Lucent Technologies
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LambdaRouter™ All Optical Switch (AOS)128/256 Release 3.0

Applications and Planning Guide

365-375-008R3.0
Issue 2
June 2002

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4 Hardware Description

5 System Planning and Engineering

6 Operations Interfaces

About this information product

Purpose

This guide highlights the features and benefits of the groundbreaking LambdaRouter™ AOS technology. It provides a system description and discusses LambdaRouter™ AOS 128/256 applications and planning requirements for the central office (CO). It covers planning considerations (such as provisioning of optical shelves), technical specifications, and ordering information.

Reason for reissue

This document reflects all GA features of the Release 3.0 LambdaRouter™ AOS.

Safety labels

Not applicable.

Intended audience

This guide is intended for use by all network planners and engineers. It serves as an overview to the LambdaRouter™ AOS 128/256 for all administrators, operators, and technicians working with the product.

Conventions used

Not applicable.

Related documentation and training

Related documents include others in the LambdaRouter™ AOS library, LambdaRouter™ Optical Network Navigation System (ONNS), Navis™ Element Manaement System (EMS), and Navis™ Network Management System (NMS) documentation, as well as vendor documentation for the PC used for the Optical Craft Interface (OCI).

The *WaveStar® Optical Line System (OLS) 1.6T Applications and Planning Guide* is also available.

Refer to the Training and Documentation (8-5) section in Chapter 8, Product Support, for information on obtaining documents and registering for LambdaRouter™ AOS courses.

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1 Introduction

Overview

Purpose This chapter introduces the LambdaRouter™ All Optical Switch (AOS).

Contents This chapter includes the following sections:

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System Description

Introduction

The LambdaRouter™ AOS is an optical cross-connect system equipped with a completely optical switching fabric. It provides optical interfaces ranging from transparent to opaque.These interfaces are located on optical circuit packs called port units.

The three types of interfaces available in the LambdaRouter™ AOS are:

- Transparent Optical Cross-Connect Interface (OXI) circuit packs (range1260 to 1360 nm and 1500 to 1620 nm)
- Optically amplified Optical Cross-Connect Interface circuit packs in the 1310 nm band (OXI-4A13) and 1550 nm band (OXI-4A15)
- Opaque Optical Cross-Connect Interface circuit packs for SONET/SDH which accept OC-192/STM-64 signals (OXI-10GC) and OC-48/STM-16 signals (OXI-2GC).

An optical cross-connection is the connection of an optical signal from an input port to a selected output port. Cross-connections switch customer traffic through the LambdaRouter™ AOS optical switch fabric, and can be either unidirectional or bidirectional.

Operations interfaces

Access to the LambdaRouter™ AOS is provided through operations interfaces, which provide for provisioning, administration, and maintenance functions.

These operations interfaces include the following local and remote interfaces:

- User panels
- Office alarms
- Optical Craft Interface (OCI)
- Navis™ Optical Element Management System (EMS).

These operations interfaces are described in Chapter 6, “Operations Interfaces and Managing Systems”.

LambdaRouter™ Optical Network Navigation System (ONNS)

Through the LambdaRouter™ Optical Network Navigation System (ONNS), the LambdaRouter™ AOS is able to provide the automatic discovery and restoration schemes demanded by today's networks. In conjunction with element and provisioning management systems (such as Navis™ Optical EMS and Navis™ Optical NMS), LambdaRouter™ ONNS maximizes the LambdaRouter™ AOS optical network capabilities.

Refer to the "LambdaRouter™ Optical Network Navigation System (ONNS)" (6-10) in Chapter 6, "Operations Interfaces and Managing Systems".

Network evolution

The need for networking at the optical layer is driven by the increase in the demand for and deployment of transmission capacity. Additionally, customers require fast on-demand cost-effective service, which means users are demanding an intelligent optical network.

As the data networking market continues to grow, customers are demanding the ability to provide end-to-end optical services quickly.

The functions needed to support this optical demand include:

- fast connection setup
- schedule-based service provisioning
- fast service restoration with multiple Quality of Service (QoS) levels
- automatic discovery of network resources and topology.

As the telecommunications industry moves into an environment of predominantly IP traffic, the demand for increased data rates dictates a need for optical channel management (for example, 10 Gbps interfaces on IP routers are becoming common). Users want to manage the entire bandwidth associated with the individual wavelengths available from Dense Wavelength Division Multiplexing (DWDM) transport equipment. IP routers are now receiving the entire 2.5 Gbps or 10 Gbps signal, for example, rather than having the cross-connect system (optical switch) de-multiplex the signal into smaller parts for delivery to the router.

On its transparent interfaces, the LambdaRouter™ AOS includes cross-connect and port capacity that are format (protocol) and bit-rate independent, which makes it future-proof. That is, as source signal rates increase, the LambdaRouter™ AOS can handle the same number of inputs.With its optically amplified interfaces, transmission loss is significantly decreased. The opaque transmission interfaces provide OEO conversion and bit monitoring functions designed for SONET/ SDH network applications.

Intelligent Optical Networking

Intelligent optical networking is a service level concept allowing customers to provide end-to-end optical channel connection setup and restoration functions, which enable fast service establishment and the ability to provide multiple levels of wavelength-based service. Intelligent optical networking is implemented on the LambdaRouter™ AOS through the LambdaRouter™ ONNS in conjunction with a system management system such as the Navis™ Optical NMS.

Intelligent optical networking offers multiple Quality of Service (QoS) levels for differentiated service based on Service Level Agreements (SLAs). With intelligent optical networking, the LambdaRouter™ AOS applications, described in Chapter 2, “Applications”, are maximized.

MicroStar™ Technology

The optical layer bandwidth management is done using Lucent Technologies MicroStar Micro-Electromechanical Systems (MEMS) Technology. MicroStar Technology relies on arrays of electrically configurable microscopic mirrors.

Switching is possible because the mirrors are rotated around micro-machined hinges. The optical connections to these mirrors are accessible for field cabling, if required.

The Switch Shelf (SWS) contains the MEMS mirror arrays, optical lenses, fiber, voltage source, and connectors required for optical switching.

Features

The LambdaRouter™ AOS features (described in Chapter 3, “Features”) are aimed at automating the optical layer bandwidth management.

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Capacity and Configurations

Capacity

The LambdaRouter™ AOS 128 provides 112 input and 112 output interface connections with a single switch fabric. The LambdaRouter™ AOS 256 provides 224 input and 224 output connections using two switch fabrics.

The LambdaRouter™ AOS provides duplex paths through the system for transport reliability. The duplex paths can be used either for internal fabric protection or to provide network level 1+1 protection.

In the LambdaRouter™ AOS 256, this physical duplication is provided by the inclusion of two switch fabrics. In the LambdaRouter™ AOS 128, the duplication is provided by a logical division of a single switch fabric into two sides.

The LambdaRouter™ AOS includes a mechanism for automatic switching of a path from the active (working) fabric side to the alternate (protection) fabric side in the event of a failure on the active switch fabric side.

Circuit pack capacity

Each optical interface cross-connection circuit packs provides input/output port pairs to make the transmission interface connections between the switch fabric and the external equipment. The number of ports provided are:

- OXI: four input/output ports
- OXI-4A13: four input/four output ports
- OXI-4A15: four input/four output ports
- OXI-10GC: one input/one output port
- OXI-2GC: two input/two output ports

Shelf capacity

The shelves that house the optical interface circuit packs are called optical interface shelves, of which there are two types:

- Optical Interface Shelf - Transparent (OIS-T) which houses the OXI, OXI-4A13, and OXI-4A15 circuit packs.

- Optical Interface Shelf - SONET/SDH (OIS-S), which houses the OXI-10GC and OXI-2GC circuit packs.

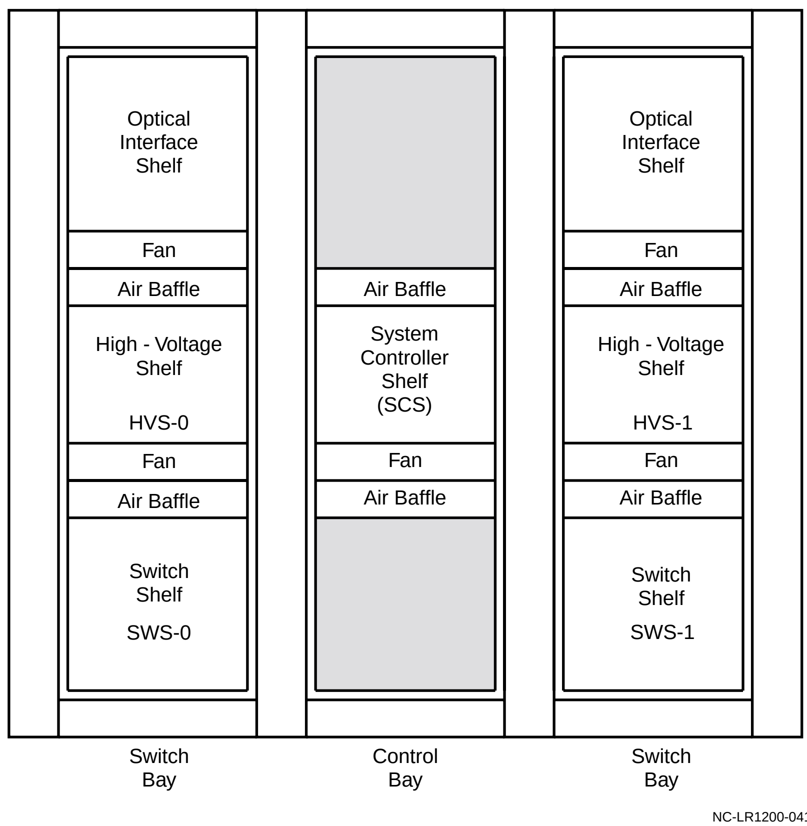
The capacity of each optical interface shelf is 32 optical cross-connect interface circuit packs.

Basic configurations

The basic configurations for the LambdaRouter™ AOS 128/256 are described in the following subsections.

LambdaRouter™ AOS 256

The LambdaRouter™ AOS 256 basic configuration starts with the three-bay system shown in the figure below.



Note: In the figure above, the optical interface shelves may be either OIS-Ss or OIS-Ts, depending on the start-up configuration you order.

There are two available basic start-up configurations for the LambdaRouter™ AOS 256: transparent and transparent/opaque.

The transparent basic start-up configuration consists of the following:

- Control Bay containing the System Controller Shelf (SCS)

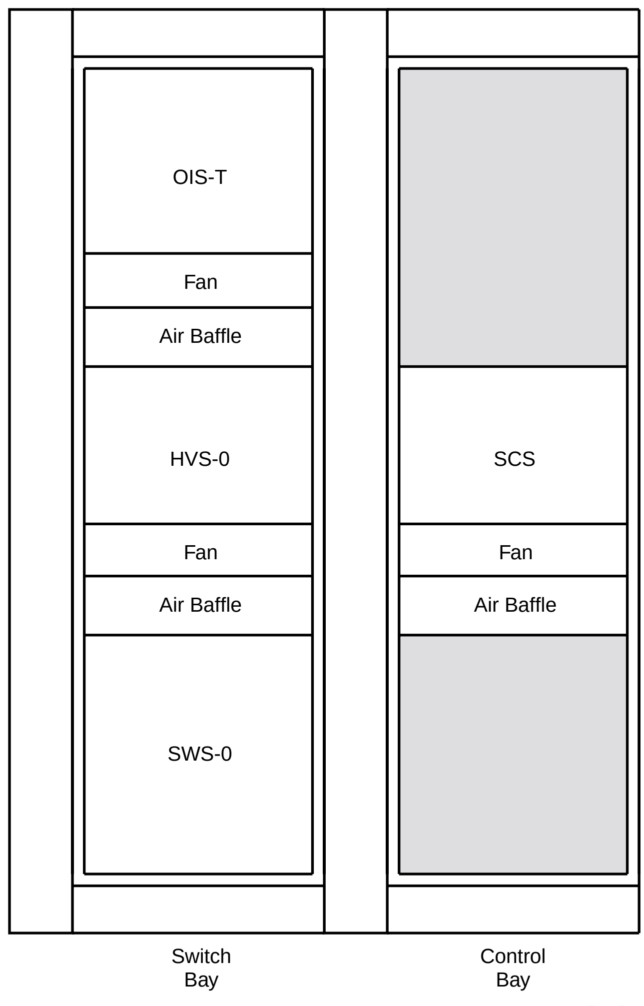
- 2 Switch Bays, each with a High-Voltage Shelf (HVS), Switch Shelf (SWS), and Optical Interface Shelf -Transparent (OIS-T).

The transparent/opaque basic start-up configuration consists of:

- Control Bay containing the SCS
- Switch Bay containing an HVS, an SWS, and one OIS-T
- Switch Bay containing an HVS, an SWS, and one Optical Interface Shelf-SONET/SDH (OIS-S).

LambdaRouter™ AOS 128

The LambdaRouter™ AOS 128 basic configuration starts with the two-bay system shown in the figure below.



This start-up configuration consists of the following:

- Control Bay containing the System Controller Shelf (SCS)
- Switch Bay containing a High-Voltage Shelf (HVS), Switch Shelf (SWS), and one Optical Interface Shelf - Transparent (OIS-T)

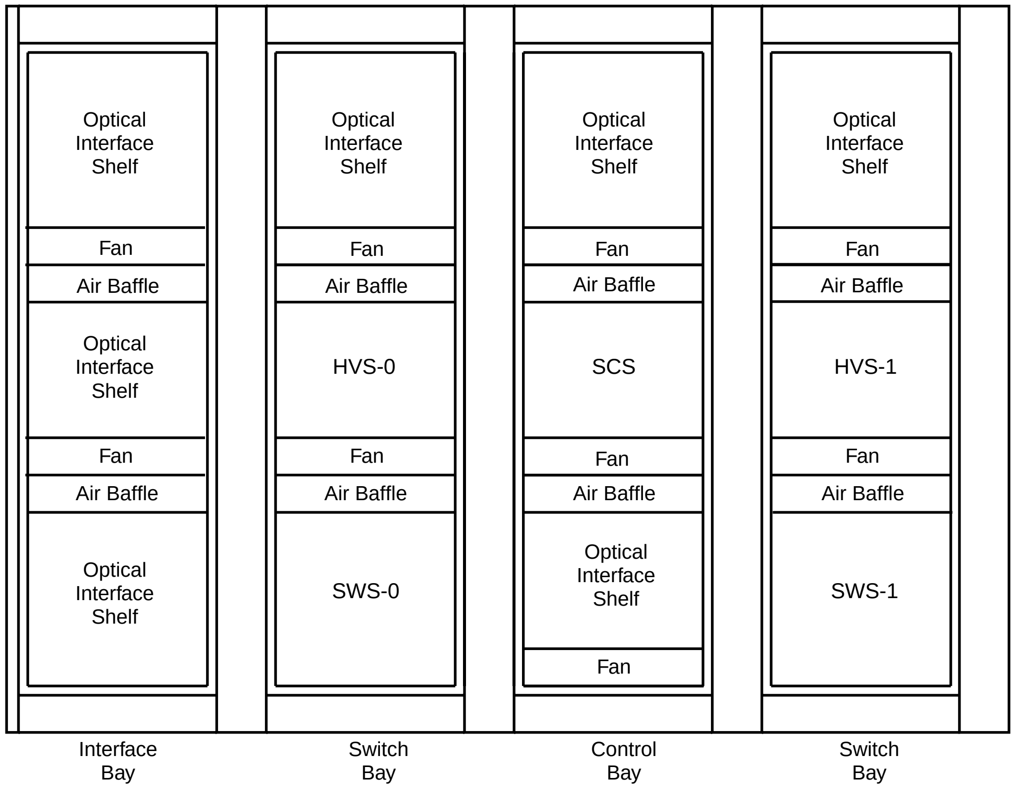
Maximum configuration

Beginning with the start-up configurations, you can build a LambdaRouter™ AOS 128/256 with a variety of interface types and speeds. Using the maximum capacity of 112 or 224 (refer to the Capacity section in Chapter 3, "Features" for capacity limitations), a mix of transparent and opaque packs are possible. Refer to Chapter 7, "Ordering" for information on custom configurations.

Depending on the model—LambdaRouter™ AOS 128 or LambdaRouter™ AOS 256—the maximum standard configuration is housed in two, three, or four bays.

LambdaRouter™ AOS 256

The maximum configuration size for the LambdaRouter™ AOS 256 is four bays which includes one Interface Bay. This is shown in the next figure.



LambdaRouter™ AOS 128

You can add optical interface shelves and port units in the LambdaRouter™ AOS 128 basic configuration; the maximum standard configuration is housed in three bays. Additionally, you can convert a LambdaRouter™ AOS 128 to a LambdaRouter™ AOS 256 by adding a Switch bay.

Some non-standard configurations of the LambdaRouter™ AOS 128 may call for the addition of a second Interface Bay.

Configuration examples

Most of the standard LambdaRouter™ AOS 128/256 installations use some transparent and some opaque interfaces; the standard configurations all include at least one OIS-T. The tables below list some configuration options. Many combinations are possible; only a few are shown as examples.

LambdaRouter™ AOS 256 basic configurations

The following table lists some possible configurations for the LambdaRouter™ AOS 256.

<table>
<tr><th rowspan="2">Bays</th><th colspan="2">Optical interface shelves</th><th colspan="3">Circuit packs/Ports</th><th rowspan="2">Notes</th></tr>
<tr><th>OIS-T</th><th>OIS-S</th><th>OXI/OXI-4A13/OXI-4A15</th><th>OXI-10GC</th><th>OXI-2GC</th></tr>
<tr><td>3</td><td>1</td><td>1</td><td>32/128</td><td colspan="2">32/32 OR 32/64</td><td>160 or 192 total ports</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3">2</td><td>16/64</td><td colspan="2">64/64 OR 64/128</td><td>128 or 192 total ports</td></tr>
<tr><td rowspan="2">32/128</td><td colspan="2">64/64 OR 48/96</td><td>192 or 224 total ports</td></tr>
<tr><td colspan="2">32/32 AND 32/64</td><td>maximum port capacity 224 ports</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3">3</td><td>16/64</td><td colspan="2">96/96 OR 80/160</td><td>160 or 224 total ports</td></tr>
<tr><td rowspan="2">32/128</td><td>96/96</td><td>-</td><td rowspan="2">maximum port capacity</td></tr>
<tr><td colspan="2">64/64 AND 16/32</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">1</td><td rowspan="2">4</td><td>24/96</td><td>128/128</td><td>-</td><td>maximum port capacity</td></tr>
<tr><td>16/64</td><td colspan="2">96/96 AND 32/64</td><td>maximum port capacity</td></tr>
<tr><td>4</td><td>1</td><td>5</td><td>16/64</td><td>160/160</td><td>-</td><td>maximum port capacity</td></tr>
<tr><td>3</td><td>2</td><td>0</td><td>56/224</td><td>-</td><td>-</td><td>all transparent; maximum port capacity</td></tr>
</table>

LambdaRouter™ AOS 128 basic configurations

The following table lists some possible configurations for the LambdaRouter™ AOS 128.

Bays	Optical interface shelves		Circuit packs/Ports			Notes
	OIS-T	OIS-S	OXI/OXI-4A13/OXI-4A15	OXI-10GC	OXI-2GC	
2	1	-	28/112	-	-	maximum capacity 112 ports
2	1	1	16/64	32/32 OR	24/48	96 or 112 total ports
				16/16 AND	16/32	maximum capacity
2	1	2	16/64	48/48	-	maximum capacity

System growth

The configurations can be expanded by adding growth bays, optical interface shelves, and circuit packs. The maximum configuration size depends on the model and type of LambdaRouter™ AOS and the type of circuit packs used. For details on configuration sizes, refer to the “Capacity” (3-2) section in Chapter 3, “Features”.

□

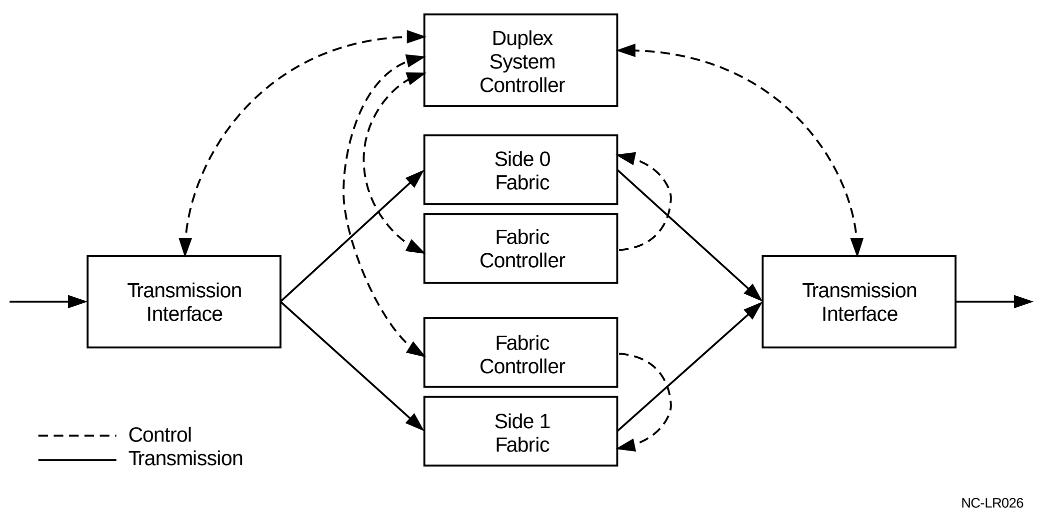
System Architecture

Introduction

This section shows the cross-connection transmission and control flow through the LambdaRouter™ AOS. There are two types of transmission interfaces provided by the LambdaRouter™ AOS: transparent (including optically amplified) and rate-specific OEO interfaces (opaque).

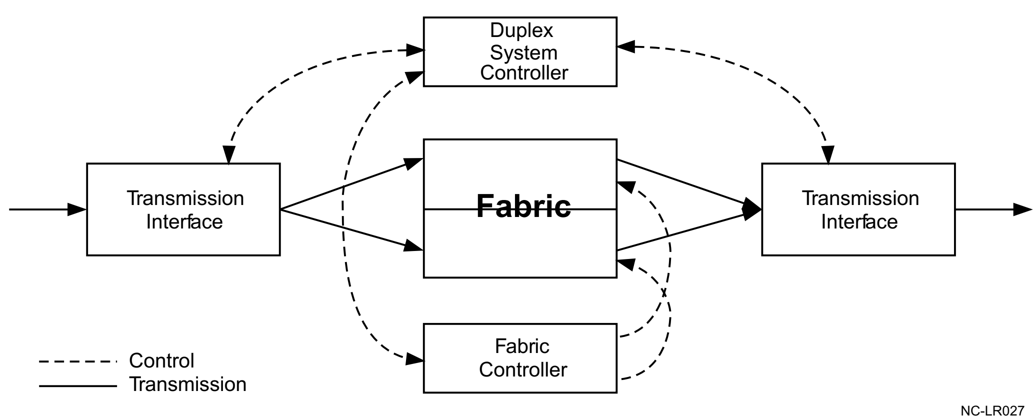
LambdaRouter™ AOS 256 transmission and control flow

The LambdaRouter™ AOS 256 flow is shown in the following figure.



LambdaRouter™ AOS 128 transmission and control flow

The LambdaRouter™ AOS 128 flow is shown in the following figure.



Working and protection

Input signals are cross-connected to output ports through one of two possible paths, designated as side 0 and side 1. The path used is the working path; the other path is the protection path.

In the LambdaRouter™ AOS 256 there are two switch fabric shelves, SWS-0 and SWS-1. In the LambdaRouter™ AOS 128, there is only one switch fabric shelf, designated SWS-0. This single shelf is logically partitioned into two fabric sides (Switch Maintenance Groups: SWMG-0 and SWMG-1).

In certain cross-connection types—such as transparent loopbacks and some bridging cross-connects—a signal may be routed through only one fabric side. Refer to the section “Bandwidth Management” (3-10) in Chapter 3, “Features”.

Cross-connection

The LambdaRouter™ AOS receives a signal at an input port of the port unit. In both types of interfaces, signals which meet or exceed the required minimum input power level continue through the LambdaRouter™ AOS to an output port. In opaque ports, the incoming signal must also meet the following requirement: the signal must have no defects.

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Transmission Interfaces

Definition

The transmission interfaces to the external equipment consist of the input and output ports on the OXI, OXI-4A13, OXI-4A15, OXI-10GC, and OXI-2GC circuit packs. These circuit packs are called port units. Among the functions that take place on these interfaces are: signal input, splitting, selection, and output. The port units provide ingress and egress ports.

The available transmission interfaces are discussed in Chapter 3, “Features”. Additional details are listed in the section, Optical parameters, in Chapter 10, “Technical Specifications”.

□

2 Applications

Overview

Purpose This chapter describes the LambdaRouter™ AOS applications.

Contents This chapter includes the following sections:

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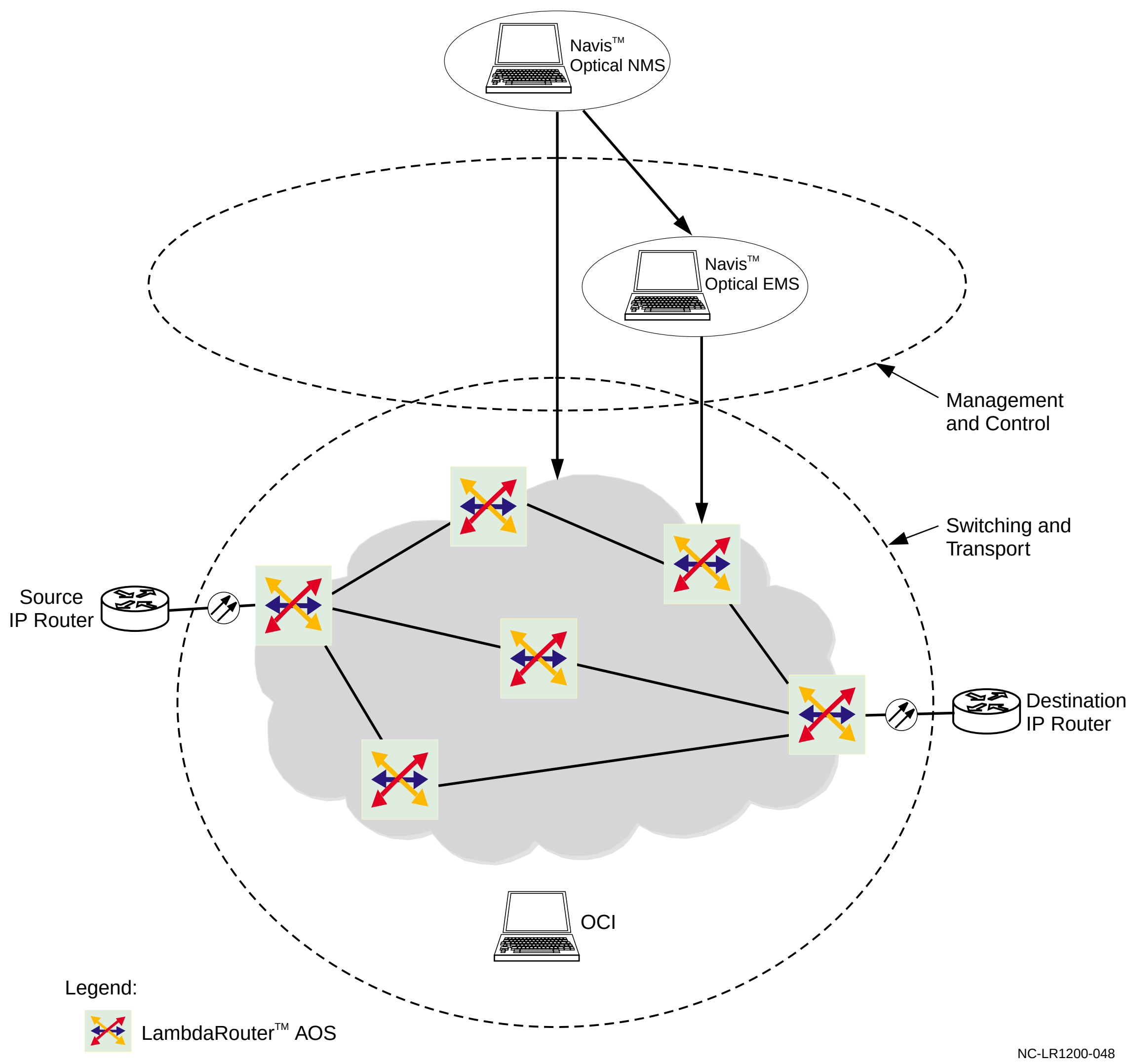
Network View of Applications

Architecture

All applications described in this chapter are facilitated by elements shown in the following figure. Illustrated in this figure are LambdaRouter™ AOSs deployed in intelligent optical networking in which switching and transport activities occur.

The figure shows the LambdaRouter™ AOS and supporting managing systems deployed in a network. Wavelength services are implemented and managed between IP routers. The Source IP Router and Destination IP Router represent customer devices between which network connectivity is to be provided.



Optical Craft Interface (OCI)

The OCI provides the on-site craft interface to a LambdaRouter™ AOS. It supports most of the functions for the local LambdaRouter™ AOS that are provided by the centralized Navis™ Optical EMS.

Navis™ Optical Element Management System (EMS)

The Navis™ Optical EMS communicates via TCP/IP with individual LambdaRouter™ AOSs in the network, and provides centralized management of individual LambdaRouter™ AOSs. Some key capabilities are:

- Provisioning of various LambdaRouter™ AOS equipment such as system-level circuit packs, port units, and ports
- Node maintenance
- Alarm reporting and management
- Cross-connect management (entry and deletion).

Navis™ Optical Network Management System (NMS)

The Navis™ Optical Network Management System (NMS) is part of a telecommunications management network that can be used to provide integrated management of an entire transport network. Navis™ Optical NMS provides network-level (end-to-end) service provisioning and restoration. It communicates with all the LambdaRouter ™ AOSs in the network and provides automatic (point-and-click) provisioning. It can also be used in conjunction with the Navis™ Optical EMS to manage all network elements individually.

LambdaRouter™ Optical Network Navigation System (ONNS)

The LambdaRouter™ ONNS is software resident on the LambdaRouter™ AOS that provides mesh-based wavelength service along with topology and network resource discovery capabilities for the LambdaRouter™ AOS.

The LambdaRouter ONNS contains a database of the LambdaRouter™ AOS connectivity used in routing computations. This database is used to determine end-to-end paths through the network. These paths may be used to meet the needs of initial service provisioning requests, or may be precomputed but activated only in response to transport failure indications from a LambdaRouter™ AOS.

Restoration

LambdaRouter™ ONNS provides mesh restoration activation by transmission of suitable cross-connect commands in response to a failure indication received from one or more LambdaRouter™ AOSs in the network. Mesh restoration is accomplished through Generalized Multiprocol Label Switching (GMPLS)-based connection management, which provides fast end-to-end connection setup and removal when start and end points are specified by the requester.

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Optical Channel Management

Benefits

The LambdaRouter™ AOS is designed to help service providers offer easy and quick provisioning of high-bandwidth connections for internet and other high-speed data and video services. Automatic service restoration is also provided in this environment.

Using microscopic mirrors, the LambdaRouter™ AOS routes optical signals from fiber to fiber without converting them to electrical signals.

The LambdaRouter™ AOS reroutes traffic at the wavelength-level without the need for manual recabling. Compare this to manual processes which often require field personnel to make as many as 12 separate cabling changes—complete with light meter readings and fiber cable cleaning operations—for a single optical-layer path change. A simple set of commands on the OCI for LambdaRouter™ AOS replaces this labor-intensive task.

Transparent and optically amplified interfaces

With its transparent circuit packs, the LambdaRouter™ AOS offers cross-connection capacity that is independent of the set of signal rates and formats that it supports. While optically amplified circuit packs operate at a single signal wave band (either 1310 or 1550 nm), these circuit packs are also format independent.

This independence, called transparency, simplifies capacity planning for two reasons:

- It is generally not necessary to allocate traffic to various port types, however, traffic is allocated based on wavelengths for the optically amplified ports.
- The cross-connection capacity of the system is independent of the bit rate, even if the bit rate of the optical channel increases.

In addition, this transparency means that, as signal rates increase in the future, the LambdaRouter™ AOS can accommodate them without the need for additional circuit packs.

Opaque interfaces

The LambdaRouter™ AOS also offers interfaces with OEO conversion for SONET/SDH 10G (OC-192/STM-64) and 2.5G (OC-48/STM-16) applications through the OXI-10GC and OXI-2GC circuit packs. These interfaces provide for monitoring of physical layer, and line and section overhead to provide performance monitoring, detection of signal defects, and detection and insertion of alarm indication signal-line (AIS-L) to support signal maintenance.

Optical layer automation

Bandwidth management at the optical layer has become a critical need of network service providers. Networking at the optical layer means managing bandwidth in units of the optical channel carried on individual wavelengths, without the need to perform time division multiplexing or packet processing.

Optical channel management includes the following:

- Adding/dropping traffic to/from the network at the client interface
- Connecting traffic through the network by means of optical line systems (OLSs).

