connect to the backplane. All optical connections in and out of the circuit packs are through face-plate-mounted optical connectors.

## Miscellaneously Mounted Shelf

---

OLS shelves can be mounted in ETSI-compatible, ED-800 type, or ED-801 type frames. The shelves used for any application other than in the OLS cabinet must be ordered miscellaneously.

Miscellaneously mounted OLS shelves are identical to those for OLS cabinets, except that the miscellaneously mounted shelves:

- include two front shelf covers
- include an attached heat baffle and cover for thermal protection

Figure 4-15 shows a diagram of a miscellaneously mounted OLS shelf with front covers.

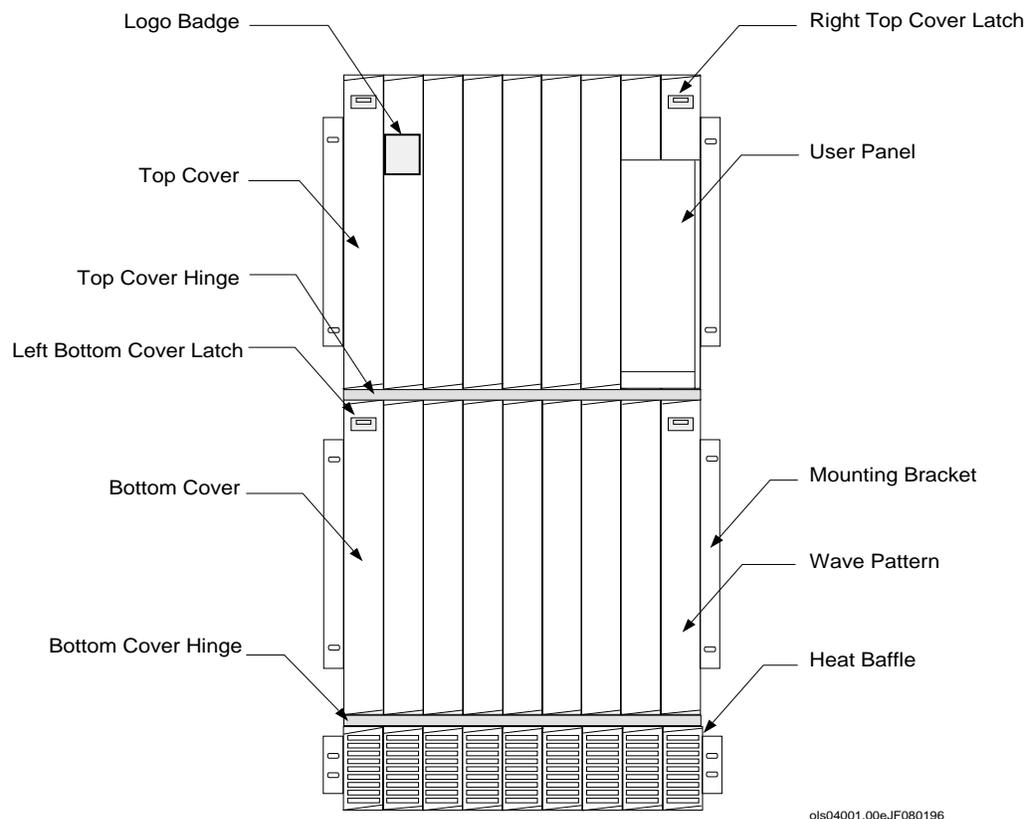
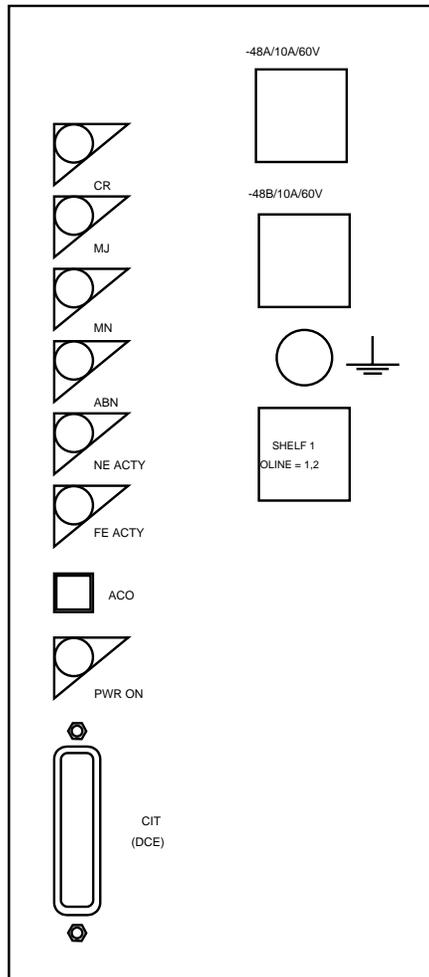


Figure 4-15. Miscellaneously Mounted Shelf with Front Covers

The miscellaneous mounted shelf user interface panel is located in the same area as the fuse panel in the cabinet-based shelves.

Figure 4-16 shows a diagram of the user panel for the miscellaneous mounted shelf.



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**Figure 4-16. User Panel for the Miscellaneous Mounted Shelf**

## **Transmission**

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OLS has two basic transmission equipment types: end terminal and repeater.

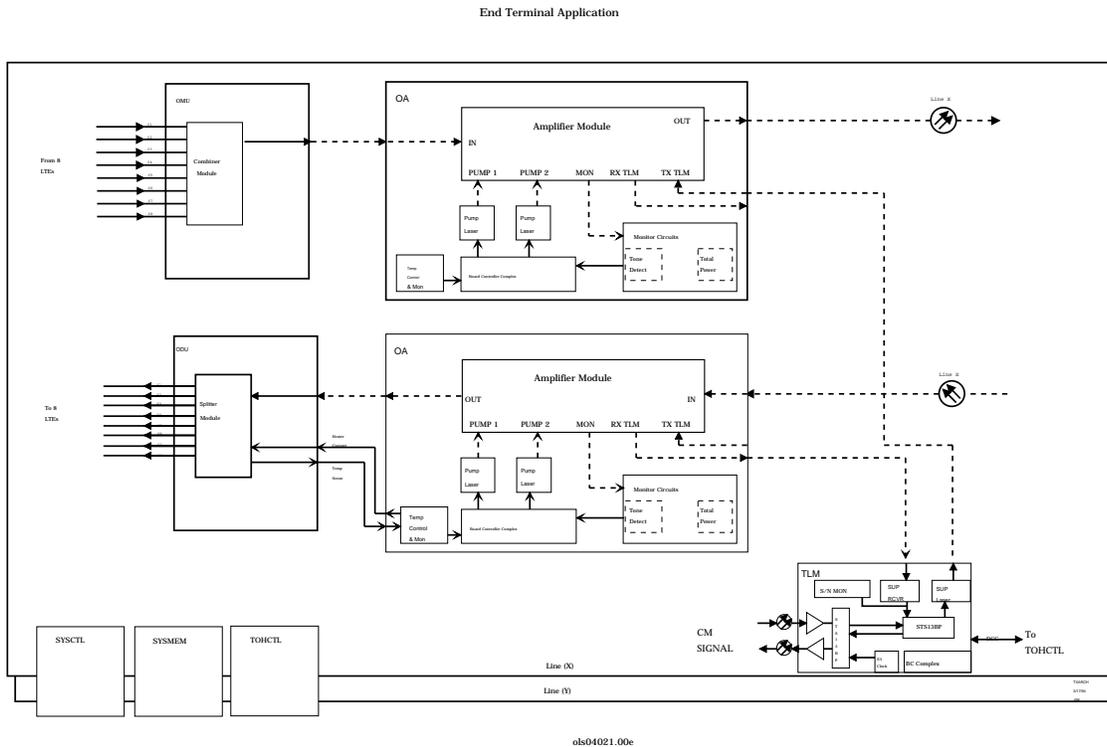
### **OLS End Terminal**

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Figure 4-17 shows a block diagram of OLS end terminal transmission. The end terminal is the first and last site in an optical line.

In the transmit direction, the end terminal performs the following functions:

1. Optically combines up to 8 different wavelengths of light (referred to as drop side signals) onto a common optical fiber.
2. Amplifies the light to +17dBm (maximum for 8 channels) and launches that signal (known as an optical line signal) onto the transmission fiber.
3. Couples the supervisory signal at 1532 nm into the optical line signal.
4. Monitors the power of each optical signal being amplified by the optical amplifier (OA).



**Figure 4-17. OLS End Terminal Transmission Block Diagram**

In the receive direction, the end terminal performs the following functions:

1. Receives the low level optical line signal from the optical line and amplifies that signal.

2. Optically demultiplexes up to eight drop side signals from the optical line.
3. Demultiplexes the supervisory signal from the received optical line signal and provides this as an output from the OA circuit pack to the TLM circuit pack.
4. Monitors the received power of each optical channel and the total received optical power.

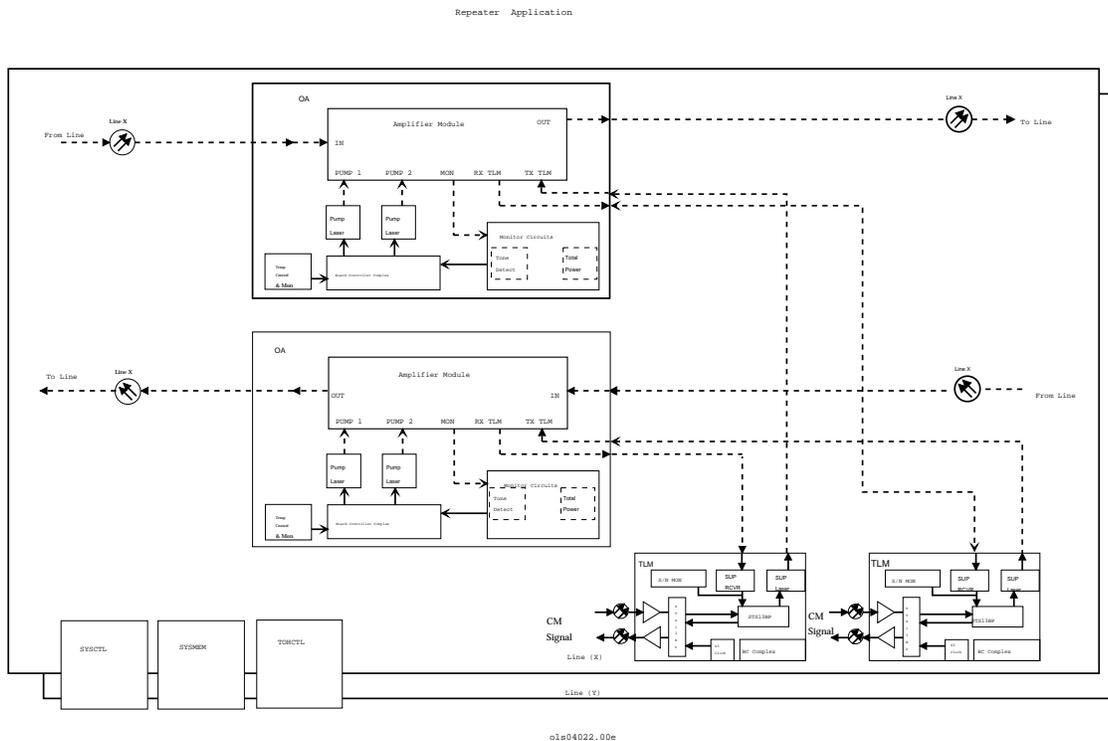
### **OLS Repeater**

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The OA is used as a repeater. On Standard Reach OLS systems, the optical signal produced by the end terminal can pass through 33dB of loss before it must be amplified. A maximum of 99dB of loss is allowed between the OLS end terminal sites (and a maximum distance of 360 km on nondispersion-shifted fiber). Repeater terminals provide the needed amplification. Figure 4-18 shows a block diagram of the OLS repeater application.

The functions performed by a repeater terminal are to:

1. Amplify the optical line signals in the  $1555 \pm 6$  nm wavelength band.
2. Add or drop the supervisory signal.
3. Monitor the received power of each optical channel and the total received optical power.



**Figure 4-18. OLS Repeater Transmission Block Diagram**

### Supervisory Signal

The OLS system uses a ninth optical signal for communication of maintenance information. This signal is generated by the TLM circuit pack and is optically multiplexed onto the optical line at each OA. This signal is also optically demultiplexed from the amplified line at each OA and returned to the TLM circuit pack, providing an add/drop function for this signal at every OLS site. This supervisory signal is in the STS-3 format. The OLS system uses the DCC channel (D1-D3) within the STS-3 format for OLS communication. The orderwire bytes (E1, E2, F1) are provided to the cus-

tomers. The payload within the STS-3 signal is also provided to the customer. For more information, see Chapter 5, "Operations, Administration, Maintenance, and Provisioning."

## **Transmission Circuit Packs and Units**

---

The OLS transmission circuit packs and units are as follows:

- optical amplifier (OA)
- optical multiplexer unit (OMU)
- optical demultiplexer unit (ODU)
- telemetry (TLM)

### **Optical Amplifier (OA)**

---

The OA circuit pack does the following:

- amplifies the optical line signal
- provides power monitors on the optical monitor point provided by the amplifier module
- controls the pump lasers, which in turn, control the OA output power

The power from the pump lasers can be varied. The result is that the OA output power can vary from a maximum of 17dBm to zero. This control is used to set the output power during normal operating conditions and to shut off the laser, if appropriate.

In the LEA7, pump power can be provisioned for Standard Reach (Nx33 dB, N≤3) or Long Reach (Mx24dB/Px25dB, M≤ 8, P≤ 7).

- provides add/drop ports for the supervisory signal
- provides temperature control for the ODU
- provides inputs from the OMUs and ODUs for version and type information. (The ODUs and OMUs change the version and type information to something other than the unconnected state.)

OLS Release 2 supports both the LEA6 and LEA7 Optical Amplifiers. Long Reach systems require the LEA7 circuit pack, while Standard Reach systems can use either the LEA6 or LEA7.

## Transmission

---

The OA amplifies the optical line signals within the 1555 nm  $\pm$ 6 nm bandwidth. Power for the amplification is provided by pump lasers. The actual amplification element is contained in the amplifier module. The optical line signal input to the OA passes through specially doped optical fiber. The same fiber is driven by a 980 nm optical output from the pump lasers. The doped fiber transfers energy from the 980 nm pump laser signal to the data signals that are in the 1555 nm optical wavelength. Typical amplifier characteristics for the signals in the 1555 nm wavelength region are:

- gain: 33dB
- noise figure: 5.0dB
- output power: +17dBm (when equipped with 8 channels)
- bandwidth: 1555 nm  $\pm$  6 nm

## Control and Maintenance

The OA has a board controller that gathers data from and controls the following circuits:

- optical demultiplexer unit (ODU) temperature monitor and control

The temperature control circuit monitors and controls the temperature of the splitter module on the ODU. The Optical Amplifier (OA) circuit pack provides current for a heater element on the ODU to adjust the temperature as required.

- tone monitor

The tone monitor detects low-frequency audio AM signals that are superimposed on the optical channels' signal by the transmitters. For OLS Release 2, the compatible transmitter is the FT-2000 OC-48 LCT. Note that the OT units also have compatible transmitters generating OLS-compatible tones.

The tone monitor also detects the AM signal on the supervisory channel, which is superimposed on the supervisory channel by the OLS telemetry (TLM) circuit pack. For each of the possible optical wavelengths, a different tone frequency is used. Table 4-2 shows the approximate tone frequencies used for each wavelength.

**Table 4-2. OLS Wavelengths and Associated Tone Frequencies**

Optical Channel	Wavelength (nm)	Tone Frequency (kHz)
1	1549.32	5
2	1550.92	7
3	1552.52	9
4	1554.13	11
5	1555.75	15
6	1557.37	17
7	1558.98	19
8	1560.61	21
9 (supervisory channel)	1532.0	12.96

The tone monitor takes a sample of the optical power after the first stage of amplification in the amplifier module and converts the sample optical signal to an electrical signal. The monitor measures the power of the electrical signals that are present in the 5 kHz to 30 kHz range, the frequency band for the tones. When the magnitude of the signal is below a predetermined threshold, the tone monitor declares the signal “not present.” When the signal level is above the predetermined level, the signal is declared “present.” The tone powers of the “present” signals are measured and used to estimate received signal power per channel (SPR-C) and total optical power received (TOPR-OL).

- -48V power monitor  
The OA monitors both A and B -48V power inputs.
- Pump power monitors

The OA monitors the laser backface currents and the laser bias currents of both pumps. A pump is turned off when these values go out of range.

### **Optical Multiplexer Unit (OMU)**

---

The optical multiplexer unit (OMU) combines up to eight drop side signals into one optical signal called the optical line signal. The OMU is used at the end terminal site.

This circuit assembly does not have a board controller complex and does not have a fault LED. However, an equipped lead is connected from this unit to the system controller complex. This equipped lead is shared among all of the OMU/ODU units. If any of the units becomes active, the equipped lead becomes active. Four status leads indicating version and type information connect this unit to the OA.

### **Optical Demultiplexer Unit (ODU)**

---

The optical demultiplexer unit (ODU) is used at the end terminal site. The optical output from the last OA in the system is input to the ODU, which demultiplexes the eight individual drop side signals from the common input.

#### **Transmission**

The common optical input comes from a faceplate mounted optical connector. The optical outputs from the ODU are connected to faceplate mounted optical connections.

#### **Control and Maintenance**

The optical splitter component on the ODU must be temperature controlled for proper operation. The temperature monitor/control is on the OA circuit pack.

### **Telemetry (TLM)**

---

The telemetry circuit pack provides the ninth optical signal on the OLS output. This signal is the supervisory signal and is used for fault location and maintenance functions. In addition, this circuit pack provides a customer maintenance signal to the customer.

A fully-equipped OLS end terminal shelf requires two TLM circuit packs, while a fully-equipped OLS repeater shelf requires four TLM circuit packs.

The TLM circuit pack hardware supports an IS-3 interface that can be used to transmit an STS-3 maintenance signal. The customer can use the payload in the STS-3 signal for site-to-site customer-specific data. In addition, three orderwire channels, E1, E2, and F1, are available.

### **Control and Maintenance**

The TLM circuit pack contains a board controller complex. The monitored parameters include:

- optical receive parameters (LOS, LOF) from the OA
- 1532 nm SUP LASER monitor point

The laser supplies a single monitor point that is active whenever laser output power or modulation are not within the acceptable range. A General Purpose Input/Output device indicates which type of laser is being used.

- the supervisory signal from the OA

This signal is monitored for received signal power (SPR-SU) and digital bit error rate (BER).

- circuit pack temperature

### **Timing**

The only timing required in the OLS system is that associated with the TLM circuit pack. This circuit pack has an on-board Stratum 3 oscillator. The following timing modes are used:

- The on-board Stratum 3 clock times the supervisory signal when there is no customer maintenance signal input or when the input is determined to be invalid.
- The input data times the supervisory signal when the customer maintenance signal is present and valid.
- The on-board Stratum 3 clock times the output customer maintenance signal when the dropped supervisory signal is not present or is invalid.

## **Drop Side Signal Requirements**

---

The optical input signals (OC-48) require an externally modulated transmitter. See “Input Power” in Chapter 10 for the required wavelengths and power for the transmitter.

The input power for the different drop side signals varies because the OA gain is not uniform across the band. Providing unequal input power compensates for the nonlinear gain profile.

The drop side signal also requires a small amount of AM modulation in the 5 - 30 kHz frequency range. This tone is detected in downstream amplifiers and is used to locate faults. The tones are shown in Table 4-2.

OLS requires the following monitors and controls for the drop side signal transmitter:

- laser temperature
- tone on/off
- tone modulation

## **Control Circuit Packs**

---

The OLS control circuit packs are as follows:

- system controller (SYSCTL)
- system memory (SYSTEMEM)
- tributary overhead controller (TOHCTL)

### **System Controller (SYSCTL)**

---

The system controller (SYSCTL) circuit pack and the system memory (SYSTEMEM) circuit pack provide the highest level of system control for OLS. The SYSCTL circuit pack provides system-level user and operations systems interfaces and performs system-wide maintenance computations. It also includes system-wide performance monitoring. The SYSCTL circuit pack supports serial telemetry and X.25 interfaces.

### **System Memory (SYSMEM)**

The system memory (SYSMEM) circuit pack provides memory support for the system controller (SYSCTL) circuit pack. The SYSMEM circuit pack contains erasable programmable read-only memory (EPROM) for nonvolatile storage of user-provisioned data and the system state and a flash EPROM for nonvolatile storage of the software for the entire system. The SYSMEM circuit pack also supports the user panel, parallel telemetry, miscellaneous discretes, and office alarms.

### **Tributary Overhead Controller (TOHCTL)**

The tributary overhead controller (TOHCTL) circuit pack processes the SONET Section overhead (D1 - D3) of the supervisory channel. The TOHCTL interfaces with the transmission overhead (TOH) on the TLM circuit pack to deliver and receive DCC data. The TOHCTL interfaces to the system controller complex by means of the OALAN.

### **DCC Channel Protection Switching**

OLS provides automatic protection for the DCC signal. The supervisory channel on optical line 1 is designated as the service DCC. The supervisory channel on optical line 2 is designated as the protection DCC. The DCC is the only protected part of the signal on the primary supervisory channel. There is no DCC carried on optical lines 3 and 4. DCC protection is implemented on an optical span basis (between 2 adjacent OLS NEs). The DCC protection switching is bidirectional, revertive, and 1x1.

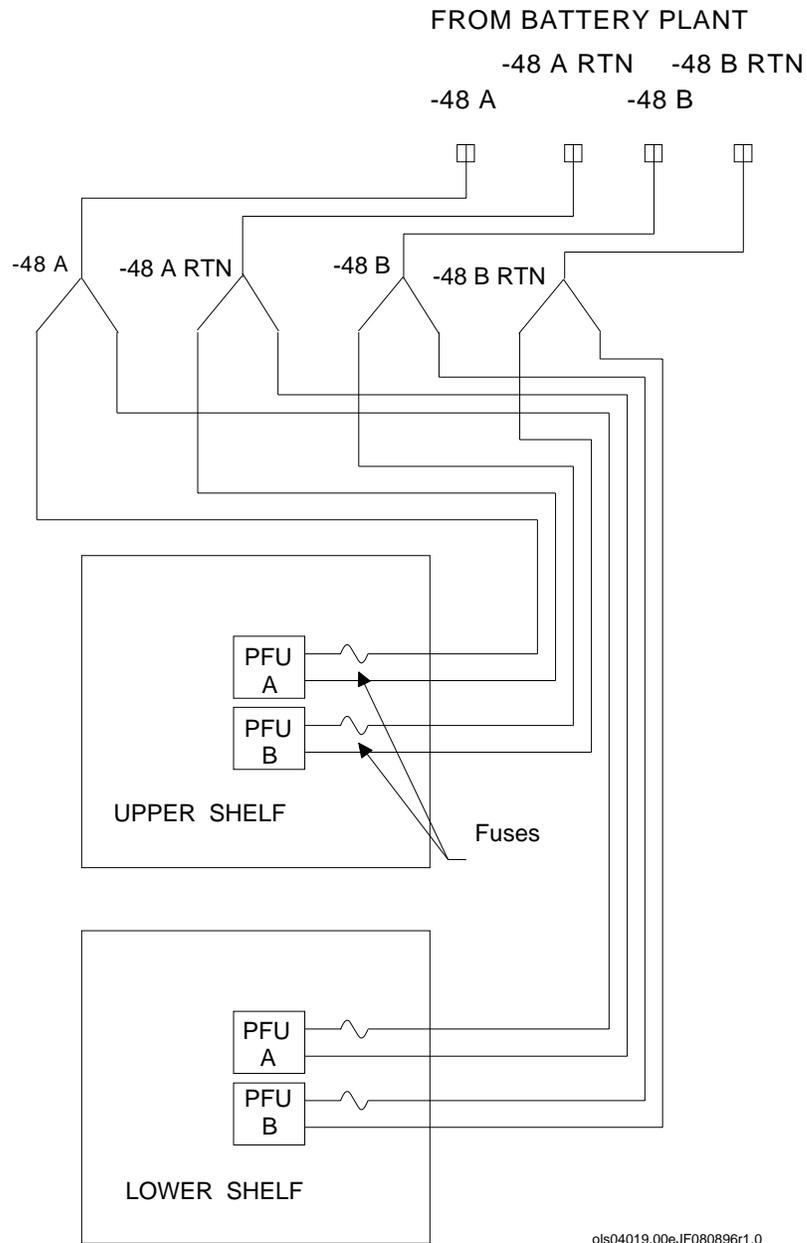
### **Power**

The OLS power distribution philosophy is based on individual rather than bulk power supplies. Each circuit pack contains DC-to-DC converters that change the office battery voltages to the voltages required. This leads to improved system reliability since heat is dissipated uniformly across the system, avoiding "hot spots."

OLS is powered by -48 V DC. The voltage range for all the components is -42.75 to -60 V DC. Power filtering and fusing are performed on the shelf level. DC-to-DC on-board power converters convert power on individual circuit packs.

### **Power Distribution for the OLS Cabinet**

Figure 4-19 shows the overall cabinet power distribution. Dual -48V feeders (feeders A and B) provide redundant power. Each cabinet uses two 8-gauge power cables that branch into two 10-gauge power cables (one for each shelf). These power cables terminate directly onto the shelves. Each branch connects to an overcurrent limiter located on the shelves.



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Figure 4-19. OLS Overall Power Distribution in Cabinet

## **Power Cables**

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The power feed cable uses stranded, color coded, and keyed connectors.

All panel-mounted power connector functions are labeled. Table 4-3 shows the color codes used for power cabling.

**Table 4-3. Power Cable Color Codes**

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<b>Description</b>	<b>Color</b>
-48V A	Red
-48V A RTN	Black
-48V B	Slate
-48V B RTN	Slate/Black

## **Shelf-Level Power Distribution**

---

Figure 4-20 shows a block diagram of the OLS power distribution at the shelf level.

## **Shelf-Level Filtering**

The filters (one for each feeder) smooth the input current to the shelf. They plug directly into the backplane via a connector. The backplane distributes -48V power to all the circuit packs by means of a printed power bus that spans the entire width of the panel.

If a fuse blows, a light illuminates on the fuse holder to indicate which holder has opened.

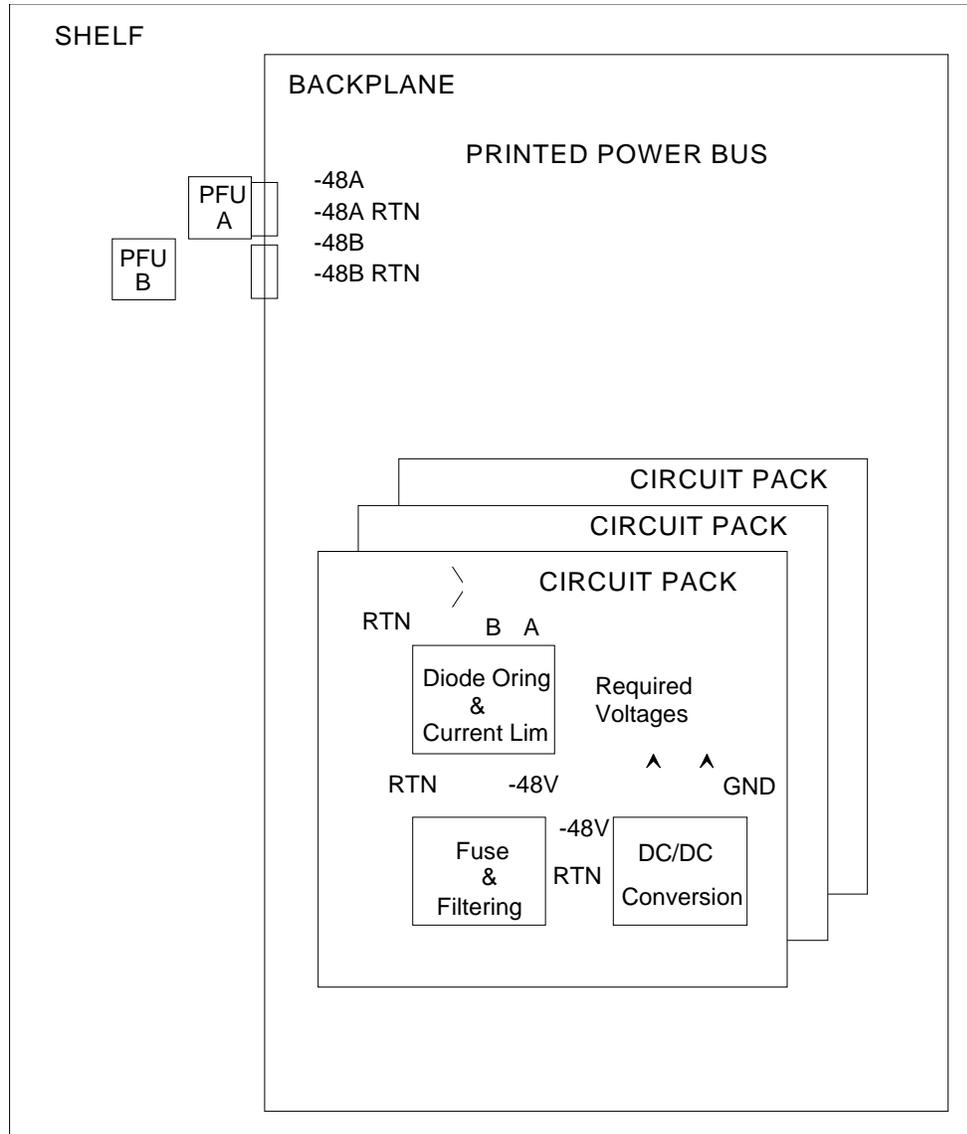


Figure 4-20. OLS Shelf Level Power Distribution

### **Backplane and Circuit Pack Interface**

All circuit packs have identical common battery power and return pins. This avoids catastrophic failure if a pack is plugged into the wrong connector.