The LambdaRouter™ AOS transforms the optical channel management from a slow, manual process to a speedy mechanized one that can be done from a centralized location.

Applications support

Applications supported by the LambdaRouter™ AOS include the following:

- Service provisioning
- Network restoration
- Traffic grooming.

Some of these applications require the LamdaRouter™ AOS be used in conjunction with the Navis™ Optical NMS and with LambdaRouter™ ONNS software. Refer to the descriptions that follow.

□

Service Provisioning

Description

The LambdaRouter™ AOS provides an orders-of-magnitude increase in the speed at which optical-layer service can be provisioned, because it eliminates the need to dispatch craft personnel for manual facility interconnections.

Provisioning, by simple point-and-click on a GUI interface, can be done in seconds and the operator can select end-points for the optical channel.

Automated distributed service

Release 3.0 of the LambdaRouter™ AOS supports automatic distributed service provisioning, along with restoration functions, through the inclusion of the LambdaRouter™ Optical Network Navigation System (ONNS).

In combination with the Control and Communication Network (CCN), LambdaRouter™ ONNS provides end-to-end path restoration.

For a description of LambdaRouter™ ONNS, refer to Chapter 6, “Operations Interfaces and Managing Systems”.

☐

Network Restoration

Types

The LambdaRouter™ AOS provides an orders-of-magnitude increase in the speed at which services can be restored via alternate paths by removing the need for manual recabling operations. In this release, several types of restoration are provided.

The Restoration Interface Processor (RIP) circuit pack is part of the distributed configuration management feature. Along with the Restoration Controller (RC) circuit pack, the RIP provides a dedicated signaling channel for communication between LambdaRouter™ AOSs. This channel then provides the message transport needed to support service routing and restoration rerouting.

The LambdaRouter™ AOS offers the following types of network restoration:

- Pre-planned
- 1+1 (pre-planned and pre-provisioned)
- mesh-based (auto-reroute)

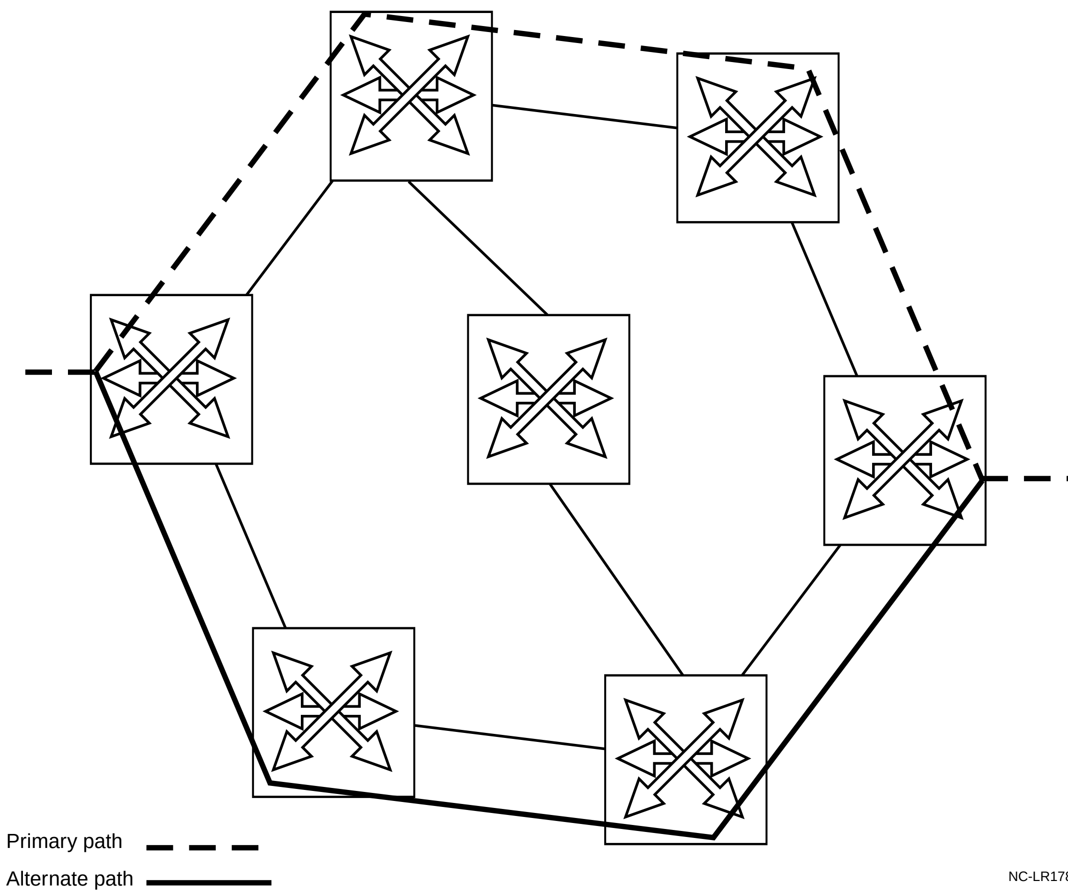
Pre-Planned

By using a managing system, such as Navis™ Optical NMS, the LambdaRouter™ AOS can be provisioned with alternate routes to be used in the event of a path failure.

1+1

In 1+1 network restoration, the restoration path is provisioned, including the end-points, when initial path provisioning is done. This means that both the primary and the restoration paths are always completely provisioned. A path failure will automatically trigger the restoration path.

The two paths (service and restoration) are shown in the following figure.

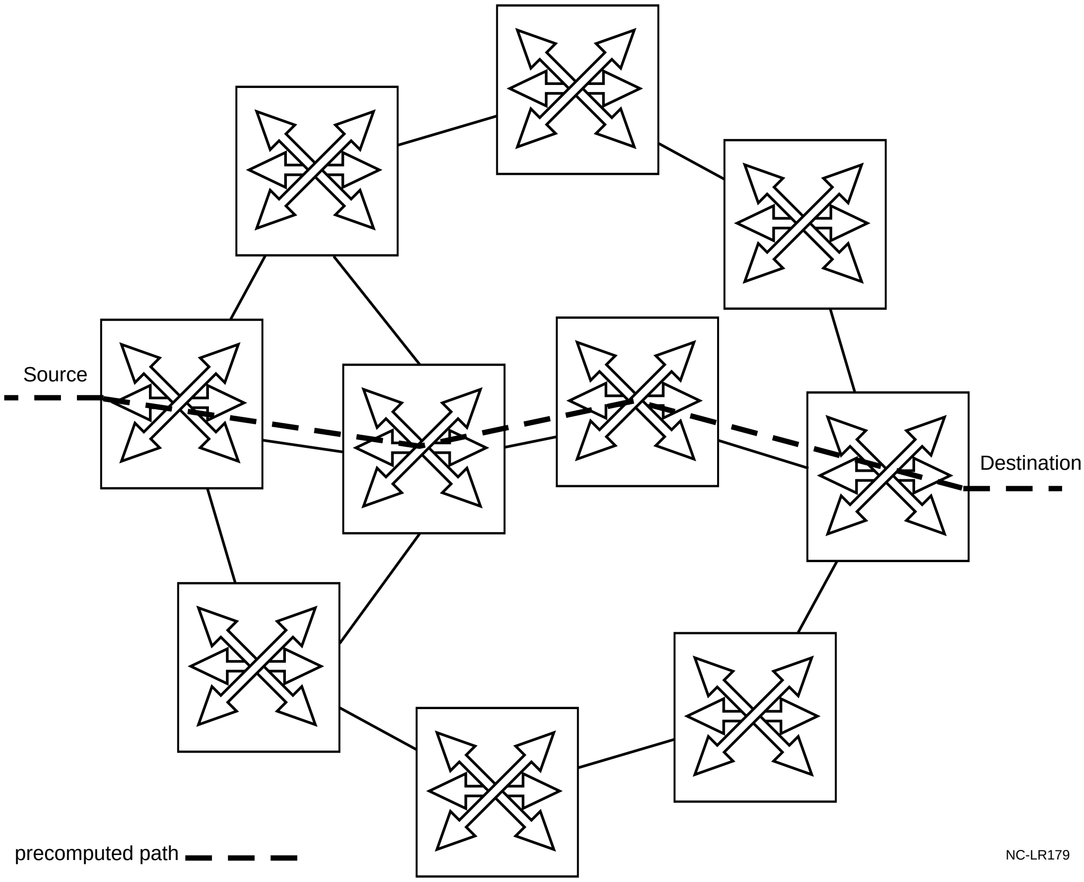


The restoration path always carries the same signal as the service path and the egress LambdaRouter™ AOS automatically switches over when the service path fails.

Mesh-based

When the LambdaRouter™ AOS is used in conjunction with LambdaRouter™ ONNS, auto-reroute restoration is possible. In this restoration scheme, the restoration path is pre-computed when initial path provisioning is done, and set up automatically in real time when a path failure is detected.

This is shown in the following figure.



In the mesh-based architecture, provided by LambdaRouter™ ONNS, protection and restoration are programmed into dynamic routing algorithms embedded into the LambdaRouter™ AOSs and maintained by the LambdaRouter™ ONNS. This architecture offers the combined switching and management capabilities needed for mesh restoration.

When a failure occurs in one or more of the elements carrying end-to-end services, a restoration algorithm is invoked to reroute the service. Link connections between LambdaRouter™ AOSs are shared as a pool of resources available to set up end-to-end paths as needed. Note that even though restoration paths are pre-computed, when a path fails, a re-computation is done to make use of the latest network connectivity information.

☐

Traffic Grooming

Description

The LambdaRouter™ AOS allows service providers to rapidly rearrange the interconnection of optical channels (that is, wavelengths) between optical line systems—such as the WaveStar® OLS 1.6T— in order to optimize wavelength use on fiber routes.

Demand for traffic is growing, often in unexpected locations which makes traditional capacity planning and long-term-engineering impossible. The network must be able to respond to forecast uncertainties and balance traffic accordingly.

□

3 Features

Overview

Purpose This chapter gives a brief description of the product features.

Contents This chapter includes the following sections:

Capacity

Description

The LambdaRouter™ AOS is strictly non-blocking for point-to-point cross connections. Duplex fabrics or fabric sides offer the capability to provide protection of connection paths against fabric or mirror failures.

The LambdaRouter™ AOS supports transparent, optically amplified, and opaque circuit packs, which are called port units.

The supported port units are the following:

- OXI providing four input and four output ports
- OXI-4A13 (transporting signals in the 1310 nm band) providing four input and four output ports
- OXI-4A15 (transporting signals in the 1550 nm band) providing four input and four output ports
- OXI-2GC providing two input and two output ports
- OXI-10GC providing one input and one output port

The LambdaRouter™ AOS consists of the following major components:

Interface shelves

The following optical interface shelves are available for the LambdaRouter™ AOS.

- Optical Interface Shelf-Transparent (OIS-T). Each OIS-T provides up to 128 two-way transparent terminations by housing a maximum of 32 OXI, OXI-4A13, and/or OXI-4A15 circuit packs.
- Optical Interface Shelf-SONET/SDH (OIS-S). This shelf can be configured as an OIS-10G, OIS-2G, or an OIS-MX (mixed 10G and 2.5G).
  - Each OIS-10G can house a maximum of 32 OXI-10GC packs and provides up to 32 two-way OC-192/STM-64 terminations.
  - Each OIS-2G can house a maximum of 32 OXI-2GC circuit packs and provides up to 64 two-way OC-48/STM-16 terminations.
  - Each OIS-MX can house a maximum of 16 OXI-10GC circuit packs and 16 OXI-2GC circuit packs.

This shelf provides up to 16 OC-192/STM-64 and 32 OC-48/STM-16 terminations.

Switch Shelf (SWS)

This shelf houses the optical cross-connect switch fabric, which contains the MicroStar® MEMS-based mirror assembly. The LambdaRouter™ AOS is designed to provide spare fabric channels to recover from inoperable or failed paths. For this reason, each switch fabric provides 256 input connectors and 256 output connectors that are accessible for internal system use. Failed paths, therefore, can generally be rerouted within the system using non-service affecting maintenance.

High-Voltage Shelf (HVS)

The HVS provides the voltages required to control the mirror positions.

System Controller Shelf (SCS)

This shelf provides the system-level control functions for the LambdaRouter™ AOS.

LambdaRouter™ AOS 256 capacity and connections

The LambdaRouter™ 256 incorporates two Switch Shelves (SWSs) to provide diverse routing through the system. This configuration supports simultaneous use of 224 input and 224 output connections between the optical interface shelves and external customer equipment, with a minimum of six additional input and six additional output fabric connections in reserve for sparing.

LambdaRouter™ AOS 128 capacity and connections

The LambdaRouter™ 128 provides diverse routing through a single SWS, which is logically partitioned into two fabric sides. This configuration supports simultaneous use of 112 input and 112 output connections between the optical interface shelves and external customer equipment, with a minimum of three additional input and three additional output fabric connections in reserve for sparing.

LambdaRouter™ AOS 128 to 256 conversion

The LambdaRouter™ AOS 128 can be converted to a LambdaRouter™ AOS 256 through a growth kit that adds the necessary components (Switch Bay). Refer to Chapter 7, “Ordering” for details on this kit.

□

Synchronization

Description

Optical signals that are passed transparently through the LambdaRouter™ AOS do not involve any external clocking or synchronization.

The signals that are processed through the optical-electrical-optical (OEO) port units (OXI-10GC and OXI-2GC), require clocking. The LambdaRouter™ AOS uses through timing. This feature uses clock recovery from incoming signals and uses that clock as a reference to transmit data. In cases in which a clock reference cannot be recovered from the incoming signal, an internally generated clock (155/622 MHz) is used as a reference for the outgoing signal.

The internal clock complies with SONET requirements for ±20 ppm stability.

Time of day clock

The LambdaRouter™ AOS has a non-volatile time of day clock that is used for resetting the system clock after a system reset. This clock ensures that the correct system time of day will be maintained after a failure without user intervention. This feature is required for performance monitoring.

□

Transmission Interfaces

Overview

There are three different types of transmission interfaces—transparent, optically amplified, and opaque. These interfaces are located on the LambdaRouter™ AOS OXI circuit packs which are called port units.

For the purposes of provisioning, the input ports and output ports are independent, that is, a particular input port is not necessarily associated with a particular output port.

WaveStar® OLS Keepalive

The LambdaRouter™ AOS port units support interworking with the WaveStar® Optical Line System (OLS) 1.6T, and use the link-based keep-alive signal it generates to monitor the health of the link.

This feature monitors the power level of the AIS-L signal delivered by the WaveStar® OLS 1.6 T on working idle links and informs the LambdaRouter™ Optical Network Navigation System (ONNS) of a link failure.

Transparent and optically amplified interfaces

Transparent and optically amplified port units provide interfaces that have bit-rate and format independence.

Transparent interfaces

On transparent interfaces, the transmission performance-related data is the measurement of optical power levels at both the switch egress locations and on the input ports. This power measurement is used only to detect loss of signal. The transparent interfaces are located on the input and output ports of the OXI packs and on the output ports of the OXI-4A13 and OXI-A15 packs.

Optically amplified interfaces

The LambdaRouter™ AOS also offers two optically amplified port units that can operate at any bit-rate and are wavelength-specific interfaces. These interfaces are located on the OXI-4A13 and OXI-4A15 circuit packs.

Optical amplification on these port units takes place in the ingress direction only; operation in the egress direction is identical to that of the OXI circuit packs.

One of these optically amplified port units operates at the 1310 nm wavelength band (OXI-4A13); the other operates at the 1550 nm wavelength band (OXI-4A15).

Functions

The OXI, OXI-4A13, and OXI-4A15 circuit packs each provide power monitoring and splitting on each input signal, and power monitoring and selection on each output signal. Each of these circuit packs has four input and four output ports.

The LambdaRouter™ AOS transparent and optically amplified interfaces are characterized by the following attributes:

- They are purely optical. (No electrical processing is performed.)
- Input signals can be of any bit rate or data format; therefore, cross-connect capacity is not affected by data rate of the input signals.
- Power monitoring is used to detect loss of input signals or to detect internal equipment failure.
- Detected failures result in switchover to the path through the alternate fabric side.

For optical parameters associated with these circuit packs, refer to the table in the section, “Optical parameters” (10-6) in Chapter 10, “Technical Specifications”.

Opaque interfaces

Opaque interfaces are interfaces that accept incoming signals of a particular bit-rate and/or format. These interfaces are rate-specific SONET/SDH interfaces that operate at a either 10 Gbps or 2.5 Gbps. The opaque interfaces have optical-electrical-optical (OEO) capabilities.

The opaque ports will typically be used as client-side interface ports, to add or drop a network user’s signal at the LambdaRouter™ AOS.

The Optical Cross-Connect 10G Client (OXI-10GC) circuit pack accepts OC-192/STM-64 signals and provides OEO conversion. This circuit pack provides a single input and a single output port.

The Optical Cross-Connect 2G Client (OXI-2GC) circuit pack accepts OC-48/STM-16 signals and provides OEO conversion. This circuit pack provides two input and two output ports.

On the LambdaRouter™ AOS's opaque OC-192/STM-64 (OXI-10GC) and OC-48/STM-16 (OXI-2GC) interfaces, power monitoring is available in the egress direction only. In both the ingress and egress directions, the incoming signals are monitored for standard SONET/SDH signal failure indications (signal defects) such as loss of frame (LOF), alarm indication signal (AIS), and bit error rate (BER) impairments to support monitoring for signal defects and to provide performance monitoring.

These opaque interfaces provide performance monitoring of signal transmissions to ensure the desired quality of service (QoS) is obtained.

The LambdaRouter™ AOS rate-specific interfaces are characterized by the following attributes:

- They provide OEO conversion.
- Incoming OC-192/STM-64 or OC-48/STM-16 signals can be processed.
- Signal defects such as LOF, AIS, and BER/EBER and maintenance signals (AIS-L) are detected.
- Performance monitoring is provided.
- Detected failures can result in switchover to the path through the alternate fabric side, according to user provisioning.

Architecture

The following figures show the functions that take place in the input and output directions of the port units.

Input

1. Physical input port
2. Monitoring (PMON) of SONET/SDH overhead (opaque only)
3. Power monitoring (PWRM - transparent and optically amplified port units)
4. Optical amplification (on the optically amplified port units only)

   Note that the optically amplified port units have an additional power monitor to monitor the amplifier output power on the input port.
5. Signal splitting (1:2 splitter).

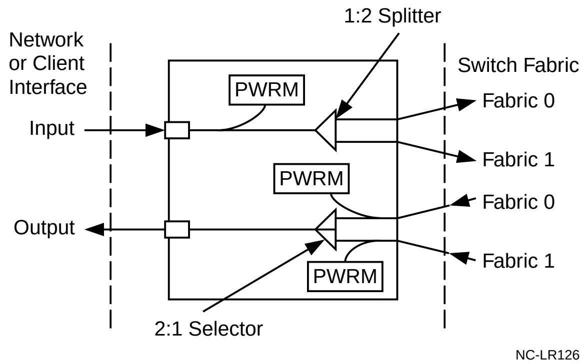
Output

1. Power monitoring (PWRM)

2. Signal selection (2:1 selector)
3. Monitoring (PMON) of SONET/SDH overhead (opaque only)
4. Physical output port (egress port).

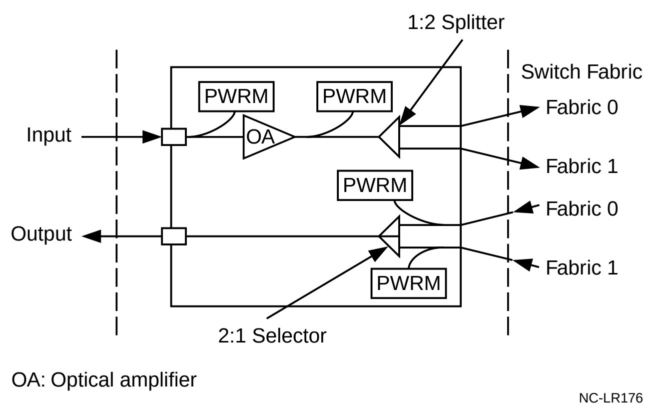
Transparent interfaces

The following figure illustrates an input and an output OXI port pair. No electrical processing is performed on this interface.



Optically amplified interfaces

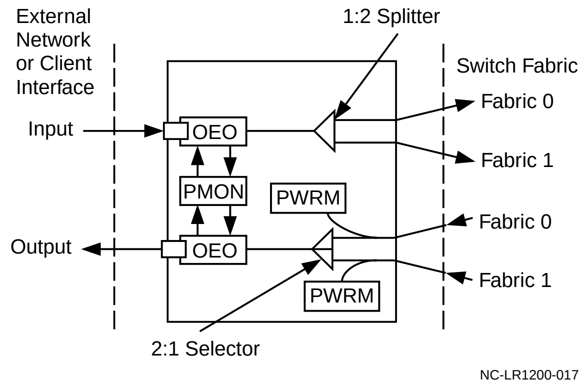
The following figure illustrates an input and an output optically amplified port pair. No electrical processing is performed on this interface.



Note that optical amplification takes place only on the input signal.

Opaque interfaces

The next figure shows an input/output opaque port pair. In this external interface, OEO conversion takes place at both input and output ports.



Physical interface

Single-mode LC connectors with a PC (physical contact) polish are used to connect to transmission facilities that connect to other network elements. The outer fiber jacket must not exceed 1.6 mm diameter.

Optics

The LambdaRouter™ AOS supports long reach, intermediate reach, and short reach optics. The opaque interfaces support short reach clients (SR-1/I.16 for 2.5G interfaces) and very short reach clients (SR-1/I-64.1 4dB budget on 10G interfaces) on the external interfaces. Intermediate reach client optics are supported with the use of line build outs (LBOs). Intermediate to long reach optics are required on the transparent OXI interfaces.

The optically amplified circuit packs support intermediate and short reach optics.

Light-path routing

Using LambdaRouter™ ONNS, the LambdaRouter™ AOS calculates the best path based on user constraints across a network of up to fifty LambdaRouter™ AOSs and sets up a light path for optical transmission.

□

Bandwidth Management

Non-blocking cross-connect

Optical networking requires the ability to provide one-way and two-way cross-connections between client-network and network-network interfaces.

The LambdaRouter™ AOS provides strictly non-blocking cross-connections (that is, it will not deny a cross-connection due to blocking in the fabric) for the number of point-to-point cross-connections equal to the system I/O capacity discussed earlier in this chapter.

Transparent and optically amplified interfaces

The LambdaRouter™ AOS transparent and optically amplified interfaces provide (optionally) the ability to manage cross-connections based on provisioned client signal characteristics (such as SONET or SDH). That is, particular transparent transmission interfaces can be provisioned for the type of client to which they are connected. Cross-connections will be denied on user-provisioned ports that do not match this provisioning.

Opaque interfaces

The LambdaRouter™ AOS provides OEO client-side interfaces for traffic handling.

The opaque port unit can be cross-connected to another opaque output port (of the same type, 10GC or 2GC) or to a transparent output port that has been provisioned for the same format. That is, an OXI-10GC pack can be cross-connected to an OXI-10GC output port or to an OXI output port that has been provisioned for 10 Gbps; similarly, an OXI-2GC can be cross-connected to an OXI-2GC output port or to an OXI output port that has been provisioned for 2.5 Gbps.

Test access

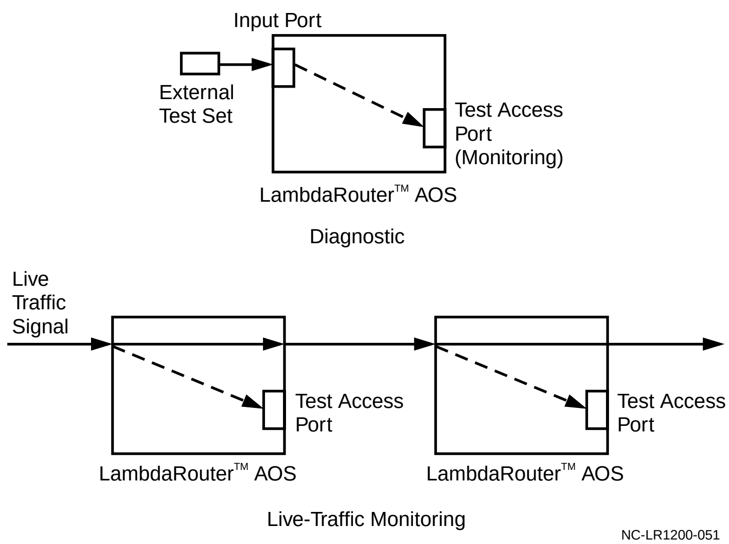
In test access, the LambdaRouter™ AOS monitors either a live traffic signal or an externally generated test signal.

Monitor-mode test access makes use of a cross-connection involving either one or both switch fabrics, from one input port to one output port. Test signal generation can be done at an input port using an external test set. Test signal interpretation of a received signal is done at an output port that either belongs to an opaque circuit pack or has an external test set connected to it.

Test access can be used for the following:

- diagnostic testing of network elements
- ensuring new facilities are operating properly
- aiding fault sectionalization activities
- monitoring transmission quality of live traffic.

The figures that follow show a diagnostic set-up and the arrangement for monitoring live traffic, respectively.



Bridging

In this release of the LambdaRouter™ AOS, 1+1 path protection can be established using the cross-connect bridging capability. These bridging paths can be part of a network span between two LambdaRouter™ AOSs. Test access makes use of the bridging function; this is illustrated in the figure labeled "Live-Traffic Monitoring" in the previous section.

Bridging capabilities can be used to support traffic rearrangement and maintenance functions as well as 1+1 path protection.

Each input signal to the LambdaRouter™ AOS is split and the resulting two input signals are sent through one of the two switch fabrics or logical switch fabric sides. The resulting output signal from each fabric side may be directed to the same output port (to provide fabric protection) or these two signals may be directed to two different output ports (to provide 1+1 path protection or bridging). The ability to direct a particular input signal to two different output ports is called 1:2 bridging or multicast bridging.

Merging

The opposite of multicast bridging, that is, the capability to direct two input signals to a particular output port, is called 2:1 merging. When the LambdaRouter™ AOS merges two signals at the same port unit output port, the optical 2:1 selector chooses one of these signals, which is then directed to the network or client interface.

Signal monitors in the egress port unit are used to select the signal based on:

- signal strength in the case of an OXI egress port
- signal strength or signal defect indicators (including LOS, LOF, AIS-L, and BER/EBER) in the case of OEO egress ports.

Topologies

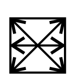
The LambdaRouter™ AOS offers the following classes of cross-connections:

- Basic—the user can provision unidirectional (one-way point-to-point) cross-connections and bidirectional (two-way point-to-point) cross-connections
- Bridged cross-connections to provide multicast bridging and corresponding signal merging and selection—this combination is needed for both 1+1 path protection and client-side protection.
- Port cross-connect loopbacks.

The cross-connections that follow are illustrated for the LambdaRouter™ AOS 256. Cross-connections for the LambdaRouter™ AOS 128 are the same, except a single fabric (SWS-0) is used, which is divided into logical sides.

Figure legend

The following conventions are used in the figures that follow.



Is a Mirror pair

* Indicates ports that are not used for cross-connections

PWRM Power Monitor

PMON SONET/SDH Overhead Monitor

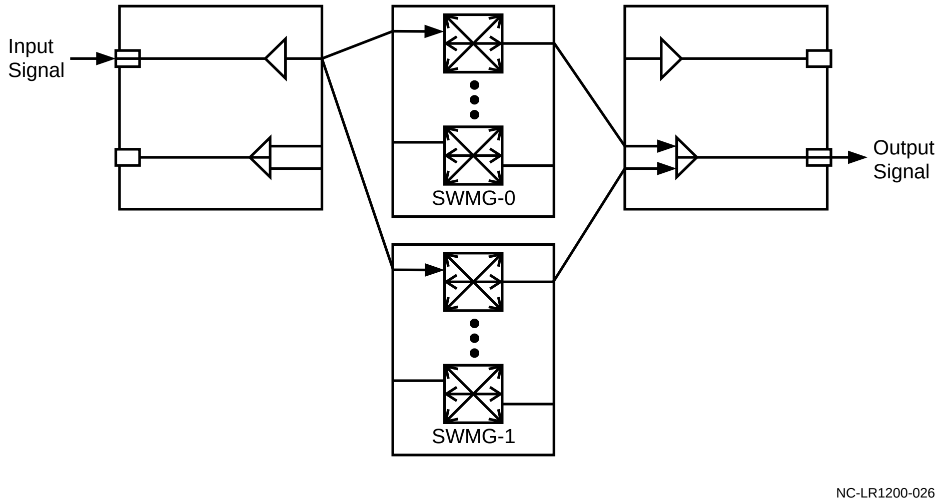
OEO Optical - electrical - optical converter

Client - side and Line - side ports may be transparent, optically amplified, or opaque

NC-LR1200-054

One-way cross-connection

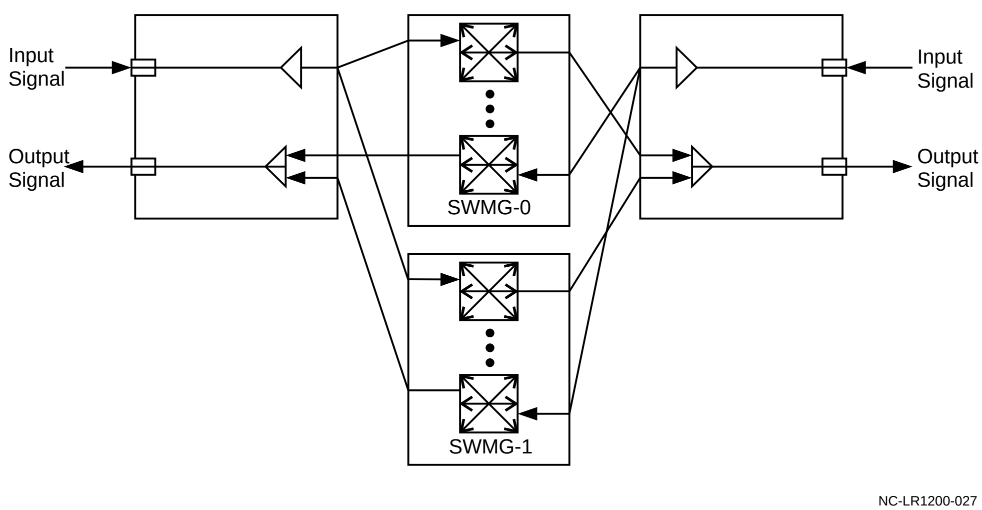
This figure shows the topology of a one-way point-to-point cross-connection providing internal path protection.



Note that an independent cross-connection can be made in the other direction at each port in the preceding figure.

Two-way cross-connection

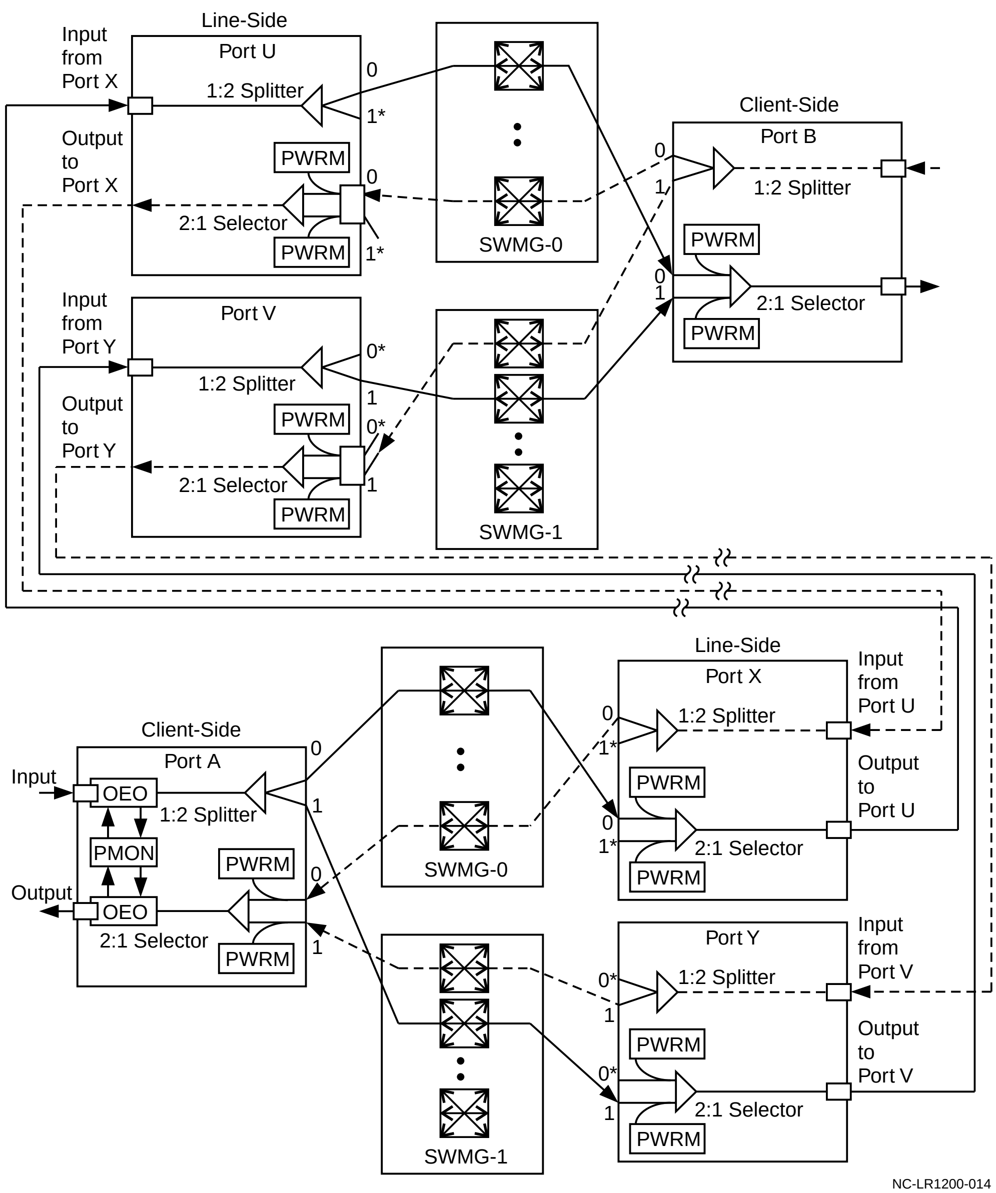
A two-way cross-connection has transmission paths in both directions and can be viewed as two independent one-way cross-connections, each of which is called a leg of the two-way cross-connection. The two-way cross-connection is duplex when the legs are routed through both switch fabric sides as shown in the topology in the following figure. Input and output signals do not have to be on the same circuit pack.