An active circuit on the circuit packs provides in-rush current protection whenever a circuit pack is inserted and also when circuit packs are equipped and bay power is applied.

### **Diode ORing, On-Board Fusing, Filtering, and Powering**

Each circuit pack is equipped with diodes that provide ORing of the two redundant feeds and their return leads as well as a fuse that protects the feeders. Board-mounted fuses are provided on each circuit pack. If one of these board-mounted fuses fails, the circuit pack fails and must be replaced with a new pack. A filtering section prior to the DC-to-DC conversion follows the fused input.

On-board power converters are used for -48V power conversion.

### **Power Monitoring**

The -48V power is monitored by a circuit on the OA circuit pack. The circuit monitors both A and B feeds using an opto-isolator with connections to the board controller.

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# Operations, Administration, Maintenance, and Provisioning

# 5

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■ Operations	5-1
General Description	5-1
Indicator Strip	5-1
Operations Interfaces	5-6
Data Communications Channel	5-8
■ Administration	5-12
Version Recognition	5-12
Security	5-12
Equipment Inventory	5-14
System Start-up	5-14
■ Maintenance	5-14
Maintenance Philosophy	5-14
Remote Maintenance Philosophy	5-15
Local and Remote Software Copy/Upgrades	5-17
Analog Transmission Maintenance	5-17
DCC Protection Switching	5-18
Automatic Detection of Facility Failures	5-18
Performance Monitoring	5-20
Provisioning Consistency Audits	5-24
Reports	5-24
Orderwire	5-26
■ Provisioning	5-27
Original Value Provisioning	5-27
Local or Remote Provisioning	5-28
Preprovisioning Circuit Packs	5-28
Provisioning on Circuit Pack Replacement	5-28

Provisionable Parameters Summary	5-28
Network Element Configuration	5-29
End Terminal Provisioning	5-29

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# Operations, Administration, Maintenance, and Provisioning

# 5

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This chapter describes the various features available to operate, maintain, administer, and provision the Optical Line System (OLS).

## **Operations**

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### **General Description**

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This section describes the hardware and software user interfaces that control the administration, maintenance, and provisioning of the OLS. The OLS maintenance procedures use the Craft Interface Terminal (CIT) to retrieve detailed reports about performance monitoring, alarms and status, and system configuration for local and remote terminals. Office alarms, the indicator strip, and the circuit pack faceplate LEDs provide audible and visible alarm information.

### **Indicator Strip**

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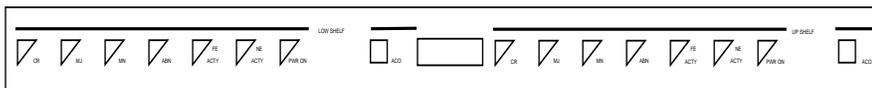
OLS is equipped with an indicator strip, located on the cabinet header. If the OLS is a dual line application, the indicator strip has LEDs for both shelves. Otherwise, the indicator strip has only one set of LEDs. Refer to Figure 5-1 and Figure 5-2. The indicator strip provides system-level infor-

mation. The indicator strip LEDs show the following local system information:

- The red LEDs indicate critical (CR) and major (MJ) alarms; a yellow LED indicates minor (MN) alarms.
- The green alarm cutoff (ACO) push-buttons, with a built-in LED, activates the alarm cutoff function and lights the LED.
- The yellow abnormal (ABN) LED lights up when a temporary condition, potentially affecting transmission, exists.
- The yellow near-end activity (NE ACTY) LED lights up when any alarm or status condition exists at the local terminal.
- The yellow far-end activity (FE ACTY) LED lights up when any alarm or status condition exists at any remote terminal.
- The green power on (PWR ON) LED is lighted when the shelf is receiving -48 V power.

The fuse panel for the OLS shelf is equipped with two fuses (-48A and -48B). One 10-amp fuse is provided for each -48V DC power feeder (power feeder A and power feeder B). Refer to Figure 5-3.

For most applications, OLS shelves are mounted in a cabinet. Some shelves, called miscellaneous mounted shelves, can be used as stand-alone products. Since miscellaneous mounted shelves do not benefit from the cabinet header indicator strip, they are equipped with their own user/fuse panel as shown in Figure 5-4.



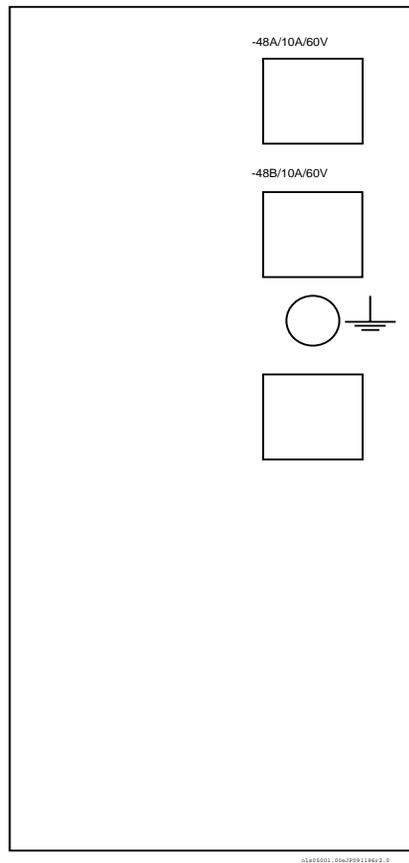
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**Figure 5-1. Indicator Strip (Dual End Terminal, Dual Repeater, End Terminal and Repeater)**



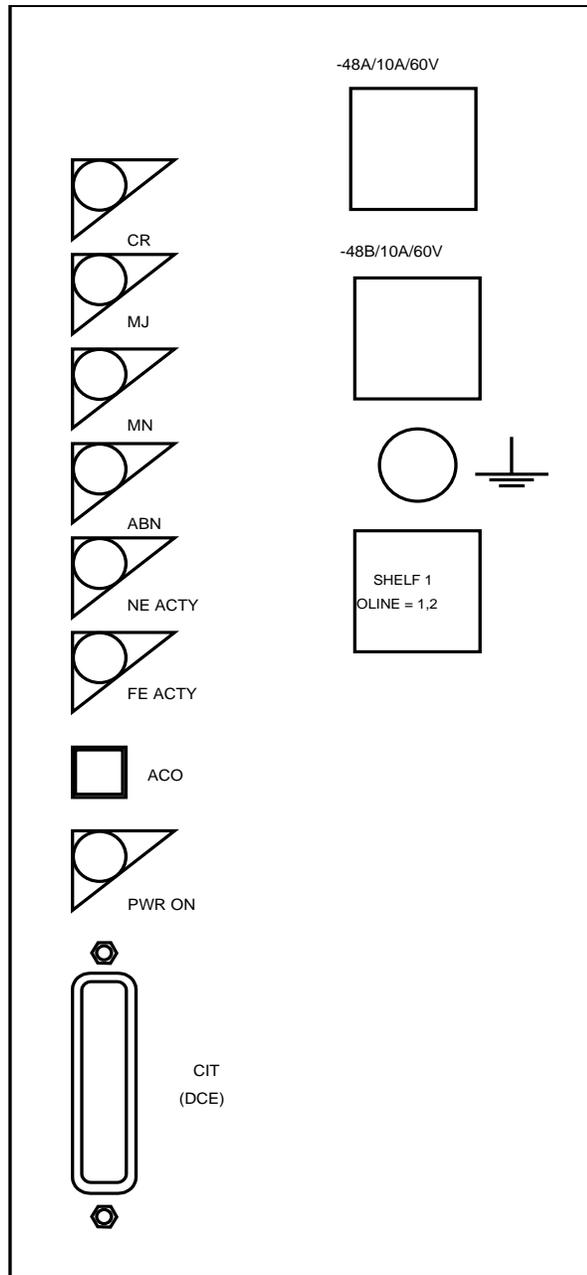
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**Figure 5-2. Indicator Strip (4 Bidirectional Line)**



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**Figure 5-3. Fuse Panel**



o1a05002.00a7F091196r2.0

Figure 5-4. Miscellaneously Mounted Shelf User Panel

## **Circuit Pack Faceplate LED**

To supplement the indicator strip's system-level view, each circuit pack has a red FAULT LED on its faceplate. A continuously lighted FAULT LED means that the OLS has isolated a failure to that circuit pack.

A flashing FAULT LED:

- on a transmission circuit pack shows that an incoming signal to that circuit pack has failed
- on the system memory (SYSMEM) circuit pack shows that the contents of the nonvolatile memory differs from the duplicate copy in the system controller (SYSCTL) circuit pack. It can also indicate corrupted data in the nonvolatile memory of the SYSMEM circuit pack

## **Operations Interfaces**

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OLS supports CIT and a message-based operations system interface (X.25), as well as office alarms, parallel telemetry, user-settable miscellaneous discretes.

### **Craft Interface Terminal (CIT)**

OLS allows you to provision two types of CIT access. The first is CIT-PC, which uses the CIT data communications equipment (DCE) port. The second is CIT-TL1, which uses the CIT data terminating equipment (DTE) port.

OLS supports CIT local access, remote access using a modem, and remote access using the data communications channel (DCC).

OLS also provides a security function to protect against unauthorized access to the CIT system functions (for example, provisioning). Security includes logins, passwords, CIT port disabling/enabling, and authorization levels for the system capabilities.

### **CIT-PC**

The CIT-PC is a personal computer in which OLS CIT software has been installed. The CIT-PC has a user friendly interface with pull-down menus and extensive on-line help. It provides detailed information and system control for specialized local and remote maintenance and administrative activities. You must use the CIT-PC if you are installing or accepting a system.

The CIT provides the following functions:

- reporting
- testing
- initializing performance-monitoring storage registers
- provisioning

### **CIT-PC Requirements**

The following are the minimum requirements for the CIT-PC:

- 386SX *IBM*-compatible desktop or laptop PC (25 megahertz [MHz] clock speed or greater)
- disk drive — one 1.44 megabyte (Mb) (3.5 inch)
- 80 Mb hard disk
- 4 Mb RAM
- 565 kilobytes conventional memory<sup>1</sup>
- *MS-DOS* operating system version 5.0 or later
- serial port (EIA-232-D) — configured as COM1, COM2, COM3, or COM4
- parallel port — configured as LPT1
- VGA color monitor

The following PCs meet the minimum requirements and can be used as CIT-PCs. This is not an exhaustive list of compatible PCs.

- Gateway 2000<sup>2</sup> 4DX2-66N
- Kenitech 386SX-25

---

1. For systems without the required conventional memory, you need to use a memory manager such as the one supplied with *MS-DOS* version 5.0 or later.

2. Registered trademark of Gateway 2000.

### **CIT-TL1**

The CIT-TL1 is a local operations system (OS) machine-to-machine communication language interface that lets you maintain and control OLS locally or remotely using an ASCII terminal and TL1 commands.

The CIT-TL1 interface is intended for use by an experienced TL1 user. The TL1 commands you enter must follow standard TL1 format. For information about using TL1 commands through the CIT, refer to the *2000 Family of Products Operations Systems Engineering Guide* (824-102-148).

To install a system, you must use the CIT-PC.

### **Message-Based Interface (X.25/TL1)**

OLS supports a message-based operations systems interface. This interface uses the X.25 protocol to provide communications with a message-based operations system and supports Transaction Language 1 (TL1). A message-based operations system can access the local OLS terminal (local access capability) and any remote terminals in a maintenance sub-network using the DCC (gateway network element [GNE] capability).

OLS provides predefined sets of OS types. An OS type is a filter that determines the types of TL1 autonomous messages that appear at a port. The sets are as follows:

- **maintenance:** send reports on the status of the system (for example: alarm and event reports).
- **memory administration:** send reports on changes in the provisioning status of equipment (for example: database changes).
- **command response only:** send no autonomous messages. You can manually request information through TL1 commands.
- **other:** send all autonomous messages.
- **peer:** automatically assign peer as the OS type if the user provisions none of the other OS types. If the OS type is peer, messages are commands and responses.

### **Data Communications Channel**

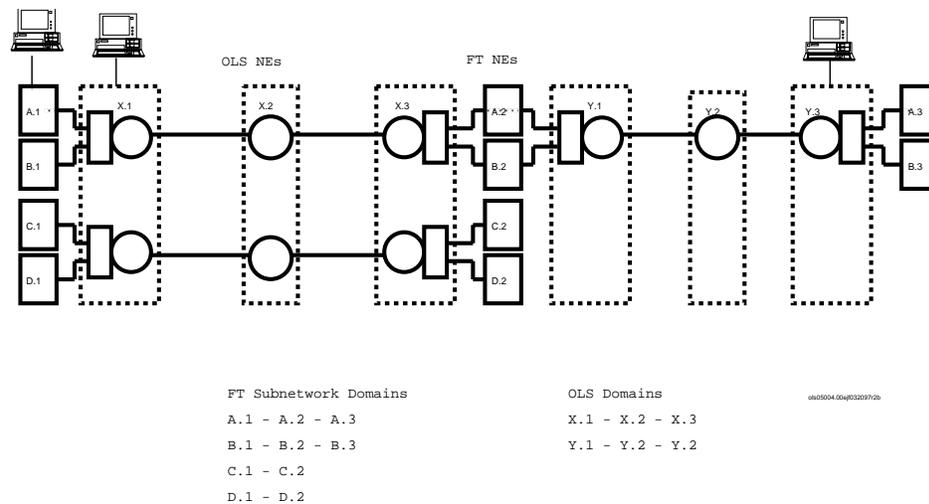
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The craft and operations interface features extend beyond the local OLS terminals to cover OLS repeater and remote OLS end terminal sites. This network operations capability uses the Synchronous Optical Network

(SONET) section data communications channel (DCC) bytes. Craft interface dialogs and operations interface messages travel in these DCC bytes.

### Access Domains

The access domain for OLS allows remote logins to any network element in the same subnetwork. For example, a CIT-PC login at an end terminal allows remote access to the other end terminal and all repeaters between them. See Figure 5-5. A CIT-PC login at OLS X1 allows remote logins to X2 and X3 but not to FT NEs designated A, B, C, or D.



**Figure 5-5. CIT Access Domain**

### CIT-TL1 Requirements

The following are the minimum CIT-TL1 hardware requirements:

- ASCII-based data communications terminal with an 80-column display, scroll capability, and local echo
- serial port (EIA-232-D)
- selectable baud rate between 1200 to 56000 baud
- XON/XOFF flow control capability

## **CIT Access**

OLS provides three CIT ports compatible with the ASCII EIA-232-D standard. The first port, accessed through the front of the OLS cabinet, is configured as data communications equipment (DCE) for direct CIT access. The port provides data rate selection from 1200 to 56000 baud. OLS automatically adjusts to the baud rate of the CIT-PC. You must set the CIT-PC baud rate using CIT-TL1.

The second port, found on the interconnection panel, is configured as data-terminating equipment to permit connection to a modem or an RS-232 switch. A pair of compatible modems are required for remote dial-up access to OLS from a CIT over the public switched telephone network.

The third port is through the DCC channel and it allows remote logins from other OLS elements in the same OLS system.

A digital data network may be used in place of the modem pair to provide remote dial-up access to OLS from the CIT.

A compatible modem or digital data network must support full duplex, asynchronous, and byte serial data transmission of eight-bit bytes with one start bit and one stop bit. The data transmission speed should be from 1200 to 56000 baud. The CIT (DTE) port provides automatic data rate selection from 1200 to 56000 baud. The CIT-PC automatically selects the highest available baud rate. You must set the CIT-TL1 to a compatible baud rate.

The modems must comply with one of the transmission standards shown in Table 5-1, depending on the desired baud rate. These standards apply to signaling used between modems.

**Table 5-1. Modem Transmission Standards**

Standard	Baud Rate
Bell 212A	1200
V.22	1200
V.22 bis	2400
V.32	4800, 9600
V.32 bis	9600 (fax), 14400 (data)

The following modems meet the minimum requirements and can be used with OLS. This is not an exhaustive list of compatible modems.

- Hayes *V-series*<sup>1</sup> Smartmodems
- *Penril*<sup>2</sup> Alliance V.32 modem
- Zoom Telephonics Zoom/Modem MX2400S
- GVC 2400 Mini Modem
- Practical Peripherals Practical Modem 2400 SA

### **Office Alarms Interface**

The office alarms interface is a set of discrete relays that control office audible and visible alarms. Separate relays handle critical, major, and minor alarms, although the critical and major alarm outputs can be wire OR'd to the office major alarm, if desired.

### **Parallel Telemetry Interface**

Parallel telemetry brings a minimum set of alarm and status information to an operations center. Six alarm closures show critical, major, and minor alarms for local and remote terminals.

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1. Registered trademark of Microcomputer Products, Inc.

2. Registered trademark of Penril Corporation.

## External Miscellaneous Discrete Interface

A standard External Miscellaneous Discrete Unit (EMDU) is available from Dantel, Inc. or Harris Corp. that can be used with the SER TLM interface of OLS to provide a set of input and output points.

The External Miscellaneous Discrete Unit (EMDU) allows an operations system to control and monitor equipment co-located with OLS through a set of input and output contact closures.

The EMDU interface offers 144 user-settable inputs that can monitor external conditions like open doors or high temperature, plus 36 user-settable outputs for the control of equipment such as external fans and generators. The EMDU can also be used to monitor the miscellaneous discrete outputs of the Optical Translator.

The state of the miscellaneous discrete inputs can be reported on demand to a remote operations center via the CIT. Miscellaneous discrete state changes are autonomously reported by the TL1 interface.

## Administration

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### Version Recognition

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OLS provides automatic version recognition of all installed hardware and software. OLS reports the type, version, and serial number of the circuit pack installed in each slot. Each circuit pack CLEI<sup>1</sup> code and serial number is stored on the circuit pack and is accessible by the system controller circuit pack. The equipment catalog item (ECI) version identification and apparatus code for each circuit pack are also provided.

The OMU and ODU units have four discrete leads that are used by the OA to determine the version and type.

### Security

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OLS provides three tiers of security to protect against unauthorized access to the CIT and OS functions (for example, provisioning). The three tiers

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1. COMMON LANGUAGE is a registered trademark and CLEI, CLLI, CLCI, and CLFI are trademarks of Bell Communications Research, Inc.

are Port Security, Network Element Login Security, and User Login Security.

### **Port Security**

This feature controls access to the system through a per-port enable/disable mechanism and inactivity time outs.

### **Network Element Login Security**

This feature controls access to the system through a lockout mechanism to disable all but administrative logins.

### **User Login Security**

This feature controls access to the system on an individual user basis including:

- **login ID and password assignment:** Requires the user to enter a valid login ID and password to access the system. OLS allows up to 100 login IDs and passwords. Two of these login IDs are privileged and the balance are reports only and general.
- **user authorization levels:** Provides four levels of access on a per login session basis:
  - **Expert:** Provides access to all commands and options. Only expert users have access to the security and access functions. These functions include assigning and changing logins/passwords, setting login/password aging times, enabling/disabling ports, setting TID names, and rebooting the system.
  - **Privileged:** Provides access to all commands and options except those that may affect all service at once, for example, TEST-AUTO-TURNUP.
  - **General:** Provides access to all commands except those relating to security and system access.
  - **Reports Only:** Provides access to the reports only (OPR-ACO and TEST-LED). The reports only users are not allowed to change any of the system provisioning values.

- **login aging:** Enables a privileged user to set individual logins to be deleted if unused for a certain number of days or on a particular date (for example, for a visitor or for temporary access during installation).
- **password aging:** Enables a privileged user to require each user to change his or her password periodically.
- **guest login:** Enables a privileged user to set a temporary login that is automatically deleted after a specified amount of time.

## **Equipment Inventory**

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OLS maintains an automatic inventory equipment list of circuit packs in the cabinet. The list contains serial numbers and CLEI codes. The inventory is automatically updated when a new circuit pack is inserted.

## **System Start-up**

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System start-up is an initialization process that identifies all nodes in an OLS subsystem and establishes communications. Start-up is triggered by the following actions:

- an OLS subsystem is started for the first time
- a node is added or deleted
- the SYSCTL in a neighboring node is replaced
- a node is reset.

## **Maintenance**

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### **Maintenance Philosophy**

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The objective of OLS maintenance is to detect failures, monitor facility performance degradation, isolate faults to specific circuit packs, and report to an OS and/or raise alarm indicators. Maintenance consists of reactive maintenance and performance monitoring. Reactive maintenance identifies a failure after it occurs. Performance monitoring identifies transmission degradation before it causes a service-affecting condition.

## Remote Maintenance Philosophy

Remote maintenance is provided through DCC. Remote access lets you perform maintenance at a remote site as if you were local to that site.

This capability provides operations support from a single location to local and remote Lucent Technologies network elements (NEs) that are in the same subnetwork. The network elements can be OLS end terminals or OLS repeaters.

OLS uses the SONET DCC to provide the following:

- **craft interface terminal (CIT) remote access:** The local terminal provides a remote login capability from its CIT to a remote terminal.
- **indicator strip remote access:** The indicator strip provides a far-end activity (FE ACTY) LED to show that one or more remote terminals have a lighted near-end activity (NE ACTY) LED.
- **operations system remote access:** A message-based operations system (X.25) can access local and remote OLS elements.
- **alarm report remote access:** The local terminal provides a summary alarm report that indicates the highest active alarm, if any, at all remote network elements in the same alarm group.
- **remote software upgrades:** This feature lets you upgrade OLS software remotely from the CIT terminal.
- **remote software copy:** This feature allows you to copy software from one OLS element to another anywhere in the subnetwork.<sup>1</sup>

## Gateway Network Element

You can use one or more OLS elements as a gateway network element. The gateway network element (GNE) serves as a single interface to the local X.25 message-based operations system of all the OLS elements in the same subnetwork.

The GNE receives operations information from these network elements through the DCC and reports that information and its own to the operations system. The operations information is in the form of TL1 messages. Through the GNE, the operations system can send TL1 commands to any

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1. All OLS Terminals in the ring or subnetwork must be running OLS Release 1.0 or later software. The node being copied from must contain the release of software being copied.

network elements in the OLS subnetwork. To use the DCC capability outside the local OLS, a TLM circuit pack and a tributary overhead controller (TOHCTL) are needed. For more information on these circuit packs, refer to Chapter 4, "Product Description."

You can use one or more OLS terminals as GNEs, but the number you use depends on your application and operations needs. For example, to reduce the number of operations data communication links between the network and operations system, you might choose to use only one OLS terminal as the GNE for the network. If you need redundancy, you might use two OLS elements as GNEs.

### Remote NE Status

Through DCC, an OLS terminal can receive and transport summary alarm and status information from remote OLS terminals that are in the same subnetwork.

The remote NE status feature conveys remote summary alarm and status information through

- logical ORing of local and remote office alarms
- a set (CR, MJ, MN) of far-end parallel telemetry relays
- a far-end activity LED
- a network alarm report that indicates the highest severity alarm active at other NEs in the subnetwork

The set of remote NEs that an OLS terminal can exchange status information with is determined by the value of the local SONET Maintenance Sub-Branch ([SMSB] or alarm group) parameter. You can provision this parameter to be a value from 0 to 255. A value of 0 means that the local NE does not exchange remote NE status with other NEs. All other values mean that the local NE exchanges remote NE status information with all other NEs having the same value and in the same SONET maintenance network.

Members of an alarm group exchange remote NE status information through one or more Alarm Gateway Network Elements (AGNEs) that are defined in the same alarm group. The AGNEs and remote NEs use the DCC to receive and report alarm status information from and to all NEs in the alarm group. When an AGNE receives alarm and status information, it rebroadcasts the information to other NEs in the group. The information allows each NE in the group to provide, for example, far-end activity indications and a remote alarm report for all other NEs in the group.

The use of AGNEs makes it unnecessary for each NE in an alarm group to communicate directly with every other NE in the group, thus using DCC resources efficiently.

### **Local and Remote Software Copy/Upgrades**

OLS lets you upgrade the LCT or OLS system software from a single site and without control circuit pack changes. Use either the CIT or a modem. System monitoring and control are fully functional during the copy.

An OLS terminal can copy software to other local or remote OLS terminals in the same subnetwork.

### **Analog Transmission Maintenance**

OLS maintenance is based on a three-tier approach to performance monitoring of analog parameters

- first tier: functioning of the Threshold Crossing Alert (TCA) which uses a provisionable delta threshold
- second tier: use of predetermined threshold values to indicate signal degrade
- third tier: use of predetermined threshold values to indicate signal failure conditions

OLS is a bit-rate-independent analog system. Tone, supervisory signal, and optical line ID are used to support maintenance of the analog transmission.

- Tone, inserted by LCT and OT transmitters, is used to verify the presence of a signal (channel). The power of the tone is used to determine the power of the optical signal.
- Supervisory signal carries the DCC for internodal communication and out-of-band messages.
- Optical line ID is carried by the supervisory signal. It is an integer associated with a line. This ID is transmitted and received by each OLS NE to identify any misconnection of fibers between sites.

## **DCC Protection Switching**

The DCC is carried in the overhead of the supervisory signal of line 1. In the event of a telemetry circuit pack or line failure, the DCC is switched to the overhead of the supervisory signal in line 2.

DCC offers the following types of protection switching:

- **Bidirectional switching**, which means protection switching is performed in both the transmit and receive directions.
- **Revertive switching**, which means the traffic switches from the service line to the protection line when a fault occurs. When the fault clears, the traffic reverts to the service line.
- **1x1 switching**, which means there is one service and one protection line.

## **Automatic Detection of Facility Failures**

OLS continuously monitors the performance of the optical signal and the health of the circuit packs. Any failures or degradations are automatically detected and reported.

## **Analog Facility Failure Conditions**

The analog facility failure conditions based on detected defects are as follows:

- **Optical Channel Loss:** An optical channel loss is declared when the signal power of the channel (SPR-C) falls below a set dB level of the strongest SPR-C present. When there is only one channel, the optical channel LOS is declared when the SPR-C falls below a set absolute level in dBm.
- **Optical Line Loss:** If all the optical channels in an optical line and the supervisory signal have loss of signal, a correlation of defects results in an optical line loss.

## **Digital Facility Failure Conditions for Supervisory Signal**

- Supervisory Signal (SUPR) loss of signal (LOS)
- SUPR loss of frame (LOF)
- SUPR Bit Error Rate (BER) signal failure

- SUPR BER signal degrade

### **Digital Facility Failure Conditions for Customer Maintenance Signal**

- Customer Maintenance Signal (CMS) LOS
- CMS LOF
- CMS BER signal failure
- CMS BER signal degrade

### **Fault Isolation**

OLS continuously monitors circuit packs and incoming signals for defects. When a fault is detected, OLS employs automatic diagnostics to isolate the failed circuit pack or signal. Failures are reported to local craft and operations systems so that repair decisions can be made. If desired, operations system personnel and local craft can use the CIT to gain more detailed information on the fault condition.