Bridging/merging—1+1 network path protection

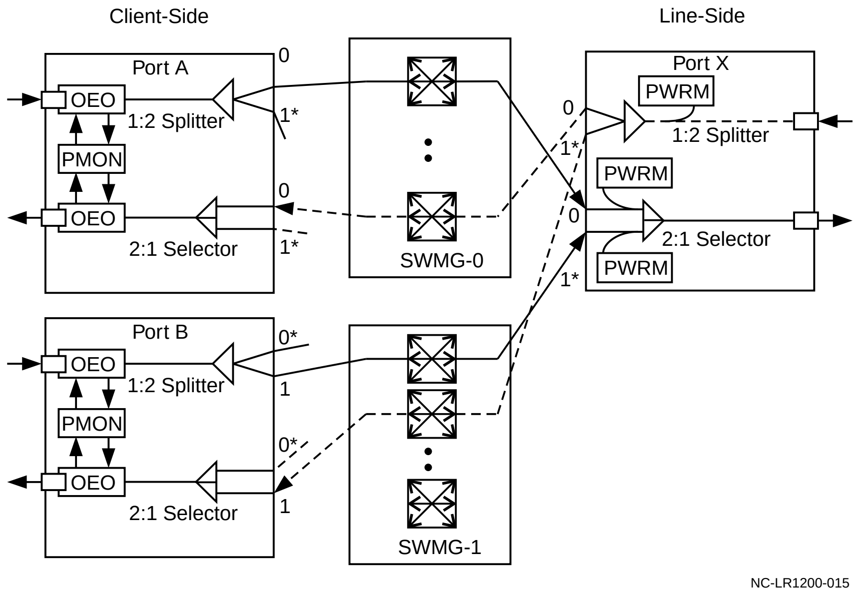
The following figure shows 1+1 network path protection using bridging and merging. One client-side uses a transparent port unit; the other uses an opaque port unit.

In this illustration, the lines connecting the two clients (that is, top to bottom portions of the figure) represent a long-distance Optical Line System (OLS) connection.



Bridging/merging—1+1 client-side protection

Bridging can also be used to provide a client-side protection configuration to a customer's site. This can be done with or without the implementation of 1+1 network path protection. The following figure illustrates client-side 1+1 protection without 1+1 network path protection.



When Port X's selector detects a problem with the signal coming from SWS-0, that is, the client-side Port A, it switches to the other switch fabric (SWS-1), which has the effect of switching to a signal provided by Port B. A similar switch is initiated if a defective signal from SWS-1 is received.

Cross-connect loopbacks

The LambdaRouter™ AOS provides for a cross-connect loopback in which an optical signal from an input port through the switch fabric is looped back to the default output port or to another output port selected by the user. The LambdaRouter™ AOS provides for two types of loopbacks.

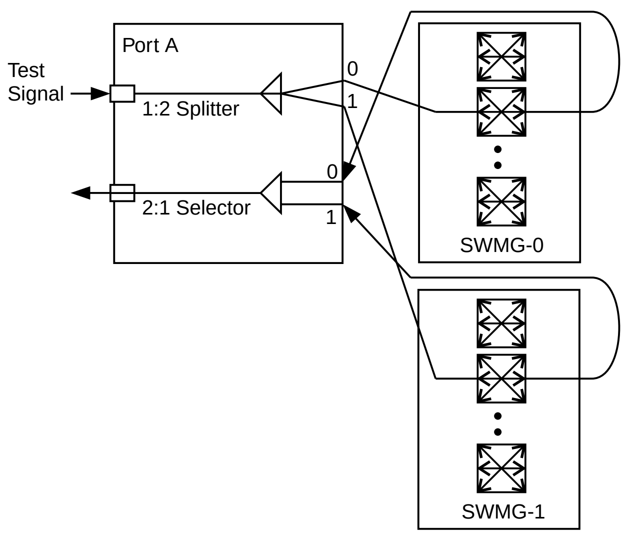
The loopbacks that follow are illustrated for the LambdaRouter™ AOS 256. Loopbacks for the LambdaRouter™ AOS 128 are the same, except the single fabric (SWS-0) is divided into two logical sides.

Normal loopbacks

A normal cross-connect loopback is a non-service-affecting topology that can be established on any type of input port, and applies only when the port is idle. This loopback may be duplex (default) or simplex by optionally selecting the switch fabric or fabric side to be used.

A normal cross-connect loopback provides a transmission path through a switch fabric back to the output of the same port or to any idle output port (user selected).

A normal loopback is shown in the following figure:



NC-LR1200-025

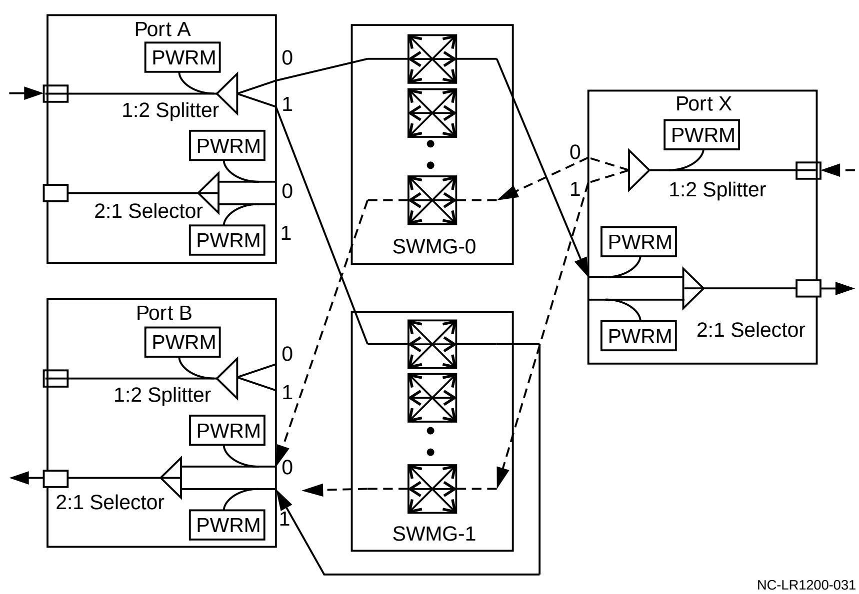
Forced loopbacks

A forced cross-connect loopback topology can be established on any type of input port that already has an existing cross-connection, and may be duplex or simplex by specifying the switch fabric or fabric side to be used.

A forced duplex cross-connect loopback is service-affecting because both switch fabrics in the LambdaRouter™ AOS 256, or both logical sides of the switch fabric in the LambdaRouter™ AOS 128, are used for the loopback and, therefore, no transmission path is available to reach the original output port.

A forced simplex cross-connect loopback is normally non-service-affecting because only one switch fabric or side is used for the loopback, while the other switch fabric or side continues to provide a simplex transmission path for the original cross-connection. However, a forced simplex cross-connect loopback may cause the output selector to switch (depending on the selected switch fabric side specified), which would briefly interrupt the signal being carried by the original cross-connection.

A forced simplex loopback is shown in the following figure:



When a forced loopback is removed, the original cross-connection is restored by the system.

□

Topology Discovery

Overview

In conjunction with Automatic Interconnection Recognition Protocol (AIRP), the LambdaRouter™ ONNS provides the ability to autonomously discover the transport topology within a network of up to fifty LambdaRouter™ AOSs.

The LambdaRouter™ AOS uses a separate Control and Communications Network (CCN) to transmit and manage LambdaRouter™ AOS to LambdaRouter™ AOS signaling.

Reference

Refer to the “LambdaRouter™ Optical Network Navigation System (ONNS)” (6-10) section of Chapter 6, “Operations Interfaces and Managing Systems” for more information on AIRP and topology discovery through LambdaRouter™ ONNS.

☐

Protection Switching

Duplicated fabric

The duplicated fabric or logical fabric sides in the LambdaRouter™ AOS provides high reliability for point-to-point cross-connections. The inclusion of two physically distinct fabrics in the LambdaRouter™ AOS 256 and two logically distinct fabric sides in the LambdaRouter™ AOS 128 provides equipment protection against failures within the system, and 1+1 network path protection for network failures outside the LambdaRouter™ AOS.

The LambdaRouter™ AOS provides both manual fabric side switching and automatic fabric side switching of individual paths through the system. In both the LambdaRouter™ AOS 128 and 256, this protection switching is the switchover of the path from switch maintenance group 0 (SWMG-0) to switch maintenance group 1 (SWMG-1)

SWMG-0 and SWMG-1 reside, in the LambdaRouter™ AOS 128, on the logical fabric sides of the single switch fabric (SWS-0) and, in the LambdaRouter™ AOS 256, on the fabrics SWS-0 and SWS-1, respectively.

Manually, the user can select traffic from either fabric or side on a per-path basis. The interruption to traffic when a switch is made is less than 1 millisecond.

Automatic transmission protection switching of the path through the system is completed in the presence of a failure within 10 milliseconds. This switching affects only the paths that have a need to switch; other traffic is unaffected.

Restoration

The LambdaRouter™ AOS offers both 1+1 and mesh-based restoration types.

The LambdaRouter™ AOS supports the LambdaRouter™ ONNS ability to autonomously calculate link- and node-diverse protection paths through a mesh network for up to fifty LambdaRouter™ AOSs for both 1+1 and distributed-mesh restoration types.

1 + 1 restoration

The LambdaRouter™ AOS offers 1 + 1 network restoration. This feature provides an alternate path that is provisioned at the same time the primary path is provisioned (and carries traffic at all times), based on bridged cross-connections. Path switching at the remote end employs merge-type cross-connections and is accomplished within 15 milliseconds.

Mesh-based restoration

A network of LambdaRouter™ AOSs supports the following integrated network restoration sizes:

- end-to-end single path—completion within 250 msec for a five hop/six node path
- complete failure of a single node (fifty node network)—completion within 4.4 secs

Duplex control

The LambdaRouter™ AOS is equipped with a system controller complex which provides redundant control. The controllers are maintained in active/standby mode; transmission continues unaffected during a switchover.

The LambdaRouter™ AOS has the following controller fault protection groups:

- System controller complex protection group consisting of two complexes, each composed of control circuit packs (SYS50D, RC, and EI) in active/standby mode. The circuit packs are described in the section “SCS circuit packs” (4-11) in Chapter 4, “Hardware Description”.
- High-Voltage Shelf controller protection group consisting of two High-Voltage Switch Interface Controller (HSWIC) circuit packs in active/standby mode.
- Optical interface shelf controller protection group consisting of two Optical Interface Switch Interface Controller (OSWIC) circuit packs in active/standby mode.

In addition, the LambdaRouter™ AOS provides duplicated primary (PRI) non-volatile memory (NVM) packs in active/standby mode, which are, in turn, backed up by a single secondary NVM memory pack (SEC).

Duplicated DCC packs provide interfaces for management systems and OCI sessions.

System and shelf controllers support both automatic and manual protection switching. Existing connections are not affected by controller switching.

□

Performance Monitoring

Introduction

The OEO circuit packs (OXI-10GC and OXI-2GC) provide non-intrusive performance monitoring of the signal transmission to ensure that the desired quality of service is provided. Because the LambdaRouter™ AOS is non-terminating equipment, the overhead is not modified in any way.

When performance monitoring is enabled, the LambdaRouter™ AOS continuously collects and processes performance monitoring data. The thresholds for various monitored parameters are set via performance monitoring profiles that are associated with ports. The thresholds for all parameters except Physical Layer parameters are user provisionable and threshold notifications may be enabled or disabled.

The performance monitoring functionality is provided by the opaque transmission interface circuit packs, the OXI-10GC and OXI-2GC.

Functions

The main performance monitoring functions supported by the LambdaRouter™ AOS are:

- initialization of current performance monitoring registers
- enabling or disabling performance monitoring data collection for SONET or SDH
- setting performance monitoring data thresholds for monitored parameters via threshold profiles and assigning performance monitoring profiles to ports
- generating quality of service (QoS) Alarm messages when thresholds are matched or exceeded
- enabling or disabling threshold crossing alerts (TCAs)

SONET/SDH interfaces

The LambdaRouter™ AOS supports performance monitoring for SONET interfaces at the Section and Line layers using the SONET overhead bits.

For SDH interfaces, LambdaRouter™ AOS supports performance monitoring at the Regenerator Section and Multiplex Section using the SDH overhead bits. In addition, SONET/SDH Physical Layer performance monitoring of Laser Bias Current (LBC) and Optical Power Transmitted (OPT) is provided.

In addition, SONET/SDH Physical Layer performance monitoring is provided using physical performance monitoring parameters rather than the overhead bits.

Performance monitoring can be performed on the incoming signal as well as the outgoing signal for all SONET/SDH ports that are equipped with OEO devices and whose operational state is enabled.

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Fault Detection and Alarms

Description

The LambdaRouter™ AOS provides continuous, autonomous, in-service fault detection and isolation on transmission and control equipment.

Office alarms and user panel and circuit pack LEDs signal alarm and event conditions. Alarm indications also include messages through the communications interfaces to the OCI, Navis™ Optical NMS, and Navis™ Optical EMS.

The LambdaRouter™ AOS monitors for both defects and failures. Defects can be declared failures as a function of system timing and correlation. Failures are alarmed and reported locally and to management systems (such as Navis™ Optical EMS). Defects are ordinarily not reported, except for those that affect customer signals; these defects are reported to the LambdaRouter™ ONNS.

There are six broad categories of failures: common, equipment, optical channel, security, Control Communications Network (CCN), and performance monitoring Quality of Service (QoS).

Common conditions

Common conditions include system alarms and events pertaining to control, system resources, and shelf fans.

Equipment conditions

Equipment conditions include circuit pack alarms and events and transmission alarms and events at internal interfaces.

Optical channel conditions

Optical channel conditions include incoming facility alarms or events, that is, signal failures at the external transmission interfaces, which are monitored by the circuit packs:

- OXI/OXI-4A13/OXI-4A15—optical signal power monitoring
- OXI-10GC/OXI-2GC—SONET/SDH transport overhead monitoring in addition to optical signal power monitoring

Security conditions

Security conditions are reported as alarms or events pertaining to security management.

Control Communications Network (CCN) conditions

CCN conditions are reported as alarms or events pertaining to the IP network used to support the LambdaRouter™ ONNS features.

Quality of Service (QoS) conditions

QoS conditions are reported as events pertaining to performance monitoring of customer signals.

□

Shutdown and Recovery

Over-voltage and low-voltage shutdown

The LambdaRouter™ AOS shuts down when it detects an office DC power drop below or a power surge above a predefined input voltage level. The cross-connection map and other provisioned data are maintained over the power loss, provided this data has been written the the NVM. Refer to the “Power supply components” (10-4) section in Chapter 10, “Technical Specifications”, for voltage cut-off thresholds.

Recovery after power failure

Power is restored to the LambdaRouter™ AOS automatically after a power failure, without user intervention, when the input voltage rises above the predefined level. When power is restored, the LambdaRouter™ AOS returns to its last saved provisioned state.

The time-of-day is restored after a failure without user or other external intervention.

During a complete system loss of power (both feeds), commands in progress are not guaranteed to be completed.

□

Software Management

Feature types

The software management features provide the highly robust software and database management system needed for a very large network element in a dynamic bandwidth management role.

These features are divided into the following types:

- Infrastructure:
  - Memory
  - Labeling
- Operations:
  - Installation
  - Backup and restore
  - Updates
  - Resets.

Non-Volatile Memory

The LambdaRouter™ AOS provides non-volatile storage for all provisionable data. Duplicated Non-Volatile Memory (NVM) media are provided as the primary means for backup. A removable secondary NVM is provided.

Labeling

The LambdaRouter™ AOS provides for labeling of databases for use in future download operations. The labeling includes system target identifier (TID), date and time created, demonstrated data integrity, and software version.

The LambdaRouter™ AOS provides labeling of the software generic in order to uniquely identify it. This generic ID is recognized by the system and can be obtained by the user upon query.

Installation

The LambdaRouter™ AOS generic and backed-up data can be downloaded from the Navis™ Optical EMS or the OCI to the primary NVM. Generic installation has no effect on transmission performance, unless the new generic also includes updates for controller software for the opaque or optically amplified circuit pack types. In this case, transmission will be interrupted for several seconds.

Back up and restore

The user can initiate manual database backup and database restoration between the following areas:

- Primary NVM and secondary NVM
- Primary NVM and the Navis™ Optical EMS
- Primary NVM and the Optical Craft Interface (OCI).

Software updates

The user can download software generics from the OCI or Navis™ Optical EMS to a primary NVM.

Resets

The controller can be reset by command (from OCI or Navis™ Optical EMS). There are two levels of reset (boot) available to the user:

- The user can reset the entire control system to the existing database (if present on NVM) or to factory defaults.
- The user can reset individual shelf controllers by access identifier (AID).

All boots from a primary NVM, software only or software plus database, complete within thirty minutes.

Upgrades

Description

The following non-service-affecting upgrades are available:

- WaveStar® LambdaRouter Release 2.0 128 to Release 3.0 LambdaRouter™ AOS 128
- WaveStar® LambdaRouter Release 2.0 256 to Release 3.0 LambdaRouter™ AOS 256

Kits are available for these upgrades, refer to Chapter 7, “Ordering”.

For information on upgrades, refer to the LambdaRouter™ *AOS 128/ 256 Release 3.0 Software Release Description.*

□

Security Access

Introduction

The following features provide security management functions for the LambdaRouter™ AOS:

- user identification and authentication including:
  — user ID and password aging
  — user ID lockout
- user access control, which determines which tasks each user is allowed to perform based on the privilege codes described below
- user notification control, which determines which messages each user can receive
- user command execution control based on an assigned user privilege level
- user logout, which can be executed by the user or the system
- security activity audit trail, which logs all commands submitted by the user
- security variable backup/restore, which includes backup and/or restore of:
  — configuration variables (such as thresholds, timeouts, passwords, etc.)
  — password creation date and time

Users and privilege

There are two levels of users: users and superusers. Superusers can execute all available TL1 commands.

There are only two superusers. These two superuser logins are pre-installed; no other users may be granted these privileges.

User privilege codes

User privilege codes are used for user access control. The privilege code is made up of a functional category concatenated with an authorization level.

The functional categories are as follows:

- Maintenance (M)
- Provisioning (P)
- Security (S)
- Test (T)

- Performance Monitoring (PM)

The authorization level ranges from 0 to 5 for all functional categories except security, which ranges from 1 to 5. An authorization level of 5 allows all privileges for the functional category.

OCI user types

Predefined user types in the OCI are used to set default values when establishing and modifying OCI user logins. These user types apply only to the OCI and not to the LambdaRouter™ AOS.

The five predefined user types are as follows:

- Superuser—S5, T5, M5, P5. PM5—has access to all security and system provisioning capabilities
- Privileged user—S3, T5, M5, P5, PM5—has access to all user capabilities except those that are security-related
- General user—S1, T4, M4, P3, PM4—has access to a limited number of user capabilities (excludes such things as software installation)
- Maintenance user—S1, T4, M4, P3, PM1—has access to testing functions
- Reports only user—S1, T1, M1, P1, PM1—can retrieve information but cannot modify the system.

□

Application Messaging

Overview

The LambdaRouter™ AOS communicates with the OCI, Navis™ Optical NMS, Navis™ Optical EMS, and with other managing systems using TL1 messages. TL1 messages include commands, responses, and system notifications.

A user logs into an OCI, Navis™ Optical EMS, or other OS, and that system accesses the LambdaRouter™ AOS to receive notifications and enter commands. The LambdaRouter™ AOS is a multi-user system.

A maximum of 12 user sessions plus one superuser session are possible simultaneously per DCC pack.

A maximum of five user sessions are possible with LambdaRouter™ Optical Network Navigation System (ONNS).

The LambdaRouter™ AOS supports the execution of multiple commands concurrently. Commands are prioritized according to the type of command and the user privilege of the login issuing the command.

Users enter commands and receive responses from the system.

The LambdaRouter™ AOS can report database changes resulting from the entered commands to a user interface (for example, Navis™ Optical EMS) that has been provisioned for this feature.

System notifications

The following types of TL1 notifications are provided:

- Protection switch changes
- Alarms
- Database changes
- System state changes.

Users can subscribe to notifications based on the security administration setup.

The following types of LambdaRouter™ ONNS TL1 notifications are provided through the LambdaRouter™ ONNS TL1 OS port:

- Network connection changes (via REPT-PTHCHG)
- Network connection state changes (via REPT-PTHEVT)
- LambdaRouter™ ONNS data repository changes (via REPT-NNCHG)

Users can subscribe to LambdaRouter™ ONNS notifications based on the LambdaRouter™ ONNS security administration setup.

Logs

The LambdaRouter™ AOS logs all system events in the following categories:

- User session activity
- Database changes
- Security activity
- Alarms
- Protection switching activity.

Reference

For additional information on the TL1 commands, refer to the *LambdaRouter™ AOS Operations Systems Engineering Guide*.

☐

4 Hardware Description

Overview

Purpose The purpose of this chapter is to provide a description of the LambdaRouter™ AOS hardware.

Contents This chapter includes the following sections:

□

General

Introduction

The LambdaRouter™ AOS is made up of bays, shelves, and circuit packs. Other equipment contained on these components, such as user panels and fans, are also described in this chapter.

Bay

A bay is a frame containing one or more shelves. All LambdaRouter™ AOS bays use ETSI-compliant Seismic Zone 4 bay frame suitable for both overhead cabling and raised-floor applications.

The LambdaRouter™ AOS has the following bay types:

- Control Bay
- Switch Bay
- Interface Bay

Each bay is ETSI-compliant with dimensions 600 x 600 x 2200 mm [23.62 x 23.62 x 86.6 inches]. An alternate bay version with dimestions 600 x 600 x 2134 mm [23.62 x 23.62 x 84 inches]—suitable for Telcordia applications—is available through special order. Contact your Lucent account executive.

The LambdaRouter™ AOS also includes two or four fiber organizer units, which are located on the right and left sides of the Switch Bays. The dimensions of each fiber organizer are 150 x 600 x 2200 mm [5.9 x 23.62 x 86.6 inches].

Shelf

A shelf is a smaller framework with cabling and slots to house circuit packs. These shelves are mounted in the LambdaRouter™ AOS bays:

- System Controller Shelf (SCS)
- Switch Shelf (SWS)
- High-Voltage Shelf (HVS)
- Optical Interface Shelf-Transparent (OIS-T)
- Optical Interface Shelf-SONET/SDH (OIS-S)

Note: The OIS-Ss are also labeled OIS-10G, OIS-2G, and OIS-MX, depending on provisioning and fibering. Refer to the section "Provisioning and Fibering" (5-8) in Chapter 5, "System Planning and Engineering".

Circuit pack

A circuit pack is a unit which provides a function to the LambdaRouter™ AOS. Power, transmission interface, voltage control, and memory are among the functions provided by the individual circuit packs. These circuit packs are described later in this chapter.

The optical interface circuit packs—OXI, OXI-4A13, OXI-4A15, OXI-10GC, and OXI-2GC—are also called port units.

User panel

Each shelf contains a user panel which provides the user with certain status and alarm and event information as well as some access and test functions. The user panels are described later in this chapter.

Power

The LambdaRouter™ AOS uses a distributed power architecture. Central Office (CO) battery voltage is distributed to its shelves by means of office cabling. Board-mounted power modules in each circuit pack convert the incoming battery voltage to the specific voltage required. Power specifications are given in Chapter 10, "Technical Specifications".

ESD grounding

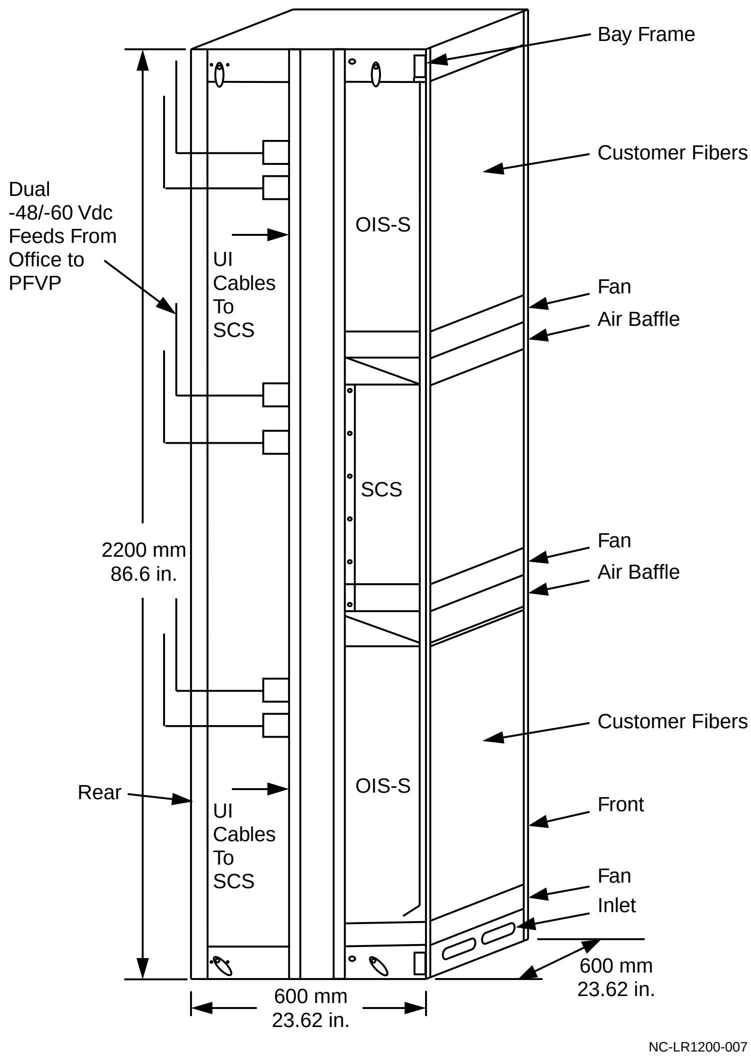
The SCS has an ESD jack on the user panel. For other components the ESD jacks are provided in the air baffle on the maintenance aisle and on the bay uprights on the wiring aisle.

□

Bays

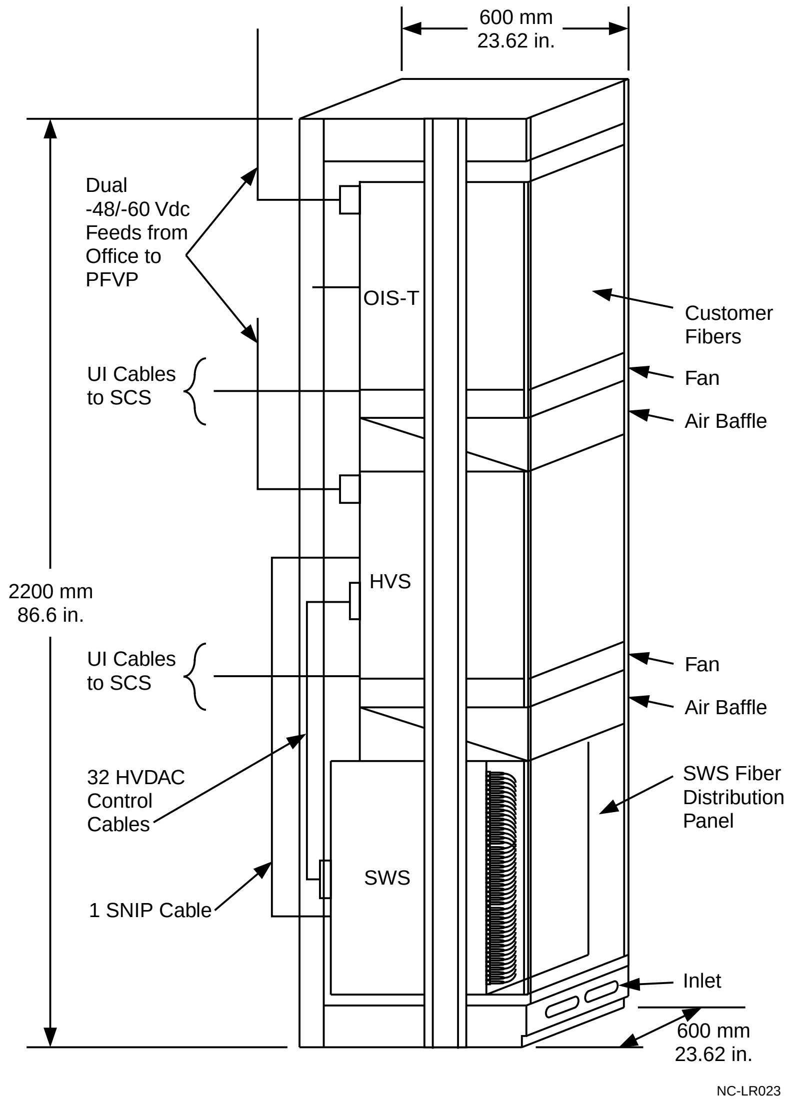
Control Bay

The Control Bay contains the SCS and up to two optical interface shelves. The dimensions and layout of the Control Bay (in this example, equipped with two OIS-Ss) are shown in the following figure.



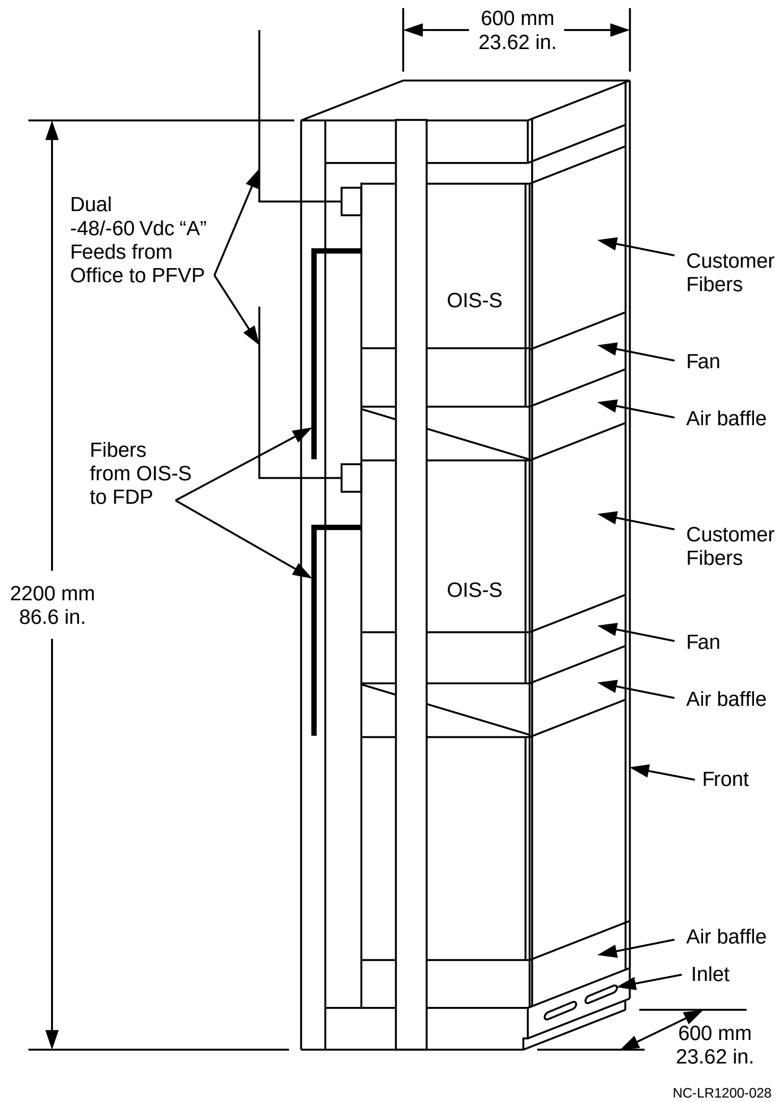
Switch Bay

The Switch Bay provides the optical switch with its control circuitry and some of the input/output (I/O) ports for the LambdaRouter™ AOS. It is made up of an SWS, HVS, and an optical interface shelf. The dimensions and layout of the Switch Bay (in this example, equipped with an OIS-T) are shown in the following figure.



Interface Bay

The Interface Bay houses the optical interface shelves—OIS-T and OIS-S. The OIS-T contains the transparent OXI/OXI-4A13/OXI-4A15 circuit packs and the OIS-S contains the opaque OXI-10GC and OXI-2GC circuit packs. Transparent and opaque circuit pack types cannot be mixed on a shelf. Circuit packs can be mixed within an Interface Bay provided the appropriate shelves are installed in the bay.



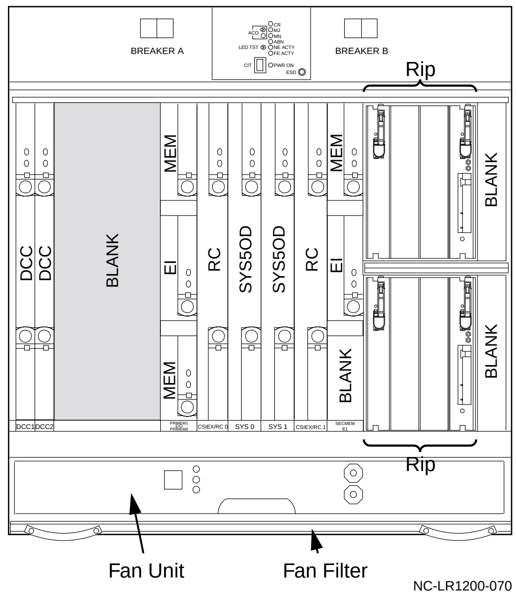
In this example, the Interface Bay is shown with two OIS-Ss. Any combination of OIS-T and OIS-S shelves can be used to fill this bay.

□

Shelves

SCS The System Controller Shelf (SCS) is located in the Control Bay and contains the circuit packs that provide the redundant main controller and memory functions for the LambdaRouter™ AOS.

This SCS is shown in the following figure.



The following circuit packs, described later in this chapter, are located on the SCS:

- DCC
- MEM
- EI
- RIPs, used for CCN connections
- RC, used for LambdaRouter™ ONNS functions
- SYS50D

SWS The Switch Shelf (SWS) is located in the Switch Bay and contains the optical switch fabric and Fiber Distribution Panel (FDP).

The connections to the MEMS mirrors are done at the FDP, which provides connections between the switch fabric and the interface shelf backplane.

In the LambdaRouter™ AOS 256, the two SWSs provide for spatially diverse paths through the system. In the LambdaRouter™ AOS 128, the single SWS provides logically diverse paths through the system. The two fabrics or logical fabric sides may be used either for protection of paths through the system or to implement 1+1 network path protection. At any time, for any path, one fabric/fabric side is active and the other standby.

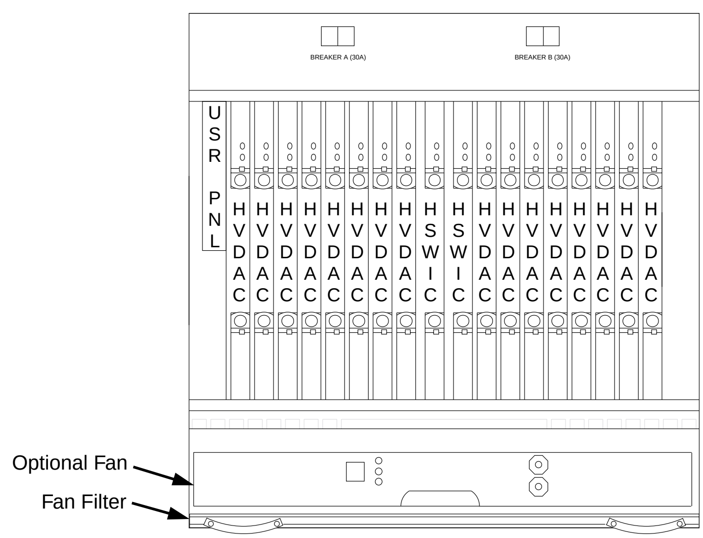
HVS

The High-Voltage Shelf (HVS) controls the voltages used to steer the individual mirrors in the MEMS arrays.

Each HVS contains 16 High-Voltage Digital-to-Analog Converter (HVDAC) circuit packs. Each of these circuit packs supports 128 high-voltage control leads and controls 32 MEMS mirrors (16 in the input array, 16 in the output array).

In addition to the HVDAC circuit packs, the HVS contains two HVS Switch Interface Controller (HSWIC) circuit packs, which provide control of the HVDAC functions and a control interface to the System Controller Shelf (SCS).

The front of the HVS is shown in the following figure.

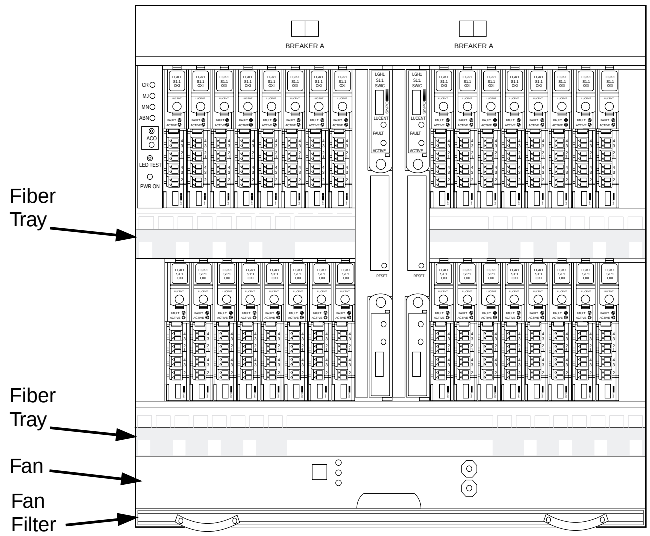


Front View

NC-LR006

OIS-T

The Optical Interface Shelf-Transparent (OIS-T) houses the OXI, OXI-4A13, and OXI-4A15 circuit packs that provide the bit-rate and format-independent interface between the LambdaRouter™ AOS and the customer equipment.



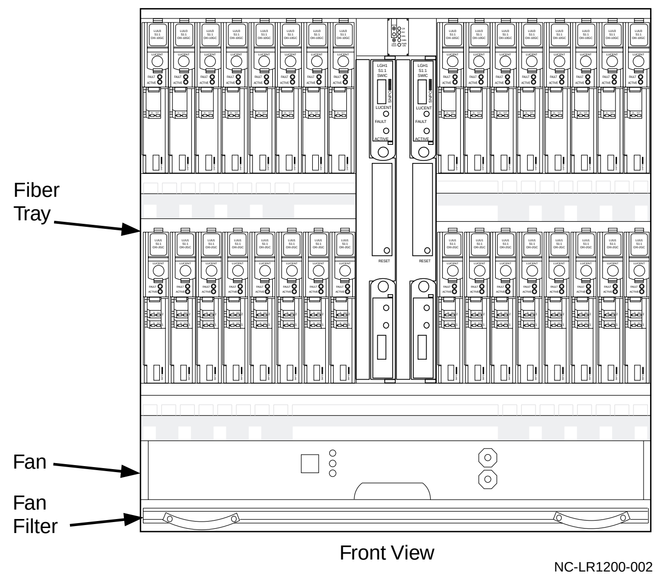
Each OIS-T contains two Optical Interface Shelf Switch Interface Controller (OSWIC) circuit packs, which provide control of the port unit functions and an interface to the SCS. This shelf also contains up to 32 transparent and/or optically amplified circuit packs.

OIS-S The OIS-S houses the OXI-10GC and OXI-2GC circuit packs that provide the OC-192/STM-64 and OC-48/STM-16 interfaces between the LambdaRouter™ AOS and the customer equipment.

Each OIS-S contains:

- two OSWIC circuit packs, which provide control of the port unit functions and a control interface to the SCS
- up to 32 opaque circuit packs.

An OIS-S, configured as an OIS-MX and housing the maximum number of circuit packs—16 OXI-10GC and 16 OXI-2GC—is shown below.



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Circuit Packs

Overview The circuit packs listed in this table are described in this section.

SCS	OIS-T	OIS-S	HVS	SWS
DCC	OXI	OXI-10GC	HVDAC	The SWS does not house any circuit packs
MEM	OXI-4A13	OXI-2GC	HSWIC	
EI	OXI-4A15	OSWIC		
RIP	OSWIC			
RC				
SYS50D				

Circuit pack faceplates Each circuit pack has a FAULT LED and an ACTIVE LED on its faceplate.

SCS circuit packs The SCS circuit packs provide control, memory, and communications functions for the LambdaRouter™ AOS. The individual circuit packs are described below.

The SCS circuit packs accept and monitor the two –48 or –60 V power feeders from the backplane and display an alarm on single power feed failure.

SYS50D

There are two SYS50D circuit packs in the SCS, which provide the main system control functions for the system. The SYS50D circuit packs are each equipped with a Reset button that can be used to reset the circuit pack.

The SYS50D circuit pack interfaces with all of the other SCS circuit packs and provides the following control functions:

- interfaces (via an internal operations network) to the HVSs and optical interface shelves
- stores and executes the operating copy of the system code and data
- performs self-audits and system-wide maintenance computations
- automatically resets the system during power up

- interfaces to the associated EI and PRI MEM0 or PRI MEM1 circuit packs

DCC

The SCS is equipped with two Data Communications Channel (DCC) circuit packs. The DCC circuit packs are each equipped with a Reset button that can be used to reset the circuit pack.

The DCC circuit packs provide the interface between the system and the operations data communications network, which may be physically accessed via the LAN connections on the EI packs.

MEM

The SCS is equipped with three Memory (MEM) circuit packs.

Two primary MEM circuit packs (PRI MEM0 and PRI MEM1) provide redundant storage of the program code and configuration data, and communicate with the SYS50D circuit packs.

A secondary MEM circuit pack (SEC MEM) is used for backup and communicates with the RC circuit packs.

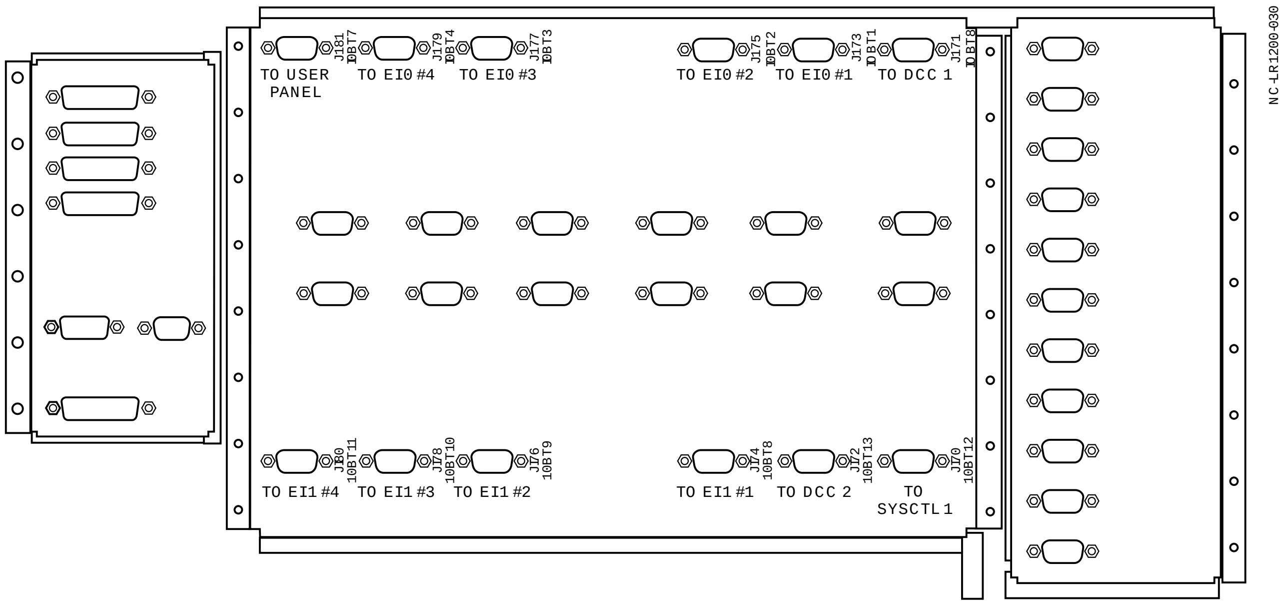
Program and configuration data on the MEM are stored on a Personal Computer Memory Card International Association (PCMCIA) flash disk card with up to 880 megabytes of memory. This card is removable and can be accessed from the faceplate of the MEM circuit packs.

EI

There are two External Interface (EI) circuit packs, which provide:

- four-port 10BaseT hub used for the OCI and the Intraoffice (IAO) LAN. The IAO LAN supports remote access to management systems, which are described in Chapter 6, “Operations Interfaces and Managing Systems”. An IP management data network is required to provide the connectivity from the IAO LAN to the remote management systems.
- SCS user panel LEDs and controls
- office alarms interface

The following figure shows the rear of the SCS and a high-level view of the sites for the EI connections.



The SCS has precabled connections on the backplane. The following table lists one possible configuration of these EI circuit pack connections. If an external hub is used, it is connected to EI1 port 4. A more detailed discussion is provided in the “Control and Communications Network (CCN)” (6-13) section of Chapter 6, “Operations Interfaces and Managing Systems”

Port	EI0	EI1
1	DCC1	DCC2
2	RC0 (DCN port on RIP pack faceplate)	RC1 (DCN port on RIP pack faceplate)
3	EI1	EI0
4	User Panel	LAN

RC

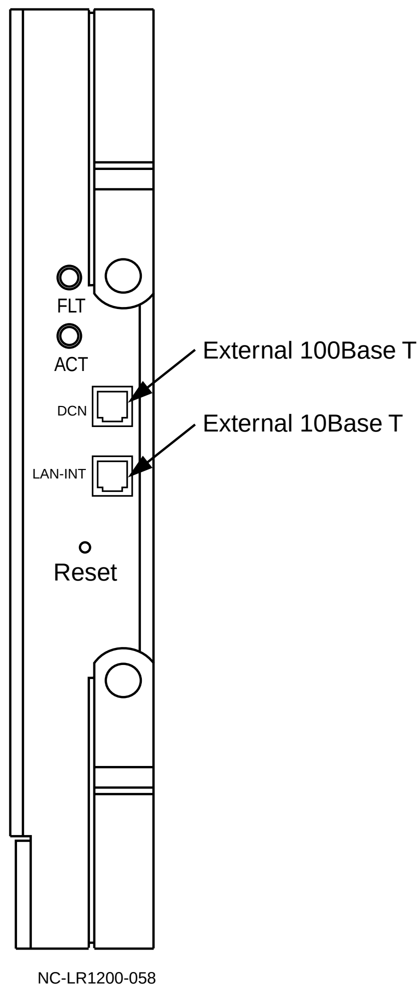
There are two Restoration Controller (RC) circuit packs in the SCS. The RC pack interfaces to the SYS50D and RIP circuit packs in the SCS.

These circuit packs handle the network connection routing, setup, and teardown, and support restoration functions. They process network restoration messages to and from the RIP packs, forwarding necessary requests to the SYS50D (e.g., requests for establishing cross-connects during path setup and restoration).

When combined with the SYS50D and EI circuit packs, this pack completes the main system controller complex. The RC and RIP circuit packs together provide for network restoration.

The RC pack faceplates include a 10BaseT LAN port for the LambdaRouter™ ONNS management connection (labeled LAN-INT) and a 100BaseT interface for future applications. Each RC pack is equipped with a Reset button that can be used to reset the circuit pack.

The RC faceplate is shown below.



The RC packs provide the following control functions:

- equipage monitoring

- power loss
- LED control
- 1 Hz clock
- time of day clock
- SYS50D status
- RIP reset

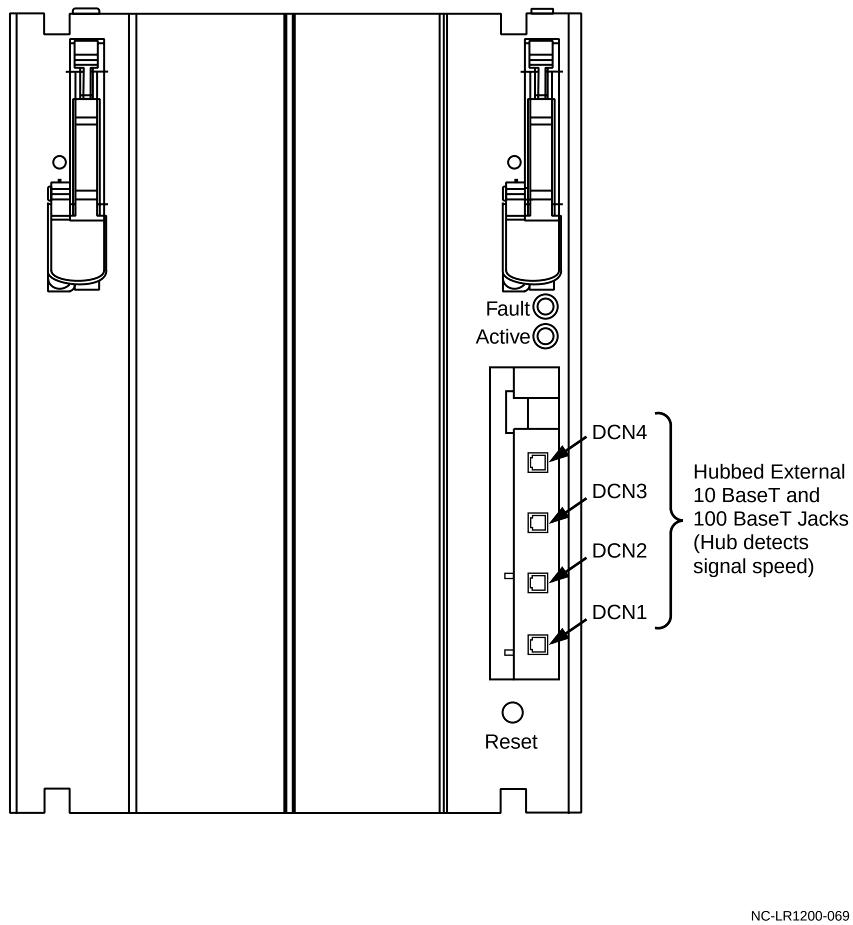
RIP

There are two Restoration Interface Processor (RIP) circuit packs in the SCS. The RIP packs interface to the RC circuit packs to provide access to the CCN to send and receive signaling messages to support network path connection setup and restoration. The RIPs forward network signalling messages to and from the RCs which in turn, process messages to and from the SYS50D as needed.

Each LambdaRouter™ AOS within a domain is provided Control and Communication Network (CCN) connectivity by means of the RIP circuit packs. Each LambdaRouter™ AOS equipped with RIPs will have a duplicate node-disjoint signalling path to neighboring LambdaRouter™ AOSs in the domain; each path corresponds to one of the RIPs.

One means of external interface to the CCN equipment is provided by four faceplate mounted RJ-45 ports (labeled DCN1 through DCN4). These ports allow the RIPs to accept signalling data from the CCN and to launch signalling data into the CCN.

Note that the four CCN ports are actually on a hub. They are labeled DCN but are 10baseT/100baseT ports for CCN connection. Refer to the following figure, which shows a RIP faceplate installed.



Internally, restoration data is distributed between the RIP and RC through the RIP circuit packs's Restoration Controllers Communications Network (RCCN) repeaters. The RCCN repeater provides the cross-over connections between the RC and RIP packs. The four RCCN repeater ports on the RIP backplane operate at 100Mbps.

The RIP circuit packs are each equipped with a Reset button that can be used to reset the circuit pack.

RC/RIP interconnectivity

Each RC and RIP circuit pack presents a four-port 100baseT hub to the SCS backplane. The interconnections are as shown in the following table. Note that the unused ports are routed to backplane connectors on the SCS.

Port	RC 0	RC 1	RIP 0	RIP 1
1	RIP 1	RIP 1	RC 0	RC 0
2	RIP 2	RIP 2	RC 1	RC 1
3	unused	unused	RIP 1	RIP 0
4	RC 1	RC 0	unused	unused

OIS-T/OIS-S circuit packs

The circuit packs on the OIS-T and OIS-S provide the interface ports to the customer equipment.

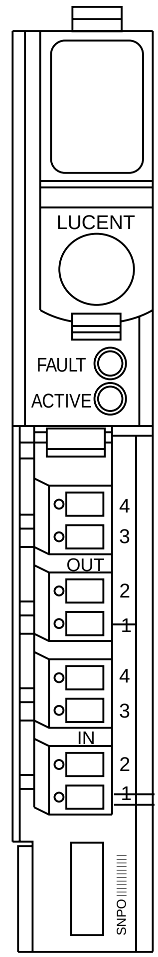
There following circuit packs reside on these shelves:

- OXI, OXI-4A13, OXI-4A15
- OXI-10GC
- OXI-2GC
- OSWIC

Transparent and optically amplified circuit packs

The OXI, OXI-4A13, and OXI-4A15 circuit packs provide four input and four output ports for a total of up to 128 input and up to 128 output ports per shelf when the maximum 32 shelf slots are populated with these circuit packs.

The main features of the transparent and optically amplified circuit pack faceplate are shown in the following figure. The size, LEDs, and arrangement and number of ports are the same for the OXI, OXI-4A13, and OXI-4A15. The label on the top of the faceplate will indicate the apparatus code, series number, and identity of the actual circuit pack.



NC-LR064

These port units perform the following functions:

- receive optical signals from the facility interface
- provide optical power monitoring and 1:2 splitting to route the signal to the redundant switch fabric sides
- receive the optical signals from the switch fabric side
- provide optical power monitoring and 2:1 selection to route the signal to the egress port for connection to an external network element

- the optically amplified circuit packs also provide controlled amplification of the input signal to establish a pre-determined output optical power level that is delivered to the fabric.

These circuit packs accept the two –48 or –60 V power feeders from the backplane and modular DC-to-DC converters supply the necessary voltage for all port unit functions.

For details on these circuit packs, refer to the section, Optical parameters, in Chapter 10, “Technical Specifications”.

Opaque circuit packs

The OC-192/STM-64 Client (OXI-10GC) circuit pack provides the SONET/SDH transmission interface for one input and one output OC-192/STM-64 optical independent line interfaces.

The OC-48/STM-16 Client (OXI-2GC) circuit pack provides the SONET/SDH transmission interface for two input and two output OC-48/STM-16 optical independent line interfaces.

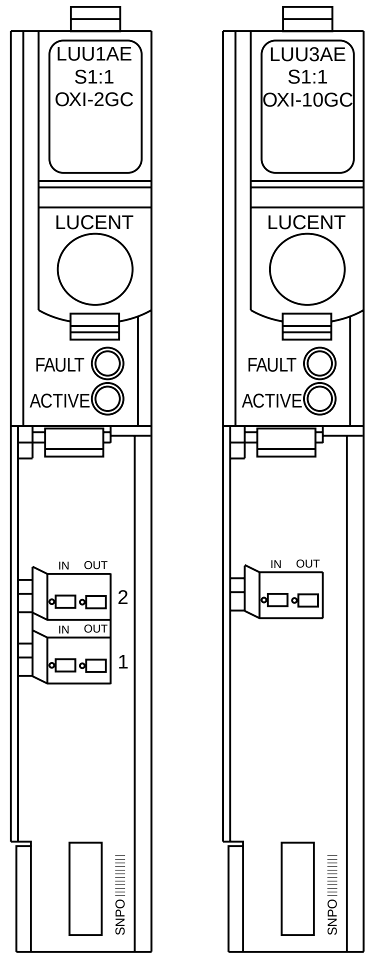
These packs perform the following functions for signals from the client interface:

- receive one optical signal from each client interface
- provide the regeneration/reshaping/retiming (3R) function for the received optical signal
- provide SONET/SDH overhead monitoring and 1:2 splitting to route the input signal to the redundant switch fabrics or fabric sides.

These packs perform the following functions for signals received from the fabric:

- receive an optical signal from the fabric side
- provide optical power monitoring and OEO conversion
- provide SONET/SDH overhead monitoring and 2:1 selection to route the signal to the client egress port for connection to an external network element.

The OXI-10GC and OXI-2GC faceplates are shown in the following figure.



NC-LR175

OSWIC circuit pack

The OSWIC circuit pack is actually the Switch Interface Controller (SWIC) pack with software necessary to manage and control the optical interface shelves. Refer also to the "HSWIC circuit pack" (4-21) for a description of this circuit pack in the HVS.

All SWICs are functionally the same; however, the SWIC in the OIS-S has a different apparatus code which is important for ordering.

When this pack resides on an optical interface shelf, it is called the OSWIC and provides control of the port unit functions. There are two

OSWIC packs on the optical interface shelf, one designated as working and the other as standby.

The inclusion of two SWIC circuit packs provides fully redundant, non-revertive, shelf control protection by automatically selecting the standby SWIC circuit pack should the working SWIC circuit pack fail.

The SWIC circuit packs are each equipped with a Reset button that can be used to reset the circuit pack. The SWIC circuit packs accept the two –48 or –60 V power feeds from the backplane. The SWIC monitors feeds on the shelf and reports loss of a single feed. The SYS50D/RC monitors the double feed via the SWIC, and reports shelf loss of power.

The SWIC circuit pack shelf control functions include:

- controlling interfaces to peripheral packs
- sensing of equipage
- handling of board-level interrupts and alarms
- controlling the power-cycle resets of peripheral packs
- providing an interface and drivers for the user panel LEDs

HVS circuit packs

The circuit packs on the HVS provide high-voltage control of the MEMS mirror array on the SWS. There are two types of circuit packs on these shelves, the HVDAC and the HSWIC.

HVDAC circuit pack

The High-Voltage Digital-to-Analog Converter (HVDAC) circuit packs provide the digital-to-analog converters and high-voltage linear amplifiers used to control the mirror arrays that make up the switch fabric. Each HVDAC circuit pack receives control information from the shelf SWIC circuit packs and provides the high-voltage channels to the switch fabric.

HSWIC circuit pack

This SWIC circuit pack is described in the “OSWIC circuit pack” (4-20) section. When this pack resides on an HVS, it is called the HSWIC and provides control of the HVDAC functions. The HSWIC provides the hardware interface for the Serial Number Identification Port (SNIP). The SNIP interface provides the unique 16-bit serial number of the SWS.

In addition to redundant switch fabrics or switch fabric sides, protection is provided by the two HSWIC circuit packs per shelf. The inclusion of two SWIC circuit packs provides fully redundant, non-revertive, shelf control protection by automatically selecting the standby SWIC circuit pack should the working SWIC circuit pack fail. The HSWIC circuit packs accept the two –48 or –60 V power feeds from the backplane.

□

Common Equipment

General

The following equipment is common to all LambdaRouter™ AOS shelves, except the SWS:

- user panel
- fans (and fan filters)
- circuit breakers
- Power Filter Voltage Protection (PFVP) units (with or without internal circuit breakers).

These are field-replaceable parts. Refer to the *LambdaRouter™ AOS 128/256 Alarm Messages and Trouble-Clearing Guide* for information on location and procedures for replacing these parts.

User panels

There are user panels on all shelves with the exception of the SWS. Each user panel provides LED indicators for shelf status, an alarm cutoff (ACO) switch, and an LED test interrupt switch. The SCS user panel provides additional capabilities, which are described later in this section.

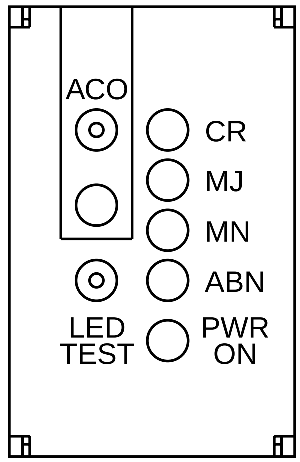
HVS, OIS-T, OIS-S user panels

The user panels on the shelves housing the port units and on the shelves housing the high-voltage units provide system-level information through LEDs, which are used to indicate the following conditions:

- Red—critical (CR) alarm
- Red—major (MJ) alarm
- Yellow—minor (MN) alarm
- Yellow—abnormal (ABN) condition
- Green—power on (PWR) indicates one or more power feeds to the shelf is active
- Green—alarm cut-off (ACO).

The user panel buttons provided are the LED TEST and ACO buttons.

The OIS-S user panel shown here is typical of all user panels. The layout may be slightly different from shelf to shelf but the LEDs and buttons are the same.



Office Alarms

The LambdaRouter™ AOS supports audible CO alarm states—critical, major, minor—which can be silenced by means of the user panel ACO button. The ACO turns off all alarm indications at once. The SCS supports a local office alarms connector, which drives the audible and visual alarms.

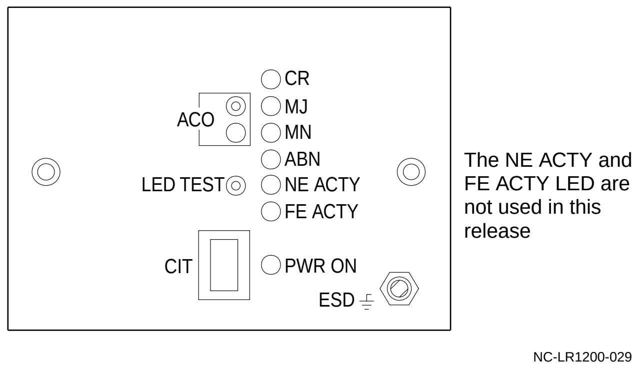
SCS user panel

The SCS user panel has the same LEDs and buttons as those listed previously for the OIS-T/OIS-S and HVS.

Note: The NE ACTY and FE ACTY LEDs are not used in this release.

The following additional connections are provided on the SCS user panel:

- ESD wrist strap ground
- CIT port (connected to EI 0 port 4) to connect an OCI to the LAN.



Fans The fans provide forced-air cooling for the shelves. The fan unit faceplates are equipped with a filter alarm reset button; power, fan failure and fan filter LEDs; and power circuit breakers.

PFVP and circuit breakers The Power Filter Voltage Protection (PFVP) unit is used in series with the power lead of each feed. There are PFVPs on the HVS, optical interface shelves, and the SCS. These units filter noise and provide low voltage and over voltage shutdown. The PFVP on the OIS-S contains the shelf circuit breakers; the other shelves have circuit breakers external to these units. Some of the PFVPs have an LED to indicate if the power is active.

□

5 System Planning and Engineering

Overview

Purpose This chapter provides information that is useful in planning your LambdaRouter™ AOS installation.

Contents This chapter includes the following sections:

□

General Planning

Overview

When planning your network, consider the eventual system size, including the following aspects:

- Power
- Interface type
- Capacity
- Growth
- Floor plan layout
- Provisioning and fibering
- Cabling—equipment interconnection
- Interworking in the CO
- Optically amplified port considerations

Lucent services

The Lucent Technologies Engineering and Installation Services Group is available to assist you in planning your network. Refer to Chapter 8, “Product Support” for information on the technical support available from Lucent.

Power

Power is supplied to the LambdaRouter™ AOS by dual –48 VDC or –60 VDC power plants. (The power supplied depends on the country in which the LambdaRouter™ AOS is deployed.) These plants are independent and maintain the current for some hours in the event of a main AC failure. With this design, the LambdaRouter™ AOS remains operational in the event of any power interruption. Refer to the section “Power” (10-4) in Chapter 10, “Technical Specifications” for power specifications.

Power feeders (–48V A and –48V B or –60V A and –60V B) power each LambdaRouter™ AOS shelf. Each of these feeders is protected by a circuit breaker.

The supply current is then passed through the Power Filter Voltage Protection (PFVP) unit, which is a filter unit that provides both low-voltage and over-voltage cut-off. The filter suppresses any noise and the low-voltage/over-voltage cut-off unit disconnects the power supply from the shelf when the voltage is beyond tolerance. These actions assure reliable operation.

Refer to the Chapter 7, “Ordering” for details on power cabling for individual shelves.

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Bay Layout

Footprint

The LambdaRouter™ AOS complies with Telcordia's *NEBS 2000 Framework Criteria* and ETSI *Engineering Requirements for Cabinets* standards for foot bay areas, floor loading, and support.

Floor plans can be engineered as either a raised-floor platform or overhead cable rack platform. Raised-floor platforms must be carefully engineered to account for the 611.6 mm x 611.6 mm [2 ft x 2 ft] floor tiles in the CO. End guards (25 mm each) are added to the right and left of the end units.

Note: If an upgrade to a LambdaRouter™ AOS 1024 is planned, overhead or underfloor space must be reserved for fiber management ducts. For more details, contact your Lucent Account Executive.

Floor loading specifications are given in Chapter 10, "Technical Specifications".