All fault conditions detected and isolated by OLS are stored and made available to be reported, on demand, through the CIT. In addition, a history of the past 500 alarm and status conditions and CIT events is maintained and available for on-demand reporting. Each event is date and time stamped.

OLS detects and reports alarm and status conditions autonomously through the office alarm relays, indicator strip, equipment LEDs, parallel telemetry, and message-based operations systems.

### **Baselining**

Signal quality degradation in the OLS is detected by measuring the following parameters for deviations from baselines:

- Total optical power received (TOPR-OL)
- Signal power per channel (SPR-C)

Measured values of these parameters vary depending on the number of optical channels present, optical amplifier performance, etc. Therefore, new baselines are required when channels are added or removed. OLS automatically measures and provisions the baseline parameters when optical channels transition from the AUTO to IS state. The user is pro-

vided with CIT/TL1 commands to baseline manually when channels are removed. For future reference, the user can also record the reason for the manual baselining.

These parameters have factory-set default thresholds that can be user-provisioned. Degradations below the thresholds result in reportable threshold-crossing alerts (TCAs).

## **Performance Monitoring**

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OLS does performance monitoring as part of its proactive maintenance philosophy. Performance parameters include digital performance data (coding violation counts on the supervisory channel) and threshold crossing alerts of analog parameters. **Proactive maintenance** refers to the process of detecting degrading conditions not severe enough to initiate alarming, but indicative of degradations that may lead to hard failures.

Certain performance parameters are inhibited during periods of unavailability.

### **Supervisory Channel Digital and Analog Performance Monitoring Parameters**

The supervisory channel carries B2 parity information. The telemetry (TLM) circuit pack can detect the following parameters:

- line coding violation (CV) counts
- line errored second counts
- line severely errored second counts
- line unavailable second counts

This data is collected in 15 minute and 24 hour bins and is available for retrieval by operations interfaces.

Thresholds are set on these parameters to show degraded performance. When a performance-monitoring threshold is crossed, it is reported to the operations system where all threshold crossings associated with a particular path can be correlated and the likely source of the degradation can be identified.

- SUPR optical parameters

- **Laser bias current (LBC-SU):** A signal indicating whether or not the system is operating within normal margins. The OC-3 laser bias current varies widely with temperature because the laser does not have a thermo-electric cooler to maintain a constant laser temperature. Typical normalized values are expected to range from 0.5 to 2 or even higher. The upper limit is set at 1.5 times the maximum (beginning of life) laser bias current limit. TCAs are reported when this upper limit is exceeded.
- **Supervisory Signal Power (SPR-SU):** The signal power is determined by monitoring the tone power on the supervisory signal. TCAs are reported when the supervisory signal power falls below -31dBm. -31dBm is a fixed value.
- **SUPR line parameters**
  - **Composite B2 coding violations (CV-L):** The sum of B2 parity violations on the supervisory signal is an indicator of the line's performance. The system calculates, writes, and checks the composite B2 parity for errors. For each line bit-interleaved-parity (BIP) error it detects, it increments the B2 parity violation counter. Each BIP-8 can detect up to 8 errors per STS-1 frame for a maximum of 8 times 3 parity errors per OC-3 frame.
  - **Errored seconds (ES-L):** An ES-L is a second in which the system detects one or more B2 parity violations or an OC-3 line alarm indication signal (AIS).
  - **Severely errored seconds (SES-L):** An SES-L is a second in which the system detects 32 or more OC-3 B2 parity violations or an OC-3 line AIS.
  - **Unavailable seconds (UAS-L):** A UAS-L is a second in which the OC-3 line is "unavailable." A line is considered unavailable during loss of signal, loss of frame, and line AIS conditions. A line is also considered unavailable from the beginning of 10 consecutive severely errored seconds until the beginning of 10 consecutive seconds, none of which are severely errored.

### **Analog Performance Monitoring Parameters for Optical Channels and Optical Line**

The following parameters are monitored for optical channels and optical lines:

- **Laser Bias Currents (LBC-P1, LBC-P2):** Laser bias currents of both OA pumps are monitored and reported as “in range” and “out of range.” An “out of range” condition causes pump shut off.
- **Laser Backface Currents (LBFC-P1, LBFC-P2):** Laser backface currents of both OA pumps are monitored and reported as “in range” and “out of range.” An “out of range” condition causes pump shut-off.
- **Signal Power per channel (SPR-C):** Signal power per channel is monitored by measurements of tone power on a channel. Its normalized values can be retrieved in a scale of 0 to 100. TCAs are reported when thresholds are crossed.
- **Total Optical Power Received (TOPR-OL):** Total optical power for all the channels is monitored and normalized values can be retrieved in a scale of 0 to 100. TCAs are reported when thresholds are crossed.

### Performance Parameter Thresholds

The current 15-minute and current 24-hour thresholds for each performance monitoring parameter, except LBFC-P1, P2, and LBC-P1, P2, are provisionable using the CIT or TL1. Whenever the current 15-minute or 24-hour threshold for a given performance-monitoring parameter is reached or exceeded, OLS generates a threshold-crossing alert (TCA). The TCA is then entered into the appropriate performance-monitoring report.

### Performance Monitoring Data Storage

OLS provides current and 32 previous 15-minute registers; and current and 6 previous 24-hour registers for all accumulated performance parameters. OLS enables you to provision the hour that the system is to begin measuring all daily performance monitoring periods. The performance monitoring parameters begin daily at the provisioned time.

OLS can retrieve and report the contents of any parameter storage register at any time. It can initialize the current 15-minute and/or current 24-hour registers at any time.

## Performance Monitoring During Failed Conditions

When a trouble condition is detected, OLS stops accumulating affected digital performance parameters per Bellcore requirements. All unaffected performance parameters continue to be accumulated during the trouble condition.

## Threshold-Crossing Alert Transmission to an Operations System

OLS supports the TL1 REPORT EVENT autonomous messages for TCA reporting. The TL1 messages provide information on the crossing of a CV, ES, SES, UAS, SNR, or optical power received threshold for the current 24-hour and 15-minute registers.

## Testing

OLS provides turn-up tests to verify signal path continuity. These tests are a combination of automatic and manual tests designed to provide the most certainty that the cables are correctly installed. OLS supports the following installation tests:

- **Local:** Local self-tests check cabling within a network element. Fiber loopbacks are necessary for these tests.
  - Automatic Turn-up Test: verifies installation cabling to and from TLM circuit packs and OA circuit packs for each optical line.
  - Automatic CMS Cable Test: verifies the continuity of customer maintenance signal cables.
  - Manual Local Test: verifies that the OMU and ODU are working properly. These tests require an optical power meter but do not require external line terminating equipment to drive the lines.
- **CMS Cable Test:** automatic test to verify the continuity of customer maintenance signal cables.

OLS also provides self-tests for office alarms, parallel telemetry, and LEDs.

## **Provisioning Consistency Audits**

---

OLS network elements provide a function that monitors (audits) the consistency of the provisioning information. This function alerts you to situations that may result in lost traffic or protection switching malfunctions.

In particular, OLS audits the following information to insure consistent operation of the ring subnetwork as a whole:

- **Target Identifier (TID):** The TID must be unique within a given subnetwork for proper operation of the OS interface. OLS uses a protocol called Directory Services<sup>1</sup> to ensure the uniqueness of TIDs for all network elements in a subnetwork. You can make changes to a TID at any time. However, if a change would result in a duplication, OLS sends an alarm and does not put the changes into effect until you make another change that removes the duplication.
- **Provision End Terminal 1A TX, 1A RCV.:** See “End Terminal Provisioning” in this chapter for information on provisioning telemetry circuit pack orientation. OLS checks at start-up and after each Set-Network-Element command that all nodes are provisioned as transmit or receive with respect to each other.

## **Reports**

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### **Active Alarms and Status**

OLS provides a report that shows all active alarm and status conditions. Immediately after you log in, OLS automatically displays the local alarm and status report on the local and remote CIT. This report shows the following alarm levels:

- Critical (CR)
- Major (MJ)
- Minor (MN)
- Abnormal (ABN)
- Near-end activity (NE ACTY)

---

1. Directory Services is based on the International Telecommunication Union, Telecommunication Standardization Sector [(ITU-T) formerly called CCITT] recommendation X.500 and proposed as a standard to the ANSI T1X1.5 working group.

The source address and description of the condition (for example, controller failure and incoming high speed signal failure) are included in the report along with the date and time it was detected. The report also indicates if the condition affects service. The option to display specified subsets of conditions by severity is also provided.

If there are no active conditions, the report indicates this.

## Performance Monitoring

OLS provides reports that contain values for all requested performance monitoring registers. The start time of each register's recording period is included.

The reports provide SONET optics, line and path, as well as TOPR (total optical power), and SPR performance monitoring data recorded in a series of 15-minute and 24-hour storage registers. Another report is provided summarizing all performance parameters that have crossed provisioned 15-minute or 24-hour thresholds within the history of the 15-minute and 24-hour registers.<sup>1</sup>

The day bin time stamp at the top of the report reflects the last time the 24-hour performance monitoring counts were initialized, even if the resulting "day" is longer or shorter than 24 hours. The report shows corrupted data as a question mark (?) for all non-24-hour day bin collection intervals, including those exceeding 24 hours.

## History

The history report displays the past 500 events. An event is any change in the OLS that may affect its performance (for example, a failure) or change its operation status (for example, loopback setup). This summary report includes time stamps showing when each condition was detected and when it cleared. The user ID of the person who initiated the command is also included. The CIT events contain a time stamp showing when the command was entered.

---

1. A series of current, recent, and 31 previous registers are provided for each parameter, allowing for up to 8 hours and 15 minutes (495 minutes) of history in 15-minute registers. Also, 5 previous, one recent, and one current 24-hour registers are provided, allowing for up to 7 days (168 hours) of history in 24-hour registers.

## Version/Equipment List

The version/equipment list report is an on-demand report that lists all the circuit packs that are present. This report also lists the circuit pack version and the software generic (if applicable).

## State

An on-demand report displays the state of each addressed slot and port (optical line, optical channel, supervisory signal, or customer maintenance signal) in the OLS. For each addressed entity, the report includes the following:

- address
- circuit pack type (for slots only)
- state

The possible port states are:

- **Auto (AUTO):** means the port is available for automatic provisioning. An optical channel transitions from the AUTO state to the IS state if a good signal is detected.
- **Not monitored (NMON):** means the port is not monitored and will not transition to the IS state even if a good signal is detected.
- **In service (IS):** means the port is fully monitored and alarmed.

The possible slot states are:

- **Auto (AUTO):** is the original value of the circuit pack slot state parameter. AUTO means the slot is available for automatic provisioning.
- **Equipped (EQ):** means the slot is fully monitored and alarmed.

## Orderwire

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Orderwire provides voice communications, through a DANTEL<sup>®</sup> unit, for maintenance personnel performing facility maintenance. OLS provides three V.11/EIA-422, 64 kb/s orderwire interfaces per line (12 for end terminals, 24 for repeaters). The three different interfaces are section orderwire, line orderwire, and section user channel. Orderwire is terminated in end terminal and repeater sites.

For you to access the orderwire interface at terminals, the shelf must be equipped with the telemetry circuit pack.

Standard equipment can be connected to these interfaces. The orderwire shelf must be installed within a few feet of the cabinet. Refer to the “Related Products” section in Chapter 7 for ordering information.

## **Provisioning**

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**Provisioning** is the assigning of values to parameters used by network elements for specific functions. OLS provides two types of provisioning: auto-provisioning and technician provisioning. Network element parameters that are auto-provisioning set themselves to a fixed value automatically when an event occurs. Technician provisioning refers to the manual provisioning of parameters through TL1 or CIT commands.

### **Original Value Provisioning**

---

Each provisionable parameter is assigned an original value at the factory. Installation provisioning is minimized with original values. A parameter is a characteristic of the system that affects its operation. A value is a number, text string, or other menu selection. The provisionable parameters and original values are copied from floppy disks in the CIT to the system memory (SYSMEM) circuit pack.

There are three complete sets of data (parameters and their values) in the system under normal conditions:

- One set contains original values of system parameters (the values assigned to parameters at the factory). This set is located in the non-volatile memory of the SYSMEM circuit pack.
- The second set contains current values of system parameters (the values currently being used by the system). This set is also located in the nonvolatile memory of the SYSMEM circuit pack.
- The third set contains current values of system parameters. This set is located in the volatile memory of the SYSCTL circuit pack.

The original values assigned at the factory cannot be changed. Current values can be overridden through local or remote provisioning.

## **Local or Remote Provisioning**

The OLS software control allows local and remote provisioning of CIT provisionable parameters. Most are provisionable through TL1 commands. The provisionable parameters and values (current and original) are maintained in the nonvolatile memory of the SYSMEM circuit pack. For more information about provisioning parameters and original values using CIT-PC or TL1 commands, refer to 365-575-301, *Optical Line System (OLS), User/Service Manual*.

## **Preprovisioning Circuit Packs**

To simplify circuit pack installation, parameters can be provisioned before the corresponding circuit pack is installed. All system parameters and values (current and original) are preserved by OLS in the nonvolatile memory of the SYSMEM circuit pack. The parameters and values are protected by the nonvolatile memory if a power failure occurs and are retrievable on demand regardless of the means used for provisioning. The parameters are downloaded automatically when the affected circuit pack is installed.

## **Provisioning on Circuit Pack Replacement**

Replacement of a failed circuit pack is simplified by automatic provisioning of its values. The system controller (SYSCTL) and SYSMEM circuit packs maintain a provisioning map of the entire system. When a transmission or timing circuit pack is replaced, the SYSCTL and SYSMEM circuit packs automatically download provisioning parameters and values to the new circuit pack.

## **Provisionable Parameters Summary**

The following list shows a high level summary of CIT provisionable parameters:

- 1A – Transmit/1A – Receive (See "End Terminal Provisioning" following.)
- Network element access security (TID, port states, etc.)
- Login ID security (login IDs, log-in aging, etc.)
- Miscellaneous discrete attributes (names, alarm levels, etc.)
- Supervisory channel (SD threshold, alarm level, etc.)

- Performance monitoring thresholds (optical, digital, and start times)
- Optical pump power (LEA7 only) to accommodate Long Reach(system type to select between Nx33 and Mx24/Px25)

### **Network Element Configuration**

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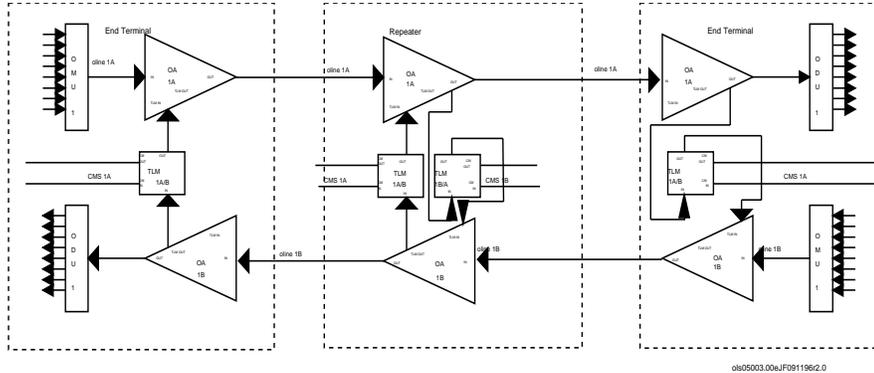
OLS automatically provisions a network element to be an end terminal or a repeater by detecting the presence or absence of the OMU and ODU (see Figure 5-6).

### **End Terminal Provisioning**

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The end terminals and repeaters in one direction (transmit) are connected to the OA circuit packs in the A slot (1A). The end terminals and repeaters in the other direction (receive) are connected to the OA circuit pack in the B slot (1B). This configures one bidirectional OLS optical line.

The 1A telemetry (TLM) circuit pack in one end terminal and all repeaters have the same orientation (transmit). The outputs of these TLM packs are connected to the 1A OA circuit pack. The 1A TLM pack in the opposite end terminal is connected to the 1B OA circuit pack. It is necessary to provision this circuit pack orientation for fault isolation. Therefore, the end terminal where the 1A TLM pack is connected to the 1A OA pack and all repeaters are provisioned as 1A – TX (transmit). The other end terminal is provisioned as 1A – RCV (receive).



**Figure 5-6. OLS Network Elements**

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# System Planning and Engineering

# 6

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■	Planning Considerations	6-1
■	Customer Maintenance Signal Synchronization	6-2
■	Protection Switching	6-2
■	Capacity	6-3
■	Engineering Rules	6-5
	Use of LBOs	6-5
	Network Topologies	6-5
	Dispersion	6-5
	OLS/OT Interworking	6-6
	Engineering Rules for OA Applications	6-7
■	Floor Plan Layout	6-8
■	Equipment Interconnection	6-10
■	Cabling	6-10
■	Environmental Considerations	6-13
■	Power Planning	6-14



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# System Planning and Engineering

# 6

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This chapter summarizes information needed for applications planning before procuring and deploying the Optical Line System (OLS).

## **Planning Considerations**

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There are several considerations to keep in mind when planning a network. Projected customer requirements determine the initial capacity needed, as well as growth. Where you install the network and how you plan to use it determine the physical installation considerations.

Before ordering or installing the equipment, you need to develop an overall plan and select or construct the building that is to serve as a terminal office or repeater site. This plan should take into consideration the eventual system size and include the following:

- synchronization
- capacity
- engineering rules
- floor plan layout
- equipment interconnection
- cabling

- environmental considerations
- power planning

Lucent Technologies offers engineering and installation services for planning and installing OLS. For more information about Lucent Technologies engineering and installation services, see Chapter 8, “Product Support.”

## **Customer Maintenance Signal Synchronization**

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Because OLS is a bit-rate-independent analog system, timing considerations are minimized. The only timing is associated with the telemetry circuit pack. The following timing modes are used:

- If the incoming customer maintenance signal (CMS) is present and valid, the supervisory signal uses it as the timing reference.
- When there is no CMS input to the TLM pack, or when the CMS is judged to be invalid, then the onboard Stratum 3 clock (51.84 MHz) times the supervisory signal.
- The output CMS is timed from the dropped supervisory signal (if present).
- If the supervisory signal is not present or is invalid, the output CMS is timed from the Stratum 3 clock.

## **Protection Switching**

---

If a telemetry circuit pack or optical line fails, the data communications channel (DCC) line is switched from its primary path on optical line 1 to its protection path on optical line 2. This protection switching of DCC prevents communication loss between network elements when optical line 1 is interrupted.

DCC protection switching is bidirectional, revertive, and 1x1.

- **Bidirectional** means protection switching is performed in the transmit and receive directions.
- **Revertive** means the traffic switches from the service line to the protection line when a fault occurs, and when the fault clears, the traffic reverts to the service line.

- **1x1** switching means there is one service and one protection line.

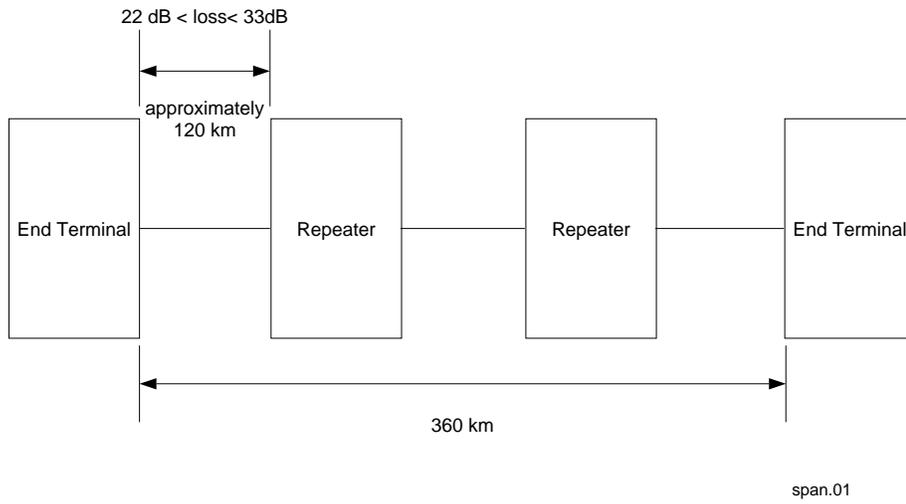
## **Capacity**

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OLS systems provide the following functions:

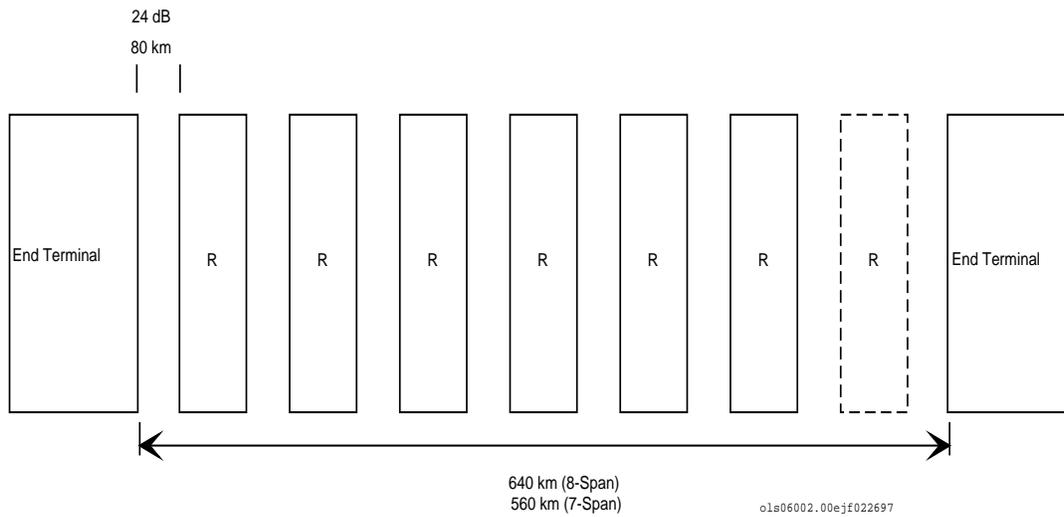
- The OLS end terminal provides dense wave division multiplexing (DWDM) of up to 8 OC-48 lines onto one optical fiber.
- The OLS repeater terminal provides signal amplification to allow transmission distances of:
  - approximately 120 km per span in Standard Reach 3-span (3x33dB) OLS systems (see Figure 6-1) for a total distance of approximately 360 km
  - approximately 80 km per span in seven-span (7x25dB) and eight-span (8x24dB) OLS systems (see Figure 6-2) for total distances of approximately 560 km and 640 km, respectively.
- Repeater sites between OLS end terminals support each span.
- 384 DS3 equivalents (258,048 two way voice circuits per fiber pair). Up to 4 fiber pairs per cabinet.

DWDM permits up to 20 Gb/s of traffic onto one optical line.



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**Figure 6-1. Span and Line Distances for 3-Span (Standard Reach) Systems**



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**Figure 6-2. Span and Line Distances for 7- and 8-Span (Long Reach) Systems**

## **Engineering Rules**

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### **Use of LBOs**

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If outside plant loss is within the nominal range, no LBOs are required. If any span has an outside plant loss below the specified limit, an LBO is required. Detailed LBO selection guidelines are provided in the *OLS Installation Manual* (365-575-315). The LBO kits are provided with the OA and ODU circuit packs.

### **Network Topologies**

---

Standard Reach OLS systems carry up to eight signals on an optical line comprised of one, two, or three spans. Long Reach systems will transmit up to eight signals on an optical line up to eight spans. For loss and distance specifications, refer to Table 6-2.

### **Dispersion**

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Guidelines for dealing with dispersion are as follows:

- With OLS systems having dispersion less than 6800 ps/nm, use of the 739Dx LCT transmitter and 41Ax OT unit is recommended.
- With OLS systems having dispersion between 6800 ps/nm and 10,000 ps/nm, use of 739Fx transmitters and 41Cx OT units is required.

The 739Fx and 41Cx can be used with OLS systems having dispersion of less than 6800 ps/nm, but the 739Dx and 41Ax are less expensive options. Dispersion is not a limiting factor on Truwave fiber; hence, the 739Dx and 41Ax are recommended for use on systems using Truwave.

## OLS/OT Interworking

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The Optical Translator can be used to concatenate multiple OLS systems. The rules for concatenating systems are presented in Table 6-1.

**Table 6-1. Engineering Rules for OLS/OT Interworking**

Per OLS System	LEA6/41A Standard Reach Systems	LEA7/41C Long Reach Systems
Max. No. Spans	3	8
<b>Per Wavelength</b>		
Max. No. OTs	10	10
Max. No. WAD Sites	10	10
Max. No. Spans	33	88
Typical Overall Length	3960 km	7040 km
<b>Per Subnetwork*</b>		
Max. No. Spans	unlimited	unlimited

\* *Subnetwork* refers to the network between two OLS end terminals that are not WAD sites.

OTs can be used at wavelength add/drop sites to:

- Permit express wavelengths to go to other OLS systems. (A single wavelength section can go through up to ten WAD sites.)
- Concatenate OLS systems with spans that conform to maximum loss guidelines for Standard Reach and Long Reach topologies.
- Concatenate OLS systems with one, two, or up to eight spans, with a maximum loss of 22 dB.

### Engineering Rules for OA Applications

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Figure 6-3 shows the configuration of an OLS system where each span is supported by two OAs. The OLS systems carry up to 8 channels on an optical line comprised of one, two, or up to eight spans. The rules for this system are shown in Table 6-2.

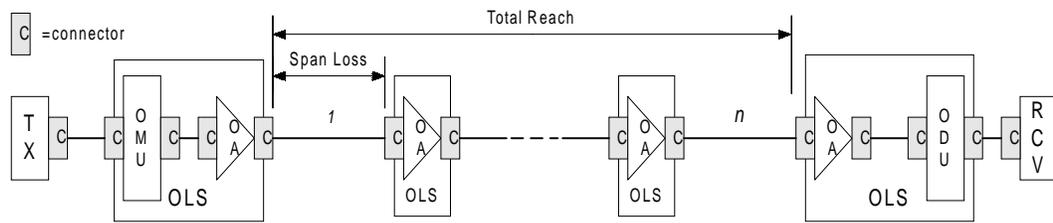


Figure 6-3. OLS OA System

**Table 6-2. Engineering Rules for OLS R2.0 (OC-48/STM-16 for Standard Single Mode Fiber)**

Application	OA	Max. No. Channels	No. of Spans	Span Loss (dB)		Total Reach (dB) Max	Max Span Distance (km)*	Max Total Reach (km)*
				Min	Max†			
Long Span	LEA6	8	1	22	33	33	132	132
			2	22	33	66	132	264
			3	22	33	99	132	396
Long Reach	LEA7	8	1	22	33	33	132	132
			2	22	30	60	120	240
			3	22	28	84	112	336
			4	21	26	104	104	416
			5	21	26	130	104	520
			6	21	26	156	104	624
			7	17	22	154	88	616
			8	17	22	176	88	640‡

\*. Fiber loss = 0.25dB/km

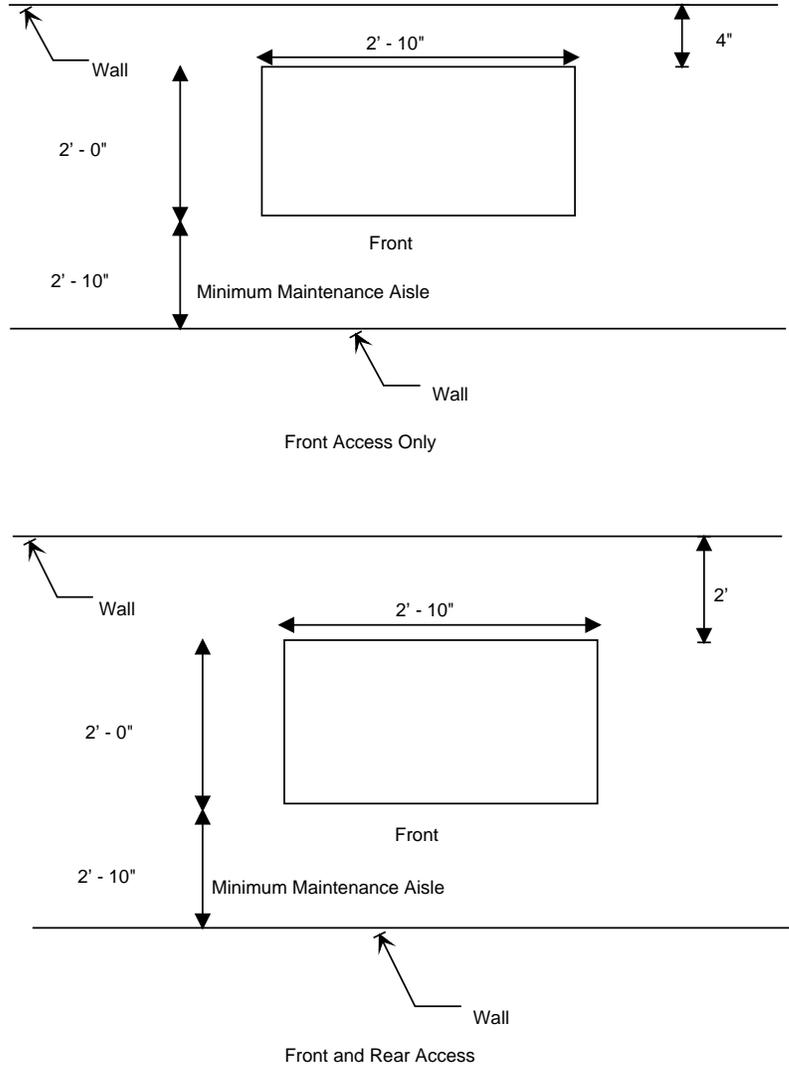
†. Some span with span loss more than the maximum value may be accommodated. Lucent Technologies provides network engineering support to optimize OLS systems for actual network. Please contact your Lucent Technologies sales representative for more information.