Capacity

The LambdaRouter™ AOS is housed in a 2-bay, 3-bay, or 4-bay configuration depending on the number and types of port units. The standard configurations range from an all-transparent system to a system containing both transparent and opaque port units:

- A LambdaRouter™ AOS 128 configuration using only transparent and/or optically amplified circuit packs (OXI, OXI-4A13, OXI-4A15) for maximum capacity consists of two bays housing a single OIS-T.
- A LambdaRouter™ AOS 256 configuration using only transparent and/or optically amplified circuit packs for maximum capacity consists of three bays housing a maximum of two OIS-Ts.
- A LambdaRouter™ AOS 256 configuration with 16 transparent or optically amplified circuit packs and 160 OXI-10GC packs (maximum capacity) consists of four bays (including an Interface Bay), which house one OIS-T and five OIS-Ss.

Modular growth

The LambdaRouter™ AOS capacity can be expanded because of the system modularity. Your system can grow to full capacity by the addition of an Interface Bay, optical interface shelves, optical interface fiber, and port units.

The maximum number of port units per optical interface shelf is 32. Port units are shipped separately and are installed in the field; filler blanks are installed in all unused port unit slots.

A LambdaRouter™ AOS 128 can be converted to a LambdaRouter™ AOS 256.

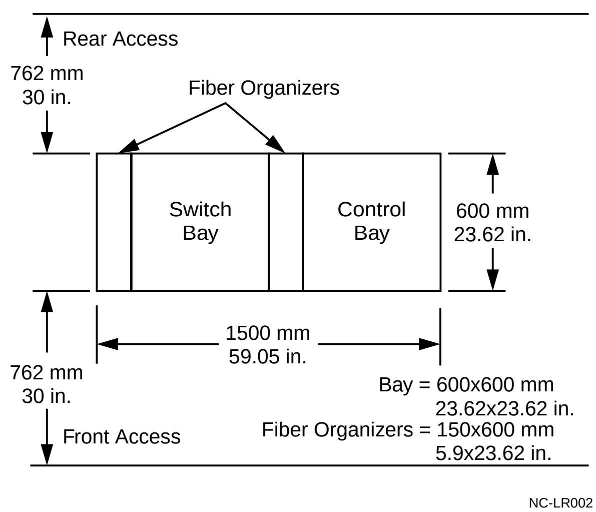
Access

The LambdaRouter™ AOS is designed to give the user front access for all circuit pack maintenance, optical connections, OCI connections, and routine maintenance such as fan filter replacement. Rear access is needed for some electrical connections, such as LAN connections, sparing and growth activities, and for some non-routine maintenance.

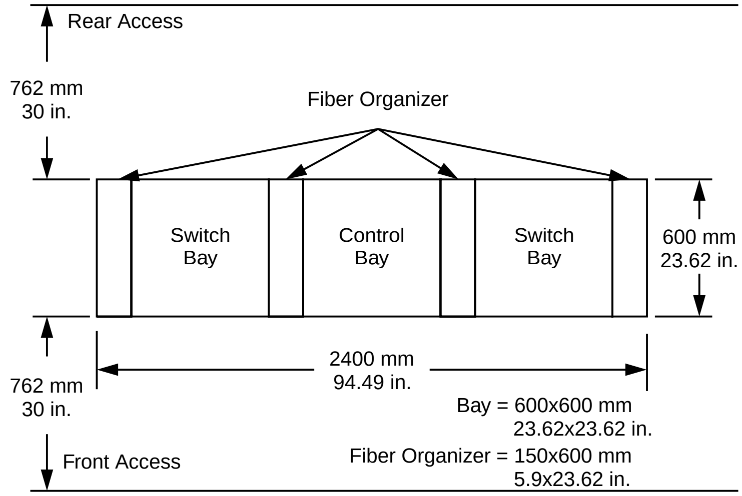
When adding the LambdaRouter™ AOS to the CO, you must leave enough space for front and rear access to allow for maintenance and operations activities and for any upgrades that may require cable rearrangement. The general requirements are 762 mm [30 inches] in both the front and back of the unit.

Layouts

The floor plan layout for the LambdaRouter™ AOS 128 2-bay configuration is shown in the following figure.



The floor plan layout for the LambdaRouter™ AOS 256 3-bay configuration is shown in the following figure.



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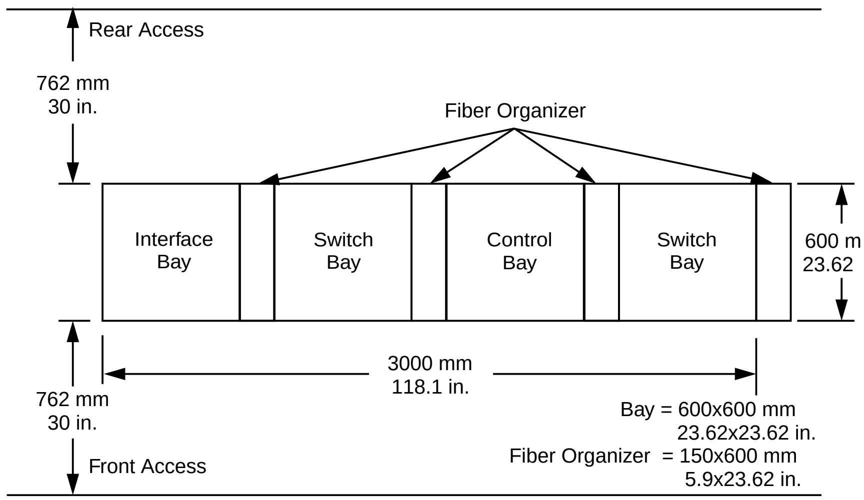
The floor plan layout for the LambdaRouter™ AOS 256 4-bay configuration is shown in the next figure.



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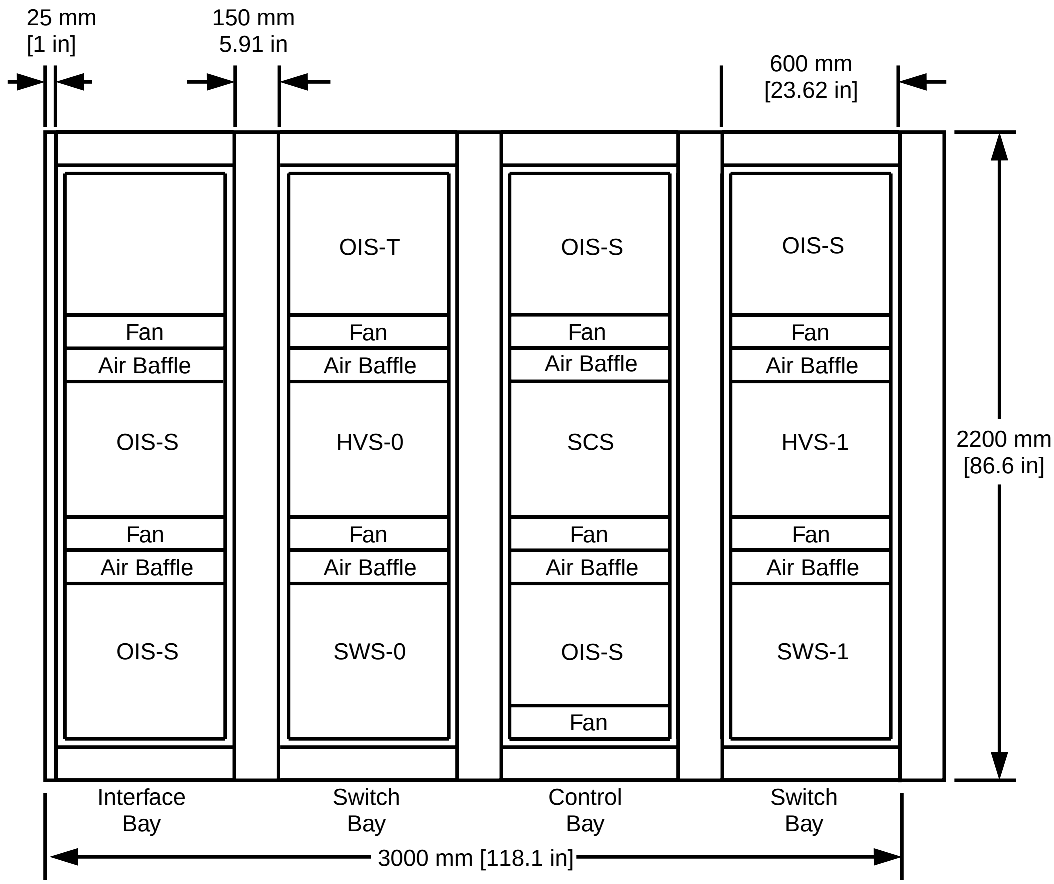
The bay arrangement for a mixed configuration of the LambdaRouter™ AOS 256 is shown in the next figure.



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Provisioning and Fibering

Overview

Because of the complexity of the many possible configurations of the LambdaRouter™ AOS, provisioning and fibering must be taken into account when planning your order.

The OIS-T is configured for the OXI, OXI-4A13, and OXI-A15 circuit packs.

The OIS-S has three possible configurations: as an OIS-10G with OXI-10GC packs, an OIS-2GC with OXI-2GC packs, or an OIS-MX with both OXI-10GC and OIS-2GC circuit packs.

Provisioning

The LambdaRouter™ AOS 256 can be provisioned for 224 input and 224 output ports. The LambdaRouter™ AOS 128 can be provisioned for 112 input and 112 output ports. (Refer to the section, Capacity, in Chapter 3, “Features”.)

Each optical interface shelf is provisioned in groups of 16 ports at a time. Once a shelf is provisioned, any number of the provisioned slots can be populated with the appropriate circuit packs.

Optical interface shelves can be partially provisioned.

De-provisioning

While the optical interface shelves can be de-provisioned, de-provisioning requires the deletion of existing cross-connects and associated circuit packs. Fibering must be removed when you de-provision a shelf.

Note that when de-provisioning, no ports are actually freed until the associated fiber is removed.

Fibering

As delivered, only 1/2 of the OIS-T shelf is fibered in the start-up configuration of the LambdaRouter™ AOS. These fibers are called switch interface (SI) cables and, there are two different types: SI-Transparent (SI-T) for the OIS-T, and SI-SONET/SDH (SI-S) for the OIS-S. Refer to the next section, “Cabling” (5-11), for cable specifications.

Additional SI cables must be ordered and field installed with the addition of any optical cross-connect circuit packs beyond 16 OXI/ OXI-4A13/OXI-A15s.

In growth situations, circuit packs may be positioned in optical interface shelves in the original Switch and Control Bays or in optical interface shelves in an additional Interface Bay. For this reason, SI fiber bundles are available in two different lengths. The longer length is used exclusively for configurations that include an Interface Bay.

Start-up configurations

The LambdaRouter™ AOS start-up configurations are:

- LambdaRouter™ AOS 256. Three bays fully equipped with an SCS, two HVSs, and two SWSs. Additionally, this configuration includes two OIS-Ts, each of which is fibered for 16 OXI/OXI-4A13/OXI-4A15 packs.
- LambdaRouter™ AOS 256. Three bays fully equipped with an SCS, two HVSs, and two SWSs. Additionally, this configuration includes one OIS-T and one OIS-S. The OIS-T is fibered for 16 OXI/OXI-4A13/OXI-4A15 packs; the OIS-S in this configuration does not include any fibering
- LambdaRouter™ AOS 128. Two bays fully equipped with an SCS, HVS, SWS, and one OIS-T. The OIS-T is fibered for 16 OXI/OXI-4A13/OXI-4A15 packs.

OIS-T

Beginning with a start-up configuration, 16 OXI/OXI-4A13/OXI-4A15 circuit packs can be added to each empty OIS-T shelf without the need for adding fibers, resulting in 64 transparent input ports and 64 transparent output ports. The remaining 16 slots on this shelf can be fibered with SI-T cables, provisioned, and, finally, any of them can be populated with OXI/OXI-4A13/OXI-4A15 packs.

When a second OIS-T shelf is used in the LambdaRouter™ AOS 256, up to 96 ports can be provisioned to accommodate OXI/OXI-4A13/ OXI-4A15 packs.

OIS-S

All slot types in the OIS-S must be provisioned regardless of the extent of fibering. Although fiber can be field-installed incrementally, the OIS-S shelf type must be determined initially as follows:

- OIS-10G—all 32 slots provisioned for OXI-10GC packs for a total of 32 input and 32 output ports

- OIS-2G—all 32 slots provisioned for OXI-2GC packs for a total of 64 input and 64 output ports
- OIS-MX—16 slots provisioned for OXI-10GC packs (16 input/output ports) and 16 slots provisioned for OXI-2GC packs (32 input/output ports).

Physical layout

When provisioning a mixed shelf, the OIS-MX, the OXI-10GC packs must occupy the top row of slots and the OXI-2GC packs must occupy the bottom row of slots.

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Cabling

Optical cabling

The optical cabling for the LambdaRouter™ AOS consists of connections made to the port units on the optical interface shelves. Refer to the previous section, “Provisioning and Fibering” (5-8), for information on how the port units are configured on the shelves.

Remote network element–port unit connections

The connections from the network element to the optical interface shelf are made using LC-terminated optical cables that connect to the faceplates of the optical port units. The fiber optic cables connecting to the port units are 8.3 micron single mode simplex Lucent MiniCord® cable or equivalent and terminated on the LambdaRouter™ AOS side with a PC (physical contact)-polished LC connector suitable for Front-of-the-Wall applications. The fiber optic cable has an outside jacket diameter of 1.6 mm.

SWS–OIS-T connections

The connections from the OIS-T to the SWS are made using fiber fanout cables (referred to as SI-T cables). There are two cables per OXI, OXI-4A13, or OXI-4A15 circuit pack and each SI-T cable contains eight discrete fibers.

The SI-T cable is terminated at one end with a multifiber connector, which connects to the connector on the back of that shelf for the OXI, OXI-4A13, or OXI-4A15 circuit pack. At the other end, the fanout cable is terminated with eight LC connectors, which make the connections to the SWS fiber distribution panel (FDP).

SWS–OIS-S connections

The connections from the OIS-S to the SWS are made using fiber cables (referred to as SI-S cables). Each SI-S cable is a bundle of 32 discrete fibers.

The SI-S cable is terminated at both ends with single-mode LC connectors. The single-connector end connects to the connector on the back of that shelf for the OXI-10GC or OXI-2GC circuit pack, and at the other end, the 32 individual fibers make the connections to the SWS FDP.

Each OXI-10GC pack supports one input and one output port, therefore the cable supports 16 OXI-10GC packs, which is 16 input and 16 output ports. There are four cables per OIS-10G shelf, two cables for each switch fabric side.

Each OXI-2GC pack supports two input and two output ports, therefore the cable supports eight OXI-2GC packs, which is 16 input and 16 output ports. There are eight cables per OIS-2G shelf; four per switch fabric side.

There are six cables per OIS-MX shelf; three per switch fabric side.

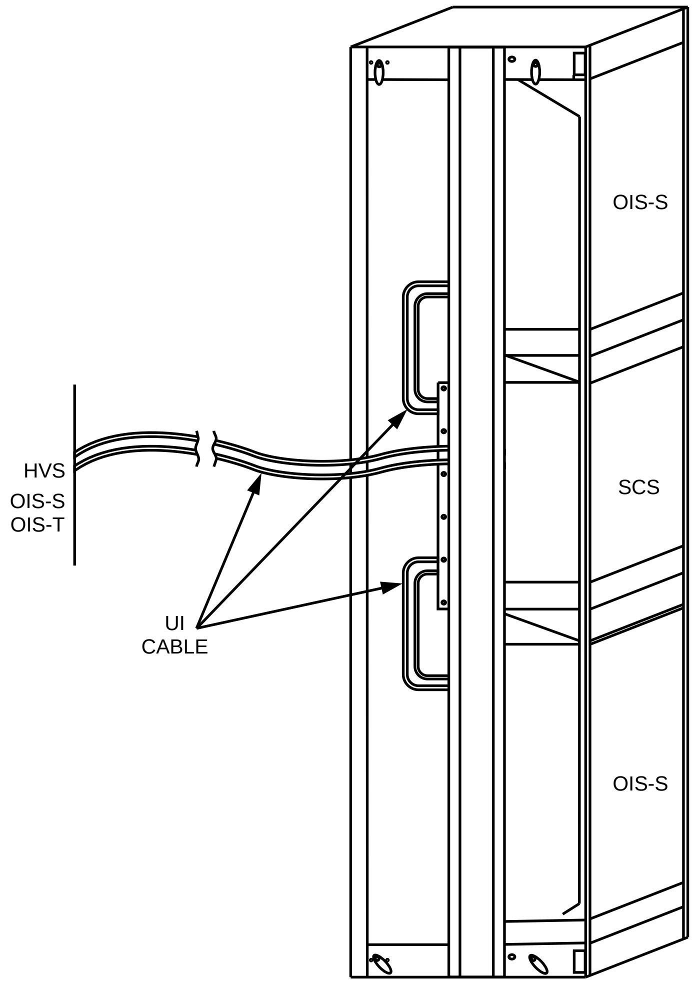
Electrical cabling

The electric cabling for the LambdaRouter™ AOS consists of cabling between the shelves.

The electrical cable characteristics are shown in the following table.

Function	Quantity 256/128	Connection From–To	Cable Type	Connectors	
Unit Interface (UI) cable to connect to the SWICs	2 per shelf (HVS, OIS-T, OIS-S)	SCS–OIS-T SCS–OIS-S SCS–HVS	Shielded twisted pair	SCS: 2mm 5x6 Metral™ type	OIS and HVS: DSUB25
Serial Number Interface Port (SNIP)	2/1	SWS–HVS	25 conductor shielded	SWS: DSUB25	HVS: DSUB25
High Voltage	64/32	HVS–SWS	68 conductor shielded	HVS: 100-pin SCSI	SWS: 68-pin SCSI

Refer to the following figure for the SCS UI connections.



RIP cabling

Each RIP circuit pack uses a CAT5E cable to carry Communications and Control Network (CCN) signalling.

Power cables

All shelves, with the exception of the SWS, require power cables. The power cables provide very low loop voltage drop between the secondary power distribution point and the individual LambdaRouter™ AOS shelves.

Cables are available in various lengths. Every shelf, with the exception of the SWS, requires one cable kit. The cable kits are described in detail in Chapter 7, "Ordering".

Connectors

When engineering your own cables, you must order either a 45-amp (for OIS-T, HVS, and SCS) or 65-amp (for OIS-S) connector kit for each shelf. The connector kits are described in detail in Chapter 7, “Ordering”.

References

For additional power cable and other engineering cable information, refer to ED-3C324-10.

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Fiber Management

Fiber organizer

The 150 mm [5.9 inches] spacer to the right and left of the Switch Bays is used for fiber organization and storage of internal cabling (refer to the figures in the “Bay Layout” (5-4) section of this chapter). The volume of this area is 150 x 600 x 2134 mm [5.9 x 23.62 x 84 inches].

Overhead vs. underfloor cabling

When planning your LambdaRouter™ AOS, you must consider the location of the equipment. Because of the number of cable connections required, customers must populate shelves that are nearest the cable source first in order to make room for subsequent equipment additions.

For example, if cable is to be run overhead, you must populate the upper shelves first. For underfloor cabling, the opposite applies, that is, you must populate the lower shelves first.

Note: If an upgrade to a LambdaRouter™ AOS 1024 is planned, overhead or underfloor space must be reserved for fiber management ducts. For more details, contact your Lucent Account Executive.

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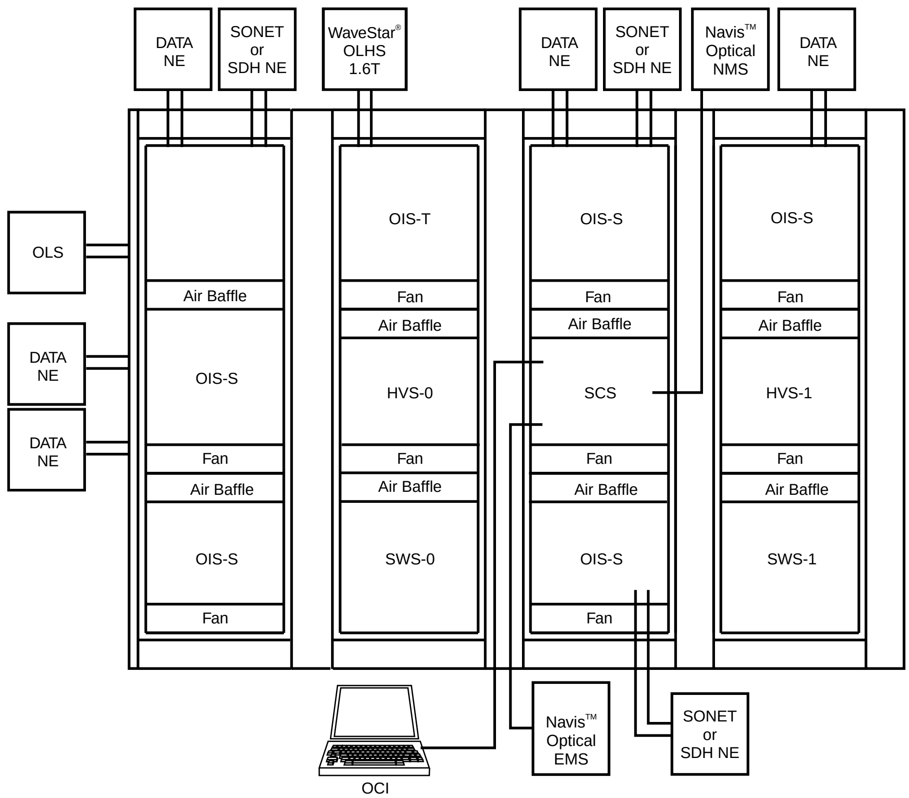
Interworking

Overview

The LambdaRouter™ AOS is used in the Central Office (CO) to manage optical connections between OLSs or between traffic sources/ sinks (such as IP routers) and line systems.



In this view, the LambdaRouter™ AOS is connected to several OLSs from Lucent and other vendors, a data network element such as an IP router or an Asynchronous Transfer Mode (ATM) switch, and a SONET/SDH network element. This figure represents a typical use of the LambdaRouter™ AOS 256.

The LambdaRouter™ AOS can be used in the following cases:

- Full line-rate drop/add connection between optical line systems, that is, an add and drop of the entire contents of any of the individual wavelengths carried by the OLS. Here, the LambdaRouter™ AOS provides connections between local traffic sources and the long-haul OLSs, that is, connections between a line system and a client device, such as an IP router, ATM switch, or digital cross-connect
- OLS to OLS through connections. At the location of the LambdaRouter™ AOS the customer signal is regenerated and then sent on to the next transmission link. Such an application can occur in intelligent optical networking.

Requirements

In planning your network, you must determine the types of interfaces you will need.

Transparent and optically amplified interfaces

The transparent and optically amplified interfaces are purely optical and do not provide any OEO conversion. On the transparent interfaces, external equipment must support intermediate reach optics (Telcordia OC-48 IR-1/ITU S-16.1 or Telcordia OC-192 IR-2/ITU S-64.2b) or the 12 dB optics defined in ITU Rec. G. 693, or long reach (LR) optics. On the amplified interfaces, the external equipment must support either the intermediate reach optics, the 4, 6, or 12 db 10G optics defined in Rec. G. 693, or short reach optics (Telcordia SR-1/ITU I-64.1).

Connection of client signals to the LambdaRouter™ AOS can be made to these port units or by means of optical extensions provided by an OLS.

Opaque interfaces

The opaque interfaces provide monitoring of SONET overhead. These interfaces directly support short reach/intra-office optics (Telcordia OC-48 SR/ITU I-16.1, Telcordia OC-192 SR-1/ITU-T I-64.1/1r), and the 4 and 6 db 10G optics defined in ITU-T Rec. G. 693.

WaveStar® OLS Interworking

The LambdaRouter™ AOS port units support interworking with the WaveStar® Optical Line System (OLS) 1.6T, Release 6.0, and use the link-based keep-alive signal generated by the WaveStar® OLS 1.6T to monitor the health of the link (add to drop OTU).

This feature monitors the power level of the AIS-L signal delivered by the WaveStar® OLS 1.6 T on working idle links and informs the

LambdaRouter™ Optical Network Navigation System (ONNS) when the signal disappears (link failure).

Interfacing to the LambdaRouter™ AOS

The LambdaRouter™ AOS fabric switches optical signals whose wavelengths lie within the 1260 to 1360 and 1500 to 1620 nm range, and which can carry any traffic type and bit rate.

When planning for loss, you must consider the typical transmit power and receiver sensitivities that are deployed in the CO equipment.

Values for these parameters are defined by the actual performance levels of the equipment and by the following factors on the equipment ports:

- Type of interface
- Reach
- Insertion loss.

For transmission loss values, refer to Chapter 10, "Technical Specifications".

Technical support

To evaluate interworking requirements when using equipment from other vendors, contact your Lucent Technologies Account Executive, who will put you in touch with a Lucent technical support specialist.

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Optically Amplified Port Considerations

Operation

The LambdaRouter™ AOS typically provides connectivity between a transmitting source that is connected to the input connector of an OXI port, and a receiving system that is connected to an output connector of (generally) some other OXI port. Included in this path are also external losses within the CO. For the case of an OXI-4A13/OXI-4A15 input port, this scenario is shown below, which also indicates the optical power levels at various points in the path.

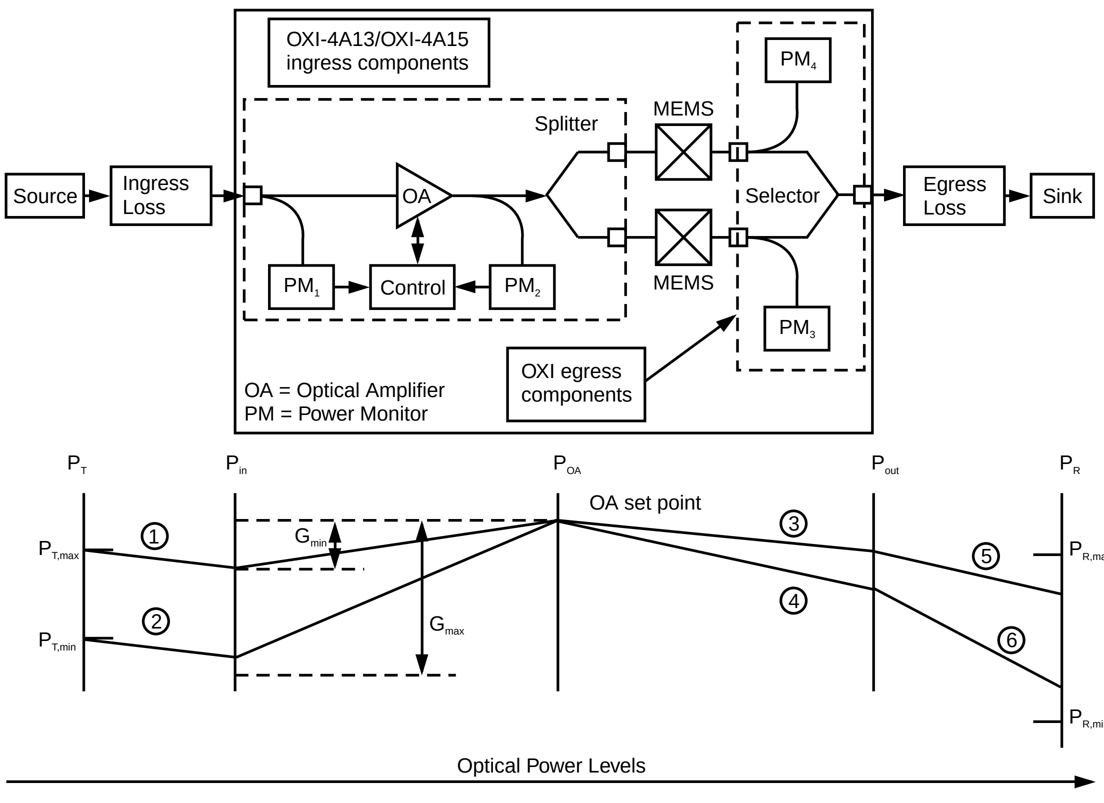

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Figure notes

In this figure the following terminology is used:

- $P_{T,max}$, $P_{T,min}$— represent the minimum and maximum expected transmitter power, as defined, for example, by ITU standards I-64.2, VSR600-2M2, etc.
- $P_{R,max}$, $P_{R,min}$ — represent the maximum and minimum receiver input levels, as also defined by the relevant standards.

- Ingress and Egress loss represent CO losses external to the LambdaRouter™ AOS. For proper operation of the system, these losses are limited to certain ranges.
- P_{in}, P_{out} — represent the power levels at the LambdaRouter™ AOS input and output connectors.
- G_{min}, G_{max} — represent the minimum and maximum gain required in the optical amplifier.

Link description

The numbered links in the preceding power-levels diagram are defined as follows:

1. This link indicates a connection from a source operating at the maximum power level, and connected to the LambdaRouter™ AOS by a minimum-loss CO connection.
2. This link indicates a connection from a source operating at the minimum power level, and connected to the LambdaRouter™ AOS by a maximum-loss CO connection.
3. This link indicates an internal connection from the optical amplifier to the LamdaRouter™ AOS output port, and that experiences the minimum internal loss, due to the splitter, MEMS fabric, connectors, etc.
4. This link indicates an internal connection from the optical amplifier to the LamdaRouter™ AOS output port, and that experiences the maximum internal loss, due to the splitter, MEMS fabric, connectors, etc.
5. This link indicates a connection from the LambdaRouter™ AOS output port to the external receiver, when the internal path and the external CO egress connection both have the minimum loss.
6. This link indicates a connection from the LambdaRouter™ AOS output port to the external receiver, when the internal path and the external CO egress connection both have the maximum loss.

Power level

The optical amplifier output power level set point is determined in such a way that for all the indicated link combinations after the amplifier, the optical power delivered to the receiver will lie within the input range of the receiver.

In order to reach this power, the gain required varies, depending on the actual input power that is delivered to the optical amplifier, as indicated in the figure. This power level may be set in two ways:

- By provisioning the optics format and types associated with the optically amplified port units. This is accomplished via the ED-Och TL1 command. The system then computes an appropriate value for the optical amplifier set point, and the optical amplifier controller maintains this value once a cross-connect is established on the port.
- By manual provisioning of a specific optical amplifier set point, in order to accommodate specific customer needs. This is also accomplished via the ED-Och TL1 command.

Assumptions

For planning purposes, the following assumptions should be used:

- For automatic provisioning, based on standard optics formats and types, Ingress and Egress losses may lie in the range of 0.5 to 3 dB, independently of each other.
- Design of the OXI-4A15 port unit has taken into account optics types Telcordia OC-192 IR-2/ITU S-64.2b/ITU VSR600-2M2; ITU VSR2000-2L2.
- Design of the OXI-4A13 port unit has taken into account optics types Telcordia OC-48 SR, IR-1/ITU I-16, S-16.1; Telcordia OC-192 SR-1/ITU I-64.1, VSR2000-2R1.
- The power level delivered to the optically amplified input port should lie in the range of -9 to +3 dBm.
- For manual provisioning of the optical amplifier output, the requested optical amplifier output power should be in the range of -1 to +4 dBm.

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6 Operations Interfaces and Managing Systems

Overview

Purpose This chapter describes the LambdaRouter™ AOS operations interfaces and the LambdaRouter™ Optical Network Navigation System (ONNS), which greatly enhance the basic LambdaRouter™ AOS capabilities.

Contents This chapter includes the following sections:

General

Introduction

There are remote and local operations interfaces supported by the LambdaRouter™ AOS, which provide for provisioning, administration, and maintenance functions. The remote operations interfaces are optional but offer greatly enhanced features when used with the LambdaRouter™ AOS.

The operations interfaces employ standard Transaction Language 1 (TL1) messaging transported by means of the TCP/IP protocol stack via a 10BaseT physical LAN interface. The system also provides local alarm indications and an interface to the local office alarm grid.

The LambdaRouter™ AOS supports File Transfer Protocol (FTP) for LambdaRouter™ AOS-to-Managing-System file transfers of generic and database files. The implementation of FTP follows IETF STD 0009.

The LambdaRouter™ AOS can also incorporate networking software, LambdaRouter™ ONNS, which, in conjunction with remote operations interfaces, leads to an enhancement in LambdaRouter™ AOS basic capabilities.

Operations interfaces

The local operations interface consists of the Optical Craft Interface (OCI), formerly called WaveStar® CIT. RS-232 access is also supported for those users who wish to provision the LambdaRouter™ AOS using TL1 commands.

The remote operations interface consists of the Navis™ Optical Element Management System (EMS). The Navis™ Optical Network Management System (NMS) can be used to manage the entire network.

User panels and office alarms, which may be considered as local operations interfaces, are described in the “Common Equipment” (4-23) section of Chapter 4, “Hardware Description”.

User interface

The LambdaRouter™ AOS supports a single method of user interface accessible by the Navis™ Optical EMS, Navis™ Optical NMS, and OCI.

These interfaces provide a fully functional GUI which supports:

- Local/remote access control based on user privilege levels (password protected)
- Displays of the LambdaRouter™ AOS equipment and their states
- Alarms displays
- Network discovery and exploration for easy access to network elements in the local network (Navis™ Optical NMS only)
- Support for user provisioning tasks
- Support for software upgrades and backup and restore functions (Navis™ Optical EMS and OCI interfaces only)
- Generation of equipage, cross-connection, port link, and alarm reports.