‡. This distance is limited by the dispersion characteristics of standard single-mode fiber (SSMF) (640km x 17ps/nm-km=10880ps/nm).

See Chapter 10, "Technical Specifications" for related information.

## **Floor Plan Layout**

Figure 6-4 shows a typical floor plan layout for OLS in a central office. LS is a front access system. The rear aisle space of 2 feet is recommended to allow the rear doors to be fully opened. If floor space is limited, the rear aisle can be reduced to no less than 4 inches. Refer to the floor plan data sheets [804-604-161-001] for explicit details.



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**Figure 6-4. Floor Plan Layout**

## **Equipment Interconnection**

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OLS is designed as a front access product; all cable and fiber connections can be made from the front of the system. This feature allows planners to design networks with OLS in controlled environment vaults, concrete huts, or other locations, where space is limited and equipment must be placed close to the wall.

All external interconnection cabling uses industry standard connectors.

## **Cabling**

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The following are major classes of signals cabled to OLS:

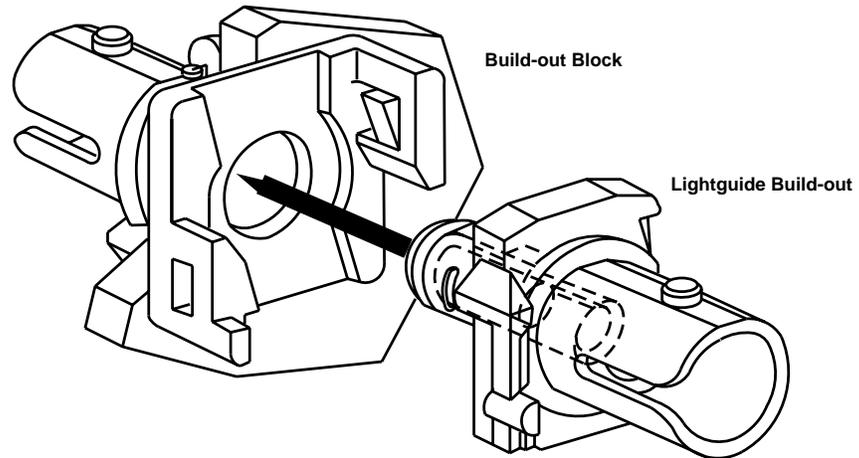
- OC-48 optical signals (drop side signals)
- OAM&P electrical signals
- Customer maintenance (CM) optical signals
- Optical line signals (multiplexed OC-48 signals)

The optical interfaces (telemetry [TLM], optical demultiplexer unit [ODU], optical multiplexer unit [OMU], and optical amplifier [OA]) are designed to provide connections through a front mounted connector system. The connector system supports the use of three different types of connectors:

- ST<sup>®</sup> type
- FC type
- SC type

The connector system also provides optical attenuation (optical lightguide build-out [LBO]) if required. All optical interfaces are factory-equipped with *ST*-type connectors with 0dB attenuation. By replacing the factory-equipped connectors, you can change the type of connector. In addition, a kit with LBO values from 3 to 10dB is shipped with the ODU. The correct LBO value must be chosen after the system is installed.

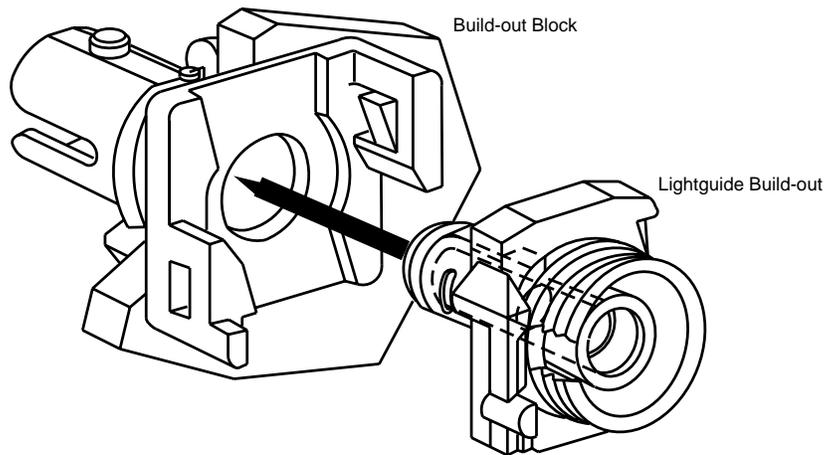
Figure 6-5 shows the build-out block and *ST*-type LBOs. Figure 6-6 shows the buildout block and FC-type LBOs. Figure 6-7 shows the build-out block and SC-type LBOs



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**Figure 6-5. ST-Type Build-Out Assembly**

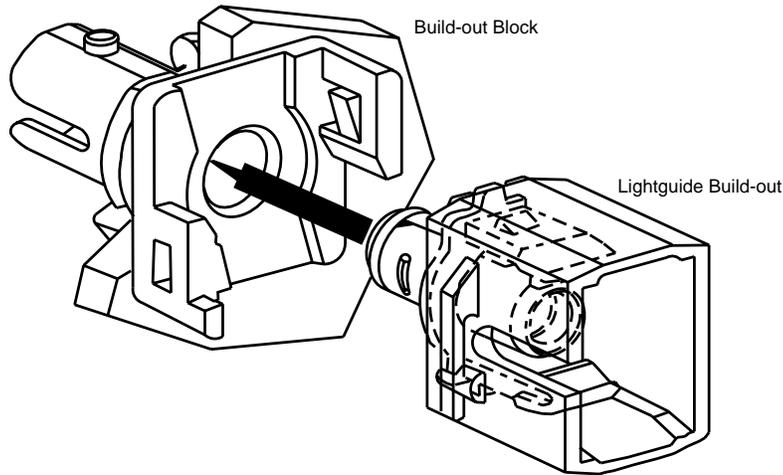
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**Figure 6-6. FC Type Build-Out Assembly**

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**Figure 6-7. SC-Type Build-Out Assembly**

All fiber jumpers used between the LCT or an external LBO cross-connect panel and the OMU and ODU units must use single-mode fiber. The intrashelf fiber jumpers and the optical line I/O fiber must use single-mode fiber. Single mode or multimode fiber (depending on the type of input source) can be used for the input customer maintenance signal. However, multimode fiber must be used for output customer maintenance signal.

When *ST*, *FC*, or *SC* connectors are used together, hybrid jumpers must be used. A hybrid jumper has different types of connector at either end. The connectors at both ends of the jumper must match the panel-mounted connectors. *ST* connectors are available for use at the LBO cross-connect panel and can be installed when OLS is installed.

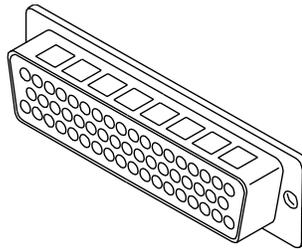
**⇒ NOTE:**

All optical fiber connectors (*ST*, *FC*, and *SC* types), lightguide build-outs, and buildout blocks should be cleaned before initial connections or subsequent reconnections are made. Refer to the “Related Products” section of Chapter 7 for ordering information on the cleaning materials needed.

The OAM&P cables are terminated with D-subminiature connectors that have crimp removable contacts (Figure 6-8).

The length of the power feeds are individually engineered and are sized to handle the maximum current drain the equipment can experience.

For more information about cabling, refer to Chapter 7, "Ordering."



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**Figure 6-8. D-Subminiature Connector**

## **Environmental Considerations**

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OLS shelves and cabinets comply with the environmental compatibility requirements in documents GR-63-CORE, Issue 1, October 1995 and GR-1089-CORE.

Perforated metal meshes are used as part of the shelf construction to cover the top and bottom areas of the shelf in order to form an electromagnetic enclosure for all circuit packs in the shelf. OLS shelves, circuit packs (CPs), and cable treatments are designed to satisfy the requirements of Bellcore TA-NWT-001089, Issue 2, 1993. OLS is also designed to meet the electromagnetic compatibility requirements of GR-1089-CORE.

OLS complies with the IEC 801-2 electrostatic discharge (ESD) recommendation for exchange carriers. The shelves are grounded to the cabinet by the shelf mounting hardware. An ESD jack is provided on the fuse panel for grounding straps.

OLS network elements dissipate 344 watts or less per cabinet. OLS dissipates heat by natural convection cooling and does not require a cooling fan. Table 6-3 presents information on power dissipation and current drains for different OLS configurations.

## **Power Planning**

---

Two -48.0 to -60.0 volt power feeders and returns (feeders A and B) should be used to power each OLS cabinet. Redundant power feeders are used to ensure maximum system reliability. All power feeders should be sized to carry the maximum cabinet power consumption.

Each feeder is equipped with a filter to reduce any switching noise that may be present on the input current.

**Table 6-3. OLS Power Planning**

J68982C-1 Equipment Package	Maximum Power Dissipation		Current Drains per Feeder*	
	Watts	Watts per Square Foot	Nominal at -48V (List 1†)	Maximum (List 2‡)
OLS End Terminal 4 Bidirectional Optical Lines	252	20.2	2.6	5.9
OLS Repeater 4 Bidirectional Optical Lines	320	25.6	3.3	7.5
OLS Dual End Terminal	276	22.1	2.9	6.5
OLS Dual Repeater	344	27.6	3.6	8.0
OLS End Terminal & Repeater	310	24.8	3.2	7.3
OLS Miscellaneously Shelf Terminal Repeater	138 172	NA NA	1.4 1.8	3.2 4.0

\*. Nominally, both feeders share the current equally for the cabinet or shelf. If one feeder fails, the remaining feeder carries the total load for the cabinet (feeder A + feeder B current).

†. In power engineering, List 1 refers to the current drains used to size batteries and rectifiers. To size batteries and rectifiers, use twice the Nominal (List 1) current drain per feeder. These current drains represent the average busy-hour current at normal operating voltages.

‡. In power engineering, List 2 refers to the current drains used to size feeder cables and fuses. To size feeder cables and fuses, use the Maximum (List 2) current drain per feeder. These current drains represent the peak current under worst case operating conditions.



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# Ordering

# 7

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■	How to Order Optical Line System Equipment	7-2
	Ordering Lightguide Office Cable	7-2
■	Worksheets	7-3
■	Ordering Guidelines	7-30
	Ordering OLS	7-30
	Package Descriptions	7-32
	Related Software and Documentation	7-33
■	Conversion Kit	7-35
■	Cables	7-36
	Intraoffice Electrical Nontransmission Cable Descriptions	7-36
■	Ordering Spare Circuit Packs/Units and Fuses	7-39
	Circuit Pack/Unit Descriptions	7-40
■	Circuit Pack/Unit Sparing Guidelines	7-41
	Lead Time	7-41
	Sparing Examples	7-41
■	Related Framework	7-46
■	Related Products	7-47
	Ordering Cleaning Materials	7-47
	Ordering METRAL Backplane Replacement Pins	7-47
	Ordering the External Miscellaneous Discrete Unit	7-49
	DANTEL Orderwire Shelf	7-50
■	Software Compatibility	7-51



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# Ordering

# 7

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This chapter provides information about:

- ordering Optical Line System (OLS) equipment
- Lucent Technologies software release ratings
- ordering related products that operate with OLS
- slot, circuit pack/unit, and software compatibility

## **How to Order Optical Line System Equipment**

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OLS consists of equipment, cables, circuit packs, miscellaneous hardware, software, and related documentation. The equipment necessary to form different applications is grouped together into J-drawing specifications and list numbers.

### **Ordering Lightguide Office Cable**

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When ordering lightguide office cable, use the *Lucent Technologies Fiber Optic Products* catalog. To order copies of this catalog, use the following information:

**Non-Lucent personnel:** contact the National Telemarketing Center, 1-800-344-0223, ext. 3023

**Lucent personnel:** contact the Lucent Technologies Ordering Center (LTOC), 1-800-458-1761

## **Worksheets**

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This section provides worksheets for ordering complete OLS packages.

The worksheets list the circuit packs/units and number per line you need to form each package. The worksheets also show other equipment needed to complete the package such as cables, software, and LBOs.

**Step 1** Use the worksheet appropriate to the package you want to order:

OLS End Terminal, 4 line	Table 7-1
OLS Dual End Terminal	Table 7-2
OLS Repeater, 4 line	Table 7-3
OLS Dual Repeater	Table 7-4
OLS End Terminal/Repeater	Table 7-5
Miscellaneously Mounted Shelf:	
End Terminal	Table 7-6
Repeater	Table 7-7
4 Line End Terminal-to-Dual End Terminal Conversion	Table 7-8
4 Line Repeater-to-Dual Repeater Conversion	Table 7-9

**Step 2** Follow the worksheet, selecting the number of circuit packs necessary for the product and number of optical lines you want. For example, if you want an end terminal with 4 bidirectional optical lines, you need to order eight optical amplifiers.

Also select the number of cables, lightguide build-outs (LBOs), and lightguide jumpers you need.

You may photocopy the worksheets to make as many copies as you need.

**Table 7-1. 4 Bidirectional Line End Terminal Worksheet (Sheet 1 of 3)**

Description	Choice	List/ Group	Reference
End Terminal Cabinet		L1	Table 7-10
End Terminal, 4 Line Kit		L101	
Is this 1A-TX or 1A-RCV terminal?	1A-TX _____ 1A-RCV _____		
Optical Amplifier circuit pack (OA)-Long Span	Quantity _____ (2 per optical line required)	L20	Table 7-16
Optical Amplifier circuit pack (OA)-Long Reach	Quantity _____ (2 per optical line required)	L21	
telemetry circuit pack (TLM)	Quantity _____ (1 per optical line required)	L25	
tributary overhead controller circuit pack (TOHCTL)	Quantity _____ (1 per cabinet required)	L30	
system controller circuit pack (SYSCTL)	Quantity _____ (1 per cabinet required)	L35	
system memory circuit pack (SYSTEMEM)	Quantity _____ (1 per cabinet required)	L40	
optical demultiplexing unit (ODU)	Quantity _____ (1 per optical line required)	L50	
optical multiplexing unit (OMU)	Quantity _____ (1 per optical line required)	L60	

**Table 7-1. 4 Bidirectional Line End Terminal Worksheet (Sheet 2 of 3)**

Description	Choice	List/ Group	Reference
lightguide jumper kit	Quantity _____ (1 per optical line required)	L161	Table 7-10
lightguide office cable (FS1EP-EP-?) "?" indicates length. Specify the length required from the Lucent Technologies catalog	Quantity _____ (20 per optical line required) Length _____		Fiber Optic Products Catalog 2492C
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable (ED-7G028-22)	Quantity _____	G301, G351, G361	Table 7-14
X.25 cable (ED-7G028-22)	Quantity _____	G602, G652	
CIT interface cable (ED-7G028-22)	Quantity _____	G702, G752	
Line OW, section OW, section user channel cable (ED-7G028-22)	Quantity _____	G401, G451, G461	
1st or 2nd serial telemetry cable (ED-7G028-22)	Quantity _____	G201, G251, G261	
METRAL Pin/Tool Kit	Yes/No _____ Enter choice		Table 7-21 and Table 7-23
CLETOP Fiber Cleaning Materials	Yes/No _____ Enter choice		Table 7-20
software and documentation			Table 7-11 and Table 7-12

**Table 7-1. 4 Bidirectional Line End Terminal Worksheet (Sheet 3 of 3)**

Description	Choice	List/ Group	Reference
DANTEL or HARRIS Miscellaneous Discrete Interface Unit	Yes/No _____ Enter choice		Table 7-24
DANTEL Orderwire Shelf	Yes/No _____ Enter choice		"DANTEL Orderwire Shelf"
ST LBO kit	Yes/No _____ (1 per optical line required)	L111	Table 7-10
FC LBO kit	Yes/No _____ (1 per optical line required)	L121	
SC LBO kit	Yes/No _____ (1 per optical line required)	L131	

**Table 7-2. Dual End Terminal Worksheet (Sheet 1 of 4)**

Description	Choice	List/ Group	Reference
Dual End Terminal Cabinet		L2	Table 7-10
Dual End Terminal Kit		L103	
Is this 1A-TX or 1A-RCV terminal?	1A-TX _____ 1A-RCV _____		

**Table 7-2. Dual End Terminal Worksheet (Sheet 2 of 4)**

Description	Choice	List/ Group	Reference
Optical Amplifier circuit pack (OA)-Long Span	Quantity _____ (2 per optical line required)	L20	Table 7-16
Optical Amplifier circuit pack (OA)-Long Reach	Quantity _____ (2 per optical line required)	L21	
telemetry circuit pack	Quantity _____ (1 per optical line required)	L25	
tributary overhead controller circuit pack	Quantity _____ (2 per cabinet required)	L30	
system controller circuit pack	Quantity _____ (2 per cabinet required)	L35	
system memory circuit pack	Quantity _____ (2 per cabinet required)	L40	
optical demultiplexing unit	Quantity _____ (1 per optical line required)	L50	
optical multiplexing unit	Quantity _____ (1 per optical line required)	L60	
lightguide jumper kit	Quantity _____ (1 per optical line required)	L161	Table 7-10

**Table 7-2. Dual End Terminal Worksheet (Sheet 3 of 4)**

Description	Choice	List/ Group	Reference
lightguide office cable (FS1EP-EP-?) "?" indicates length. Specify length required from the Lucent Technologies catalog	Quantity _____ (20 per optical line required) Length _____		Fiber Optic Products Catalog 2492C
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable (ED-7G028-22)	Quantity _____	G301, G351, G361	Table 7-14
X.25 cable (ED-7G028-22)	Quantity _____	G602, G652	
CIT interface cable (ED-7G028-22)	Quantity _____	G702, G752	
Line OW, section OW, section user channel cable (ED-7G028-22)	Quantity _____	G401, G451, G461	
1st or 2nd serial telemetry cable (ED-7G028-22)	Quantity _____	G201, G251, G261	
METRAL Pin/Tool Kit	Yes/No _____ Enter choice		Table 7-21 and Table 7-23
CLETOP Fiber Cleaning Materials	Yes/No _____ Enter choice		
software and documentation			Table 7-11 and Table 7-12
DANTEL or HARRIS Miscellaneous Discrete Interface Unit	Yes/No _____ Enter choice		Table 7-24
DANTEL Orderwire Shelf	Yes/No _____ Enter choice		"DANTEL Orderwire Shelf"

**Table 7-2. Dual End Terminal Worksheet (Sheet 4 of 4)**

Description	Choice	List/ Group	Reference
ST LBO kit	Yes/No _____ (1 per optical line required)	L111	Table 7-10
FC LBO kit	Yes/No _____ (1 per optical line required)	L121	
SC LBO kit	Yes/No _____ (1 per optical line required)	L131	

**Table 7-3. 4 Bidirectional Line Repeater Worksheet (Sheet 1 of 4)**

Description	Choice	List/ Group	Reference
4 Bidirectional Line Repeater Cabinet		L1	Table 7-10
Repeater Kit		L102	

**Table 7-3. 4 Bidirectional Line Repeater Worksheet (Sheet 2 of 4)**

Description	Choice	List/ Group	Reference
Optical Amplifier circuit pack (OA)-Long Span	Quantity _____ (2 per optical line required)	L20	Table 7-16
Optical Amplifier circuit pack (OA)-Long Reach	Quantity _____ (2 per optical line required)	L21	
telemetry circuit pack	Quantity _____ (2 per optical line required)	L25	
tributary overhead controller circuit pack	Quantity _____ (1 per cabinet required)	L30	
system controller circuit pack	Quantity _____ (1 per cabinet required)	L35	
system memory circuit pack	Quantity _____ (1 per cabinet required)	L40	
lightguide jumper kit	Quantity _____ (1 per optical line required)	L161	Table 7-10
lightguide office cable (FS1EP-EP-?) "?" indicates length. Specify length required from the Lucent Technologies catalog	Quantity _____ (8 per optical line required) Length _____		Fiber Optic Products Catalog 2492C

**Table 7-3. 4 Bidirectional Line Repeater Worksheet (Sheet 3 of 4)**

Description	Choice	List/ Group	Reference
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable (ED-7G028-22)	Quantity _____	G301, G351, G361	Table 7-14
X.25 cable (ED-7G028-22)	Quantity _____	G602, G652	
CIT interface cable (ED-7G028-22)	Quantity _____	G702, G752	
Line OW, section OW, section user channel cable (ED-7G028-22)	Quantity _____	G401, G451, G461	
1st or 2nd serial telemetry cable (ED-7G028-22)	Quantity _____	G201, G251, G261	
METRAL Pin/Tool Kit	Yes/No _____ Enter choice		Table 7-21 and Table 7-23
CLETOP Fiber Cleaning Materials	Yes/No _____ Enter choice		Table 7-20
software and documentation			Table 7-11 and Table 7-12
DANTEL or HARRIS Miscellaneous Discrete Interface Unit	Yes/No _____ Enter choice		Table 7-24
DANTEL Orderwire Shelf	Yes/No _____ Enter choice		"DANTEL Orderwire Shelf"

**Table 7-3. 4 Bidirectional Line Repeater Worksheet (Sheet 4 of 4)**

Description	Choice	List/ Group	Reference
ST LBO kit	Yes/No _____ (1 per optical line required)	L111	Table 7-10
FC LBO kit	Yes/No _____ (1 per optical line required)	L121	
SC LBO kit	Yes/No _____ (1 per optical line required)	L131	

**Table 7-4. Dual Repeater Worksheet (Sheet 1 of 4)**

Description	Choice	List/ Group	Reference
Dual Repeater Cabinet		L2	Table 7-10
Dual Repeater Kit		L104	

**Table 7-4. Dual Repeater Worksheet (Sheet 2 of 4)**

Description	Choice	List/ Group	Reference
Optical Amplifier circuit pack (OA)-Long Span	Quantity _____ (2 per optical line required)	L20	Table 7-16
Optical Amplifier circuit pack (OA)-Long Reach	Quantity _____ (2 per optical line required)	L21	
telemetry circuit pack	Quantity _____ (2 per optical line required)	L25	
tributary overhead controller circuit pack	Quantity _____ (2 per cabinet required)	L30	
system controller circuit pack	Quantity _____ (2 per cabinet required)	L35	
system memory circuit pack	Quantity _____ (2 per cabinet required)	L40	
lightguide jumper kit	Quantity _____ (1 per optical line required)	L161	Table 7-10
lightguide office cable (FS1EP-EP-?) "?" indicates length. Specify length required from the Lucent Technologies catalog	Quantity _____ (8 per optical line required) Length _____		Fiber Optic Products Catalog 2492C

**Table 7-4. Dual Repeater Worksheet (Sheet 3 of 4)**

Description	Choice	List/ Group	Reference
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable (ED-7G028-22)	Quantity _____	G301, G351, G361	Table 7-14
X.25 cable (ED-7G028-22)	Quantity _____	G602, G652	
CIT interface cable (ED-7G028-22)	Quantity _____	G702, G752	
Line OW, section OW, section user channel cable (ED-7G028-22)	Quantity _____	G401, G451, G461	
1st or 2nd serial telemetry cable (ED-7G028-22)	Quantity _____	G201, G251, G261	
software and documentation			Table 7-11 and Table 7-12
METRAL Pin/Tool Kit	Yes/No _____ Enter choice		Table 7-21 and Table 7-23
CLETOP Fiber Cleaning Materials	Yes/No _____ Enter choice		Table 7-20
DANTEL or HARRIS Miscellaneous Discrete Interface Unit	Yes/No _____ Enter choice		Table 7-24
DANTEL Orderwire Shelf	Yes/No _____ Enter choice		"DANTEL Orderwire Shelf"

**Table 7-4. Dual Repeater Worksheet (Sheet 4 of 4)**

Description	Choice	List/ Group	Reference
ST LBO kit	Yes/No _____ (1 per optical line required)	L111	Table 7-10
FC LBO kit	Yes/No _____ (1 per optical line required)	L121	
SC LBO kit	Yes/No _____ (1 per optical line required)	L131	

**Table 7-5. End Terminal/Repeater Worksheet (Sheet 1 of 4)**

Description	Choice	List/ Group	Reference
End Terminal/Repeater Cabinet		L2	Table 7-10
End Terminal/Repeater Kit		L105	
Is this 1A-TX or 1A-RCV end terminal shelf?	1A-TX _____ 1A-RCV _____		

**Table 7-5. End Terminal/Repeater Worksheet (Sheet 2 of 4)**

Description	Choice	List/ Group	Reference
Optical Amplifier circuit pack (OA)-Long Span	Quantity _____ (2 per optical line required)	L20	Table 7-16
Optical Amplifier circuit pack (OA)-Long Reach	Quantity _____ (2 per optical line required)	L21	
telemetry circuit pack	Quantity _____ (1 per optical line required [end terminal shelf]) (2 per optical line required [repeater shelf])	L25	
tributary overhead controller circuit pack	Quantity _____ (2 per cabinet required)	L30	
system controller circuit pack	Quantity _____ (2 per cabinet required)	L35	
system memory circuit pack	Quantity _____ (2 per cabinet required)	L40	
optical demultiplexing unit	Quantity _____ (1 per optical line required [end terminal shelf only])	L50	
optical multiplexing unit	Quantity _____ (1 per optical line required [end terminal shelf only])	L60	
lightguide jumper kit	Quantity _____ (1 per optical line required)	L161	Table 7-10

**Table 7-5. End Terminal/Repeater Worksheet (Sheet 3 of 4)**

Description	Choice	List/ Group	Reference
lightguide office cable (FS1EP-EP-?) "?" indicates length. Specify length required from the Lucent Technologies catalog	Quantity _____ (20 per optical line for end terminal required 8 per optical line for repeater required) Length _____		Fiber Optic Products Catalog 2492C
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable (ED-7G028-22)	Quantity _____	G301, G351, G361	Table 7-14
X.25 cable (ED-7G028-22)	Quantity _____	G602, G652	
CIT interface cable (ED-7G028-22)	Quantity _____	G702, G752	
Line OW, section OW, section user channel cable (ED-7G028-22)	Quantity _____	G401, G451, G461	
1st or 2nd serial telemetry cable (ED-7G028-22)	Quantity _____	G201, G251, G261	
software and documentation			Table 7-11 and Table 7-12
METRAL Pin/Tool Kit	Yes/No _____ Enter choice		Table 7-21 and Table 7-23
CLETOP Fiber Cleaning Materials	Yes/No _____ Enter choice		Table 7-20
DANTEL or HARRIS Miscellaneous Discrete Interface Unit	Yes/No _____ Enter choice		Table 7-24
DANTEL Orderwire Shelf	Yes/No _____ Enter choice		"DANTEL Orderwire Shelf"