The LambdaRouter™ Optical Network Navigation System (ONNS) provides a network-level user interface, which provides the following:

- Network maps
- Network discovery and exploration for easy access to each network element in the local network
- Support for network provisioning tasks (including path provisioning)
- Generation of network-level reports.

The LambdaRouter™ ONNS GUI is described in the Navis™ Optical NMS documentation listed in Chapter 8, "Product Support".

Management communications interface

The interface between the LambdaRouter™ AOS and the operations environment—the OCI, Navis™ Optical EMS, or other Managing System—is provided by the 802.3 compliant 10/100BaseT LAN. Access to and from the remote systems, Navis™ Optical EMS or other managing system, is provided via an IP-based management communications network connected to the IAO LAN. Typically this will be accomplished by connection to EI1, port 4 on the SCS.

If an external hub is used on one of the LAN connectors, the number of possible LAN connections is increased. The external hub can be connected to EI1 port 4 on the SCS. Refer also to the section, "EI" (4-12) in Chapter 4, "Hardware Description". For a detailed discussion on possible IAO LAN configurations, refer to the "Control and Communications Network (CCN)" (6-13) section of this chapter.

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Optical Craft Interface (OCI)

Description

The Optical Craft Interface (OCI) is a desktop or laptop computer loaded with the required LambdaRouter™ AOS software. It provides the following:

- A GUI based on Windows NT® or Windows 2000 Professional
- Transaction Language 1 (TL1) interface to the network element
- TL1 command entry cut-through
- Access connections
- Security features to prevent unauthorized access.

The OCI GUI provides an easy and intuitive access to operations. When this GUI is used the TL1 interface is not visible to the user. Many customers develop standardized scripts for use in the field for standard operations.

The OCI user has the means for local and remote access. Remote access uses an external WAN connection to the LambdaRouter™ AOS's LAN port.

The OCI is generally co-located with the LambdaRouter™ AOS. The OCI PC can be connected directly to the front of the LambdaRouter™ AOS frame. This connection can also be made over the IAO LAN.

The OCI provides detailed information and control of the following:

- Provisioning
- Loopback operation and testing
- Reporting
- Alarms and events
- Equipment view and status
- Software management
- Cross-connect assignments
- Protection switching.

PCMCIA card

The PC or laptop computer must be equipped with a 10BaseT interface network card to communicate with the network element, and a drive that supports a PCMCIA card to create a flash card that will be inserted into the LambdaRouter™ AOS.

Remote access

An OCI or other managing system connected to a LambdaRouter™ AOS may remotely access other LambdaRouter™ AOSs on the network. The support capabilities are the same for both local and remote LambdaRouter™ AOS systems.

Remote access requires TCP/IP connectivity from the local LambdaRouter™ AOS to the remote LambdaRouter™ AOS. File transfers are accomplished by means of FTP.

☐

RS-232 Terminal Access

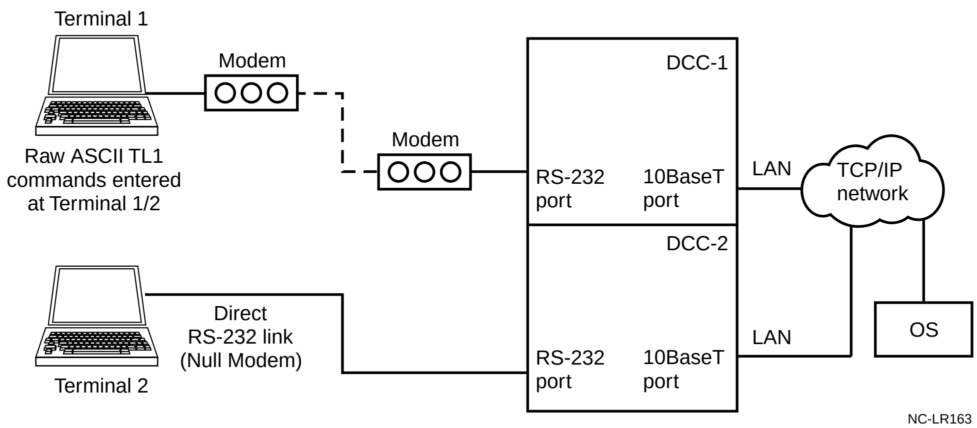
Description

The RS-232 terminal access feature allows a LambdaRouter™ AOS to be provisioned using TL1 commands issued from a personal computer running terminal emulation software.

Connection

The terminal is connected, either directly using an RS-232 null modem cable or via modem, to one of the LambdaRouter™ AOS dual independent RS-232 serial ports located on the back of the SCS. An RS-232 adapter cable is used to connect the terminal to the SCS. The adapter cable splits the DB25 connection on the SCS into two DB9 connectors.

The following figure illustrates the connection of a terminal to the LambdaRouter™ AOS using both a direct null modem link and a modem link.



To access the RS-232 interface, the terminal must initially be configured as follows:

Parameter	Setting
Bits Per Second	19200
Data Bits	8
Parity	N (none)
Stop Bits	1

After the initial connection, the Bits Per Second parameter can be changed.

Access considerations

Security parameters, as provisioned on the LambdaRouter™ AOS, apply to the RS-232 connection. Users must log in prior to issuing TL1 commands, and may only issue TL1 commands for which they have adequate security privilege levels.

When using the RS-232 terminal access link, due to the relatively slow speed of the connection, it is recommended that autonomous messages be limited.

□

Navis™ Optical Element Management System (EMS)

Description

The Navis™ Optical EMS is an element management system (EMS) that supports the LambdaRouter™ AOS through LAN connectivity and centralized element management functions. The Navis™ Optical EMS has a GUI and communicates with the LambdaRouter™ AOS using TL1 messages. The Navis™ Optical EMS communicates with each LambdaRouter™ AOS individually.

When used as an end-user system, Navis™ Optical EMS provides a GUI for users to access and manage a LambdaRouter™ AOS system with visibility down to the circuit pack and port levels. As an end-user system, Navis™ Optical EMS provides element management functions including fault, configuration, and security management.

After a successful login, the Navis™ Optical EMS then logs session activities and performs other critical interactions.

Reference

For further information on this management system, refer to the Navis™ Optical EMS documentation listed in Chapter 8, “Product Support”.

□

Navis™ Optical Network Management System (NMS)

Description

The Navis™ Optical Network Management System (NMS) is a management tool that provides comprehensive and integrated management of an entire transport network. Navis™ Optical NMS can provide provisioning and maintenance management for the LambdaRouter™ AOSs and other network elements in the LambdaRouter™ AOS network.

The Navis™ Optical NMS interfaces with other systems, such as Navis™ Optical EMS, to provide complete network management from a single point.

Features

The following features are available in the Navis™ Optical NMS:

- Optical end-to-end path management
- Multiple levels of Quality of Service (QoS) service provisioning
- End customer GUI and service provider GUI
- Point-and-click, web-based user interface.

Interface

The Navis™ Optical NMS interfaces directly to the LambdaRouter™ AOS for purposes of management of end-to-end paths through a network of LambdaRouter AOSs. This interface is provided by a 10BaseT interface on the RC circuit packs on the System Controller Shelf, and employs a special purpose set of TL1 commands.

For purposes related to element management, such as data synchronization and processing alarms and events, the Navis™ Optical NMS interfaces with the LambdaRouter™ AOS via the Navis™ Optical EMS.

Reference

For additional information on this managing system, refer to the Navis™ Optical NMS documentation listed in the “Documentation” (8-5) section of Chapter 8, “Product Support”.

□

LambdaRouter™ Optical Network Navigation System (ONNS)

Description

The LambdaRouter™ Optical Network Navigation System (ONNS) is software that resides on the LambdaRouter™ AOSs. In conjunction with the Network Network Interface (NNI) transport links between the LambdaRouter™ AOSs and with the Control and Communications Network (CCN), the LambdaRouter™ ONNS provides intelligent optical networking. This capability provides automatic end-to-end path routing and connection setup and teardown in response to user requests, as well as determination of restoration paths (in support of 1+1 or mesh restoration as described earlier).

With mesh restoration, LambdaRouter™ ONNS initiates rerouting of customer traffic upon notification of a path failure; this involves path computation and inter-LambdaRouter™ AOS signalling to effect switchover to the new path.

The CCN provides the reliable communication method that enables LambdaRouter™ ONNS to signal for the set up and tear down of network paths. These paths may be either the service path set-up (in response to a customer request) or a failure-driven restoration path.

Using the NNI links, in conjunction with Automatic Interconnection Recognition Protocol (AIRP), the LambdaRouter™ ONNS autodiscovers the optical-layer transport connectivity, topology and network resources to support the set-up and tear-down of client-client connections. LambdaRouter™ ONNS, employing Generalized Multiprotocol Label Switching (GMPLS), automatically calculates and provisions the best available routes (with node disjoint routing and restoration protection) upon the TL1 request from the managing system (e.g., the Navis™ Optical NMS), or in response to a path failure event requesting mesh restoration.

The AIRP provides "blind" discovery of LambdaRouter™ AOS neighbors, when these systems are interconnected by optical line systems whose drop-side OT output lasers are provisioned to turn off when the corresponding input side has no signal present. That way, the application of the AIRP discovery signal to an idle link connection input (ADD OT) by an "upstream" LambdaRouter™ AOS results in the appearance of signal at the corresponding DROP side, activating the discovery processing at the "downstream" LambdaRouter™ AOS.

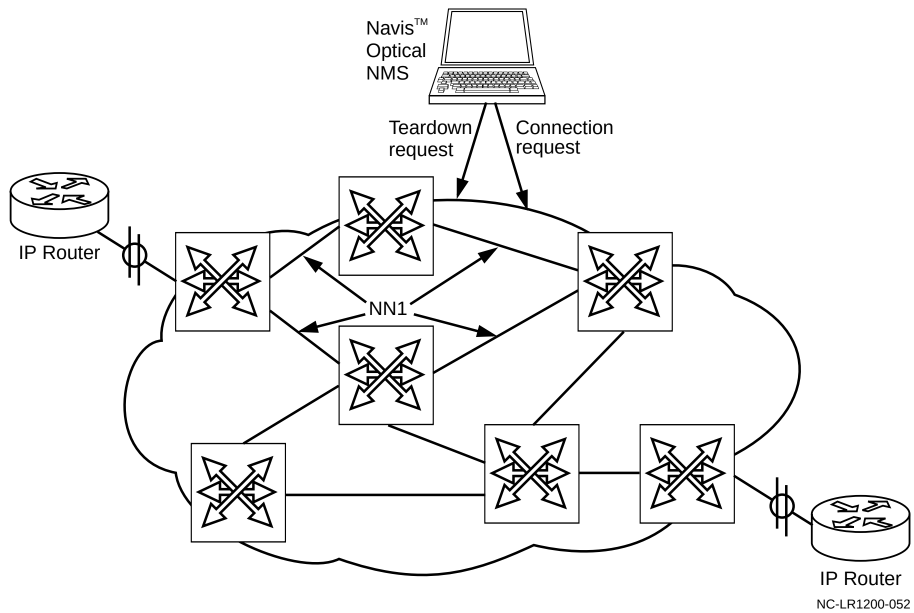
The discovery signal, conveyed by a 16-byte section trace byte sequence (J0), contains both the CCN network address (IP address of the RC pack) of the sending LambdaRouter™ AOS, as well as the ID of the sending port. In this way, the "downstream" LambdaRouter™ AOS learns both the CCN address and the sending port of its "upstream" neighboring LambdaRouter™ AOS. A CCN response message is then delivered to the neighbor, which contains the CCN address and receiving port ID of the "downstream" LambdaRouter™ AOS. Now the LambdaRouter™ AOS that originated the discovery process also knows its neighbor CCN address and associated receiving port ID. Neighbor data at each LambdaRouter™ AOS is passed to its local LambdaRouter™ ONNS for use in path routing computations.

The basic generation and receive processing of the discovery signal is supported by two different port architectures. If the NNI ports are implemented with OEO circuit packs, then the ports themselves are used for the J0 sequence generation and reception. If the NNI ports are implemented with transparent ports, the J0 processing is performed by OEO packs dedicated to this purpose: these are called *link probe* ports. Appropriate cross-connects are made between a link probe port and the transparent port in order to either send or receive the discovery signal to or from the NNI port. Generally, both OXI-10GC and OXI-2GC link probe ports must be available in order to support transparent NNI ports that may be provisioned with either 10G or 2.5G transmission rates, depending on the line system ports to which they are connected.

If necessary, LambdaRouter™ AOS to LambdaRouter™ AOS neighbor information may be manually provisioned to enable proper LambdaRouter™ ONNS operation.

For either NNI port type, and even if "blind" discovery might not be supported due to line system behavior, the AIRP procedures for link verification are available. These procedures provide for both automatic periodic verification, and on-demand verification of link connections extending from output ports on one LambdaRouter™ AOS to input ports on its neighbor. These procedures will indicate whether the transmission connectivity is still intact, and also verify neighbor data that were previously determined either manually or automatically. LambdaRouter™ ONNS is informed about any defects in the link data to remove the offending link connection from the list of currently-available transport resources. Also, event reports are generated by the affected LambdaRouter™ AOSs to alert craft personnel about the link defect.

An optical network of LambdaRouter™ AOSs is shown below:



Features

The main features of the LambdaRouter™ ONNS include:

- Network topology management and discovery, employing AIRP for auto-discovery of neighbor connections and ports, which facilitates advertisements of transport resource availability among the LamdaRouter™ AOS network elements.
- Connection management—end-to-end connection routing, set-up, and tear-down through the LambdaRouter™ ONNS capable elements with start and end points specified by the requester.
- Restoration management
  - 1+1 end-to-end network protection
  - mesh restoration (both non-revertive and revertive)
  - Unprotected connections.
- User and management interface—TL1 over TCP/IP.

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Control and Communications Network (CCN)

General

The Control and Communications Network (CCN) and Operations Network (ON) used to support the LambdaRouter™ ONNS functions and operations-messaging both use Transmission Control Protocol/ Internet Protocol (TCP/IP, shortened to IP). Several different basic configurations can be used to set up the CCN and ON. This section covers basic rules, example configurations, and some description of the protocols used in the CCN and ON for this release of the LambdaRouter™ AOS.

Rules

The phrase *internal IP port* refers to the RC and RIP Ethernet 100BaseT ports whose connectivity is provided by the LambdaRouter™ AOS backplane. There are no RJ-45 jacks for these ports. The phrase *external IP port* refers to the RC and RIP IP ports whose connectivity is provided by Ethernet RJ-45 jacks on the RC and RIP circuit pack faceplates.

Connectivity rules

The following connectivity rules apply to the IP configuration:

- The RIPs must terminate disjoint IP paths to each neighboring LambdaRouter™ AOS. This implies that connections from RIP1 must terminate on a router different from the router that terminates connections from RIP2. If an IP network is not used for RIP to RIP connectivity, then direct diverse dedicated lines are used.
- The RC0 and RC1 packs both use their external 10BaseT IP port (RJ-45 jack labeled INT-LAN) for access to the Navis™ Optical NMS (or other network management system) IP network, which is responsible for network path administration.
- DCC1 and DCC2 must both have connectivity to the IP network used by the Navis™ Optical EMS (or other element management system), which is responsible for network element administration such as provisioning and alarm monitoring.
- The local OCI must have connectivity to the DCC circuit packs.
- No external connections are made between the RC and RIP circuit packs. Ethernet connectivity between these packs is provided by internal 100BaseT IP ports whose connections on the LambdaRouter™ AOS backplane.

- IP hubs and IP routers used in the CCN must be either transparent to, or support, the following protocols:
  - Open Shortest Path First (OSPF)
  - MultiProtocol Label Switching (MPLS) with Resource ReSerVation Protocol - Traffic Engineering (RSVP-TE)

  Note: If a CCN IP router is transparent to—but does not participate in—OSPF and MPLS, then the LambdaRouter™ AOS MPLS algorithms will not be able to guarantee node disjoint Label Switched Paths (LSPs).

Refer to the section “SCS circuit packs” (4-11) in Chapter 4, “Hardware Description” for illustrations of the RC and RIP circuit pack faceplates, which show the 10BaseT and 100BaseT connections.

IP address and subnetwork rules

The following IP address and subnetwork rules apply to the IP configuration:

- The RC0 and RC1 internal 100BaseT Ethernet IP ports on the LambdaRouter™ AOS backplane are provisioned with the same public IP address/subnetwork mask. This is enforced by the system whenever that port on either RC circuit pack is provisioned with an IP address/subnetwork mask.
- The RIP1 and RIP2 and RC0 and RC1 packs internal 100BaseT Ethernet IP ports on the LambdaRouter™ AOS backplane must all be in the same subnetwork. No other IP port is to be assigned to that subnetwork. This implies that the total number of public IP addresses on that backplane subnetwork is three. This limitation is required so that the OSPF algorithm running on the RIPs correctly identifies the two RIPs and active RC used to support LambdaRouter™ ONNS messaging.
- All external IP ports on the RC and RIP packs must be in subnetworks different from that assigned for the internal 100BaseT Ethernet IP ports on the LambdaRouter™ AOS backplane.
- RIP1 external 100BaseT IP ports and RIP2 external 100BaseT IP ports should be on *different* subnetworks. However, the external 10BaseT IP ports on RIP1 and RIP2 should be on the *same* subnetwork.

Note: The bottom-most RJ-45 jack on the RIP is dedicated to the RIP 10BaseT IP port. The remaining three RJ-45 jacks above it can be either 10BaseT or 100BaseT, as determined by the input speed at each jack. A hub within the RIP directs the incoming packet stream to either the 10BaseT or 100BaseT IP port according to incoming speed.

The LambdaRouter AOS provides External Interface (EI0 and EI1) circuit packs in the System Controller Shelf (SCS). The EI circuit packs are typically used as 4-port hubs for the DCC circuit packs and the OCI. Refer to the section “SCS circuit packs” (4-11) in Chapter 4, “Hardware Description” for an illustration of the SCS backplane and a description of the EI0 and EI1 backplane connectors.

Protocols

The LambdaRouter™ AOS uses the Operations Network for management system TL1 commands and messages. TCP/IP is used for TL1 command and message transport.

The CCN is used for IP network topology discovery, transport port discovery messaging, and creation of Label Switch Paths (LSPs) for redundant and highly reliable IP communication between LambdaRouter™ ONNS applications. The CCN uses User Datagram Protocol (UDP) and Transmission Control Protocol (TCP) for message delivery.

In the CCN, Open Shortest Path First (OSPF) is used to broadcast and, thereby, discover IP network neighbors and overall topology, and is used for calculating shortest paths between IP network nodes. OSPF uses UDP for message transport. Resource ReSerVation Protocol (RSVP-TE) is used to set up the redundant LSPs that are used between RIP circuit packs on neighbor LambdaRouter™ AOSs. RSVP-TE uses RAW-IP for the messages to set up the LSPs. The LambdaRouter™ ONNS applications use TCP/IP sessions with MPLS labels over the LSP tunnels for network path administration and restoration messages between LambdaRouter™ AOSs.

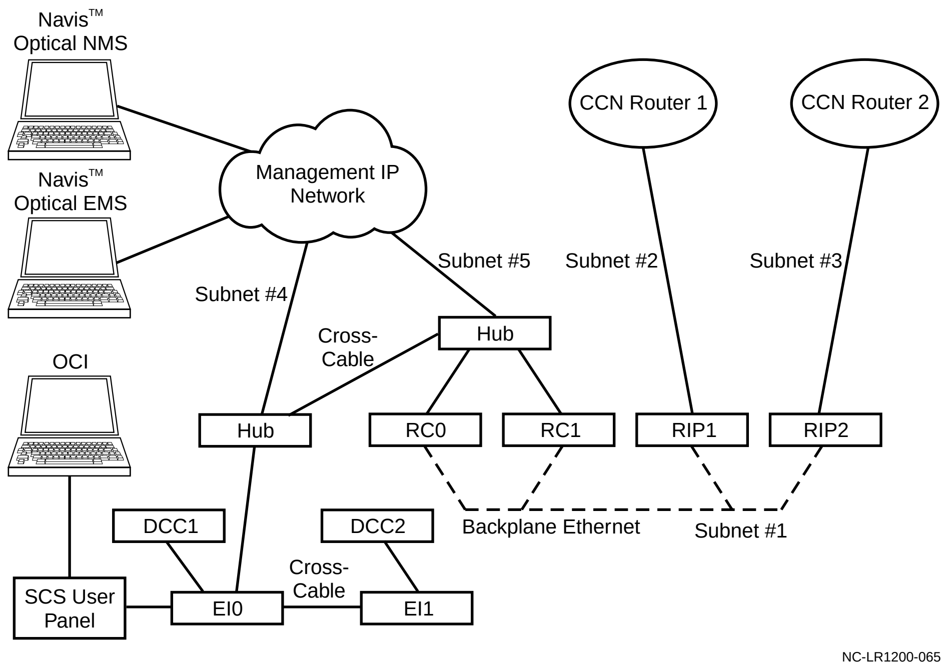
Examples

The following figures show example IP configurations.

Connection using EI circuit packs

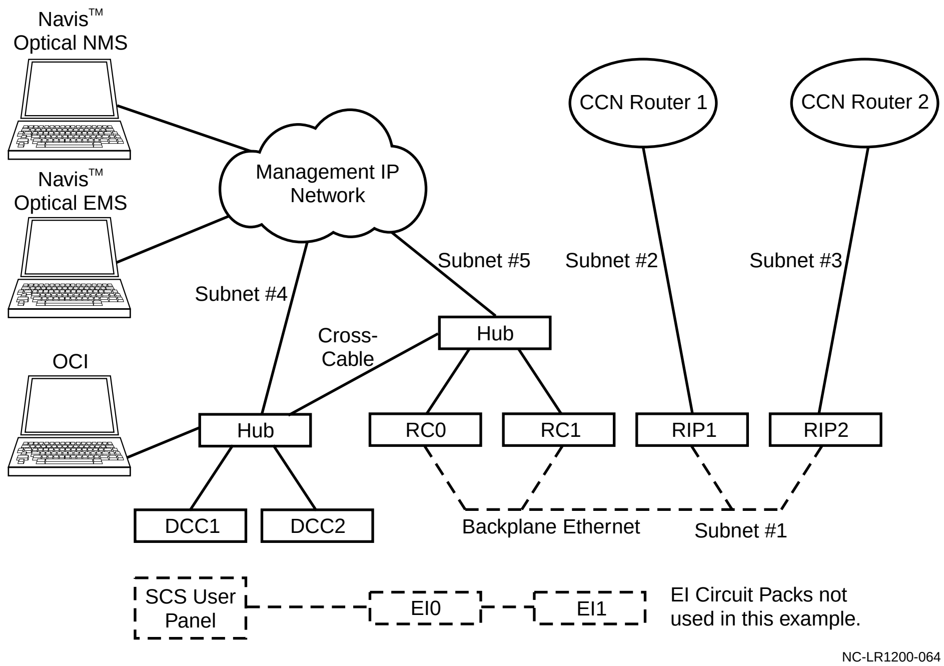
A typical configuration (shown below) using the EI circuit packs is made up of the following connections:

- OCI connected to the SCS User Panel, which connects to EI0 port 4
- EI0 port 3 connected to EI1 port 3 using a cross cable
- DCC1 connected to EI0 port 1
- DCC2 connected to EI1 port 1
- EI0 port 2 connected to an IP hub for communication with Navis™ Optical EMS and Navis™ Optical NMS.



Connection without EI circuit packs

The IP configuration does not require use of the EI circuit packs. The next figure shows the IP network without EI connections.

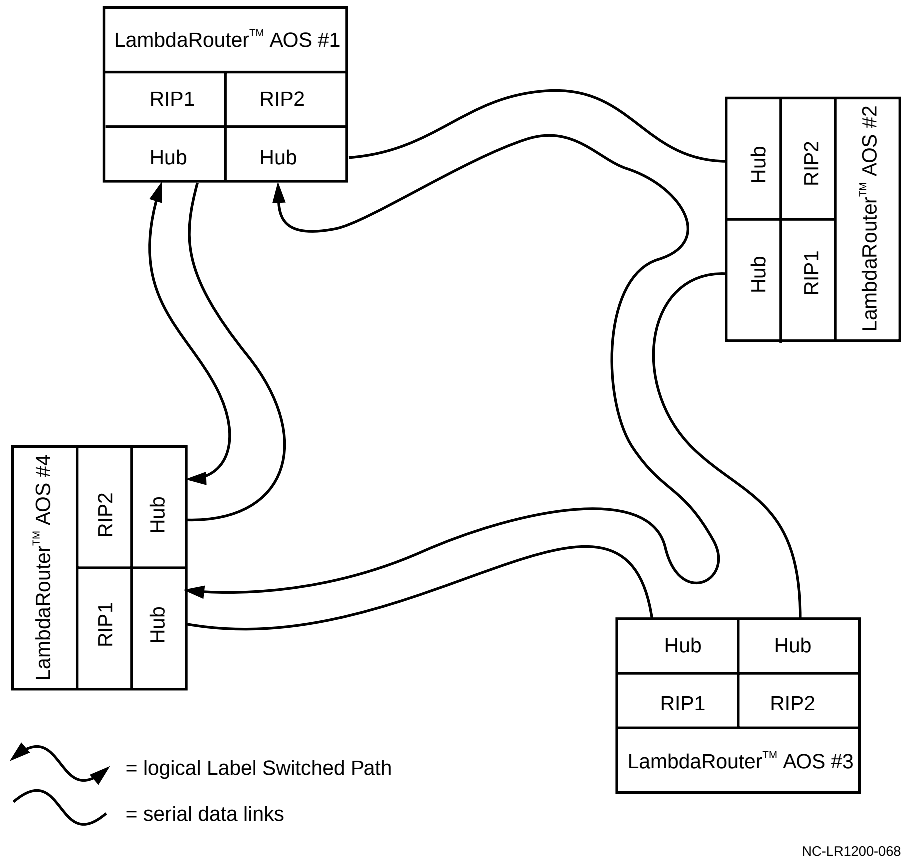


Direct connect CCN ring topology

CCN connectivity may also be implemented by employing bidirectional serial data links between neighboring LambdaRouter™ AOSs. In this arrangement, there are no external IP routers. Essentially, the LambdaRouter™ AOSs are connected in a bidirectional ring for purposes of CCN connectivity. Switching of LSPs is performed only by the RIP packs. Physical connections to the ring will use the RJ-45 ports on the front of the RIP packs. External media converters must be employed to convert the CCN signal format from Ethernet to a suitable serial format, such as T1 or E1. In order for each LambdaRouter™ AOS to have two diverse LSPs to each of its neighbor LambdaRouter™ AOSs, LSPs must traverse both RIP1 and RIP2 circuit packs on intervening LambdaRouter™ AOSs.

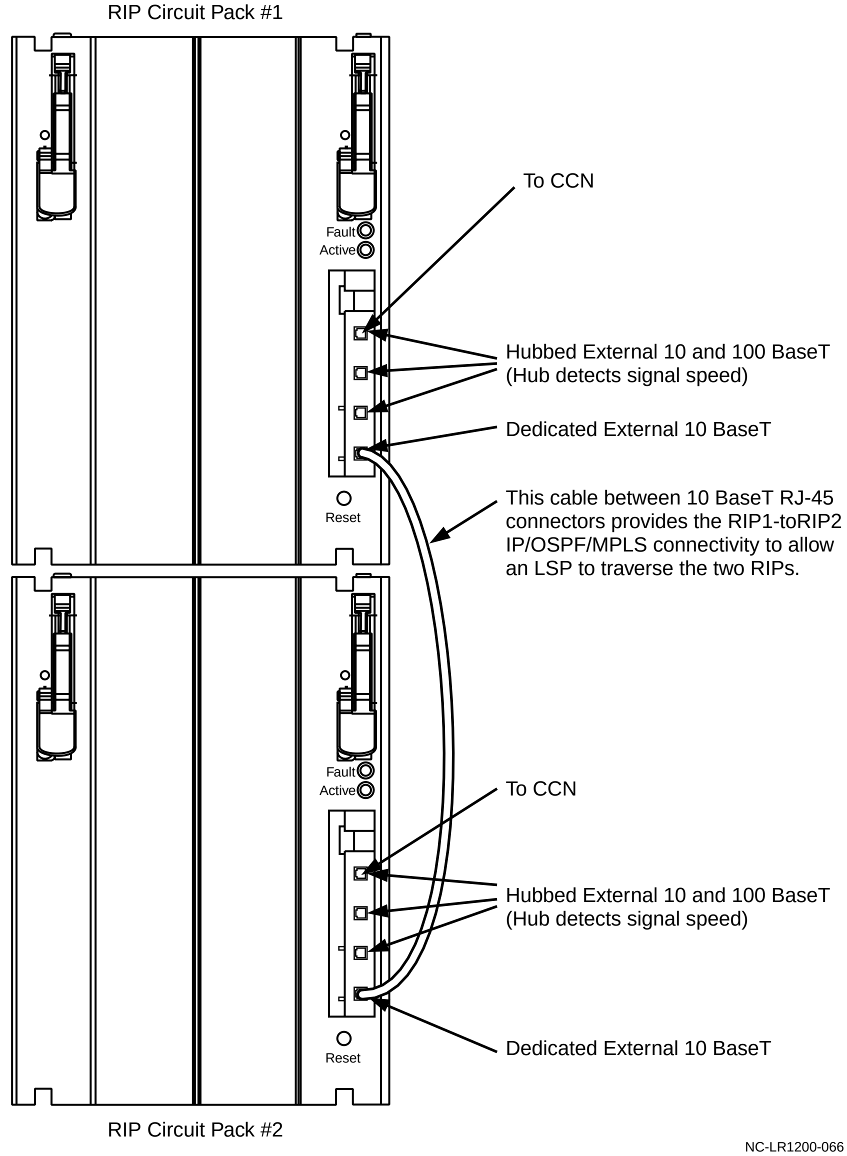
Directly interconnected RIP network

The following figure shows an interconnected IP network composed of RIPs and their corresponding hubs. In this case the RIPs alone constitute the OSPF/MPLS network used to construct the LSPs.



RIP to RIP connectivity using external 10BaseT IP port

For LSPs to traverse both RIP1 and RIP2 circuit packs on intervening LambdaRouter™ AOSs an external connection must be made between the two RIP packs. This is shown in the following figure.



7 Ordering

Overview

Purpose This chapter describes the LambdaRouter™ AOS 128/256 orderable components. This information can be used to help you plan your order.

Contents This chapter includes the following sections:

How to Order

Start-up configuration

In an effort to simplify the ordering process, the start-up configurations of the LambdaRouter™ AOS are ordered as a single comcode. These configurations are intended to serve as the basis for subsequent configuration development and growth.

The start-up configurations simplify the initial ordering, however, additional fiber must be ordered separately to use all available ports, and port units must be ordered separately. Software and documentation must also be ordered separately.

There are limitations associated with the start-up configurations (as described in this chapter) and customized configurations can be developed using the LambdaRouter™ *AOS 128/256 Release 2.0/3.0 Engineering and Ordering* drawing, ED-9C324-10.

Site survey

Local engineers must complete a site survey. As a result of this survey, additional cables (including power cables) and other materials will be ordered to complete the LambdaRouter™ AOS installation.

Optical fiber

Note that fiber optic cables to connect to external customer network elements must also be ordered separately; refer to the "Optical fiber" (7-9) section later in this chapter.

Ordering system components

For the most up-to-date and detailed view of orderable components, refer to the LambdaRouter™ *AOS 128/256 Release 2.0/3.0 Engineering and Ordering*, ED-9C324-10, which is available from the Lucent Technologies. Refer to the Training and Documentation section of Chapter 8, "Product Support" for contact information.

Software Ordering Guide

For convenience, ordering information for a software/documentation kit is included in this section. This kit includes the latest release of generic software. To order individual components, including the latest release of software, refer to the LambdaRouter™ *AOS 128/256 Software Ordering Guide* (Select Code 365-374-010R3.0).

Placing your order

Contact your Lucent Account Executive to actually place your order for the LambdaRouter™ AOS or any of its components.

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What You Need

Initial ordering requirements

To obtain and install a LambdaRouter™ AOS, you will need to order the following items as a minimum:

- One of the available start-up configurations
- Software and documentation
- Optical circuit packs and fibering

The orderable items are discussed in the next sections of this chapter.

Additional ordering options

Depending on how you are equipping your system, you will need to order fibering for installations with more than 16 OXI/OXI-4A13/OXI-4A15 circuit packs, including any installations with OIS-Ss. If you use any OIS-Ss, you must order SI-S cable.

Spares and replacement items can also be ordered.

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Bays and Circuit Packs

LambdaRouter™ AOS 256 start-up configurations

There are two start-up configurations for the LambdaRouter™ AOS 256, one with two OIS-Ts and one with one OIS-T and one OIS-S.