**Table 7-5. End Terminal/Repeater Worksheet (Sheet 4 of 4)**

Description	Choice	List/ Group	Reference
ST LBO kit	Yes/No _____ (1 per optical line required)	L111	Table 7-10
FC LBO kit	Yes/No _____ (1 per optical line required)	L121	
SC LBO kit	Yes/No _____ (1 per optical line required)	L131	

**Table 7-6. Miscellaneously Mounted Shelf - End Terminal (Sheet 1 of 3)**

Description	Choice	List/ Group	Reference
Miscellaneously Mounted Shelf - End Terminal Shelf		L10	Table 7-10
Miscellaneously Mounted End Terminal Kit		L106	
Optical Amplifier circuit pack (OA)-Long Span	Quantity _____ (2 per optical line required)	L20	Table 7-16
Optical Amplifier circuit pack (OA)-Long Reach	Quantity _____ (2 per optical line required)	L21	
telemetry circuit pack	Quantity _____ (1 per optical line required)	L25	
tributary overhead controller circuit pack	Quantity _____ (1 per shelf required)	L30	
system controller circuit pack	Quantity _____ (1 per shelf required)	L35	
system memory circuit pack	Quantity _____ (1 per shelf required)	L40	
optical demultiplexing unit	Quantity _____ (1 per optical line required)	L50	
optical multiplexing unit	Quantity _____ (1 per optical line required)	L60	

**Table 7-6. Miscellaneously Mounted Shelf - End Terminal (Sheet 2 of 3)**

Description	Choice	List/ Group	Reference
lightguide jumper kit	Quantity _____ (1 per optical line required)	L161	Table 7-10
lightguide office cable (FS1EP-EP-?) "?" indicates length. Spec- ify length required from the Lucent Technologies catalog	Quantity _____ (20 per optical line required) Length _____		Fiber Optic Products Catalog 2492C
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable (ED-7G028-22)	Quantity _____	G301, G351, G361	Table 7-14
X.25 cable (ED-7G028-22)	Quantity _____	G602, G652	
CIT interface cable (ED-7G028-22)	Quantity _____	G702, G752	
Line OW, section OW, sec- tion user channel cable (ED-7G028-22)	Quantity _____	G401, G451, G461	
1st or 2nd serial telemetry cable (ED-7G028-22)	Quantity _____	G201, G251, G261	
software and documentation			Table 7-11 and Table 7-12
METRAL Pin/Tool Kit	Yes/No _____ Enter choice		Table 7-21 and Table 7-23
CLETOP Fiber Cleaning Materials	Yes/No Enter choice		Table 7-20

**Table 7-6. Miscellaneously Mounted Shelf - End Terminal (Sheet 3 of 3)**

Description	Choice	List/ Group	Reference
DANTEL or HARRIS Miscellaneous Discrete Interface Unit	Yes/No _____ Enter choice		Table 7-24
DANTEL Orderwire Shelf	Yes/No _____ Enter choice		"DANTEL Orderwire Shelf"
ST LBO kit	Yes/No _____ (1 per optical line required)	L111	Table 7-10
FC LBO kit	Yes/No _____ (1 per optical line required)	L121	
SC LBO kit	Yes/No _____ (1 per optical line required)	L131	

**Table 7-7. Miscellaneously Mounted Shelf - Repeater (Sheet 1 of 3)**

Description	Choice	List/ Group	Reference
Miscellaneously Mounted Shelf - Repeater Shelf		L10	Table 7-10
Miscellaneously Mounted -Repeater Kit		L107	
Optical Amplifier circuit pack (OA)-Long Span	Quantity _____ (2 per optical line required)	L20	Table 7-16
Optical Amplifier circuit pack (OA)-Long Reach	Quantity _____ (2 per optical line required)	L21	
telemetry circuit pack	Quantity _____ (2 per optical line required)	L25	
tributary overhead controller circuit pack	Quantity _____ (1 per shelf required)	L30	
system controller circuit pack	Quantity _____ (1 per shelf required)	L35	
system memory circuit pack	Quantity _____ (1 per shelf required)	L40	
lightguide jumper kit	Quantity _____ (1 per optical line required)	L161	Table 7-10

**Table 7-7. Miscellaneously Mounted Shelf - Repeater (Sheet 2 of 3)**

Description	Choice	List/ Group	Reference
lightguide office cable (FS1EP-EP-?) "?" indicates length. Specify length required from the Lucent Technologies catalog	Quantity _____ (8 per optical line required) Length _____		Fiber Optic Products Catalog 2492C
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable (ED-7G028-22)	Quantity _____	G301, G351, G361	Table 7-14
X.25 cable (ED-7G028-22)	Quantity _____	G602, G652	
CIT interface cable (ED-7G028-22)	Quantity _____	G702, G752	
Line OW, section OW, section user channel cable (ED-7G028-22)	Quantity _____	G401, G451, G461	
1st or 2nd serial telemetry cable (ED-7G028-22)	Quantity _____	G201, G251, G261	
software and documentation			Table 7-11 and Table 7-12
METRAL Pin/Tool Kit	Yes/No _____ Enter choice		Table 7-21 and Table 7-23
CLETOP Fiber Cleaning Materials	Yes/No _____ Enter choice		Table 7-20
DANTEL or HARRIS Miscellaneous Discrete Interface Unit	Yes/No _____ Enter choice		Table 7-24
DANTEL Orderwire Shelf	Yes/No _____ Enter choice		"DANTEL Orderwire Shelf"

**Table 7-7. Miscellaneously Mounted Shelf - Repeater (Sheet 3 of 3)**

Description	Choice	List/Group	Reference
ST LBO kit	Yes/No _____ (1 per optical line required)	L111	Table 7-10
FC LBO kit	Yes/No _____ (1 per optical line required)	L121	
SC LBO kit	Yes/No _____ (1 per optical line required)	L131	

**Table 7-8. 4 Line End Terminal-to-Dual End Terminal Conversion Worksheet (J68982C-1) \***

Description	Choice	List	Reference
Telemetry circuit pack	Quantity _____ (1 per optical line required)	L25	Table 7-10 and Table 7-16
Tributary overhead controller pack	Quantity _____ (1 per shelf required)	L30	
System controller pack	Quantity _____ (1 per shelf required)	L35	
System memory circuit pack	Quantity _____ (1 per shelf required)	L40	
Conversion kit <sup>†</sup>	Quantity _____ (1 per conversion required)	L310	Table 7-13 <sup>‡</sup>

**Table 7-8. 4 Line End Terminal-to-Dual End Terminal Conversion Worksheet  
 (J68982C-1) — Continued \***

Description	Choice	List	Reference
Dual End Terminal kit	Quantity _____ (1 per cabinet required)	L103	Table 7-10
Lightguide Jumper kit	Quantity _____ (1 per optical line required)	L161	Table 7-10
Lightguide office cable (FS1EP-EP-?) "?" indicates length"	Quantity _____ (20 per optical line required)		Fiber Optic Products Catalog 2492C
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable (ED-7G028-22)	Quantity _____	G301, G351, G361	Table 7-14
X.25 cable (ED-7G028-22)	Quantity _____	G602, G652	
CIT interface cable (ED-7G028-22)	Quantity _____	G702, G752	
Line OW, section OW, section user channel cable (ED-7G028-22)	Quantity _____	G401, G451, G461	
1st or 2nd serial telem- etry cable (ED-7G028-22)	Quantity _____	G201, G251, G261	
METRAL Pin/Tool Kit	Yes/No _____ Enter choice		Table 7-21 and Table 7-23
CLETOP Fiber Clean- ing Materials	Yes/No _____ Enter choice		Table 7-20
ST LBO kit	Yes/No _____ (1 per optical line required)	L111	Table 7-10

**Table 7-8. 4 Line End Terminal-to-Dual End Terminal Conversion Worksheet  
(J68982C-1) — Continued\***

Description	Choice	List	Reference
FC LBO kit	Yes/No _____ (1 per optical line required)	L121	Table 7-10
SC LBO kit	Yes/No _____ (1 per optical line required)	L131	

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\* Depending on the type of Repeater application and configuration you want, order the appropriate OA, ODU, and OMU circuit packs, and LBOs.

† Please refer to document #: 365-575-312 (MIP001) for the conversion procedure. This procedure assumes one empty shelf prior to the conversion.

‡ Table 7-13 provides ordering information for the underlying components in the conversion kit.

**Table 7-9. 4 Line Repeater-to-Dual Repeater Conversion Worksheet (J68982C-1) \***

Description	Choice	List	Reference
Telemetry circuit pack	Quantity _____ (1 per optical line required)	L25	Table 7-10 and Table 7-16
Tributary overhead controller pack	Quantity _____ (1 per shelf required)	L30	
System controller pack	Quantity _____ (1 per shelf required)	L35	
System memory circuit pack	Quantity _____ (1 per shelf required)	L40	
Conversion kit <sup>†</sup>	Quantity _____ (1 per conversion required)	L310	Table 7-13 <sup>‡</sup>
Dual Repeater kit	Quantity _____ (1 per cabinet required)	L104	Table 7-10
Lightguide Jumper kit	Quantity _____ (1 per optical line required)	L161	Table 7-10
Lightguide office cable (FS1EP-EP-?) "?" indicates length	Quantity _____ (8 per optical line required)		Fiber Optic Products Catalog 2492C

**Table 7-9. 4 Line Repeater-to-Dual Repeater Conversion Worksheet  
(J68982C-1) — Continued \***

Description	Choice	List	Reference
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable (ED-7G028-22)	Quantity _____	G301, G351, G361	Table 7-14
X.25 cable (ED-7G028-22)	Quantity _____	G602, G652	
CIT interface cable (ED-7G028-22)	Quantity _____	G702, G752	
Line OW, section OW, section user channel cable (ED-7G028-22)	Quantity _____	G401, G451, G461	
1st or 2nd serial telemetry cable (ED-7G028-22)	Quantity _____	G201, G251, G261	
DANTEL or HARRIS EMDU kit	Yes/No _____ Enter choice	L 300 or L301	Table 7-24
METRAL Pin/Tool Kit	Yes/No _____ Enter choice		Table 7-21 and Table 7-23
CLETOP Fiber Cleaning Materials	Yes/No _____ Enter choice		Table 7-20
ST LBO kit	Yes/No _____ (1 per optical line required)	L111	Table 7-10
FC LBO kit	Yes/No _____ (1 per optical line required)	L121	
SC LBO kit	Yes/No _____ (1 per optical line required)	L131	

- 
- \* Depending on the type of Repeater application and configuration you want, order the appropriate OA, ODU, and OMU circuit packs, and LBOs.
  - † Refer to Document #: 365-575-312 (MIP001) for the conversion procedure. This procedure assumes one empty shelf prior to the conversion.
  - ‡ Table 7-13 provides ordering information for the underlying components in the conversion kit.

## Ordering Guidelines

### Ordering OLS

This section provides the following aids for ordering complete OLS packages:

- ordering tables for systems, additional circuit packs, cables, software, and documentation
- package descriptions

**Table 7-10. OLS J68982C-1 Equipment Shipped Separately  
 (Sheet 1 of 2)**

List No.	Description
main L1	End Terminal or Repeater (up to 4 optical lines) cabinet equipped with 2 shelves.
main L2	Dual End Terminal or Dual Repeater (up to 2 optical lines per system) cabinet equipped with 2 system shelves.
main L10	Miscellaneously-mounted Shelf
sub L101*	End Terminal (4 line) kit
sub L102*	Repeater (4 line) kit
sub L103*	Dual End Terminal kit
sub L104*	Dual Repeater kit
sub L105*	End Terminal and Repeater kit
sub L106*	Miscellaneously Mounted Shelf - End Terminal kit
sub L107*	Miscellaneously Mounted Shelf - Repeater kit
sub L20	Optical Amplifier circuit pack, 2 per optical line (LEA6)
sub L21	Optical Amplifier circuit pack, 2 per optical line (LEA7)
sub L25	Telemetry circuit pack, 1 per optical line for end terminal, 2 per optical line for repeater (LDA1)
sub L30	Tributary Overhead Controller (TOHCTL), 1 per system (LEA5)

**Table 7-10. OLS J68982C-1 Equipment Shipped Separately  
(Sheet 2 of 2)**

List No.	Description
sub L35	System Controller(SYSCTL) circuit pack, 1 per system (LEA1)
sub L40	system memory(SYSMEM) circuit pack 1per system (LEA2)
sub L50	optical demultiplexing unit (ODU), 1 per optical line (605A) end terminal only
sub L60	optical multiplexing unit (OMU), 1 per optical line (505A) end terminal only
main/sub L161	lightguide jumper kit TLM, OMU, ODU to OA (1per line)
sub L111	LBO kit, ST (1 per line)
sub L121	LBO kit, FC (1 per line)
sub L131	LBO kit, SC (1 per line)
	lightguide office cable from outside to OA, TLM, ODU, and OMU (FS1EP-EP-?) <sup>†</sup>
G301, G351, G361	Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable (ED-7G028-22)
G602, G652	X.25 cable (ED-7G028-22)
G702, G752	CIT interface cable (ED-7G028-22)
G401, G451, G461	Line OW, section OW, section user channel cable (ED-7G028-22)
G201, G251, G261	1st or 2nd serial telemetry cable (ED-7G028-22)
L310	Conversion Kit (4 Line-to-Dual)

\* These list numbers are factory installed and are not ordered separately.

<sup>†</sup> Refer to the the *Lucent Technologies Fiber Optic Products* catalog for standard and customized cable lengths.

## **Package Descriptions**

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### **4 Bidirectional Line End Terminal/Repeater Application (L1) Package**

**Description:** The End Terminal/Repeater package provides a 2 shelf cabinet equipped with a heat baffle, fuse panel, power filters, indicator strip, cables, rear cover, and door.

### **Dual End Terminal/Repeater Application (L2) Package Description:**

The Dual End Terminal/Repeater package provides a 2 shelf cabinet equipped with a heat baffle, fuse panel, power filters, indicator strip, cables, rear cover, and door.

### **Miscellaneous Mounted Shelf Application (L10) Package Description:**

The Miscellaneous Mounted Shelf package provides a miscellaneous mounted shelf, heat baffle, and covers.

### **End Terminal (4 Line) (L101) Package Description:**

The End Terminal package provides the necessary labels for an end terminal application.

**Repeater (4 Line) (L102) Package Description:** The Repeater package provides the necessary labels for a repeater application.

**Dual End Terminal (L103) Package Description:** The Dual End Terminal package provides the necessary labels for a dual end terminal application.

**Dual Repeater (L104) Package Description:** The Dual Repeater package provides the necessary labels for a dual repeater application.

**End Terminal/Repeater Combination (L105) Package Description:** The End Terminal/Repeater combination package provides the necessary labels for an end terminal/repeater application.

**Miscellaneously Mounted Shelf - End Terminal (L106) Package Description:** The Miscellaneously Mounted Shelf - End Terminal package provides the necessary labels for a miscellaneously mounted shelf - end terminal application.

**Miscellaneously Mounted Shelf - Repeater (L107) Package Description:** The Miscellaneously Mounted Shelf - Repeater package provides the necessary labels for a miscellaneously mounted shelf - repeater application.

**Lightguide Jumper (L161) Package Description:** The lightguide jumper package provides four 50 in. lightguide jumpers and associated labels that are required for one line intrashelf interconnections.

**ST LBO (L111) Package Description:** The ST lightguide build-out kit provides a kit of lightguide build-outs with ST connectors for one bidirectional OLS line.

**FC LBO (L121) Package Description:** The FC lightguide build-out kit provides lightguide build-outs with FC connectors for one bidirectional OLS line.

**SC LBO (L131) Package Description:** The SC lightguide build-out kit provides lightguide build-outs with SC connectors for one bidirectional OLS line.

See "Ordering Spare Circuit Packs/Units and Fuses" for descriptions of the individual circuit packs and units.

### **Related Software and Documentation**

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Table 7-11 and Table 7-12 provide list numbers for OLS software and documentation.

**Table 7-11. OLS J68982CS-1 Software and Documentation Shipped with or Separately from Equipment**

<b>J68982CS-1 List No.</b>		<b>Description</b>
main	2	OLS Software R2.0.0-OLS
sub	M2R	Application Software Right-to-Use Fee (new system)
sub	P2R	Operating System Software Right-to-Use Fee (new system)
sub	B	<i>User Service Manual</i>

**Table 7-12. Ordering Additional Copies of Software and Documentation**

---

<b>Release</b>	<b>Software Release Description</b>	<b>User Service Manual*</b>	<b>Programmed 3.5" Diskettes</b>
2.0.0-OLS	107896607	367-575-301 Issue 2	108128851

---

\* Additional copies of all documentation (except the *Software Release Description*) must be ordered through the Customer Information Center.

## **Conversion Kit**

---

Table 7-13 contains information on the conversion kit for the OLS.

**Table 7-13. Conversion Kit (L310, 4 Line-to-Dual)**

<b>Description</b>	<b>List</b>	<b>Group</b>	<b>Quantity</b>	<b>Comcode</b>
Bus Termination	ED-7G028-20	G-6	2	
User Panel Extension Cable for Upper Shelf (3')	ED-7G028-20	G-10A	1	
User Panel Extension Cable for Lower Shelf (7')		G-10B	1	
CIT (DCE) Extension Cable for Upper Shelf (5')		G-27A	1	
OLS Indicator Strip Assembly			1	847419652
481A Circuit Module			1	107678864

## Cables

This section contains information on the cables required for OLS.

**Table 7-14. Intraoffice Electrical Nontransmission Cables (Associated with OLS)**

Application	T5G276-33 Figure	ED-7G028-22		Remarks
		Group	Length	
Line OW, section OW, section user channel	8, 10, 11	401	as required	2850 ft. maximum
		451	150 ft.	
		461	250 ft.	
X.25 cable	13	602	as required	150 ft. maximum
		652	150 ft.	
1st or 2nd serial teleme- try cable	14	201*	as required	4000 ft. maximum
		251	150 ft.	
		261	250 ft.	
miscellaneous discrete 1 and 2, office alarm, parallel teleme- try	15, 16, 17, 18	301	as required	
		351	150 ft.	
		361	250 ft.	
CIT Interface cable	20	702	as required	150 ft. maximum
	20	752	150 ft.	

\* Use group 201 to connect from serial TLM 1 to the Miscellaneous Discrete Unit.

### Intraoffice Electrical Nontransmission Cable Descriptions

**Line OW:** Line orderwire provides voice communication (E2 byte) between adjacent OLS network elements.

**Section OW:** Section orderwire provides voice communication (E1 byte) between adjacent OLS network elements.

**Section User Channel:** Section user cable provides access to overhead section user channel bits.

**X.25:** X.25 cable provides access to an OS interface.

**Serial Telemetry:** Serial telemetry cable connects OLS to a serial telemetry interface.

**Miscellaneous Discrete:** Miscellaneous discrete cable connects OLS to a user definable set of monitor points.

**Office Alarm:** Office alarm cable connects OLS to the office alarms.

**Parallel Telemetry:** Parallel telemetry cable connects OLS to a parallel telemetry interface.

**CIT Interface:** Craft Interface Terminal (CIT) Data Terminating Equipment (DTE) provides a remote interface to OLS that is functionally similar to the CIT Data Communications Equipment(DCE) port. The port may be used to load software and perform system diagnostics.

**Table 7-15. Power Cables (associated with OLS) (Sheet 1 of 2)**

Description	T5G276-33 Figure	ED-9C103-22		Remarks
		Group	Length	
-48V (A) power feeder	1	1	15 feet	used to power 2 shelves in a cabinet
-48V (B) power feeder	1	2	15 feet	used to power 2 shelves in a cabinet
-48V (A) power feeder	1	3	15 feet	used to power miscellaneous mounted shelf
-48V (B) power feeder	1	4	15 feet	used to power miscellaneous mounted shelf
-48V (A) power feeder	1	11	as required	used to power 2 shelves in a cabinet

**Table 7-15. Power Cables (associated with OLS) (Sheet 2 of 2)**

Description	T5G276-33 Figure	ED-9C103-22		Remarks
		Group	Length	
-48V (B) power feeder	1	12	as required	used to power 2 shelves in a cabinet
-48V (A) power feeder	1	13	as required	used to power miscellaneous mounted shelf
-48V (B) power feeder	1	14	as required	used to power miscellaneous mounted shelf

The items in Table 7-15 provide the assembly and wiring required for one 8 Ga, -48V power feeder.

## Ordering Spare Circuit Packs/Units and Fuses

---

Table 7-16 provides comcodes for ordering spare circuit packs/units. Guidelines to help you determine the number of spares to keep on hand are provided in the “Circuit Pack/Unit Sparing Guidelines” section later in this chapter.

**Table 7-16. Circuit Pack/Unit Comcodes**

Circuit Packs/Units	Code	Comcodes	CLEI
SYSCTL	LEA1	107272510	SNC3SH0A
SYSTEM	LEA2	107786568	SNC3TJTA
TOHCTL	LEA5	107273328	SNC2S00B
TLM	LDA1	107272569	SNC2R00B
OMU	505A	107292179	SNC2JL0A
ODU	605A	107292187	SNC2KL0A
OA	LEA6	107273366	SNC2U00B
OA	LEA7	107742439	SNC7RROC

Table 7-17 provides the comcode for ordering the power fuse.

**Table 7-17. Ordering Information For Power Fuse**

Item	Fuse Capacity	Comcode
Fuse	10 Amperes	405749920
Fuse Cap*	--	40741179
Fuse Holder	--	407604388

---

\* The fuse cap lamp is a fuse status indicator. The cap lamp works correctly when it is fully engaged and the fuse retainer is locked in place. If the lamp lights in any other position, it may incorrectly indicate a bad fuse

## **Circuit Pack/Unit Descriptions**

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For more information on electrical and optical circuit packs and units, refer to Chapter 4, "Product Description."

**SYSCTL (L35):** The system controller circuit pack provides system level user and operations system interfaces and performs system wide maintenance and performance monitoring operations. SYSCTL supports serial telemetry and X.25 interfaces.

**SYSTEMEM (L40):** The system memory circuit pack provides memory support for SYSCTL. User provisioned data and system software are stored in EPROMs on the SYSTEMEM circuit pack.

**TOHCTL (L30):** The tributary overhead controller circuit pack processes the SONET section overhead of the supervisory channel. TOHCTL interfaces with the TLM circuit pack to exchange DCC data.

**TLM (L25):** The telemetry circuit pack provides the supervisory signal that is used for fault location and maintenance functions. This circuit pack also provides the customer maintenance signal and three orderwire channels.

**OMU (L60):** The optical multiplexer units combine the eight drop side signals into one optical signal called the optical line signal.

**ODU (L50):** The optical demultiplexer units demultiplex the optical line signal into the eight drop side signals.

**OA (L20):** The optical amplifier (LEA6) circuit pack amplifies the optical signal and controls the pump lasers.

**OA (L21):** Used for Long reach (LEA7) applications, this optical amplifier circuit pack amplifies the optical signal and controls the pump lasers.

## **Circuit Pack/Unit Sparing Guidelines**

This section provides the sparing information for OLS. The information is provided in the form of graphs. An example using the graphs is included.

You can use sparing information for 10-day and 64-day lead times and up to 20000 circuit packs in service. Lead time is the time between placing an order for a circuit pack/unit and receiving it.

### **Lead Time**

**Lead time**, also known as turnaround time, is defined as the elapsed time from when a circuit pack is known to fail at a given service location to when a repaired (or new) circuit pack arrives at the location where spare circuit packs are stocked (centralized or local) to maintain a circuit spare level consistent with the circuit pack population in service.

Lead time should not be confused with Mean Time to Repair (typically, 2 to 4 hours), which is the time elapsed from when a circuit pack is known to fail in service to when a spare circuit pack is placed in service to replace the failed pack.

### **Sparing Examples**

This section provides guidelines and a procedure to help you determine how many spare circuit packs or units to order for OLS. The steps listed below show how to use Table 7-18, Figure 7-1, and Figure 7-2 to determine how many spare circuit packs to order to maintain 99.9% service continuity, given either a 10-day lead time or a 64-day lead time.

1. Refer to Table 7-18 and determine the circuit pack or unit (CP/Unit) FIT rate. For example, the circuit pack (CP) FIT rate for SYSMEM (LEA2) is 1600.
2. Select the chart corresponding to one of the following lead times:
  - Figure 7-1 for 10-day lead time
  - Figure 7-2 for 64-day lead time

For example, if the lead time is 10 days, use Figure 7-1.

3. Refer to the chart and select the curve that represents the nearest CP FIT rate. For example, the nearest curve for a FIT rate of 1149 (SYSTEM MEM CP) is 1000.
4. Follow the curve to the intersection with the vertical line that represents the number of circuit packs in service at a given location. For example, let us say that there are 100 circuit packs in service.
5. The horizontal line immediately above the intersection represents the minimum number of circuit pack spares recommended for that location. For example, suppose there are 100 circuit packs in service at a location, the FIT rate is 1149, and the lead time is 10 days (see Figure 7-1). In this case, you would need to order and stock 2 spare circuit packs at this location.

**Table 7-18. CP/Unit FIT Rates for OLS**

---

<b>Description</b>	<b>Code</b>	<b>FIT*</b>
SYSCTL	LEA1	1374
SYSTEM	LEA2	1149
TOHCTL	LEA5	969
ODU	605A	374
OMU	505A	354
OA	LEA6	4726
OA	LEA7	6000
TLM	LDA1	1414

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\* Based on the Lucent Technologies *Reliability Information Note-book*, 7th Edition, August 1995.

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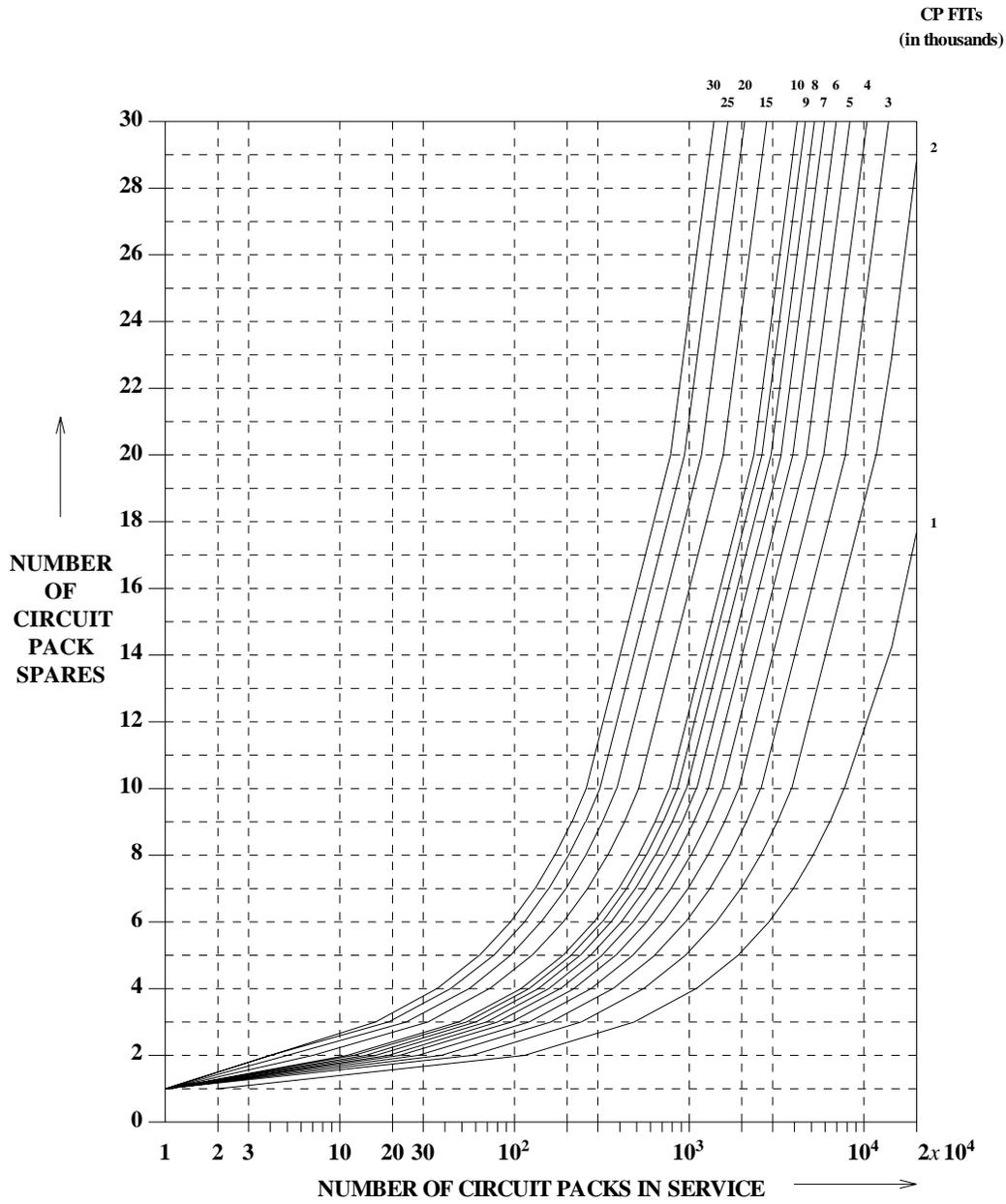


Figure 7-1. Sparing Chart -- 10-Day Lead Time

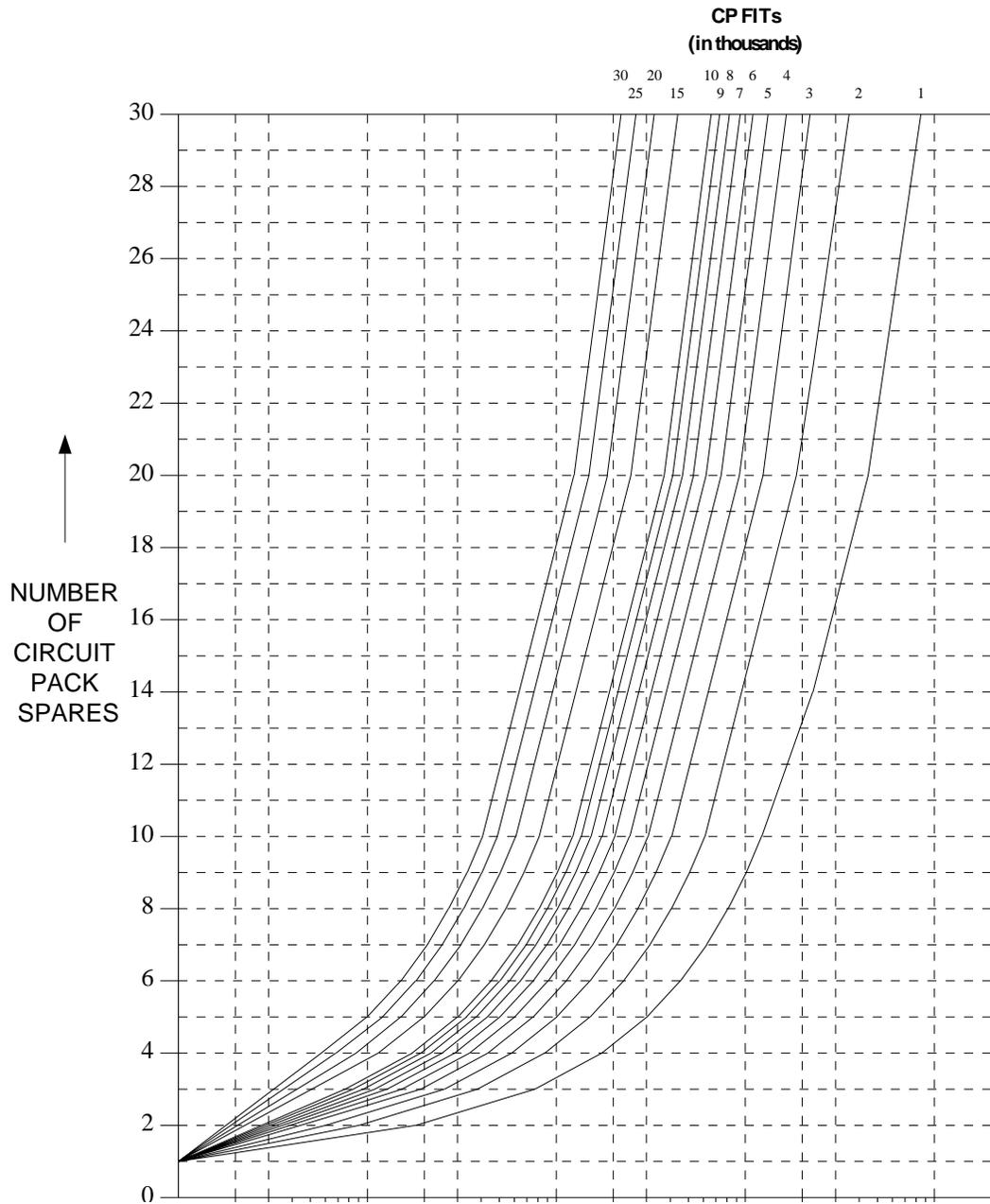


Figure 7-2. Circuit Pack Sparing Chart -- 64-Day Lead Time

## Related Framework

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This section is provided for your convenience, as an overview to OLS cabinet hardware and framework. To order framework for the miscellaneous mounted shelf, use the *Seismic Network Bay Frame Application, Planning and Ordering Guide* (065-215-200).

1. OLS provides front access for all office and user interfaces. All inter-office cables and fiber connections are possible from the front of the system.
2. 120V AC power is needed near the cabinet to power a PC or charge a portable PC.
3. The following table provides ordering information for recommended cable racking systems and end guards for OLS.

**Table 7-19. Related Cabinet Hardware**

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Framework	Number	Group
cable rack	ED-5D742-70	2 10
end guard	ED-5D743-70	21 22

## **Related Products**

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### **Ordering Cleaning Materials**

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Table 7-20 lists cleaning materials recommended for optical fiber connectors (*ST*, *FT*, and *SC* types). Order these materials directly from **Speer Fiber Optics** at **1-908-359-1173**.

**Table 7-20. Cleaning Materials for Optical Fiber Connectors\***

<b>Manufacturer's Product Name</b>	<b>Manufacturer's Part Number</b>
Cletope Cassette	14100500
Cletope Replacement Reel	14100700
Cletope Sticks (200 sticks/box)	14100400

\* Speer Fiber Optics, 18 Pierson Drive, Belle Mead, NJ 08502

### **Ordering METRAL Backplane Replacement Pins**

---

Backplane pins sometimes bend or break from incorrect circuit pack insertion and removal. Table 7-21 through Table 7-23 provide information on pin types and pin replacement kits for the OLS. Order these materials directly from **Berg Electronics** at **1-717-938-6711**.

**Table 7-21. METRAL Pin Ordering Information**

<b>Pin Type (Kit Device Code)</b>	<b>Quantity per kit</b>	<b>Pin Length (mm)</b>
88929-102	25	5.75/4.3
88929-106	25	5.75/13.6
88929-119	25	8.00/4.3
88930-101	25	Blade

**Table 7-22. OLS Equipment Locations and Pin Types**

Circuit Pack	Backplane Location	Rows Using Pin Type: 88929-102	Rows Using Pin Type: 88929-106	Rows Using Pin Type: 88929-119	Rows Using Pin Type: 88930-101
SYSMEM (LEA2)	20-604	1-18, 25-72, 97-156	19-24, 85-96	157-162	
SYSCTL (LEA1)	20-584	1-12, 49-72, 85-114, 127-150	151-156	157-162	
TOHCTL (LEA5)	20-554	19-66, 85-90, 97-102, 115-138	151-156	157-162	
OA (LEA6, LEA7, LEA104, LEA105)	20-534, 20-434, 20-330, 20-230	1-12, 109-114, 121-150	151-156	157-162	
TLM (LDA1)	52-180, 52-230, 52-280, 52-330	19-42, 55-90	91-96	97-102	
OMU/ODU (505A/605A)	52-382, 52-430, 52-478, 52-526	1-24, 73-96		97-102	
USER PNL	45-557	1-12			
PWR A	50-597				1-12
PWR B	44-597				1-12

**Table 7-23. Ordering METRAL Pin Kit/Pin Tool Kit**

<b>Product Name</b>	<b>Supplier's Order Number *</b>
METRAL pin replacement tool kit	MT-370-01

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\* Berg Electronics, 825 Old Trail Road, Eters, PA. 17319

### **Ordering the External Miscellaneous Discrete Unit**

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Table 7-24 lists External Miscellaneous Discrete Units (EMDUs) available from DANTEL, Inc. and HARRIS, Inc. These units provide user-settable functions, as described in Chapter 5, for the control and monitoring of equipment co-located with the OLS.

These units are optional. You may order the units either directly from the manufacturer using the order numbers listed in the table, or from Lucent Technologies using the Comcode Numbers listed.

You must use Cable ED-7G028-22 G201 to connect an External Miscellaneous Discrete Unit to the first Serial Telemetry SER TLM1(P19) port.

**Table 7-24. Ordering Information for External Miscellaneous Discrete Unit (EMDU)\***

Manufacturer's Name	Manufacturer's Model Name	Manufacturer's Order Number	Lucent Comcode Number†
Dantel‡	Alarm Control Block	Model No. 46220-00	407567924
Dantel	Mounting Bar	A25-00508-01	406863621
Harris**	C-1000 Centurion	594-T043	407567932
Harris	Strip Terminal		407809003

\* This is not the EMDU kit. This table acts as an EMDU model number reference only. For kits, order by list number.

† It is recommended that you use the Lucent Technologies comcode number when ordering.

‡ Dantel, Inc., 2991 No. Argyle Avenue, Fresno, CA 93727-1321

\*\* Harris Corp., Controls Division, Network Support Products, 1850 No. Greenview Ave, M/S 184, Richardson TX 75081

### **DANTEL Orderwire Shelf**

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The DANTEL orderwire shelf provides a 64 kb/s interface to the OLS. It is shipped separately and does not mount in an OLS Cabinet.

The orderwire shelf is optional and is available from either Lucent Technologies or DANTEL Inc. (tel: 209-292-1111). Use the following information, when ordering:

**Lucent Comcode:** 407790286 Kit, DANTEL interface voice-data orderwire

**DANTEL Part #:** D18-05547-04

## Software Compatibility

The following table provides information on the compatibility of OLS software generic releases and equipment configurations. An 'X' indicates that the software release is designed to recognize, maintain, and operate with the specified equipment configuration.

**Table 7-25. OLS Slot/Circuit Pack/ Software Compatibility (Sheet 1 of 3)**

Slot	Supported Pack Codes	Software Generic Release 2.0.0 Quantity	
		without protection	with protection
<b>4 Line End Terminal (Lower Shelf [Shelf 1]), Miscellaneously Mounted Shelf, or Dual End Terminal (Upper or Lower Shelf)</b>			
TLM 1A/B	LDA1	1	1
TLM 2 A/B	LDA1	0 or 1	1
OMU 1	505A	1	1
ODU 1	605A	1	1
OMU 2	505A	0 or 1	1
ODU 2	605A	0 or 1	1
OA 1A	LEA6/LEA7	1	1
OA 1B	LEA6/LEA7	1	1
OA 2A	LEA6/LEA7	0 or 1	1
OA 2B	LEA6/LEA7	0 or 1	1
TOHCTL	LEA5	1	1
SYSCTL	LEA1	1	1
SYSTEMEM	LEA2	1	1
<b>4 Line End Terminal Upper Shelf (Shelf 2)</b>			
TLM 3A/B	LDA1	0 or 1	0 or 1

**Table 7-25. OLS Slot/Circuit Pack/ Software Compatibility (Sheet 2 of 3)**

Slot	Supported Pack Codes	Software Generic Release 2.0.0 Quantity	
		without protection	with protection
TLM 4A/B	LDA1	0 or 1	0 or 1
OMU 3	505A	0 or 1	0 or 1
ODU 3	605A	0 or 1	0 or 1
OMU 4	505A	0 or 1	0 or 1
ODU 4	605A	0 or 1	0 or 1
OA 3A	LEA6/LEA7	0 or 1	0 or 1
OA 3B	LEA6/LEA7	0 or 1	0 or 1
OA 4A	LEA6/LEA7	0 to 1	0 or 1
OA 4B	LEA6/LEA7	0 or 1	0 or 1
<b>4 Line Repeater Shelf (Lower Shelf [Shelf 1]), Miscellaneously Mounted Shelf, or Dual Repeater (Upper or Lower Shelf)</b>			
TLM 1A/B	LDA1	1	1
TLM 1B/A	LDA1	1	1
TLM 2A/B	LDA1	0 or 1	1
TLM 2B/A	LDA1	0 or 1	1
OA 1A	LEA6/LEA7	1	1
OA 1B	LEA6/LEA7	1	1
OA 2A	LEA6/LEA7	0 or 1	1
OA 2B	LEA6/LEA7	0 or 1	1
TOHCTL	LEA5	1	1
SYSCTL	LEA1	1	1
SYSTEM	LEA2	1	1

**Table 7-25. OLS Slot/Circuit Pack/ Software Compatibility (Sheet 3 of 3)**

Slot	Supported Pack Codes	Software Generic Release 2.0.0 Quantity	
		without protection	with protection
<b>4 Line Repeater Upper Shelf (Shelf 2)</b>			
TLM 3A/B	LDA1	0 or 1	0 or 1
TLM 3B/A	LDA1	0 or 1	0 or 1
TLM 4A/B	LDA1	0 or 1	0 or 1
TLM 4B/A	LDA1	0 or 1	0 or 1
OA 3A	LEA6/LEA7	0 or 1	0 or 1
OA 3B	LEA6/LEA7	0 or 1	0 or 1
OA 4A	LEA6/LEA7	0 or 1	0 or 1
OA 4B	LEA6/LEA7	0 or 1	0 or 1



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# Product Support

# 8

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■ Engineering and Installation Services	8-1
■ Technical Support	8-2
■ Documentation Support	8-6
■ Training Support	8-6
■ Warranty Support	8-6
■ Account Executive Support	8-6



This chapter describes how Lucent Technologies supports the Optical Line System (OLS). Support includes engineering and installation services, technical support, documentation support, and training.

## **Engineering and Installation Services**

The Lucent Technologies Customer Support and Operations (CS&O) organization is committed to providing customers with quality product support services. Whether you need assistance in engineering, installation, normal system maintenance, or disaster recovery, the support staff provides you with the quality technical support you need to get your job done. Each segment of the CS&O organization regards the customer as its highest priority and understands your obligation to maintain quality service for your customer.

Within the CS&O organization, the Engineering and Installation Services group provides a highly skilled force of support personnel to provide customers with quality engineering and installation services. These engineering and installation specialists use state-of-the-art technology, equipment, and procedures to provide customers with highly competent, rapid response services. These services include analyzing your equipment request, preparing a detailed specification for manufacturing and installa-

tion, creating and maintaining job records, installing the equipment, and testing and turning over a working system.

When the CS&O organization provides job records and installs the equipment, operationally affective changes to the system are automatically identified and applied to the system at no additional cost.

The Engineering and Installation Services group provides the customer with an individually tailored, quality-tested job that meets our published high standards and the customer's operational requirements. The group ensures that the customer's system order is integrated into a complete working system tailored to office conditions and preferences. This process provides for the customer's complete needs. It includes provisions for cabling, lighting, power equipment, and ancillary connections to local and/or remote alarm systems. The group also responds to any customer changes that occur during installation.

All equipment engineered and installed by Lucent Technologies is thoroughly tested and integrated into a reliable system at cutover. Once approved by Lucent Technologies' Quality Assurance Test group (the industry's toughest), the system is turned over to the customer.

The group also provides any specialized engineering and installation services required for unusual or highly individualized applications. These specialized services may include engineering consultations and database preparation. Your local Account Executive can provide more information about these services.

## **Technical Support**

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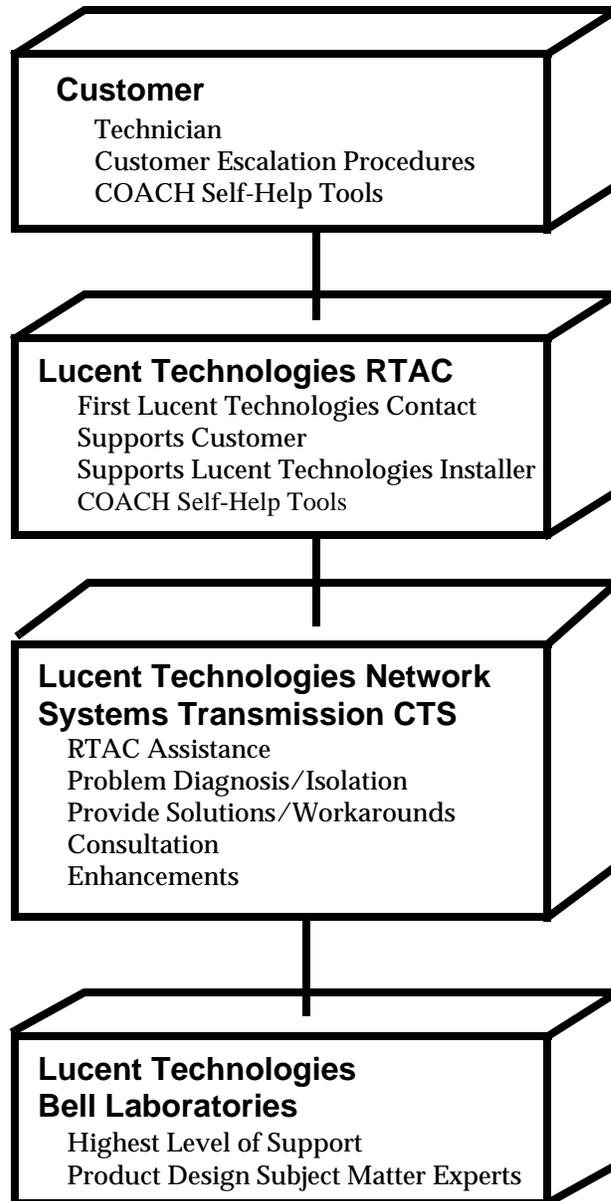
Assistance in maintaining your installed system is available through the Regional Technical Assistance Center (RTAC) and Customer Technical Support (CTS). As shown in Figure 8-1, your single point of contact is the RTAC. RTAC personnel troubleshoot field problems 24 hours a day over the phone and, if necessary, on site. For technical assistance, simply call **1-800-225-RTAC (7822)**. One call guarantees support. You can also call this number to provide comments on OLS or to suggest enhancements.

RTAC organizations are supported by a centralized CTS for transmission products. CTS maintains a close relationship with Bell Laboratories to expedite resolutions and maintain contact with the development community. This association provides continuous accessibility to every phase of a product life cycle and assures a prompt resolution to all inquiries.

CTS has also established a technical support medium: the COACH customer support tools. COACH is a system of on-line support tools aimed at providing product news and bulletins, diagnostic services, compatibility information, and on-line documents. COACH tools provide you with the most up-to-date product information so that problems are either prevented or quickly resolved. COACH tools reside on a dedicated time-share computer accessible over toll free lines and are available 24 hours a day, seven days a week. For information about how to access COACH, contact your local Account Executive.

Many transmission products are currently supported by COACH, including OLS.

Once connected to COACH, the user specifies which product to access and COACH grants the appropriate combination of tools and commands. Each one of these tools and commands is reached through a centralized, menu-driven computer program. Every screen provides help in making appropriate menu selections. COACH users achieve proficiency quickly because of the consistency of menu selections among products.



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Figure 8-1. Product Support

These COACH tools are available to the user:

Diagnostic dictionary	The diagnostic dictionary contains histories of previously encountered problems and the descriptions of the solutions or workarounds. Your support staff can use this tool when published documentation or standard diagnostic procedures fail to address a problem. Your support staff is allowed to enter problems and solutions into the customer input area of the diagnostic dictionary. CTS personnel evaluate the data daily and, when appropriate, the data is moved to the general area.
News and bulletins	Immediately after a user log in to the COACH tools, the news and bulletins tool displays bulletins containing urgent information relating to all the user's products. All users are automatically notified about urgent matters such as problems with scheduled releases, recalls of hardware or software, or scheduled maintenance for computer support. Less urgent messages are distributed through news items that can be sent to individuals or categories of users. Notification of news appears on the screen immediately following current bulletins.
Compatibility data	Occasionally, hardware/software configuration problems arise when new software generics are issued. The compatibility data tools permit users to view the correct hardware configuration associated with a specific software generic. The user simply enters the appropriate software generic number and COACH responds with page-formatted lists of circuit packs compatible with the selected software generic.
Ordering guides	With the COACH ordering guide tool, users can obtain an electronic copy of the latest version of the ordering guide for selected products served by COACH tools. This eliminates the time-consuming delays experienced in distributing printed documentation.
COACH user's guide	COACH supplies an on-line version of its user's guide. The COACH user's guide includes instructions on using the customer support tools and documents any changes to the previous version of the guide.

CTS strives to provide proactive and responsive technical customer support for all its products. Through the combined efforts of the individual customer support groups and through COACH tools, CTS provides you with the best possible customer support.

## **Documentation Support**

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The Lucent Technologies Customer Training and Information Products (CTIP) organization provides a customer comment form in the front of this guide. Please use the form to report errors or make suggestions about the document. If the form is missing, please send or fax your comments to:

Lucent Technologies  
Customer Training and Information Products  
Building 21, Room 3A-06  
1600 Osgood Street  
North Andover, MA 01845

Fax Number: (508) 960-6835

## **Training Support**

---

For course information, refer to “Training” in the “About This Document” chapter.

## **Warranty Support**

---

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

## **Account Executive Support**

---

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

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# Reliability and Quality

# 9

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■ Overview	9-1
■ Reliability Specifications	9-2
■ Maintainability Specifications	9-4
■ Warranty	9-4



---

# Reliability and Quality

# 9

---

## Overview

---

Reliability is a key ingredient of a product's life cycle, beginning at the earliest planning stage and continuing into product architecture, design and simulation, documentation, prototyping, testing, design change control, manufacturing and product testing (which includes 100% screening), product quality assurance, product field performance, and product field return management. Each stage of the product's life cycle relies on people and processes that contribute to product reliability growth with customer satisfaction as the primary goal.

Using critical elements to ensure the product's reliability, product development requires strict adherence to

- Design standards
- Design and test practices
- Comprehensive qualification programs
- System-level reliability integration
- Reliability audits and predictions
- Development of assurance standards for the manufactured product

During manufacturing and field deployment, OLS's reliability is further enhanced by

- Premanufacturing
- Qualification
- Accelerated product testing
- Production screening
- Product quality tracking
- Failure mode analysis
- Feedback and corrective actions

Independent Quality Representatives are also present at manufacturing locations to ensure Shipped Product Quality.

## **Reliability Specifications**

---

The tables in this chapter list OLS reliability specifications.

The numbers in Table 9-1 are based on the *Reliability Prediction Procedure for Electronic Equipment*, Issue 5, December 1995.

The mean time to repair assumption is less than or equal to two hours (includes dispatch, diagnostic, and repair time).

**Table 9-1. OC-48 Channel Unavailability (min/year/channel)**

Description	Value
2 Line* End Terminal	0.003
2 Line* Repeater	0.002
4 Line* End Terminal	0.006
4 Line* Repeater	0.005
360 km 4 Line* System (2 x 4 Line* End Terminals and 2 x 4 Line* Repeaters)	0.020

---

\*. One line used for protection

**Table 9-2. Telemetry Channel Unavailability (min/year/channel)**

Equipment	Value
End Terminal	42
Repeater	49

**Table 9-3. Silent Failure Unavailability**

Equipment	Value
End Terminal	0
Repeater	0

**Table 9-4. Mean Time\* Between Maintenance Activities**

Equipment	Mean Time
2 Line End Terminal	42 months
2 Line Repeater	40 months
4 Line End Terminal	21 months
4 Line Repeater	20 months

\*. Figures in Table 9-4 are based on the Lucent Technologies  
*Reliability Information Notebook*, 7th Edition, August 1995.

**Table 9-5. Product Infant Mortality and Design Life**

Specification	Value
Infant Mortality	$\leq 1.6$ times the steady state failure rate
Product Design Life	25 years

**Table 9-6. CP/Unit FIT Rates per Bellcore RPP\***

Description	Code	FIT
SYSCTL	LEA1	3387
SYSMEM	LEA2	7118
TOHCTL	LEA5	2549
ODU	605A	1540
OMU	505A	1538
OA	LEA6/LEA7	16848
TLM	LDA1	6625

---

\*. Based on Method I of the *Reliability Prediction Procedure for Electronic Equipment*, Issue 5, December 1995.

---

## **Maintainability Specifications**

---

OLS requires no periodic maintenance. Continuous performance monitoring allows OLS to detect problems before they become service-affecting.

## **Warranty**

---

The terms and conditions of sale include a five-year warranty on OLS hardware and a one-year warranty on software.

---

# Technical Specifications

# 10

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■ Optical Connector Interfaces	10-1
■ Transmission Medium	10-1
■ Lightguide Jumpers	10-1
■ Optical Safety (BRH Classification)	10-2
■ Operating Wavelength	10-2
■ Optical Dispersion	10-2
■ Optical Return Loss	10-2
■ Optical Reflections Tolerance	10-2
■ Optical Line Rate	10-2
■ Optical Amplifier Output Power	10-2
■ Outside Plant Loss	10-4
■ Capacity	10-4
■ Transmission Standards Compliance	10-4
■ Cable Access	10-5
■ Power Specifications	10-5
■ Dimensions	10-7
Circuit Pack/Unit Dimensions	10-8
■ Floor Loading Specifications	10-9
■ Environmental Specifications	10-11
■ Handling and Transportation	10-12
■ Reliability Specifications	10-13
■ Hardware Unavailability	10-14
■ Silent failure unavailability	10-15
■ Mean Time Between Maintenance Activities	10-15
■ Input Power	10-15
■ Tone Frequencies	10-16

■ Optical Signal to Noise Ratio (SNR)	10-17
■ Customer Maintenance Signal	10-18
■ Engineering Rules	10-19
Use of LBOs	10-19
Network Topologies	10-19
Dispersion	10-20
OLS/OT Interworking	10-20
Engineering Rules for OA Applications	10-21

This chapter contains the technical specifications for the Optical Line System (OLS). Bellcore *Technical Reference 253* (TR 253) is the basis for this information.

## **Optical Connector Interfaces**

---

The OLS optical amplifier, telemetry circuit packs, optical multiplexer and optical demultiplexer units use ST<sup>®</sup> lightguide connectors, FC lightguide connectors, or SC lightguide connectors.

## **Transmission Medium**

---

Single-mode fiber

## **Lightguide Jumpers**

---

Single-mode lightguide jumpers are used on the optical amplifier and telemetry-supervisory circuit packs.

Multimode lightguide jumpers are used with the telemetry - customer maintenance signal.

## **Optical Safety (BRH Classification)**

OLS meets the Class 1 optical safety standard.

## **Operating Wavelength**

The operating wavelength range for OLS is 1550 nm  $\pm$  6 nm.

## **Optical Dispersion**

Optical dispersion for OC-48 standard performance (1.55  $\mu$ m) is 19 ps/nm-km on single-mode fiber.

## **Optical Return Loss**

The optical return loss for OLS is > 40dB

## **Optical Reflections Tolerance**

The OA ports within OLS tolerate up to - 27dB of reflectance.

## **Optical Line Rate**

OLS supports an optical line rate of up to 20 Gb/s.

## **Optical Amplifier Output Power**

Table 10-1 provides values for the output power of the Optical Amplifier (OA).