Transparent start-up configuration

Order the LambdaRouter™ AOS 256 transparent start-up configuration as comcode 848843629. This configuration includes the following:

- 1 Control Bay with fully equipped System Controller Shelf (SCS)
- 2 Switch Bays, each equipped with:
  - one fully equipped SWS
  - one fully equipped HVS
  - one OIS-T equipped with two OSWIC packs and fibered to accommodate 16 OXI, OXI-4A13, and/or OXI-4A15 circuit packs (64 ports)
- All bay framework, including fiber organizers, for the three bays
- 64 SI-T cables
- Alarm and LAN cable
- 8 UI cables

Transparent/opaque start-up configuration

Order the LambdaRouter™ AOS 256 transparent/opaque start-up configuration as comcode 848843611. This configuration includes the following:

- 1 Control Bay with fully equipped System Controller Shelf (SCS)
- 1 Switch Bay with:
  - one fully equipped SWS
  - one fully equipped HVS
  - one OIS-T equipped with two OSWIC packs and fibered to accommodate 16 OXI, OXI-4A13, and/or OXI-4A15 circuit packs (64 ports)
- 1 Switch Bay with:
  - one fully equipped SWS
  - one fully equipped HVS

  - one OIS-S equipped with two OSWIC packs (SI-S cable must be ordered separately)
- All bay framework, including fiber organizers, for the three bays
- 32 SI-T cables
- Alarm and LAN cable
- 8 UI cables

LambdaRouter™ AOS 128 start-up configuration

There is one start-up configuration available for the LambdaRouter™ AOS 128, order comcode 848843637.

Transparent start-up configuration

This configuration includes the following:

- 1 Control Bay with fully equipped System Controller Shelf (SCS)
- 1 Switch Bay with:
  - one fully equipped SWS
  - one fully equipped HVS
  - one OIS-T equipped with two OSWIC packs and fibered to accommodate 16 OXI, OXI-4A13, and/or OXI-4A15 circuit packs (64 ports)
- All bay framework, including fiber organizers, for the two bays
- 32 SI-T cables
- Alarm and LAN cable
- 4 UI cables

Growth and interface equipment

To complete your LambdaRouter™ AOS order, you must order circuit packs. Additionally, you may need to order SI cables, optical interface shelves, and an Interface Bay.

Generally, fibering is required for configurations using more than 64 transparent input and 64 transparent output ports, which includes any installation using OIS-Ss.

Fiber cables are available in two different lengths to accommodate all possible placements of the optical interface shelves, including those in the Interface Bay, within each standard configuration.

Differences in port counts associated with each optical interface shelf require different fiber cable quantities:

- OIS-T requires 64 SI-T cables
- OIS-10G requires 4 SI-S cables
- OIS-2G requires 8 SI-S cables
- OIS-MX requires 6 SI-S cables

When ordering, note the provisioning rules associated with the LambdaRouter™ AOS. Refer to the section, Provisioning and Fibering, in Chapter 5, "System Planning and Engineering".

The following growth material can be ordered.

Ordering Number	**Item**
848725438	Interface Bay
848748786	OIS-S growth kit which includes 2 SWICs and UI cabling (fibering is not included)
848748794	OIS-T growth kit which includes 2 SWICs and UI cabling (fibering is not included)
109123059	OXI circuit packs. Each circuit pack provides four input and four output ports.
109164731	OXI-4A13 circuit packs. Each circuit pack provides four input and four output ports.
109176172	OXI-4A15 circuit packs. Each circuit pack provides four input and four output ports.
108883646	OXI-2GC circuit pack. Each circuit pack provides two input and two output ports.
109202598	OXI-10GC circuit packs. Each circuit pack provides one input and one output port.
848523809	SI-T cable (OXI):23 ft
848748331	SI-T cable (OXI):35 ft (required only for OIS-T or OIS-S installations within an Interface Bay)
109030965	SI-S cable (OXI-10GC/OXI-2GC): 25 ft
109030973	SI-S cable (OXI-10GC/OXI-2GC): 35 ft (required only for LambdaRouter™ AOS 256 OIS-S installations within an Interface Bay)
848820411	128 to 256 growth kit

Circuit pack codes

The LambdaRouter™ AOS circuit packs are identified by the codes listed in the following table.

Circuit Pack	CLEI™ Code	Apparatus Code	Comcode
MEM	WMPQABS	LCY2AE	108730086
EI	WMC2807	LCZ1AE	108730094
RIP	WMC8RL9	LLY9AE	109211078
RC	WM7CHWG	LEZ2AE	109211177
SYS50D	WMPQABW	LEY20BE	108735200
DCC	WMPQABU	LEY2AE	108733189
(H)SWIC	WMPQAA3	LGH1	108643842
(O)SWIC	WMPQAA3	LGH1	108643842
	WM1CY10	LGH1AE	109098913
HVDAC	WM6WHX0	LGJ4	109154500
OXI	WMI7HHK	LGK2	109123059
OXI-2GC	WMI3Y70	LUU1AE	108883646
OXI-10GC	WMIU7T2	LUU3AE	109202598
OXI-4A13	WMI72HO	LGK4	109164731
OXI-4A15	WMI73HO	LGK5	109176172

Note: The SWIC circuit packs are identical, they are only identified as HSWIC and OSWIC once they are plugged in. Refer to the “Circuit Packs” (4-11) section in Chapter 4, “Hardware Description”. All SWICs are functionally the same; however, the OSWIC in the OIS-S has a different apparatus code (LGH1AE) than the OSWIC in the OIS-T (LGH1).

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Additional Equipment

Software and documentation

You must order a software and documentation package for the LambdaRouter™ AOS. This package is described in the following table.

Comcode	Item
109197822	Software and documentation. This item includes the LambdaRouter™ AOS 128/256 software, the LambdaRouter™ *AOS 128/256 Software Release Description* (paper) and the user documentation on CD-ROM. The user documentation includes the following: LambdaRouter™ *AOS 128/256 Applications and Planning Guide* LambdaRouter™ *AOS 128/256 User Operations Guide* LambdaRouter™ *AOS 128/256 Alarm Messages and Trouble-Clearing Guide* LambdaRouter™ *AOS 128/256 Operations Systems Engineering Guide*

Documentation

You can order additional copies of the user documents on CD-ROM or individual paper documents from Lucent Technologies. Refer to the Training and Documentation section of Chapter 8, "Product Support" for contact information.

Optical fiber

Fiber optic cable for LambdaRouter™ AOS use must be 8.3 micron single-mode simplex Lucent MiniCord cable or equivalent and terminated on the LambdaRouter™ AOS side with a PC-polished LC connector suitable for Front-of-the-Wall applications. The fiber optic cable outside jacket must be 1.6 mm.

Optical fiber to connect the LambdaRouter™ AOS to remote network elements is not listed in the ordering codes provided in this chapter.

Fans

In Release 3.0, all optical interface shelves and System Controller shelves are equipped with fan units. In this release, the High-Voltage Shelf may optionally be equipped with a fan unit.

When ordering fans for replacement, spares, or upgrade, order the large fan unit for the optical interface shelves (OIS-T and OIS-S); order the standard fan unit for the HVS and SCS.

Comcode	Item
408649564	standard fan unit
408542231	large fan unit
408280287	standard fan filter (box of 25). Individual fan filters cannot be ordered.
408653046	large fan filter (box of 20). Individual fan filters cannot be ordered.

Miscellaneous equipment

The next table lists other orderable components (replacements) for the LambdaRouter™ AOS. Refer to the “Ordering Spares” (7-14) section for additional orderable items.

Comcode	Item
848812947	Cleaning kit refill (universal)
848812939	Cleaning kit (Switch Bay and growth shelf)
109121228	Cleaning kit (LC backplane connector)
408549798	PCMCIA card
408544245	SCS circuit breaker
407838556	HVS circuit breaker
408640902	OIS-T circuit breaker
848756805	UI cable (5 feet)
848759684	UI cable (15 feet)
848737979	UI cable (25 feet)
109080739	100BaseT Cat5 LAN cable: 150 ft straight-through
109080663	100BaseT Cat5 LAN cable: 150 ft crossover
109262592	100BaseT Cat5 cable (RC to EI): 15 ft
848601241	Alarm and LAN cables (both straight-through and crossover), external CO connector kit, 150 feet

Comcode	Item
408699809	Single SI-S jumper cable kit (25 ft)
408699825	Single SI-S jumper cable kit (35 ft)
848822995	RS-232 Cable

OCI

The LambdaRouter™ AOS requires an Optical Craft Interface (OCI). This is a customer-supplied PC or laptop computer on which the OCI software is to be loaded. The requirements for this PC are given in the "OCI requirements" (10-10) section of Chapter 10, "Technical Specifications".

Upgrades

The Release 2.0 WaveStar LambdaRouter can be upgraded to a Release 3.0 LambdaRouter™ AOS. To upgrade the hardware, you must order an upgrade kit, comcode 848845202, and the Release 3.0 software, comcode 109197822.

The upgrade kit contains the following:

- 2 RIP circuit packs
- 2 RC circuit packs
- 2 fans and filters
- Interconnection cables
- Upgrade label kit

When upgrading to LambdaRouter™ AOS Release 3.0, use the *LambdaRouter™ AOS 128/256 Release 3.0 Upgrade* document, select code 365-375-014R3.0, for reference.

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Power Cables

Overview

Power cables must be ordered for the LambdaRouter™ AOS at the completion of the Site Survey.

The following subsections list the cables required for each shelf. Every shelf requires one kit as listed in the tables below and each kit includes a set of two power cables with associated connectors. If you choose to engineer the cables yourself, you must order the connectors described in the subsection, “Connectors” (7-13).

SCS power cables

The power cables required for the SCS are shown in the following table.

Kit Comcode	Kit Description	Voltage Drop
848773073	12 ft (3.66 m) 6-gauge power cables	0.1 V
848773107	50 ft (15.2 m) 6-gauge power cables	0.36 V
848773115	75 ft (22.9 m) 6-gauge power cables	0.54 V

HVS power cables

The power cables required for the HVS are shown in the following table.

Kit Comcode	Kit Description	Voltage Drop
848773073	12 ft (3.66 m) power cables 6-gauge (16 mm^2)	0.12 V
848773081	50 ft (15.2 m) power cables 4-gauge (25 mm^2)	0.32 V
848773099	70 ft (21.3 m) power cables 2-gauge (35 mm^2)	0.3 V

OIS-T power cables

The power cables required for the OIS-T are shown in the following table.

Kit Comcode	Kit Description	Voltage Drop
848773073	12 ft (3.66 m) power cables 6-gauge (16 mm^2)	0.27 V
848773081	50 ft (15.2 m) power cables 4-gauge (25 mm^2)	0.72 V
848773099	70 ft (21.3 m) power cables 2-gauge (35 mm^2)	0.65 V

OIS-S power cables

The power cables required for the OIS-S are shown in the following table.

Kit Comcode	Kit Description	Voltage Drop
848773131	30 ft (9.14 m) power cables 4-gauge (25 mm^2)	0.65 V
848773149	50 ft (15.2 m) power cables 2-gauge (35 mm^2)	0.7 V
601950884	50 ft (15.2 m) power cables 6-gauge spliced to 2/0 cable (68 mm^2)	0.35 V
601950900	50 ft (15.2 m) power cables 6-gauge spliced to 4/0 cable (108 mm^2)	0.23 V
601956998	75 ft (22.9 m) power cables 6-gauge spliced to 4/0 cable (108 mm^2)	0.34 V

Connectors

When engineering your own cables, you must order either a 45-amp or 65-amp connector kit for each shelf as shown in the table below.

45-Amp Kit Comcode (required for OIS-T, SCS, HVS)	45-Amp Kit Description
848771861	2 45-amp connectors for 2-gauge (35 mm^2) wire
848771853	2 45-amp connectors for 4-gauge (25 mm^2) wire
848771846	2 45-amp connectors for 6-gauge (16 mm^2) wire
65-Amp Kit Comcode (required for OIS-S)	65-Amp Kit Description
848771879	WT Storey connector which mates to #4 AWG wire
848771887	WT Storey connector which mates to #2 AWG wire

Ordering Spares

Spares The following equipment may be ordered as spares.

Comcode	Item
108643842	SWIC for the HVS, and OIS-T (apparatus code LGH1)
109098913	SWIC for the OIS-S (apparatus code LGH1AE)
109154500	HVDAC (apparatus code LGJ4)
	SCS circuit packs:
108733189	DCC (apparatus code LEY2AE)
108735200	SYS50D (apparatus code LEY20BE)
108730094	EI (apparatus code LCZ1AE)
108730086	MEM (apparatus code LCY2AE)
109211177	RC (apparatus code LEZ2AE)
109211078	RIP (apparatus code LLY9AE)
109054908	Personality module (apparatus code LLY10AE)
109123059	OXI circuit pack (apparatus code LGK2)
109164731	OXI-4A13 circuit pack (apparatus code LGK4)
109176172	OXI-4A15 circuit pack (apparatus code LGK5)
109202598	OXI-10GC circuit pack (apparatus code LUU3AE)
108883646	OXI-2GC circuit pack (apparatus code LUU1AE)
408649564	Standard fan unit
408542231	Large fan unit
848511408	OIS-T/HVS user panel
848732731	OIS-S user panel
847783859	SCS user panel
408520765	Power filter for SCS, HVS, and OIS-T
408527851	Power filter and circuit breaker for OIS-S
848601241	Alarm and cable kit

Sparing recommendations

Information on sparing rates is given in Chapter 9, "Quality". It is recommended, however, that as a minimum, one of each type of circuit pack be kept on hand as a spare. Operating company policy on sparing should prevail.

As described in the "Component Sparing" (9-3) section of Chapter 9, "Quality", the quantity of spares is determined by the quantity of circuit packs in your system. The following table lists the circuit pack counts per shelf to use as a reference when ordering spares for your system.

Shelf	Circuit Packs
HVS	16 HVDACs (LGJ4) 2 SWICs (LGH1)
SCS	2 DCCs (LEY2AE) 2 SYS50Ds (LEY20BE) 2 EIs (LCZ1AE) 3 MEMs (LCY2AE) 2 RCs (LEZ2AE) 2 RIPs (LLY9AE)
OIS-T	2 SWICs (LGH1) maximum of 32 circuit packs, which can be any combination of OXI (LGK2), OXI-4A13 (LGK4) and OXI-4A15 (LGK5) circuit packs
OIS-S	2 SWICs (LGH1AE) maximum of 32 OXI-10GCs (LUU3AE) or 32 OXI-2GCs (LUU1AE)

Order spare port units based on the number in your installation.

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8 Product Support

Overview

Purpose This chapter gives details on product support including related training and documentation.

Contents This chapter includes the following sections:

Engineering and Installation

Overview

The Lucent Engineering and Installation Services Group provides support personnel dedicated to providing you with quality engineering and installation services. Using state-of-the-art technology, equipment, and procedures, these specialists provide rapid, expert service.

Services

The Engineering and Installation Services Group provides:

- Analysis of your equipment needs
  - Cabling
  - Lighting
  - Power equipment
  - Connection to alarms
- Preparation of detailed specifications for manufacturing and installation
- Creation and maintenance of job records
- Installation of equipment
- System test and turn over

Custom services

When purchasing these engineering and installation services, your order is integrated into a complete working system tailored to your office conditions and preferences.

Required services

Because of the complexity of the system, some level of Engineering and Installation services is required. The minimum requirement includes a Site Survey and installation of the LambdaRouter™ AOS.

Reference

Contact your local Lucent Technologies Account Executive for information about purchasing these services.

Technical Support

Warranty

The LambdaRouter™ AOS comes with a one-year warranty on hardware and a 90-day warranty on software.

Services

Lucent Worldwide Services provides a full lifecycle of services and solutions to help you plan, design, implement, and operate your network in today's rapidly changing and complex environment.

Engineering Services

Engineering Services provides information and technical support to customers during the planning, implementation, and placement of equipment into new or existing networks. We determine the best, most economical equipment solution for a customer and help ensure equipment is configured correctly for the customer’s network needs, works as specified, and is ready for installation on delivery.

These services consist of the following:

- equipment engineering
- software engineering
- site records
- engineering consulting
- additional engineering services (for example, network realignment, system capacity planning, system health assessment).

Installation Services

Lucent Technologies offers Installation Services focused on providing the technical support and resources customers need to efficiently and cost-effectively install their network equipment. We offer a variety of options that provide extensive support and deliver superior execution to help ensure the system hardware is installed, tested, and functioning as engineered and specified. Installation Services provides a complete flexible solution tailored to meet customers' specific needs.

These services consist of the following:

- equipment installation
- specialized equipment installation
- network connectivity services

- installation support services

Technical Support

Lucent Technologies provides the following Technical Support Services that are available 24 hours a day, 7 days a week:

- Remote Technical Support (RTS)—to troubleshoot and resolve system problems
- On-site Technical Support (OTS)—on-site assistance with operational issues and remedial maintenance
- Repair and Replacement (R&R)—technical support services for device repair/return or parts replacement
- Lucent OnLine Customer Support—online access to information and services that can help resolve technical support requests.

Contact information

Customers can reach Technical Support Services at: 1-866-LUCENT8. International customers can call +630-224-4672.

The Worldwide Services website provides additional information: *http://www.lucent.com/products*

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Training and Documentation

Course information and registration

Lucent Technologies offers courses in various aspects of its optical product line, including the LambdaRouter™ AOS.

You can access the Lucent training catalog online; use one of the following web sites:

- *http://product-training.web.lucent.com* (internal Lucent)
- *http://www.lucent-product-training.com*

To arrange for courses to be taught at your facility (customized and dedicated scheduling), call the Lucent Learning Organization (LLO) organization. Refer to one of the websites listed above for the phone number for your country. In the U.S., call 1-888-LUCENT8.

LambdaRouter™ AOS courses

Instructor-led courses are offered at Lucent facilities in Florida, or they may be given at customer locations.

The available LambdaRouter™ AOS courses are listed in the table below.

Course Number	Course
LW2259	LambdaRouter™ AOS 128/256 Applications and Planning—instructor-led
LW2459	LambdaRouter™ AOS 128/256 Installation and Testing—instructor-led, hands-on
LW2659	LambdaRouter™ AOS Operations and Maintenance—instructor-led, hands-on

Documentation

Documentation supporting the LambdaRouter™ AOS is shipped with the software, as follows:

- LambdaRouter™ *AOS 128/256 Release 3.0 Library,* CD-ROM
- LambdaRouter™ *AOS 128/256 Release 3.0 Software Release Description,* paper

Extra copies of the CD-ROM (Select Code 365-375-012R3.0) can be ordered. The CD-ROM contains the following documents, each of which can also be ordered in paper:

- LambdaRouter™ *AOS 128/256 Release 3.0 Applications and Planning Guide*, Select Code 365-375-008R3.0
- LambdaRouter™ *AOS* 128/256 *Release 3.0 User Operations Guide*, Select Code 365-375-009R3.0
- LambdaRouter™ *AOS* 128/256 *Release 3.0 Alarm Messages and Trouble-Clearing Guide,* Select Code 365-375-010R3.0
- LambdaRouter™ *AOS 128/256 Release 3.0 Operations Systems Engineering Guide,* Select Code 365-375-013R3.0
- LambdaRouter™ *AOS 128/256 Release 3.0 Upgrade,* Select Code 365-375-014R3.0

The LambdaRouter™ *AOS 128/256 Release 3.0 Installation Guide (*Select Code 365-375-011R3.0) is available to Lucent installers.

Other LambdaRouter™ AOS documents

The following LambdaRouter™ AOS documents are also available.

- LambdaRouter™ *AOS 128/256 Release 2.0/3.0 Engineering and Ordering*, ED-9C324-10
- LambdaRouter™ *AOS 128/256 Release 3.0 Software Ordering Guide*, Select Code 365-374-010R3.0

Other documents

For information on the LambdaRouter™ Optical Network Navigation System (ONNS), refer to the *LambdaRouter™ Optical Network Navigation System (ONNS) User Guide*, Select Code 365-375-015.

For customers using the Navis™ Optical PM, Navis™ Optical NMS or Navis™ Optical EMS with the LambdaRouter AOS, the following documents are available:

- Navis™ *Optical Element Management System (EMS) Release 7.0 Administration Guide*, Select Code 190-224-151R7.0
- Navis™ *Optical Element Management System (EMS) Release 7.0 Applications and Planning Guide*, Select Code 190-224-153R7.0
- Navis™ *Optical Network Management System (NMS) Release 6.0 Applications and Planning Guide*, Select Code 365-309-250R6.0
- Navis™ *Optical Network Management System (NMS) Release 6.0 Provisioning Guide,* Select Code 365-309-251R6.0
- Navis™ *Optical Network Management System (NMS) Release 6.0 Maintenance Guide,* Select Code 365-309-252R6.0

Customers with WaveStar® OLS 1.6T devices in their network may find information in the *WaveStar® Optical Line Systems (OLS) 1.6T (400G/800G) Application and Planning Guide, Release 6.1*, Select Code 365-575-786R6.1.

Customers may need information from the vendor of the personal computer used for the OCI.

Ordering documents

The LambdaRouter™ AOS documents can be ordered as individual paper copies or as a set on CD-ROM.

You can order an annual subscription to the document set. For information, contact your Lucent account executive.

Contact information is provided in the following table.

Mail	Lucent Technologies Att: Order Entry 2855 N. Franklin Road P.O. Box 19901 Indianapolis, IN 46219	
E-mail (international only)	*intlorders@lucent.com*	
Internet Address	*www.lucentdocs.com*	
From:	**Telephone**	**Fax**
U.S.A	1-888-LUCENT8	1-800-566-9568
North American Region	1-317-322-6615	1-317-322-6699
Asia/Pacific Region and Caribbean and Latin America Region	+317-322-6416	+317-322-6699
Europe, Middle East, and Africa	+317-322-6416	+317-322-6699

9 Quality

Overview

Purpose This chapter gives failure rates and sparing information.

All data in this chapter is based on the circuit pack Failures in Time (FIT) rates that are calculated according to Bellcore's Method 1, *Reliability Prediction Procedure for Electronic Equipment*, Issue 6, December 1997.

Contents This chapter includes the following sections:

Component Reliability Specifications

Circuit packs The table below shows the steady-state LambdaRouter™ AOS circuit pack failure rates.

Circuit Packs	Apparatus Code	Failure Rate (FIT)
RC	LEZ2AE	6000
RIP	LLY9AE	6000
DCC	LEY2AE	2700
EI	LCZ1AE	3900
HVDAC	LGJ4	5350
MEM	LCY2AE	1400
SWIC (OSWIC and HSWIC)	LGH1/LGH1AE	6000
OXI	LGK2	3871
OXI-4A13	LGK4	4510
OXI-4A15	LGK5	4510
OXI-10GC	LUU3AE	4223
OXI-2GC	LUU1AE	5762
SYS50D	LEY20BE	6200

MIcroStar MEMS The table below shows the steady-state MEMS failure rates.

Component	Failure Rate (FIT)
MEMS (total)	115
MEMS (individual cross-connects)	150

Other equipment The following table shows the steady-state equipment failure rates.

Equipment	Failure Rate (FIT)
Circuit breaker	10
Power filter	84
User panel	110
Fan unit	1600
PCMCIA flash card	660

Component Sparing

Introduction

The recommended number of spare circuit packs or other common equipment (such as fan units) to have on hand can be determined by using the graphs in this section. These graphs are based on lead time required, FIT, and number of circuit packs or other pieces of equipment.

Use these graphs to determine how many spares are required for each piece of equipment (such as circuit packs and fan units) at each location to maintain 99.9 percent service continuity.

FITs are found in the tables earlier in this chapter.

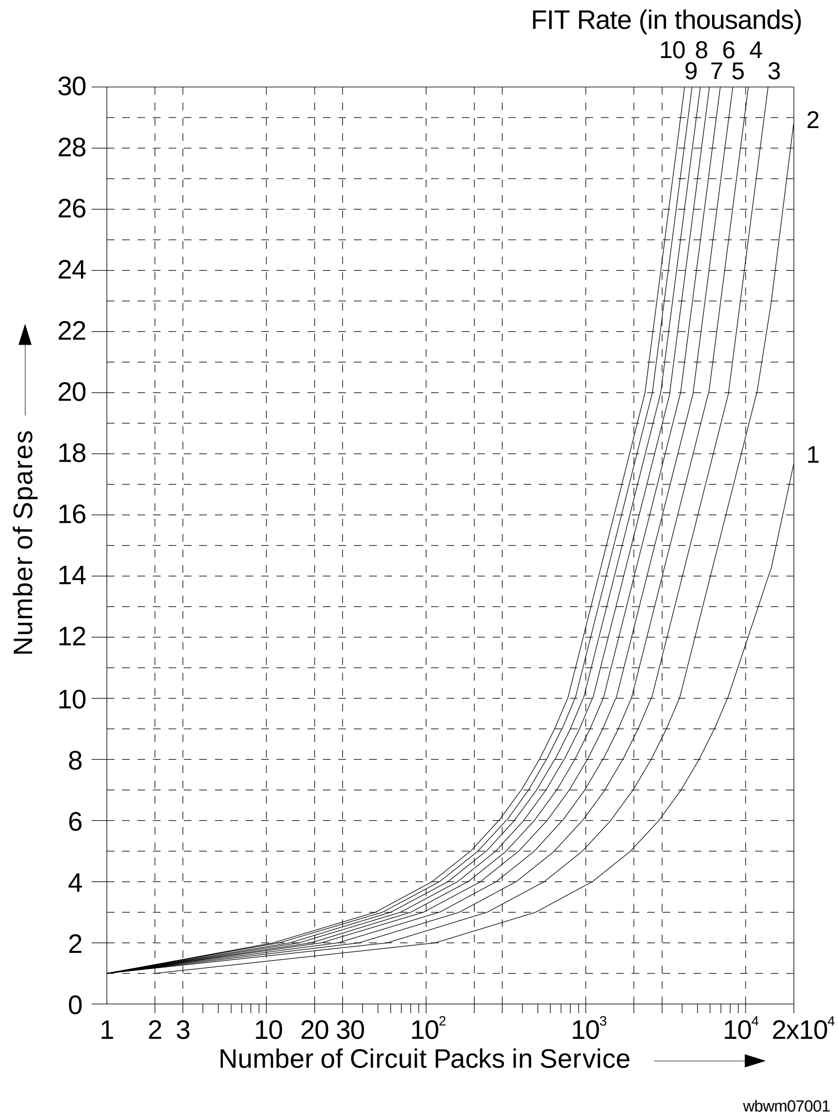
How to use the graphs

To determine the number of spares, perform the following steps.

1. Select the graph for the lead time you want, 10-day or 64-day.
2. Determine the quantity you have of the component you want to spare.
3. Read that number on the x-axis of the graph for the lead time you want.
4. Determine the failure rate for the component you want to spare from the table on the preceding page.
5. Select the curve for that failure rate on the graph.
6. Read the number of spares from the y-axis at the spot where items 3 and 5 intersect.

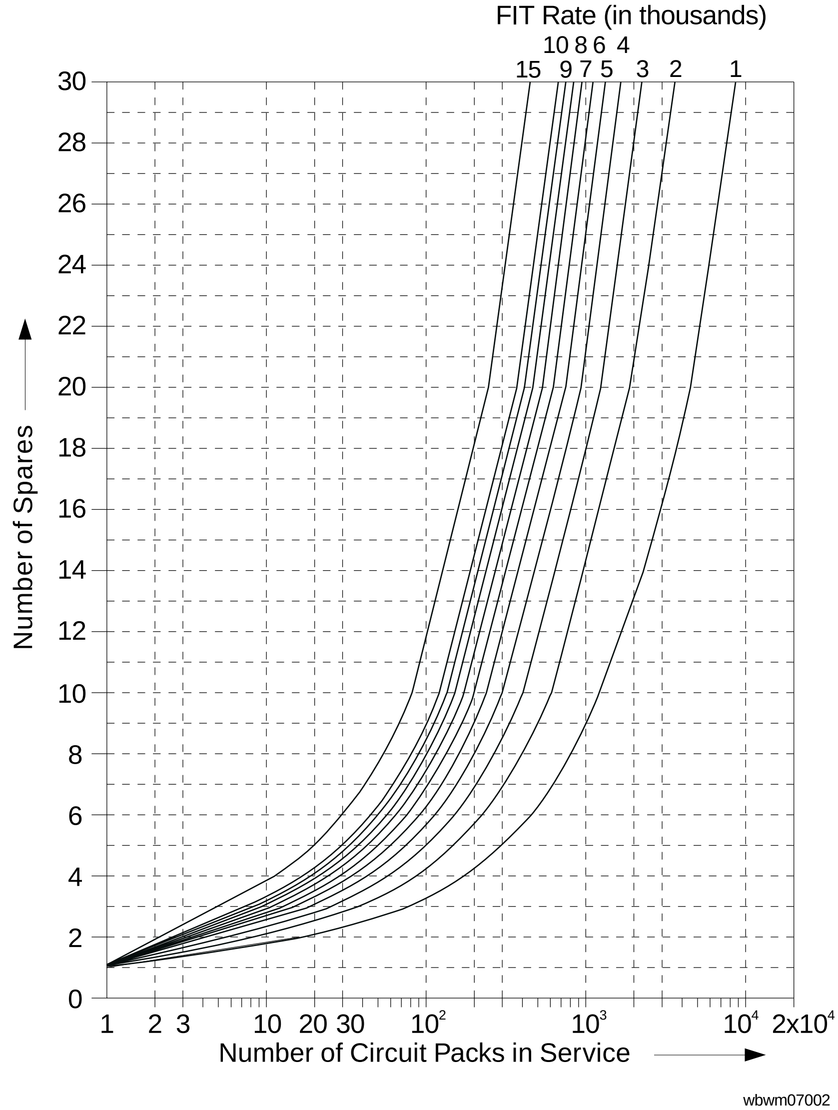
10-day lead time

Use the following graph to determine the number of spare circuit packs to stock at a particular location for a 10-day lead time.



64-day lead time

Use the following graph to determine the number of spare circuit packs to stock at a particular location for a 64-day lead time.



System Reliability Specifications

MTTR The mean time to repair (MTTR) assumption for the LambdaRouter™ AOS is a maximum of two hours, including dispatch, diagnostics, and repair time for plug-in replaceable units, and a maximum of 24 hours for all other hardware.

IMF The number of failures that a product experiences during the first year of service may be greater than the number of subsequent annual steady-state failures. The infant mortality factor (IMF) for the LambdaRouter™ AOS is a maximum of 1.3. Therefore, the first-year failure rate is 1.3 times the steady-state failure rate.

Maintainability specifications The LambdaRouter™ AOS does not require periodic optical equipment maintenance activities. Continuous performance monitoring enables the system to detect conditions before they affect service.

The Fan Filters must be replaced once every six months.

System unavailability The following table provides steady-state system unavailability estimates for the LambdaRouter™ AOS due to system failures.

System Unavailability Metric	LambdaRouter™ AOS 256	LambdaRouter™ AOS 128
Total system	0.0016 min/year	1.45 min/year
Downtime per optical port (OXI)	1.62 min/year	3.07 min/year
Downtime per optical port (OXI-4A13)	1.96 min/year	3.41 min/year
Downtime per optical port (OXI-4A15)	1.96 min/year	3.41 min/year
Downtime per optical port (OXI-10GC)	3.84 min/year	5.3 min/year
Downtime per optical port (OXI-2GC)	3.42 min/year	4.87 min/year
Downtime for control and reconfiguration (without RIP option)	0.99 min/year	1.26 min/year
Downtime for control and reconfiguration (with RIP option)	1.46 min/year	1.72 min/year
Downtime for alarm visibility (without RIP option)	0.99 min/year	1.26 min/year
Downtime for alarm visibility (with RIP option)	1.46 min/year	1.72 min/year

MTBMA The following table shows the mean time between maintenance activities (MTBMA) for the LambdaRouter™ AOS.

Entity	LambdaRouter™ AOS 256 MTBMA (months)	LambdaRouter™ AOS 128 MTBMA (months)
SWS	156.4	158.8
SCS	26.6	26.6
HVS	6.4	12.8
OIS-10G	8.7	8.7
OIS-2G	6.6	6.6
OIS-MX	7.5	7.5
OIS-T (32 OXI packs)	9.4	9.4
OIS-T (16 OXI and 16 OXI-4A13/OXI-4A15 packs)	8.8	8.8
OIS-T (32 OXI-4A13/OXI-4A15 packs)	8.2	8.2
Start-up System (3-bay)	2.3	4.2

Silent failures The LambdaRouter™ AOS is designed to minimize unavailability due to silent failures. All equipment failures in the system that may result in a loss of service or protection capabilities will trigger office alarms or generate autonomous messages.

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10 Technical Specifications

Overview

Purpose This chapter provides technical specifications for the LambdaRouter™ AOS.

Contents This chapter includes the following sections:

Standards Compliance

Overview

The LambdaRouter™ AOS equipment complies with the following standards.

North America

- Safety
  — United States and Canada listed to UL 60950, Third Edition
- EMC
  — FCC Part 15 Class A
  — ICES 003 Class A

NEBS

- SR-3580 Issue 1, November 1995
  — Level 3
  — Illumination
  — Altitude
  — Acoustic Noise
  — Thermal Heat Dissipation

Europe

CE Marked in accordance with:

- Low Voltage Directive 73/23/EEC
- EMC Directive 89/336/EEC

ETSI

- ETSI 300 019
  — Class 1.2
  — Class 2.3
  — Class 3.1
- ETSI 300 132-2
  — Interface A

Reliability

The LambdaRouter™ AOS transmission and control hardware meets Telcordia specification in GR-1339-CORE.