**Table 10-1. OA Output Power**

No. of Equipped OLS Channels	Output Power (dBm) for 8-Channel Systems	Output Power (dBm) for 16-Channel Systems
0	11.9 ±±± 0.9	8.1 ± 0.9
1	12.4 ± 0.7	8.6 ±± 0.7
2	12.4 ± 0.7	9.1± 0.7
3	13.7 ± 0.7	10.8 ± 0.7
4	14.5 ± 0.7	11.8 ± 0.7
5	15.2 ±± 0.7	12.7 ± 0.7
6	15.7 ± 0.7	13.3 ± 0.7
7	16.0 ± 0.7	13.9 ± 0.7
8	16.0 ± 0.7	14.1 ± 0.7
9		14.5 ± 0.7
10		14.9 ± 0.7
11		15.2 ± 0.7
12		15.5 ± 0.7
13		15.8 ± 0.7
14		16.0 ± 0.7
15		16.3 ± 0.7
16		16.5 ± 0.7

The OA output power depends only on the number of equipped input channels. It is adjusted automatically by software whenever the number of channels changes. The table above lists the OA output power as a function of the number of equipped OLS channels. The output power ranges of the table assume a 0dB output LBO.

## **Outside Plant Loss**

---

Table 10-2 shows minimum and maximum plant loss values for OA.

**Table 10-2. Plant Loss Between OA Sites**

---

<b>Optical Amplifier Standard Performance</b>	<b>Loss Between OA Sites</b>	
	<b>Min (dB)</b>	<b>Max (dB)</b>
Standard-reach (3-span System)	22.0	33
Long Reach (7-Span Systems)	20	25
Long-Reach (8-Span Systems)	20	24

## **Capacity**

---

384 DS3 15equivalents (258,048 two-way voice circuits per fiber pair). Up to 4 fiber pairs per cabinet.

## **Transmission Standards Compliance**

---

OLS meets single-mode interoffice digital fiber optic systems requirements and objectives as specified in TR 253 and TR 499. Table 10-3 shows OA spacing for the OLS.

**Table 10-3. Minimum and Maximum OA Spacing for OLS**

---

OA Spacing Parameter		<math>10^{-9}</math> accumulated error rate for systems up to 400 kilometers (250 miles)
3-Span Systems	Max	33 dB
	Min	22 dB
7-Span Systems	Max	25 dB
	Min	20 dB
8-Span Systems	Max	24 dB
	Min	20 dB

### **Cable Access**

---

- Front for all customer access
- Connectorized cabling with commercially available connectors

### **Power Specifications**

---

This section provides power specifications on the OLS. Table 10-4 shows power planning information for the OLS.

**Table 10-4. OLS Power Planning**

J68982C-1 Equipment Package	Maximum Power Dissipation		Current Drains per Feeder*	
	Watts	Watts per Square Foot	Nominal at -48V (List 1†)	Maximum (List 2‡)
OLS End Terminal 4 Bidirectional Optical Lines	252	20.2	2.6	5.9
OLS Repeater 4 Bidirectional Optical Lines	320	25.6	3.3	7.5
OLS Dual End Terminal	276	22.1	2.9	6.5
OLS Dual Repeater	344	27.6	3.6	8.0
OLS End Terminal & Repeater	310	24.8	3.2	7.3
OLS Miscellaneously Mounted Shelf	138	NA	1.4	3.2
Terminal	172	NA	1.8	4.0
Repeater				

\*. Nominally both feeders share the current equally for the cabinet or shelf. If one feeder fails, the remaining feeder carries the total load for the cabinet (feeder A + feeder B current).

†. In power engineering, List 1 refers to the current drains used to size batteries and rectifiers. To size batteries and rectifiers, use twice the Nominal (List 1) current drain per feeder. These current drains represent the average busy-hour current at normal operating voltages.

‡. In power engineering, List 2 refers to the current drains used to size feeder cables and fuses. To size feeder cables and fuses, use the Maximum (List 2) current drain per feeder. These current drains represent the peak current under worst case operating conditions.

Table 10-5 shows OLS power specifications.

**Table 10-5. OLS Power Specifications**

---

Specification	Value
Voltage Range, all components	-42.75 to -60 V DC
Power Feeders	Two -48 V power feeders ("A" and "B") required
Fuse Size (per shelf)	10 amps

## **Dimensions**

---

Table 10-6 shows the dimensions of physical OLS components.

**Table 10-6. OLS Physical Dimensions**

---

<b>Equipment</b>	<b>Dimensions</b>
OLS Cabinet*	72 inches (183 cm) high 34 inches (86 cm) wide 24 inches (60 cm) deep
OLS Shelf (Cabinet)	29 inches (73 cm) high 20 inches (50 cm) wide 12 inches (30 cm) deep
OLS Heat Baffle (Cabinet)	3 inches (8 cm) high 20 inches (50 cm) wide 12 inches (30 cm) deep
OLS Shelf (Miscellaneous)	31 inches (80 cm) high 20 inches (50 cm) wide 12 inches (30 cm) deep

---

\*. OLS cabinets and miscellaneous shelves are central office white, the cabinet end guards, cable racks, and lower door frame are office soft blue.

---

### **Circuit Pack/Unit Dimensions**

---

Table 10-7 shows the OLS circuit pack and unit dimensions.

**Table 10-7. OLS Circuit Pack/Unit Dimensions**

---

Equipment	Dimensions
SYSCTL	14 inches (35.6 cm) high 1 inches (2.5 cm) wide 8 inches (20.0 cm) deep
SYSTEM	14 inches (35.6 cm) high 0.8 inches (2.0 cm) wide 8 inches (20.0 cm) deep
OA	14 inches (35.6 cm) high 4 inches (10.0 cm) wide 8 inches (20.0 cm) deep
TOHCTL	14 inches (35.6 cm) high 0.8 inches (2.0 cm) wide 8 inches (20.0 cm) deep
OMU	9 inches (22.8 cm) high 2 inches (5.0 cm) wide 6 inches (15.0 cm) deep
ODU	9 inches (22.8 cm) high 2 inches (5.0 cm) wide 6 inches (15.0 cm) deep
TLM	9 inches (22.8 cm) high 2 inches (5.0 cm) wide 8 inches (20.0 cm) deep

### **Floor Loading Specifications**

---

Table 10-8 shows floor loads for the OLS.

**Table 10-8. OLS Floor Loads**

Configuration	End Terminal		Repeater	
	Weight (lbs)	Weight per Square Foot (lbs/sq. ft.)	Weight (lbs)	Weight per Square Foot (lbs/sq. ft.)
Miscellaneous Shelf	95	NA	90	NA
1-Shelf Cabinet	568	45.4	564	45.1
2-Shelf Cabinet	615	49.2	608	48.6

## **Environmental Specifications**

---

Table 10-9 shows the various temperatures and humidity levels at which the OLS can operate.

**Table 10-9. Operating Temperature/Humidity Values**

---

<b>Operating Condition</b>	<b>Temp/Humidity</b>
Normal Operating Temperature	5°C to 40°C (41° to 104°F)
Short-Term* Operating Temperature	-5°C to 50°C (23° to 122°F)
Normal Operating Humidity†	5% to 85%
Short-Term* Operating Humidity†	5% to 90%
Max. Operating Temperature Change Rate	1°C/min. (1.8° F/min.)

---

\*. Short-term refers to a period of up to 96 consecutive hours and a total of 15 days in one year.

†. Non-condensing.

---

Earthquake and vibration, fire resistance, and airborne contaminant requirements meet the standards of GR-63-CORE Issue 1, Oct. 1995.

Electrostatic, electromagnetic, electrical grounding, and safety requirements meet standards of GR-63-CORE Issue 1, Oct. 1995.

OLS meets the electromagnetic compatibility requirements (EMC) of GR-1089-CORE.

OLS is UL<sup>1</sup> listed and CSA<sup>2</sup> certified.

---

1. Registered trademark of Underwriters Laboratories, Inc.

2. Registered trademark of Canadian Standards Association.

## **Handling and Transportation**

---

Table 10-10 shows the tolerance ranges for various handling and transportation conditions.

**Table 10-10. Handling and Transportation Tolerance Ranges**

---

<b>Condition</b>	<b>Tolerance Range</b>
Vibration & Shock Design Criteria	Complies with GR-63-CORE, Issue 1, Oct 1995
Temperature (Transport/Storage)	-40 °C to 70°C 40°F to 158°F
Relative Humidity (Transport/Storage)	5% to 95%
Storage/Shipment (Altitude)	-200ft to 40,000ft (-61m to 12,133m)

## Reliability Specifications

---

Table 10-11 shows the Failures in Time (FIT) rates for OLS circuit packs and units.

**Table 10-11. CP/Unit FIT Rates per Bellcore RPP\***

---

Description	Code	FIT
SYSCTL	LEA1	3387
SYSTEM	LEA2	7118
TOHCTL	LEA5	2549
ODU	605A	1540
OMU	505A	1538
OA	LEA6/LEA7	16848
TLM	LDA1	6625

---

\*. Based on Method I of the *Reliability Prediction Procedure for Electronic Equipment*, Issue 5, December 1995.

---

## Hardware Unavailability

---

Hardware unavailability is based on *Reliability Prediction Procedure for Electronic Equipment*, Issue 4, September 1992 and a MTTR of less than or equal to four hours. Table 10-12 shows the OLS channel unavailability.

**Table 10-12. Channel Unavailability (min/year/channel)**

---

Description	Value
2 Line* End Terminal	0.003
2 Line* Repeater	0.002
4 Line* End Terminal	0.006
4 Line* Repeater	0.005
360 km 4 Line* System (2 x 4 Line* End Terminals and 2 x 4 Line* Repeaters)	0.02

---

\*. One line is used for protection.

---

Table 10-13 shows telemetry channel unavailability for the OLS.

**Table 10-13. Telemetry Channel Unavailability**

---

Telemetry Channel Unavailability (min/year/channel)	
End Terminal	Repeater
42	49
.0017	.0023

### **Silent failure unavailability**

---

For the OLS End Terminal and Repeater, there is zero (0) silent failure unavailability.

### **Mean Time Between Maintenance Activities**

---

Mean Time Between Maintenance Activities is based on the *Lucent Technologies Reliability Information Notebook*, 6th edition. Table 10-14 shows the mean time between maintenance periods.

**Table 10-14. Mean Time Between Maintenance Activities**

---

Equipment	Mean Time
2 Line End Terminal	42 months
2 Line Repeater	40 months
4 Line End Terminal	21 months
4 Line Repeater	20 months

### **Input Power**

---

The input power for each OC-48 signal wavelength must meet the ranges given in the table below, which are verified to  $\pm 0.7$ dB accuracy. Customer maintenance signal input power is covered in the “Customer Maintenance Signal” section of this chapter.

For installation and acceptance purposes, use a calibrated power meter. Adjust your calculations to take into account any power meter inaccuracy. Table 10-15 provides input power specifications for the OLS.

**Table 10-15. Input Power Specifications**

---

Drop Side Signal	Wavelength (nm)	Power (dBm) ( $\pm 1.0$ )
1	1549.32	-4.0
2	1550.92	-5.3
3	1552.52	-6.5
4	1554.13	-7.2
5	1555.75	-7.7
6	1557.37	-8.2
7	1558.98	-8.0
8	1560.61	-6.5

## **Tone Frequencies**

---

The frequencies of the tones used for each wavelength are given in the Table 10-16.

**Table 10-16. OLS Tone Frequencies**

Optical Channel	Wavelength (nm)	Tone Frequency (kHz)
1	1549.32	5
2	1550.92	7
3	1552.52	9
4	1554.13	11
5	1555.75	15
6	1557.37	17
7	1558.98	19
8	1560.61	21
Supervisory Channel	1532.0	12.96

### **Optical Signal to Noise Ratio (SNR)**

Table 10-17 shows the optical SNR for the OLS.

**Table 10-17. OLS Optical SNR**

Condition	System Output SNR
Worst Case Minimum SNR (No pump failure)	20.0dB
Worst Case Minimum SNR (1 pump failure)	16.5dB

## Customer Maintenance Signal

The customer maintenance signal has a standard IS-3 Intermediate Reach (IR) and Short Reach (SR) interface. This is an STS-3 rate and format signal with a growth increment of one IS-3 per telemetry circuit pack, a scrambled NRZ format line code, and a protection ratio of 0x1 (circuit pack plus line). The IS3 circuit pack is IR and SR compliant as shipped from the factory and can be configured for applications with spans up to 3.6 km. Table 10-18 shows the optical interface specifications for this signal:

**Table 10-18. Optical Interface Specifications**

Parameter	IS-3
Minimum Wavelength	1270 nm
Maximum Wavelength	1380 nm
Spectral Width	170 nm
Maximum Transmitter Power	- 14.0 dBm
Minimum Transmitter Power	- 20.8 dBm
Maximum Received Power	- 14.0 dBm
Receiver Sensitivity	- 30.8 dBm
Minimum System Gain*	10dB
Optical Path Penalty <sup>†</sup>	1.0dB
Connector Loss <sup>‡</sup>	1.5dB
Unallocated Margin	2.0dB
Minimum Loss Budget	0.0dB
Maximum Loss Budget	5.5dB
Maximum Span Length	Refer to next table

\*. The minimum system gain takes into account aging, temperature, and manufacturing tolerances.

†. Optical path penalty includes effects of dispersion, reflection, and jitter that occur on the optical path.

‡. One connector (0.75dB) on each end is assumed.

The IS-3 interface can interwork with an OC-3 interface or an IS-3 interface over multi-mode fiber, subject to the distance limitations in Table 10-19.

**Table 10-19. IS-3 Interface Distance Limitations**

---

Fiber Bandwidth	Distance
1000 MHz-km	3.4 km
800 MHz-km	3.3 km
500 MHz-km	2.7 km
300 MHz-km	1.9 km

The IS-3 interface is dispersion-limited.

## **Engineering Rules**

---

### **Use of LBOs**

---

If outside plant loss is within the nominal range, no LBOs are required. If any span has an outside plant loss below the specified limit, an LBO is required. Detailed LBO selection guidelines are provided in the *OLS Installation Manual* (365-575-315). The LBO kits are provided with the OA and ODU circuit packs.

### **Network Topologies**

---

Standard Reach OLS systems carry up to eight signals on an optical line comprised of one, two, or three spans. Long Reach systems will transmit up to eight signals on an optical line up to eight spans. For loss and distance specifications, refer to Table 10-21.

## Dispersion

---

Guidelines for dealing with dispersion are as follows:

- With OLS systems having dispersion less than 6800 ps/nm, use of the 739Dx LCT transmitter and 41Ax OT unit is recommended.
- With OLS systems having dispersion between 6800 ps/nm and 10,000 ps/nm, use of 739Fx transmitters and 41Cx OT units is required.

The 739Fx and 41Cx can be used with OLS systems having dispersion of less than 6800 ps/nm, but the 739Dx and 41Ax are less expensive options. Dispersion is not a limiting factor on Truewave fiber; hence, the 739Dx and 41Ax are recommended for use on systems using Truewave.

## OLS/OT Interworking

---

The Optical Translator can be used to concatenate multiple OLS systems. The rules for concatenating systems are presented in Table 10-20.

**Table 10-20. Engineering Rules for OLS/OT Interworking**

Per OLS System	LEA6/41A Standard Reach Systems	LEA7/41C Long Reach Systems
Max. No. Spans	3	8
<b>Per Wavelength</b>		
Max. No. OTs	10	10
Max. No. WAD Sites	10	10
Max. No. Spans	33	88
Typical Overall Length	3960 km	7040 km
<b>Per Subnetwork*</b>		
Max. No. Spans	unlimited	unlimited

\* *Subnetwork* refers to the network between two OLS end terminals that are not WAD sites.

OTs can be used at wavelength add/drop sites to:

- Permit express wavelengths to go to other OLS systems. (A single wavelength section can go through up to ten WAD sites.)
- Concatenate OLS systems with spans that conform to maximum loss guidelines for Standard Reach and Long Reach topologies.
- concatenate OLS systems with one, two, or up to eight spans, with a maximum loss of 22 dB.

### Engineering Rules for OA Applications

---

Figure 10-1 shows the configuration of an OLS system where each span is supported by two OA's. The OLS systems carry up to 8 channels on an optical line comprised of one, two, or up to eight spans. The rules for this system are shown in Table 10-21.

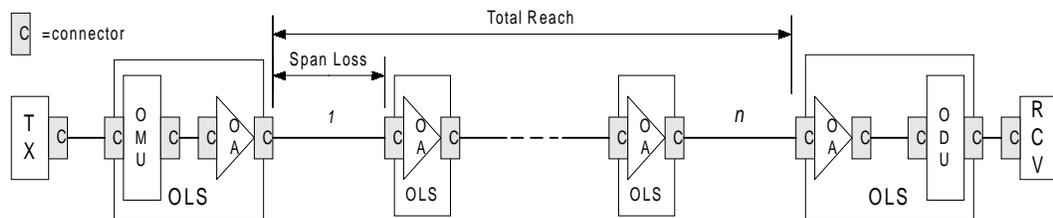


Figure 10-1. OLS OA System

**Table 10-21. Engineering Rules for OLS R2.0 (OC-48/STM-16 for Standard Single Mode Fiber)**

Application	OA	Max. No. Channels	No. of Spans	Span Loss (dB)		Total Reach (dB) Max	Max Span Distance (km)*	Max Total Reach (km)*
				Min	Max†			
Long Span	LEA6	8	1	22	33	33	132	132
			2	22	33	66	132	264
			3	22	33	99	132	396
Long Reach	LEA7	8	1	22	33	33	132	132
			2	22	30	60	120	240
			3	22	28	84	112	336
			4	21	26	104	104	416
			5	21	26	130	104	520
			6	21	26	156	104	624
			7	17	22	154	88	616
			8	17	22	176	88	640‡

\*. Fiber loss = 0.25dB/km

†. Some span with span loss more than the maximum value may be accommodated. Lucent Technologies provides network engineering support to optimize OLS systems for actual network. Please contact your Lucent Technologies sales representative for more information.

‡. This distance is limited by the dispersion characteristics of standard single-mode fiber (SSMF) (640km x 17ps/nm-km=10880ps/nm).

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## Glossary

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### Numerics

#### 1A-TX

1A-Transmit. A dual or 4-line end terminal whose optical amplifier “A” lines are used in the transmit direction.

#### 1A-RCV

1A-Receive. A dual or 4-line end terminal whose optical amplifier “A” lines are used in the receive direction.

#### 0x1 Line Operation

A 0x1 protection system having one bidirectional service line and no protection line.

#### 1+1 Line Protection

A protection system having two bidirectional lines. The transmitting terminal transmits the same payload on two lines. The receiving terminal monitors two lines and chooses one as the working line, the other as the standby line. When a protection switch occurs, the receiving terminal selects the signal from the standby line causing the standby line to become the working line, and the original working line to become the standby line. The status of the lines remains the same (nonrevertive) after the fault clears.

#### 1x1 Line Protection

A protection system having two bidirectional lines, one of which is designated the service line, while the other is designated the protection line. The service line normally carries traffic. When a protection switch occurs, the protection line is selected to carry traffic. When the fault clears, the original service line reverts to its original status as the working line. Also see *Revertive Switching*.

---

## A

#### ABN

Abnormal (condition)

#### ACO

Alarm Cutoff — A push-button switch on the indicator strip that can be used to retire an audible office alarm.

#### AGNE

Alarm Gateway Network Element

**AID**

Access Identifier — A unique identifier used to address equipment slots and ports, as well as facility tributaries, that are defined for the OLS architecture.

**AIS**

Alarm Indication Signal — A code transmitted downstream in a digital network indicating that an upstream failure has been detected and alarmed if the upstream alarm has not been suppressed.

**Asynchronous**

Refers to network elements that are not timed from references traceable to a single Stratum-1 source.

**AUTO**

Automatic — One possible state of a port or slot. When a port is in the AUTO state and a good signal is detected, the port automatically enters the IS (in-service) state. When a slot is in the AUTO state and a circuit pack is detected, the slot automatically enters the EQ (equipped) state.

---

**B**

**BCLAN**

Board Controller Local Area Network — The internal local area network that provides communications between the Line Controller circuit pack and board controllers on the circuit packs associated with a high speed line.

**Bidirectional Switch**

Protection switching performed in both the transmit and receive directions.

---

**C**

**CIT**

Craft Interface Terminal — A personal computer that meets OLS minimum requirements and has Interface-2000 software installed.

**Closed Ring Network**

A network formed of a ring-shaped configuration of systems

**CMS**

See customer maintenance signal

**CO**

Central Office

**Co-located**

Located in the same Central Office

**CR**

Critical (alarm)

**CS&O**

Lucent Technologies Customer Support and Operations

**Current Value**

The value currently assigned to a provisionable parameter.

**Customer Maintenance Signal**

A 155Mb/s optical signal originating from customer supplied equipment, and used for customer maintenance activities. It is carried as part of the supervisory signal.

**CV**

Coding Violation

---

**D**

**DACS**

Digital Access and Cross-Connect System

**DACS III-2000**

One of Lucent Technologies' SONET-ready digital access and cross-connect systems.

**DACS IV-2000**

One of Lucent Technologies' SONET-ready digital access and cross-connect systems.

**Data**

A collection of system parameters and their associated values.

**dB**

Decibels

**DCC**

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

**DCE**

Data Communications Equipment — The equipment that provides the signal conversion and coding between the data terminating equipment and the line. The DCE may be separate equipment or a part of the data terminating equipment.

**DDM-2000**

Lucent Technologies' SONET-ready network multiplexer that can function as a lightwave terminal. It is designed primarily for loop feeder and interoffice applications that will work in existing asynchronous as well as the emerging SONET networks.

**Demultiplexing**

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

**Dispersion**

Time-broadening of a transmitted light pulse

**Divergence**

When the OA provides unequal amplification of incoming wavelengths, the result is a power divergence between wavelengths.

**Doping**

The addition of impurities to a substance in order to attain desired properties.

**DRAM**

Dynamic Random Access Memory

**Drop Side Signal**

An optical signal suitable for transmission over OLS, an OC-48 signal.

**DS3**

Digital Signal Level 3 (44.736 Mb/s)

**DS-NE**

Directory Service 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)]. There can be one DS-NE per ring.

**DTE**

Data Terminating Equipment — The equipment that originates data for transmission and accepts transmitted data.

**Dual Ring Interworking**

A configuration of two ring networks that share two common nodes. DRI permits a circuit with one termination in one ring and one termination in another ring to survive a loss-of-signal failure of the shared node that is currently carrying service for the circuit.

**DWDM**

Dense Wave Division Multiplexing

---

**E****EC-1**

Electrical Carrier level-1 signal — An STS-1 signal that has been shaped and encoded for transmission over electrical media.

**ECI**

Equipment Catalog Item

**EEPROM**

Electrically Erasable Programmable Read-Only Memory

**EMC**

Electromagnetic Compatibility

**EMDU**

External Miscellaneous Discrete Unit

**EMI**

Electromagnetic Interference — High-energy, electrically induced magnetic fields that cause data corruption in cables passing through the fields.

**End Terminal**

The OLS equipment that terminates ten optical line signals.

**EQ**

Equipped — A memory administrative state for slots.

**Erbium**

A soft rare earth element used in metallurgy and nuclear research.

**Erbium Doped Fiber Amplifier (EDFA)**

An amplifier that performs by having a light signal pass through a section of erbium- doped fiber and using the laser pump diode to amplify the signal.

**ES**

Errored Seconds — A performance monitoring parameter.

**ESD**

Electrostatic Discharge

**ET**

End Terminal — Equipment that terminates optical line signals.

**Express Traffic**

In a WAD site, wavelengths going between two co-located OLS end terminals without going through an LCT.

---

**F**

**FE ACTY**

Far-End Activity

**FEBE**

Far-End-Block Error — An indication returned to the transmitting terminal that an errored block has been detected at the receiving terminal. A block is a specified grouping of bits.

**FERF**

See RDI.

**FIT**

Failures in Time — Circuit pack failure rates per  $10^9$  hours as calculated using the method described in *Reliability Prediction Procedure for Electronic Equipment*, Issue 4, September 1992.

---

**G**

**Ga**

Gauge

**Gb/s**

Gigabits per second

**GHz**

Gigahertz —  $10^9$  cycles per second

**GNE**

Gateway Network Element — A network element that passes information between other network elements and operations systems through a data communication network.

---

**I**

**IEC**

International Electrotechnology Commission or Interexchange Carrier

**IR**

Intermediate Reach

**IS**

In Service — A memory administrative state for ports. IS refers to a port that is fully monitored and alarmed.

**ITCO**

Independent Telephone Company

**IXC**

Interexchange Carrier

---

**J**

**Jitter**

Jitter is defined as short-term variations of the significant instants of a digital signal from their ideal positions in time.

---

## K

### **Krypton line**

1547.82 nm —wavelength used in a standard laser source.

---

## L

### **Large Capacity Terminal**

A four-fiber OC4-rate multiplexer with add-drop capability. LCTs support standard SONET ring or span protection switching, and can be used with OLS to increase transport capacity.

### **LBC**

Laser bias current

### **LBFC**

Laser backface currents

### **LBO**

Lightguide Build-Out — An equalizer network between the terminals and the DSX panel (or equivalent). It guarantees the proper signal level and shape at the DSX panel (or equivalent).

### **LCT**

FT-2000 OC-48 Lightwave System Large Capacity System

### **Lead time**

The amount of time that passes between placement of a product order and receipt of the product.

### **LEC**

Local Exchange Carrier

### **LED**

Light-Emitting Diode

### **Line**

An optical transmission line. In T1/Bellcore terminology, “line” refers to a transmission medium, together with the associated high speed equipment, required to provide the means of transporting information between two consecutive Network Elements, one of which originates the line signal while the other terminates the line signal.

### **Local Traffic**

All wavelengths being added/dropped through LCTs at a WAD site.

### **LOF**

Loss of Frame

**Long Reach**

The capability to concatenate 7 or 8 spans between end terminals before regeneration is required

**LOS**

Loss of Signal

---

**M**

**μm**

Micrometer

**Menu**

A set of possible values for a parameter.

**Midspan Meet**

The capability to interface between two lightwave terminals of different vendors. This applies to high speed optical interfaces.

**MJ**

Major (alarm)

**MN**

Minor (alarm)

**MTBF**

Mean Time Between Failures

**MTBMA**

Mean Time Between Maintenance Activities

**Multiplexing**

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

---

**N**

**NE**

Network Element

**NE ACTY**

Near-End Activity

**NEBS**

Network Equipment-Building System

**NGLN**

Next Generation Lightwave Network

**nm**

Nanometer (10<sup>-9</sup> meters)

**NMA**

Network Monitoring and Analysis System

**NMON**

Not Monitored — A memory administrative state for ports.

**Nonrevertive switching**

In nonrevertive switching, there is a working and a standby line, circuit pack, etc. When a protection switch occurs, the standby line or circuit pack is selected and becomes the working line. The original working line or circuit pack becomes the standby. This status remains in effect when the fault clears, that is, there is no switch back to the original status. Also see **1+1 Line Protection**.

**NRZ**

Nonreturn to Zero

**NSA**

Nonservice Affecting

**NSAP Address**

Network Service Access Point Address — An automatically assigned number that uniquely identifies a Network Element for the purposes of routing DCC messages.

---

**O**

**O&M**

Operation and Maintenance

**OALAN**

Overhead Access Local Area Network — The internal local area network that provides communications between the System Controller circuit pack and the Overhead Controller circuit pack.

**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.

**OC3**

Optical Interface Circuit Pack — The FT-2000 OC-48 Lightwave System OC3 Optical Interface circuit pack interfaces with one bidirectional OC-3 signal.

**ODU**

Optical Demultiplexer — takes the OLS optical signal and separates it into the eight OC-48 signals.

**OLS End Terminal**

Terminal equipment consisting of a co-located Optical Multiplexer Unit (OMU) and Optical Demultiplexer Unit (ODU) for bidirectional transmission, Optical Amplifiers (OA), and OLS Telemetry packs.

**OLS Repeater Terminal**

Bidirectional terminal consisting of a pair of Optical Amplifiers (OA) and the corresponding OLS telemetry packs.

**OMU**

Optical Multiplexer Unit--takes up to eight OC-48 signals and combines them into a single signal

**OOF**

Out-of-Frame

**Open Ring Network**

**Network formed of a point-to-point configuration of systems.**

**Operations Interface**

Any interface providing you with information on the system behavior or control. These include the equipment LEDs, interface strip, CIT, office alarms, and all telemetry interfaces.

**Operations Interworking**

The capability to access, operate, provision, and administer remote systems through craft interface access from any site in a SONET network or from a centralized operations system.

**Optical Channel**

A OC-48 wavelength within an optical line signal. There are eight such wavelengths, or channels, in one line signal.

**Optical Line Build-out (LBO)**

An attenuator placed between FT-2000 OC-48 Lightwave systems and the LGX (or equivalent). It guarantees the optical level will be below the receiving equipment's maximum received power requirements.

**Optical Line ID**

A portion of the supervisory signal that identifies optical lines to prevent misconnections between sites.

**Optical Line Signal**

A multiplexed optical signal containing eight wavelengths or channels.

**Optical Line System**

A lightwave transmission system that multiplexes up to eight wavelengths, transmits the resulting multiplexed signal, and then demultiplexes the signal at the other end.

### **Optical Section**

See Span

### **Optical Translator (OT)**

A unit that electrically regenerates any incoming OC48 wavelength in the 1.3-1.5 micrometer range into a specific outgoing OC48 wavelength.

### **Optical WAD**

See Wavelength Add/Drop.

### **Orderwire**

A section of the supervisory signal that is used for communication between sites.

### **Original Value Provisioning**

The original values are preprogrammed at the factory. These values can be overridden using local or remote provisioning.

### **OS**

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

---

## **P**

### **Parallel Telemetry**

A set of alarms and status information reported to an operations center.

### **Parameter**

A characteristic of the system that affects its operation.

### **Platform**

In OLS, a platform is a family of equipment and software configurations designed to support a particular application.

### **PM**

Performance Monitoring — Measures the quality of service and identifies any degrading or marginally operating systems (before an alarm would be generated).

### **POH**

Path Overhead — Overhead assigned to and transported with the payload until the payload is demultiplexed. It is used for functions that are necessary to transport the payload.

### **Preprovisioning**

The capability to provision a slot before installing a circuit pack.

### **Proactive Maintenance**

Refers to the process of detecting degrading conditions not severe enough to initiate protection switching or alarming, but indicative of an impending signal fail or signal degrade defect.

### **Protection Switching**

The switching of traffic from a malfunctioning line to one that is working.

### **PROTN**

Protection

### **Provisioning**

Assigning a value to a system parameter.

### **PWR**

Power

---

## **R**

### **RCV**

Receive

### **RDI**

Remote defect indicator — [Previously called far-end-receive failure (FERF)] An indication returned to a transmitting terminal that the receiving terminal has detected an incoming section failure.

### **Repeater Terminal**

In OLS, a bidirectional terminal consisting of a pair of optical amplifiers and the corresponding telemetry packs.

### **Reactive Maintenance**

Refers to discovering defects/failures and then clearing them.

### **Regeneration**

The process of reconstructing a digital signal to eliminate the effects of noise and distortion.

### **Revertive Switching**

In revertive switching, there is a service and protection line or circuit pack. When a protection switch occurs, the protection line or circuit pack is selected. When the fault clears, service reverts to the original service line. See 1x1 Line Protection.

### **RF**

Radio Frequency

### **RFI**

Remote failure indication — (Previously called yellow signals.) A signal that alerts upstream STS-1 path terminating equipment that a down stream failure has been alarmed along the STS-1 path. This action prevents multiple alarms from being activated for the same failure and ensures that craft will be dispatched to the correct location of the failure.

### **RPP**

Reliability Prediction Procedure

**RT**

Remote Terminal

**RTAC**

Regional Technical Assistance Center

---

**S**

**SA**

Service Affecting

**SD**

Signal Degrade

**SDH**

Synchronous Digital Hierarchy — a European standard

**SEFS**

Severely Errored Frame Seconds — A performance-monitoring parameter.

**SES**

Severely Errored Seconds — A performance-monitoring parameter.

**SESP**

P-bit Severely Errored Seconds — A performance-monitoring parameter.

**SF**

Signal Fail

**Short Reach**

The capability to concatenate up to 3 spans between end terminals before regeneration is required

**Single-ended Operations**

The single-ended operations capability provides operations support from a single location to remote network elements (NEs) in the same SONET subnetwork. With this capability you can perform operations, administration, maintenance, and provisioning on a centralized basis. The remote NEs can be those that are specified for the current release.

**Site Address**

The unique address for each regenerator or terminal in a repeatered span.

**SNR**

Signal to Noise ratio; the relative strength of signal compared to noise.

**SONET**

Synchronous Optical Network

**Span**

An uninterrupted bidirectional fiber section between two network elements.

**Span Growth**

A type of growth in which one wavelength is added to all lines before the next wavelength is added.

**Span Loss**

Loss (in dB) of optical power due to the span transmission medium (includes fiber loss and splice losses).

**SPE**

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

**STM-n**

Synchronous Transport Module level n — the basic building block of SDH.

**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-1E**

Now referred to as EC-1. A signal typically carried by coaxial cables from one equipment location to another. The term EC-1 refers to the organization and data rate of the signal and also to the voltage template the signal must conform to and the impedances for which the voltage template is valid.

**STS1E**

Interface Circuit Pack — The FT-2000 OC-48 Lightwave System STS1E Interface circuit pack interfaces with up to three bidirectional STS-1 signals.

**Subnetwork**

A group of interconnected/interrelated network elements. The most common connotation is a SONET network in which the network elements have data communications channel connectivity.

**Supervisory Signal**

An optical signal originating with the telemetry circuit pack that is used to communicate maintenance information.

**Synchronous**

Refers to network elements that are timed from references traceable to a single Stratum-1 source.

**Synchronous Network**

The synchronization of transmission systems with payloads to a master (network clock that can be traced to a single reference clock).

**SYSCTL**

System Controller circuit pack.

**SYSTEM**

System Memory circuit pack.

---

## **T**

### **T1X1 and T1M1**

The ANSI committees responsible for telecommunications standards.

### **TA**

Technical Advisory

### **TABS**

Telemetry Asynchronous Byte Serial (Protocol)

### **TCA**

Threshold-Crossing Alert — A condition set when a counter exceeds a user-selected high or low threshold. A TCA does not generate an alarm but is available on demand through the CIT.

### **THz**

Terrahertz ( $10^{12}$  Hz)

### **TID**

Target Identifier — A provisionable parameter used to identify an FT-2000 OC-48 Lightwave network element. Typically, the TID is the common language location identifier (CLLI<sup>TM</sup>) of the FT-2000 1x1 End Terminal, FT-2000 Add/Drop-Rings Terminal, and FT-2000 Repeater Bays.

### **TL1**

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

### **TLM**

Telemetry circuit pack

### **TOHCTL**

Tributary Overhead Controller.

### **Tone**

An AM signal in the 5 - 30 kHz range that is superimposed on the drop side signal for power measurements.

### **Truewave Fiber**

Non-zero dispersion fiber (previously referred to as DEB fiber).

### **TSO**

Technical Support Organization

### **TX**

Transmit

---

## U

### UAS

Unavailable Seconds

### Upgrade

An upgrade is the addition of new capabilities (features). This requires new software and may require new hardware.

---

## V

### Value

A number, text string, or other menu selection associated with a parameter.

---

## W

### Wavelength Add/Drop (WAD)

The process of adding and dropping wavelengths to provide more efficient transmission. For example, a central office contains two or more OLS end terminals, some wavelengths can be added and dropped locally while others go express between the end terminals by means of OTs.

### Wavelength Blocking

At a WA/D site with branching, if a wavelength goes express between two co-located OLS end terminals, that wavelength can only be added or dropped at the third co-located end terminal. Wavelength interchange permits the wavelength on the third end terminal to be converted into an available wavelength at the other two end terminals.

### Wavelength Growth

A type of growth in which all eight wavelengths are added to a single line before more lines are added.

### Wavelength Interchange

The ability to change the wavelength associated with an OC-48 signal into another wavelength.

### Wavelength Section

The path followed by an STS48 from its creation to its termination.

### Wideband Communications

Voice, data, and/or video communications at digital rates from DS0 to DS1 rates (64Kb/s to 1544Kb/s)

---

## **X**

### **X.25**

Communications protocol.

---

## **Z**

### **Zero Code Suppression**

A technique used to reduce the number of consecutive zeros in a line-codes signal (B3ZS for DS3 signals).

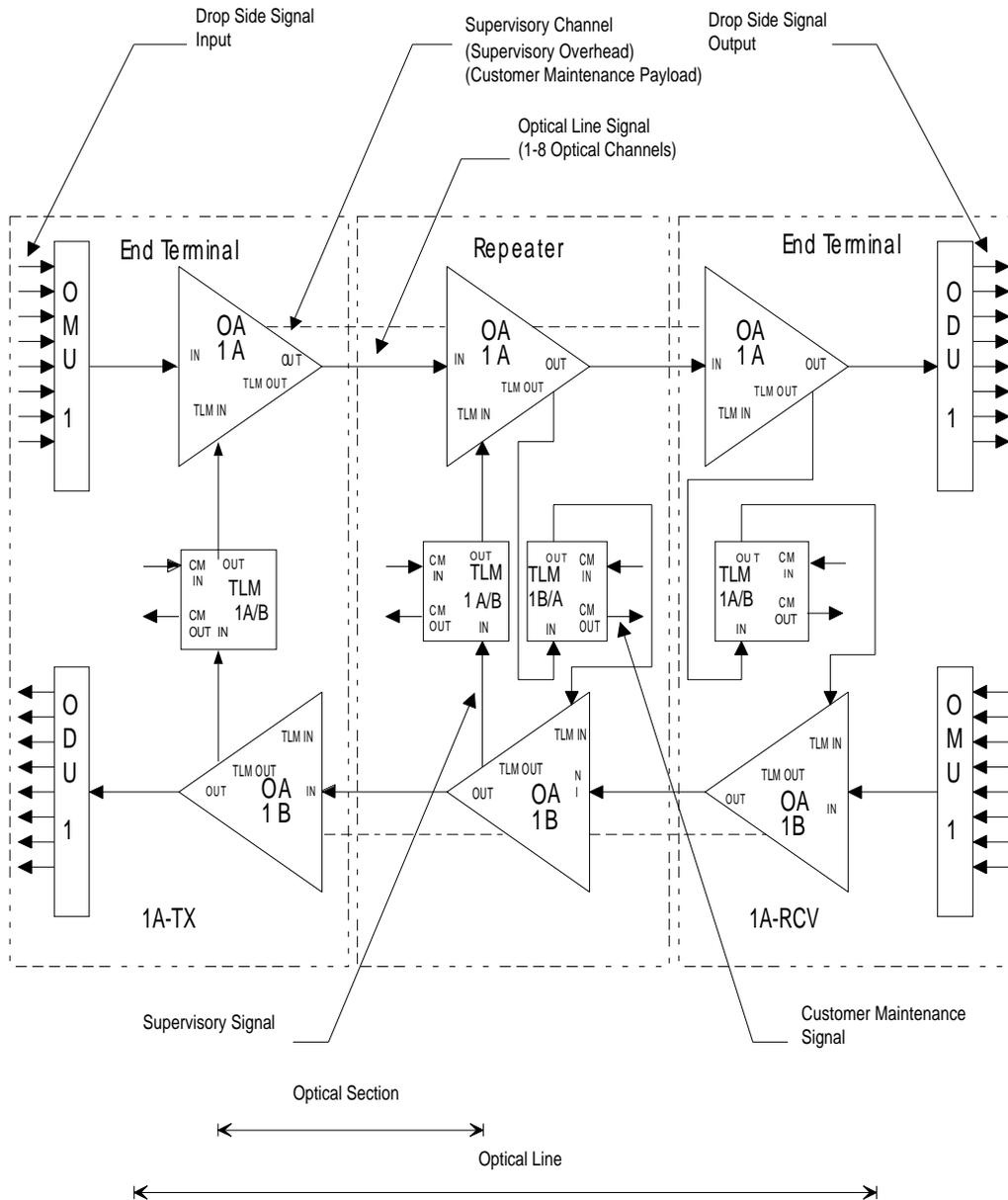


Figure GL-1. OLS Terminology

## Index

---

### Numerics

- 1A-Transmit/1A-Receive. See End Terminal Provisioning
  - 4-Fiber Ring application, 3-12
    - shelf slot labeling, 4-22
- 

### A

- access
  - cable, 4-15, 10-5
  - CIT port, 4-18, 5-10
  - drop side optical fibers, 4-15
  - fibers in shelves, 4-16
  - front, 2-13, 4-2, 6-8
  - IS-3, 10-5
  - OAM&P cables, 4-15
  - operations system, 4-4
  - optical input/output connectors, 4-19
  - power feeder cables, 4-15
- Account Executive Support, 8-6
- administration
  - performing on a centralized basis, 2-8, 13
- alarms
  - group, 5-15
  - levels, 5-24
  - report, 5-15
  - system-level, 2-6
- analog transmission maintenance, 5-17
- applications
  - 4-Fiber Ring, 3-12
  - Dual 1x1 End Terminal, 3-9
  - list of, 2-4
  - ring, 3-10
  - span capacity growth, 3-15
- architecture, 4-1
- AT&T
  - 2000 Product Family, 1-1
- authorization level
  - expert, 5-13
  - general, 5-13
  - privileged, 5-13
  - reports only, 5-13
- automatic

- version recognition, 2-10, 5-12
  - automatic protection
    - types of, 2-11
  - autonomous messages, 5-23
- 

### B

- backplane, 4-42
  - bandwidth
    - optical amplifier, 4-32
  - BCLAN, 4-4
  - benefits
    - of OLS, 2-2
  - bin
    - day, 5-25
  - board controller local area network, 4-4
  - BRH classification, 10-2
  - BRT-2000 Access System, 1-2
  - bulletins, 8-5
- 

### C

- cabinets
  - description, 2-14, 4-1, 4-4
  - dimensions, 4-2, 10-7
  - indicator strip, 4-4
  - label strips, 4-21
- cables
  - access, 4-15, 10-5
  - dressing, 4-15
  - fiber and power feeder
    - access, 4-15
  - nontransmission
    - description, 7-29
  - OAM&P
    - access, 4-15
  - power, 4-8
- cabling, 6-10
  - connectorized, 2-5
- capacity, 6-3, 10-4
- circuit packs
  - FIT rates, 7-35
- circuit packs
  - backplane interface, 4-42
  - CLEI codes, 2-10, 7-31
  - design, 4-24

- dimensions, 10-8
- diode oring, 4-42
- filtering, 4-42
- fuses, 4-42
- powering, 4-42
- preprovisioning, 5-28
- sparing graphs, 7-33
- transmission, 4-31
- CIT, 5-6
  - access, 4-18, 5-10
  - access through DCC, 5-10
  - access through DCE port, 5-10
  - access through DTE port, 5-10
  - modems, 5-10
  - security, 5-6
- CIT-PC
  - described, 5-6
  - functions, 5-7
  - requirements, 5-7
- CIT-TL1
  - described, 5-8
  - interface
    - described, 2-7
    - requirements, 5-9
- CLEI codes, 2-10, 7-31
- COACH, 8-3
- compactness, 2-14
- compatibility
  - software, 7-43
- compatibility data, 8-5
- configuration
  - OLS, 3-6
- control
  - architecture, 4-2
  - circuit packs, 4-36
  - TLM circuit pack, 4-35
- copy
  - remote, 2-10
- craft access
  - remote, 2-8
- current drain, 6-15
- customer maintenance
  - fiber connections dressing, 4-16
- customer maintenance signal synchronization, 6-2

---

## D

DACS III-2000 Cross-Connect System, 1-2

DACS IV-2000 Cross-Connect System, 1-2

DACScan™-2000 Controller, 1-2

DANTEL shelf

- ordering, 7-42

data communication links

- reduce number of, 2-9, 5-16

DCC, 5-8, 5-15

- craft interface terminal (CIT) remote access, 5-15
- protection switching, 4-37, 5-18, 6-2

DDM-2000 Multiplexers, 1-2

dense wave division multiplexing, 1-2, 2-3, 3-1, 6-3

diagnostic dictionary, 8-5

dimensions

- cabinet, 4-2, 10-7
- circuit packs, 10-8

diode oring

- circuit packs, 4-42

Directory Service Network Element. See DS-NE

discrete

- interface
  - user-settable, 2-8

dispersion

- optical, 10-2

documentation support, 8-6

drawings

- list of, xxvi

drop side signal

- requirements, 4-36

DS-NE, 2-11

Dual 1x1 End Terminal application

- labeling, 4-22
- single, 3-9

Dual End Terminal

- description, 4-12

DWDM, 1-2, 2-3, 3-1, 6-3

---

## E

EDFA, 3-1

electrical signal

- measuring optical power, 4-33

electromagnetic compatibility, 6-13, 10-9

electrostatic discharge, 4-8, 6-13

enclosures

- for OLS, 4-1

End Terminal for 4 Bidirectional Optical Lines

- description, 4-8

End Terminal Provisioning, 5-28, 5-29

engineering  
  services, 8-1  
engineering rules, 6-5  
environmental  
  considerations, 6-13  
  specifications, 10-9  
EPROM  
  SYSTEM circuit pack, 4-37  
equipment  
  interconnection, 6-10  
  inventory, 5-14  
erbium-doped fiber amplifiers, 3-1

---

## F

fault  
  automatic diagnostics, 5-19  
features, 4-1  
  for Release 1, 1-6  
  summary, 2-1-2-17  
fibers  
  customer maintenance  
    dressing, 4-16  
  dressing in shelves, 4-15  
  types supported, 1-2  
filter units, 4-8  
filtering  
  circuit packs, 4-42  
  shelf level, 4-40  
FIT rates, 7-35  
floor  
  loading specifications, 10-8  
  plan layout, 6-8  
frequencies  
  tones, 10-14  
functions  
  basic OLS, 2-1  
fuse panel  
  description, 4-19  
fuses  
  circuit packs, 4-42  
  shelf level, 4-40

---

## G

gain

  optical amplifier, 4-32  
gateway network element. See GNE  
GNE, 2-8, 2-9, 5-8, 5-15, 5-16  
  access to SONET maintenance subnetwork, 5-15  
  redundancy, 2-9, 5-16  
  and TL1, 2-9

---

## H

Hardware Warranty, 8-6  
hardware warranty, 8-6  
help  
  on-line, 2-7  
history  
  report, 5-25

---

## I

indicator strip, 4-4, 5-1  
  remote access, 5-15  
input power, 10-13  
installation, 2-5  
  services, 8-1  
interconnection  
  equipment, 6-10  
  panel, 4-18  
interface  
  backplane and circuit pack, 4-42  
  operations, 2-7, 5-6  
IS-3 Access, 10-5

---

## J

jumpers  
  lightguide, 10-1

---

## L

label strips, 4-21  
  Dual End Terminal, 4-22  
  End Terminal for 4 Bidirectional Optical Lines, 4-22  
LANs, 4-4

laser  
  TLM circuit pack, 4-35  
lightguide  
  connectors, 10-1  
lightguide jumpers, 10-1  
line parameters, 5-21  
local area networks  
  internal  
    and controllers, 4-4  
login  
  ID, 5-13  
  password, 5-13

---

## M

maintainability specifications, 9-4  
maintenance  
  activities  
    mean time between, 10-13  
  analog transmission, 5-17  
  objectives, 5-14  
  performing on a centralized basis, 2-8, 13  
  procedures, 5-1  
  remote, 5-15  
  TLM circuit pack, 4-35  
mean time between maintenance activities, 10-13  
memory  
  conventional  
    minimum, 5-7  
  manager, 5-7  
message-based  
  interface (X.25/TL1), 5-8  
modem  
  transmission standards, 5-11  
multimode  
  lightguide jumpers, 10-1  
multiplexing  
  dense wave division, 2-3, 3-1

---

## N

network  
  planning considerations, 6-1  
news, 8-5  
noise  
  optical amplifier, 4-32

---

## O

OA circuit pack  
  description, 2-3, 4-31  
  power monitor, 4-42  
  temperature monitor and control, 4-32  
  tone monitor, 4-32  
OC-48 optical signals, 3-3  
ODU units  
  description, 4-34  
  fastening in shelf, 4-19  
  slot locations, 4-17  
  temperature control, 4-32  
ODUs and OMUs  
  slot allocations, 4-17  
office alarms  
  interface, 2-7  
OLS  
  4-Fiber Ring application, 3-12  
  basic configuration, 3-6  
  benefits, 2-2  
  functions  
    list of, 2-1  
  introduction, 1-1–1-7  
  packages, 1-4  
  ring applications, 3-10  
  span capacity growth, 3-15  
  transmission elements, 3-2  
OMU units  
  description, 4-34  
  fastening in shelf, 4-19  
  slot locations, 4-17  
operating wavelengths, 10-2  
operations  
  interfaces, 5-6  
    list of, 2-7  
  message-based (X.25 protocol), 5-8  
  office alarms, 5-11  
  parallel telemetry, 5-11  
  performing on a centralized basis, 2-8, 13  
  remote, 2-8  
  single-ended, 2-8, 13  
  system  
    remote access, 2-8, 5-15  
operations system (OS). See OS or operations, system  
optical  
  connectors, 10-1  
  dispersion, 10-2

- fibers
  - dressing in shelves, 4-15
  - line ID, 5-17
  - reflections tolerance, 10-2
  - safety, 10-2
- Optical Amplifier (OA) circuit pack.
  - See OA circuit pack
- Optical Demultiplexer Unit (ODU). See ODU units
- optical line
  - connector, 4-19
  - optical line ID, 5-17
- Optical Line System. See OLS
- Optical Multiplexer Unit (OMU).
  - See OMU units
- optical parameters, 5-20
- optical power
  - sampling, 4-33
- ordering
  - cables
    - nontransmission, 7-28
    - power, 7-30
  - circuit packs, 7-31
  - DANTEl shelf, 7-42
  - documentation, 7-27
  - software, 7-27
- ordering guides, 8-5
- ordering worksheets, 7-2
- orderwire
  - interface
    - gain access to, 5-27
    - voice communications, 5-26
- original values, 5-27
  - factory assigned, 5-27
- OS
  - interfaces, 2-7
  - remote access, 2-8
  - types
    - command response only, 5-8
    - defined, 5-8
    - maintenance, 5-8
    - memory administration, 5-8
    - other, 5-8
    - peer, 5-8
    - predefined sets of, 5-8
- output power
  - optical amplifier, 4-32

---

**P**

- package descriptions, 7-25
- packages
  - for Optical Line System, 1-4, 4-1
- parallel telemetry
  - interface, 2-8
- parameters
  - line, 5-21
  - optical, 5-20
  - performance, 5-22
  - provisionable, 5-28
- performance
  - monitoring
    - 24-hour counts, 5-25
    - continuous, 2-11
  - thresholds, 2-11
- physical dimensions, 10-7
- planning
  - considerations, 6-1
  - network, 6-1
- plant loss, 10-4
- port
  - DCE, 5-6
  - DTE, 5-6
- port states
  - auto (AUTO), 5-26
  - in service (IS), 5-26
  - not monitored (NMON), 5-26
- power
  - cables, 4-8
  - dissipation, 6-15
  - distribution
    - philosophy, 4-37
    - shelf level, 4-40
  - filter units, 4-8
  - filtering, 4-20
  - for circuit packs, 4-42
  - modules, 2-17
  - monitor, 4-42
  - planning, 6-14
  - specifications, 10-6
- power planning, 6-14
- procedures
  - maintenance, 2-6
- protection
  - DCC channel, 4-37
- protection switching, 5-18, 6-2

- 1x1, 6-2
- bidirectional, 6-2
- revertive, 6-2
- protocol. See X.25
- provisionable parameters, 5-28
- provisioning, 2-11, 5-27
  - CIT parameters
    - local and remote, 5-28
  - consistency audits, 5-24
  - map, 5-28
  - performing on a centralized basis, 2-8, 13

---

## R

- registers
  - description, 5-22
  - history, 5-25
- reliability, 4-37, 9-1
- specifications, 10-11
- remote
  - alarms, 2-8
    - in same subnetwork, 5-16
  - login, 2-8, 2-10
  - NE status, 5-16
  - software copy, 2-10, 5-15
- remote access
  - alarm report, 5-15
  - CIT, 5-15
  - indicator strip, 5-15
  - operations system, 5-15
- Repeater for 4 Bidirectional Optical Lines
  - description, 4-10
- repeater shelf
  - description, 4-17
- report
  - addressed slot
    - state of, 5-26
  - alarm and status, 5-24
  - history, 5-25
  - performance monitoring register values, 5-25
  - version/equipment list, 5-26
- requirements
  - CIT-PC, 5-7
  - CIT-TL1, 5-9
  - followed for OLS, 4-8
- ring applications with OLS, 3-10

---

## S

- security
  - authorization
    - levels of, 5-13
  - guest login, 5-14
  - login aging, 5-14
  - login ID, 5-13
  - network element login, 5-13
  - password, 5-13
  - password aging, 5-14
  - port, 5-13
  - tiers of, 5-12
  - user authorization levels, 5-13
  - user login, 5-13
  - See also authorization
- Service Net-2000 Architecture, 1-2
- shelf design, 2-15
- shelves
  - cable dressing, 4-15
  - description, 4-14
  - filters, 4-40
  - power distribution, 4-40
  - slot allocations, 4-17
- signal to noise ratio, 10-14
- signals
  - wavelengths supported, 1-3
- single-mode
  - lightguide jumpers, 10-1
- SLC®-2000 Access System, 1-2
- slot allocations
  - ODUs and OMUs, 4-17
- slot states
  - auto (AUTO), 5-26
  - equipped (EQ), 5-26
- SNR, 10-14
- software
  - copy, 2-10
  - download
    - remote, 2-8, 5-15
- software compatibility, 7-43
- span
  - capacity growth, 1-3, 3-15
- sparing
  - circuit packs, 7-33
- specifications
  - customer maintenance signal, 10-15
  - environmental, 10-9

- floor loading, 10-8
- IS-3, 10-16
- maintainability, 9-4
- reliability
  - FIT rates, 10-11
- splitter module, 2-3
- squelch map
  - ring, 5-24
- ST connector
  - optical line, 4-19
- standards
  - for OLS, 4-8
- Stratum 3 oscillator
  - TLM circuit pack, 4-35
- SUP LASER
  - TLM circuit pack, 4-35
- supervisory signal, 5-17
  - description, 4-30
  - monitored in TLM circuit pack, 4-35
- support
  - documentation, 8-6
  - technical, 8-2
- synchronization, 6-2
- SYSCTL circuit pack
  - description, 4-36
  - serial telemetry, 4-36
  - X.25 interfaces, 4-36
- SYSTEM circuit pack, 4-37
  - EPROM, 4-37
- system
  - control
    - architecture, 4-2
    - circuit packs. See SYSCTL circuit pack
  - reliability, 4-37
  - startup, 5-14

- automatic, 2-5
- thresholds
  - performance parameter, 5-22
- timing, 6-2
  - customer maintenance signal, 6-2
  - TLM circuit pack, 4-35
- TL1, 2-8
  - and GNE, 2-9
- TLM circuit pack
  - description, 4-34
  - monitoring of supervisory signal, 4-35
  - temperature monitoring, 4-35
  - timing, 4-35
- TOHCTL, 5-16
  - circuit pack, 4-4
  - description, 4-37
- tone, 5-17
  - frequencies, 4-33, 10-14
- monitor
  - OA circuit pack, 4-32
- Transaction Language 1. See TL1
- transmission
  - characteristics, 10-4
  - circuit packs
    - functions, 4-31
  - distances, 3-6
  - equipment configurations, 4-27
  - medium, 10-1
  - optically amplified
    - explanation of, 3-1
  - repeater, 4-29
  - supervisory signal, 4-30
  - with LCT
    - diagram, 3-3
- Tributary Overhead Controller. See TOHCTL

---

## T

- technical support, 8-2
- telemetry (TLM) circuit pack
  - See TLM circuit pack, 4-34
- temperature
  - control
    - for ODU, 4-32
- temperature monitoring
  - TLM circuit pack, 4-35
- tests, 2-5
- turnup

---

## U

- unavailability
  - OC-48 channel, 10-12
  - silent failure, 10-12
  - telemetry channel, 10-12
- units
  - design, 4-24
- upgrade
  - system, 2-10

---

**V**

version recognition  
    automatic, 2-10, 5-12

---

**W**

warranty, 9-4  
Warranty Support, 8-6  
wavelengths  
    and span capacity growth, 1-3  
    associated tone frequencies, 4-33  
    operating, 10-2  
worksheets, 7-2

---

**X**

X.25  
    interface, 2-8