The LambdaRouter™ AOS software and process quality are compliant with Telcordia specifications GR-282-CORE and TR-NWT-000179, respectively.

Safety

The LambdaRouter™ AOS is classified as an FDA/CDRH Class I and as an IEC-60825-1 Class 1 laser product. This product is capable of optically cross-connecting FDA/CDRH Class IIIb laser emissions originating from other external laser sources. FDA/Class IIIb Non-Interlocking Protective Housing labeling is affixed to the product.

Common equipment

The hardware is common to SONET and SDH environments.

Power

Power supply components

The table below gives the power specifications for the LambdaRouter™ AOS.

Power Item	Description
Nominal power	–48 VDC/–60 VDC
Voltage range, all components	**–48 VDC** Normal: –40.5 to –57 VDC Abnormal: 0 to –40.5 and –57 to –60 VDC
	–60 VDC Normal: –50 to –72 VDC Abnormal: 0 to –50 and –72 to –75 VDC
Power feeders	Two –48 VDC or –60 VDC power feeders (A and B) per shelf
Circuit breakers	**OIS-S** two 60 Amps **OIS-T** two 30 Amps **HVS** two 25 Amps **SCS** two 10 Amps
Power filter voltage protection unit	**OIS-S** 60 Amps **OIS-T** 30 Amps **HVS** 30 Amps **SCS** 30 Amps
System power wiring Main cable wire size (max 0.25 V drop, 50-ft run)	**OIS-S** 4/0 **OIS-T** 2/0 **HVS** #2 AWG **SCS** #4 AWG
Voltage protection	Thresholds: –38.5V ± 1V (power cutoff), –43V ± 0.5V (power restoration), and –77V ± 2V (overvoltage)

Power consumption

The power consumption for each shelf is the sum of the power consumption of each circuit pack on that shelf.

The following table gives the estimates for a full complement of circuit packs per shelf.

Shelf	**Current/Power**		
	at 39.5 V	**at 48 V**	**at 60 V**
SCS	8.10 Amps/320 Watts	6.67 Amps/320 Watts	5.33 Amps/320 Watts
OIS-S	37.9 Amps/1496 Watts	31.2 Amps/1496 Watts	24.9 Amps/1496 Watts
HVS	11.14 Amps/440 Watts	9.16 Amps/440 Watts	7.33 Amps/440 Watts
OIS-T (32 OXI-4A13/ OXI-4A15 circuit packs)	24.1 Amps/952 Watts	19.83 Amps/952 Watts	15.87 Amps/952 Watts
OIS-T (32 OXI circuit packs)	10.6 Amps/420 Watts	8.75 Amps/420 Watts	7 Amps/420 Watts

Heat dissipation

The following table shows the heat dissipated from the bays equipped as described.

Bay	**Equipment**	**Heat Dissipated (Watts)**
Switch Bay	SWS, HVS, and 1 OIS-S with 32 OXI-10GC packs	1936
Switch Bay	SWS, HVS, and 1 OIS-T with 32 OXI (LGK2) packs	860
Switch Bay	SWS, HVS, and 1 OIS-T with 32 OXI-4A13/OXI-4A15 (LGK4/5) packs	1392
Control Bay	SCS and 2 OIS-Ss with 64 OXI-10GC packs	3312
Interface Bay	3 OIS-Ss filled with OXI-10GC packs	4488

Note: Each OIS-T can support up to 32 optical interface circuit packs (any combination of OXI, OXI-4A13, and OXI-4A15 packs).

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Transmission

Optical parameters LambdaRouter™ AOS optical parameters are listed in the table..

Parameter	**Value**
Optical pass band (OXI)	1260–1360 nm 1500–1620 nm
Optical pass band (OXI-4A13)	1290–1340 nm
Optical pass band (OXI-4A15)	1530–1565 nm
Maximum optical power at fabric	100 mw (+20 dBm)
Static crosstalk, composite, all ports operating	< –44 dB
Optical return loss	> 35 dB
Chromatic dispersion	< 0.5 ps/nm
Polarization dependent loss (PDL)	< 0.3 dB
Polarization mode dispersion (PMD)	< 0.5 ps
Mirror settling time	< 10 msec
Insertion loss (OXI packs end-to-end)	Minimum 6.1 dB Typical 8.3 dB Maximum 11.3 dB
Insertion loss (OXI ingress port to OEO internal receiver)	Minimum 5.9 dB Typical 8.0 dB Maximum 11.1 dB
Insertion loss (internal OEO transmitter to OXI egress port)	Minimum 5.55 dB Typical 7.5 dB Maximum 10.35 dB
Maximum OXI input signal level	+25 dBm
Minimum OXI input signal level	–25 dBm
Maximum (minimum) input signal level for OXI-4A13 circuit packs	+3 dBm (–9 dBm)
Maximum (minimum) input signal level for OXI-4A15 circuit packs	+3 dBm (–9 dBm)

Parameter	Value
Internal (fabric-facing) optics type on OEO packs	Intermediate reach (Telcordia OC-48 IR-1/ITU S-16.1 or Telcordia OC-192 IR-2/ITU S-64.2b)
OXI-10GC circuit pack client-side interworks with OC-192/STM-64 short reach/intra-office optics	Telcordia SR-1/ITU I-64.1
OXI-2GC circuit pack client-side interworks with OC-48/STM-16 short reach/intra-office optics	Telcordia SR-1/ITU I-16

Cross-connect performance

The LambdaRouter™ AOS sustains a cross-connection completion rate of 20 cross-connection legs per second through the TL1 management interface.

Bursts of restoration cross-connections through the LambdaRouter™ ONNS interface are supported at a rate of 100 one-way cross-connections per second. The LambdaRouter™ AOS supports restoring up to one-half the system switch capacity in each burst.

□

Equipment Dimensions

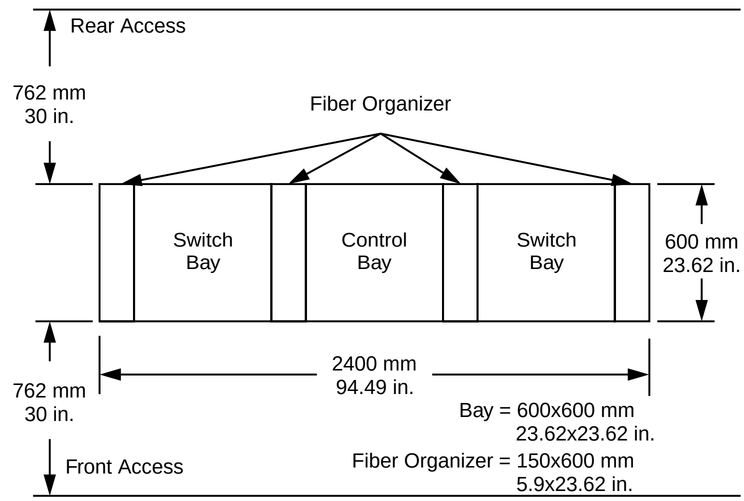
Circuit pack dimensions

The dimensions for the LambdaRouter™ AOS circuit packs are given in the following table.

Circuit Pack	Dimensions: mm [inches]		
	Height (board)	**Width (slot)**	**Depth**
DCC	336 [13.23]	20 [0.79]	270 [10.63]
SYS50D	336 [13.23]	35 [1.38]	270 [10.63]
RC	336 [13.23]	40 [1.57]	270 [10.63]
RIP	119 [4.69]	120 [4.71]	270 [10.63]
EI	96 [3.77]	35 [1.38]	270 [10.63]
MEM	96 [3.77]	35 [1.38]	270 [10.63]
OXI	156 [6.14]	25 [0.98]	350 [13.36]
OXI-4A13	156 [6.14]	25 [0.98]	350 [13.36]
OXI-4A15	156 [6.14]	25 [0.98]	350 [13.36]
OXI-10GC	204 [8.03]	29 [1.14]	350 [13.36]
OXI-2GC	204 [8.03]	29 [1.14]	350 [13.36]
OSWIC/HSWIC	336 [13.23]	30 [1.18]	350 [13.36]
HVDAC	336 [13.23]	25 [0.98]	350 [13.36]

Bay dimensions

The dimensions, 2200 mm x 600 mm x 600 mm [86.6 in. x 23.62 in. x 23.62 in.], are identical for all of the LambdaRouter™ AOS bays. There are also two Fiber Organizers located to the right and left of the each of the Switch Bays. The LambdaRouter™ AOS 128 has two Fiber Organizers. The LambdaRouter™ AOS 256 has four Fiber Organizers (shown in the following figure). These Fiber Organizers are 2200 mm x 150 mm x 600 mm [86.6 in. x 5.9 in. x 23.62 in.]..



The widths for a LambdaRouter™ AOS configurations vary depending on the number of bays in the configuration. The table below gives the widths for the LambdaRouter™ AOS configurations. (Excluded from this table are the 1-inch end guards that may be used on the right and left ends of a LambdaRouter™ AOS installation.)

Configuration	Width:mm [inches]
LambdaRouter™ AOS 128 2-bay configuration	1500 [59.05]
LambdaRouter™ AOS 256 3-bay configuration	2400 [94.48]
LambdaRouter™ AOS 256 4-bay configuration	3000 [118.1]

Operations Interfaces

Office alarms

The steady-state current and the maximum transient current (20 ms duration) for office alarm connections must not exceed 0.9A at 60V or 1.8A at 30V.

TL1

The LambdaRouter™ AOS communicates with the OCI and Navis™ Optical EMS and with other managing systems using TL1 messages. These messages are compliant with the following Telcordia standards.

- GR-831-CORE syntax and semantics
- GR-199-CORE provisioning message sets
- GR-833-CORE maintenance message sets
- GR-834-CORE testing message sets
- TR-NWT-835 security message sets.

OCI requirements

This following are the recommended requirements for the customer-furnished computer used for the OCI:

- Windows 2000 Professional or NT Workstation 4.0 with Service Pack 6
- Pentium® III 500 MHz processor with 256 MB of RAM
- Standard floppy drive for 1.44 MB 3.5-inch disks
- A 6.5 GB hard disk with 500 MB free space
- 4x speed CD-ROM drive
- Personal Computer Memory Card International Association (PCMCIA) Type II slot with driver software that supports read/write of PCMCIA flash cards
- 11.5" or greater SVGA monitor capable of 1024 x 768 resolution
- 10/100 BaseT LAN interface network interface card (NIC)
- Microsoft Peer Web Services FTP server must be installed

The OCI application requires a minimum of 50 MB of hard disk space. An additional 30 MB is required during installation of the OCI software. Multiple releases of the application may be installed on an OCI single computer. A minimum of 50 MB of hard disk space is required for each release stored on the OCI.

□

Environmental

Floor loading

The LambdaRouter™ AOS floor loading weights are given in the next table.

Equipment	Weight: kg [lbs]
OIS-T	38.7 [87]
OIS-S	38.7 [87]
Switch Bay (with one optical interface shelf)	417 [917]
Control Bay (with two optical interface shelves)	289 [635]
Interface Bay (with two optical interface shelves)	306 [673]
LambdaRouter™ AOS 128 (2 bays)	497 [1117]
LambdaRouter™ AOS 256 (3 bays)	856 [1923]
LambdaRouter™ AOS 256 (4 bays)	1001 [2209]

Operating conditions

The LambdaRouter™ AOS is designed to operate in a controlled environment that complies with the conditions listed in the following table.

Operating Conditions	Normal	Short Term
Ambient temperature	5° to 40°C [41° to 104°F]	–5° to 50°C [23° to 122°F]
Maximum temperature rate of change	30°C/hr [54°F/hr]	30°C/hr [54°F/hr]
Ambient relative humidity	5% to 85% non-condensing	5% to 90% non-condensing
Altitude non-operational	-61 to 12200 m [-200 to 40000 ft]	NA
Altitude operational	–61 to 1981 m [–200 to 6500 ft]	NA

In the table above, ambient refers to conditions at 1.5 meters [5 feet] above the floor and 380 mm [15 inches] in front of the LambdaRouter™ AOS equipment. Short term is a period of not more than 96 consecutive hours and not more than 15 days in a year.

All devices and components in the LambdaRouter™ AOS are case temperature-rated from –5° to 85°C [23° to 185°F].

Heat dissipation

Aisle-facing surface temperature is 38°C [100°F] or less at normal ambient 26°C [79°F].

Storage and transportation

The LambdaRouter™ AOS is designed to be fully operational after being subjected to the environmental conditions listed in the following table during storage and transportation.

Condition	Range
Low Temperature Exposure and Thermal Shock	–40°C to 23°C [–40°F to 73°F]
Maximum rate of change	30°C/hour [54°F/hour]
Soak	–40°C [–40°F] at least 72 hours
Transition duration	less than 5 minutes
High Temperature Exposure and Thermal Shock	23°C to 70°C [73°F to 158°F]
Maximum rate of change	30°C/hour [54°F/hour]
Soak	70°C [158°F] at least 72 hours
Transition duration	less than 5 minutes
High Relative Humidity (RH) Exposure	23°C to 40°C [73°F to 104°F] any relative humidity
Temperature transition	30°C/hour [54°F/hour]
RH transition	90—95% at 40°C [104°F]: less than 4 hours
Temperature soak	90—95% at 40°C [104°F]: 96 hours
Transition duration	less than 5 minutes
Maximum absolute humidity	.024 kg H_2O/kg of dry air .053 lb H_2O/lb of dry air

□

Appendix A: Abbreviations and Acronyms

Numerics

10BT 10 BaseT

10G 10 Gigabits per second

100BT 100 BaseT

2G/2.5G 2.5 Gigabits per second

A

ABN Abnormal

ACO Alarm Cut-Off

ACO/TST Alarm Cut-Off and Test

ACT Active

ACTY Activity

ADC Analog-to-Digital Converter

ADM Add/Drop Multiplexer

AID Access Identifier

AINS Automatic In-Service

AIRP Automatic Interconnection Recognition Protocol

AIS Alarm Indication Signal

AlS-L Alarm Indication Signal-Line

AlS-MS Alarm Indication Signal-Multiplex Section

ALM Alarm

ALSO Automatic Laser Shut-Off

ANR Abnormal

ANSI American National Standards Institute

AOS All Optical Switch

APP Apparatus Code

APR Automatic Power Reduction

ARP Address Resolution Protocol

ARST Autonomous Reset

ASAP Alarm Severity Assignment Profile

ASCII American Standard Code for Information Interchange

ASIC Application-Specific Integrated Circuit

ATM Asynchronous Transfer Mode

ATTR Attribute

B

BBE Background Block Error

BER Signal Degrade B2 Bit Error Rate

BIP Bit Interleaved Parity

BT BaseT

C

CC Communication Client

CCD CTLI-D Controller Device

CCN Control Communications Network

CIT Craft Interface Terminal

CLEI™ Common Language® Equipment Identifier

CO Central Office

COM Common

CONTR Controller

CP Circuit Pack

CP-ID Circuit Pack Identifier

CPF Circuit Pack Failure

CPLD Complex Programmable Logic Device

CPU Central Processing Unit

CR Critical

CSA Canadian Standards Association

CSMA/CD Carrier Sense Multiple Access/Collision Detect

CSR Composite Service Request

CTL Controller

CTLI-D Control Interface to Devices

CV Coding Violation

CV-L Coding Violation-Line (Near End)

CV-LFE Coding Violation-Far End Line

CV-S Coding Violation-Section

D

DAC Digital-to-Analog Converter

DATAFLT Database Fault

DBCHG Database Change

DCC Data Communications Controller; Data Communications Channel

DCE Data Communications Equipment

DHCP Dynamic Host Configuration Protocol

DLC Download Client

DLS Download Server

DNS Domain Name Server

DOS Detection of Signal

DTE Data Terminal Equipment

DTP Data Transfer Process

DVM Digital Voltage Meter

DWDM Dense Wavelength Division Multiplexing

E

EB Errored Block

EBER Signal Fail B2 Excessive Bit Error Rate

ECI Equipment Catalog Item

ECS Express Connection Service

EEPROM Electrically Erasable Programmable Read Only Memory

EI External Interface

EIS Engineering Information Standards

ELSR Edge Label Switched Router

EM Equipment Management

EMI Electromagnetic Interference

EMS Element Management System

EO Expansion Operations Network

EOF End of File

EOL End of Line

EOR End of Record

EPROM Electrically Programmable Read Only Memory

EQ Equipped; Equipment

EQPT Equipment

ESD Electrostatic Discharge

ES Errored Seconds

ES-L Errored Seconds-Line (Near End)

ES-LFE Errored Seconds-Far End Line

ES-S Errored Seconds-Section

ETS European Telecommunications Standard

ETSI European Telecommunications Standards Institute

F

FCC Federal Communications Commission; Fast Communications Channel

FCIO Function Controller Input/Output Device

FDA/CDRH Federal Drug Administration, Center for Devices and Radiological Health

FDP Fiber Distribution Panel

FE Far End

FEND Far End

FI Facility Interface

FIFO First In First Out

FIT Failure In Time

FLT Fault

FM Fault Management

FTP File Transfer Protocol

G

GBELX Gigabit Ethernet

GMPLS Generalized Multiprotocol Label Switching

GMT Greenwich Mean Time

GPIO General Purpose Input/Output

GUI Graphical User Interface

H

HSBB High-Speed Broadband

HSWIC High-Voltage Shelf Switch Interface Controller

HV High Voltage

HVCPG High-Voltage Shelf Controller Protection Group

HVDAC High-Voltage Digital-to-Analog Converter

HVFAN High-Voltage Shelf Fan

HVS High-Voltage Shelf

I

IAO Intraoffice

IAO LAN Intraoffice Local Area Network

ID Identifier

IDC Insulation Displacement Connector

IEC International Engineering Consortium

IEEE Institute of Electrical and Electronics Engineers

IETF Internet Engineering Task Force

IF In Frame

IFMT Interface Format

IIC Inter-Integrated Circuit

IMF Infant Mortality Factor

IMPROPRML Improper Removal

INTSFT Internal Software

I/O Input/Output

IOPT Interface Optics

IP Internet Protocol

IP-CPY-MEM In Progress–Copy Memory

IR Intermediate Reach

IS In Service

IS-NR In Service-Normal

ISO International Standards Organization

ITE Information Technology Equipment

ITU International Telecommunications Union

ITU-T International Telecommunications Union—Telecommunication Standardization Sector

J

J0 SONET/SDH Section Trace Byte

JTAG Joint Test Action Group

K

KA Keep Alive

KAALM Keep Alive Alarm

L

L<number> Layer <number>

L/MS Line/Multiplex Section

LAN Local Area Network

LBC Laser Bias Current

LC Lucent Connector

LED Light-Emitting Diode

LID LED Interface Device; Logical Identifier

LLC Logical Link Control

LLO Lucent Learning Organization

LM Loss Parameter

LMPTST Lamp Test

LOF Loss of Frame

LOS Loss of Signal

LPBKCRS Loopback Cross-Connect

LPBK-DX Loopback–Duplex

LPBK-SX Loopback–Simplex

LR Long Reach

LSAP LLC Service Access Point

LSBB Low Speed Broadband

LVDS Low Voltage Differential Signal

M

M Maintenance

MA Management; Messaging Agent

MAC Media Access Control

MAN Metropolitan Area Network

MD Mediation Device

MEA Mismatch of Equipment and Attributes

MEM Memory

MEMS Micro-Electromechanical System

MIB Management Information Base

MJ Major

MLOS Mapper Loss of Signal

MMIS Memory Mismatch

MN Minor

MON Monitoring

MONE Monitor E-tributary

MONEF Monitor E- and F-tributary

MONF Monitor F-tributary

MPLS Multiprotocol Label Switching

MS Multiplex Section

MS_F_BBE Multiplex Section Far End Background Block Errors

MS_F_ES Multiplex Section Far End Errored Seconds

MS_F_SES Multiplex Section Far End Severely Errored Seconds

MS_F_UAS Multiplex Section Far End Unavailable Seconds

MS_N_BBE Multiplex Section Near End Background Block Errors

MS_N_ES Multiplex Section Near End Errored Seconds

MS_N_SES Multiplex Section Near End Severely Errored Seconds

MS_N_UAS Multiplex Section Near End Unavailable Seconds

MT Maintenance

MTBMA Mean Time Between Maintenance Activities

MTTF Mean Time To Failure

MTTR Mean Time To Repair

N

NBF Non-blocking Fabric

NDF New Data Flag

NE Near End; Network Element

NEBS Network Equipment-Building System

NEDS Network Equipment Development Standards

NEND Near End

NIC Network Interface Card

NMON Non-Monitoring

NMS Network Management System

NNI Network to Network Interface

NP Network Path

NR Not Reported

NSA Non-Service-Affecting

NVM Non-Volatile Memory

NVMU Non-Volatile Memory Usage

NVMW Non-Volatile Memory Wearout

NVRAM Non-Volatile RAM

O

OA Optical Amplifier

OC-n Optical Carrier <number>

OCH Optical Channel

OCI Optical Craft Interface

OEO Optical to Electrical to Optical

OICPG Optical Interface Shelf Controller Protection Group

OIFAN Optical Interface Shelf Fan

OIM Optical Interface Module

OIS Optical Interface Shelf

OIS-10G Optical Interface Shelf-10Gbps

OIS-2G Optical Interface Shelf-2.5Gbps

OIS-MX Optical Interface Shelf-Mixed

OIS-S Optical Interface Shelf-SDH/SONET

OIS-T Optical Interface Shelf-Transparent

OLS Optical Line System

OMERR Out of Memory Error

ON Operations Network

ONI Operations Network Interface

ONNS Optical Network Navigation System

OOF Out of Frame

OOS Out of Service

OOS-AU Out of Service Autonomous

OOS-MA Out of Service Management

OPI Operations Peripheral Interface

OPR Operate; Optical Power Received

OPT Optical Power Transmitted

OS Operations System

OSPF Open Shortest Path First

OSWIC Optical Interface Shelf Switch Interface Controller

OTDR Optical Time Domain Reflectometer

OTU Optical Translator Unit

OXC Optical Cross-Connect

OXI Optical Cross-Connect Interface

OXI-10GC Optical Cross-Connect Interface-10 Gbps Client

OXI-2GC Optical Cross-Connect Interface-2.5 Gbps Client

OXI-4A13 Optical Cross-Connect Interface-4 ports with optical amplifiers in the 1310 nm band

OXI-4A15 Optical Cross-Connect Interface-4 ports with optical amplifiers in the 1550 nm band

P

P Provisioning

PCMCIA Personal Computer Memory Card International Association

PFVP Power Filter Voltage Protection

PFVP-CB Power Filter Voltage Protection with Circuit Breaker

PIC Peripheral Interface Controller

PID Password Identifier

PLD Programmable Logic Device

PM Performance Monitoring

PMD Polarization Mode Dispersion

PMOD Personality Module

POR Power On Reset

PPP Point-to-Point Protocol

PRI Primary Nonvolatile Memory

PROGFLT Program Fault

PROV Provisioned

PSCHG Protection Switch Change

PST Primary State

PU Port Unit

PWR Power

PWRM Power Monitor

Q

QoS Quality of Service

R

RC Restoration Controller

RCCN Restoration Controllers Communications Network

RIP Restoration Interface Processor

RS Regenerator Section

RS_N_BBE Regenerator Section Near End Background Block Errors

RS_N_ES Regenerator Section Near End Errored Seconds

RS_N_SES Regenerator Section Near End Severely Errored Seconds

RS_N_UAS Regenerator Section Near End Unavailable Seconds

RSVP Resource Reservation Protocol

RSVP-TE Resource Reservation Protocol-Traffic Engineering

RU Resource Usage

S

S Security

SA Service-Affecting

SAP Service Access Point

SB Secondary Boot

SCC System Controller Complex

SCCPG System Controller Complex Protection Group

SCFAN System Controller Shelf Fan

SCMMA System Controller in Maintenance

SCS System Controller Shelf

SD Signal Degrade

SDH Synchronous Digital Hierarchy

SDRAM Synchronous Dynamic Random Access Memory

SEC MEM Secondary Non-Volatile Memory

SEEPROM Serial EEPROM

SEFS Severely Errored Framing Seconds

SEFS-S Severely Errored Framing Seconds-Section

SELV Safety Extra Low Voltage

SES Severely Errored Seconds

SES-L Severely Errored Seconds-Line (Near End)

SES-LFE Severely Errored Seconds-Far End Line

SES-S Severely Errored Seconds-Section

SF Signal Fail

SI Switch Interface

SID Source Identifier

SI-S Switch Interface-SONET/SDH (cable)

SI-T Switch Interface-Transparent (cable)

SLA Service Level Agreement

SLN Serial Number

SMC Serial Management Controller

SMEM Secondary MEM

SMF Single Mode Fiber

SMI Serial Management Interface

SMS Service Management System

SN Serial Number

SNIP Serial Number Identification Port

SNMP Simple Network Management Protocol

SNMS SubNetwork Management System

SONET Synchronous Optical Network

SPLTR Splitter

SR Short Reach

SRC Subrack Controller

SSN Series Number

STBY Standby

STBYS Standby Switched

STCHG State Change

STM Synchronous Transfer Mode

STS Synchronous Transport Signal

SWIC Switch Interface Controller

SWIP Switch Interface Point

SWMG SWIP Maintenance Group

SWS Switch Shelf

SYSCTL System Controller

T

T Test

TA Test Access

TAM Test Access Monitoring

TC Transient Condition

TCA Threshold Crossing Alert

TCP/IP Transmission Control Protocol/Internet Protocol

TID Target Identifier

TL1 Transaction Language 1

TMN Transport Management Network

TSA Test Alarm

TSS Technical Support Services

U

UAS Unassigned; Unavailable Seconds

UAS-L Unavailable Seconds-Line (Near End)

UAS-LFE Unavailable Seconds-Far End Line

UDP User Datagram Protocol

UEQ Unequipped

UI Unit Interface

UIA User Interface Appliance

UID User Identification

UL Underwriters Laboratories

UNEQ Unequipped

UNI User to Network Interface

UPC User Privilege Code

V

V/V Voltage to Voltage

VSR Very Short Reach

W

WAN Wide Area Network

WDM Wavelength Division Multiplexing

WINS Windows Internet Network Service

□

Glossary

Numerics

0x1 Facility Interface
A transmission interface without line or equipment protection switching.

0x1 Line Operation
Operation between network elements, without protection in a single bidirectional line (no protection line is available).

1+1 Client Protection
A protection architecture, in which connections between a LambdaRouter™ All Optical Switch and client network elements can be configured as 1+1 at the optical level.

1+1 Protection Group
A protection architecture, in which one working function is protected by one protection function. In addition, the protection function is fully synchronized with the working function. The functions are permanently bridged upstream, and one is selected downstream.

1+1 Restoration
A type of network restoration. The restoration path, including the end-points, is provisioned when initial path provisioning is done. The restoration path always carries the same signal as the service path, and the egress LambdaRouter™ All Optical Switch automatically switches over to it when the service path fails.

1x1 Protection Group

A protection architecture, in which one working function is protected by one protection function. In contrast to the 1+1 Protection Group, the protection function is not fully synchronized with the working function.

A

Access Identifier (AID)

A technical specification for explicitly naming entities (both physical and logical) of a network element, following Telcordia TL1 syntax.

Accumulation Registers

Used in performance monitoring. Registers that provide data storage for each SONET (Section and Line) and SDH (Regenerator Section and Multiplex Section) transmission parameter monitored.

Activation

The process of starting software or using the data in execution the first time after installation.

Active (ACT)

Indication that a circuit pack or module is in service and is currently providing service functions. ***See also*** Standby.

Active Path

One of two signals entering a constituent path selector. The active path is the one currently being selected.

Add/Drop Multiplexer (ADM)

A synchronous network element capable of combining signals of different rates and having those signals added to or dropped from the stream.

Alarm

A visible or audible signal to the operations environment that a communication, equipment, or processing failure has occurred.

Alarm Correlation

A LambdaRouter™ All Optical Switch feature that minimizes the number of alarm messages generated for a single fault condition.

Alarm Cut-Off (ACO)

A mechanism to silence local Central Office audible alarms. It is activated by a user panel button or a user command.

Alarm Indication Signal (AIS)

A code sent downstream in a network to indicate an upstream failure.

Alarm List

A LambdaRouter™ All Optical Switch status report that lists active alarms on the network element. It includes alarm level and type, affected equipment, effect on service, condition description, and additional details of the failure, if available.

Alarm Log

A history and time sequence of the setting and clearing of alarms on the LambdaRouter™ All Optical Switch. The alarm log contains as many as 512 alarm messages. It includes the type of trouble, time of occurrence, identification of affected equipment, effect on service, alarm level, alarm condition state, and additional details of the failure, if available.

Alarm Notification Category

One of the types of LambdaRouter™ All Optical Switch alarm messages: Optical Channel, Equipment, Common, Security, Control Communications Network (CCN), or Quality of Service (QoS) Alarm.

Alarm Severity

An attribute that defines the priority of an alarm message. The way alarms are processed depends on their severity.

American Standard Code for Information Interchange (ASCII)

A standard seven-bit code that represents letters, numbers, punctuation marks, and special characters in the interchange of data among computing and communications equipment.

Apparatus Code (APP)

A circuit pack identifier stored in EEPROM.

Asynchronous

The essential characteristic of time-scales or signals, such that their corresponding significant instants do not necessarily occur at the same average rate.

Asynchronous Transfer Mode (ATM)

A high-speed transmission technology characterized by high bandwidth and low delay. It uses a packet switching and multiplexing technique that allocates bandwidth on demand.

Authorization Level

A numeric code that determines what commands within a functional category a user may access on the LambdaRouter™ All Optical Switch. The authorization level ranges from 0 (lowest) to 5 (highest) for all functional categories except security, which ranges from 1 to 5. Assigning an authorization level of 0 disables that functional category for a particular user.

Automatic Interconnection Recognition Protocol (AIRP)

A protocol used by LambdaRouter™ All Optical Switch in conjunction with LambdaRouter™ Optical Network Navigation System (ONNS), to perform automatic port neighbor discovery.

Automatic Port Neighbor Discovery

A network element process that uses the Automatic Interconnection Recognition Protocol (AIRP) to automatically discover the association of input ports and output ports in adjacent LambdaRouter™ All Optical Switch network nodes.

Auto-Provisioning

The capability of the LambdaRouter™ All Optical Switch to discover its hardware configuration and to create associated database entries autonomously using the original (default) or user-defined, pre-provisioned parameters. These parameters are maintained in non-volatile memory (NVM) and/or hardware registers.

Automatic Protection Switch

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

B

Backup and Restore

The capability to copy and restore databases between Primary Non-Volatile Memory (NVM) and Secondary NVM, Primary NVM and Navis™ Optical Element Management System, and Primary NVM and Optical Craft Interface.

Bandwidth Management

The capability that allows LambdaRouter™ All Optical Switch users to provision either unidirectional or bidirectional optical, or optical-electrical-optical (OEO), cross-connections for transmission paths through the switch fabric.

Bay

A hardware frame in which shelves are mounted and housed.

Bidirectional Line

A transmission path consisting of two fibers that handle traffic in both the transmit and receive directions.

Bit Error Rate (BER)
The ratio of error bits received to the total number of bits transmitted.

Blank (BLK)
The status of a circuit pack slot that contains a bus extender (blank) circuit pack; the pack itself.

Bridging
A one-way 1:2 multicast from an input port where a 1:2 splitter routes the two one-way signals through the duplicated switch fabric to two different output ports. Each one-way leg is a simplex transmission path. ***See also*** Merging.

Broadband Communications
Voice, data, and/or video communications at greater than 2 Mbps rates.

Busy State
Indication that a port is being used in a cross-connection.

C

Calibration Database
A database that indicates initial control voltages for each Switch Shelf mirror in an array. The calibration data is delivered on a non-volatile memory (NVM) card and is installed by inserting the card into the secondary NVM (SEC MEM) on the LambdaRouter™ All Optical Switch.

Card
A removable integrated circuit board/circuit pack.

Central Office (CO)
A building in which common carriers terminate customer circuits.

Channel
A (one-way) transmission pathway from an input port to an output port in the network element, at any supported transmission rate and/or format.

Circuit Pack (CP)
A single field-replaceable electronic or opto-electronic unit. It comprises mechanical piece-parts, electronic components, and their associated connections and performs a specific function.

Circuit Pack Extraction
The process of software acknowledgement of an event associated with the physical removal of a circuit pack from a shelf slot, or the opening of its latch.

Circuit Pack Identifier (CP-ID)

A code that is derived from the circuit pack type (apparatus code), serial number, series number (version), CLEI™ code, and ECI code of each circuit pack. The circuit pack identifier is readable by the system upon insertion of the pack in any allowable slot.

Circuit Pack Insertion

The process of acknowledging and subsequently provisioning a valid circuit pack that has been inserted into a shelf slot. Circuit pack insertion requires equipage and latch closure acknowledgments, and a response to the insertion cannot be completed prior to the detection of the latch closure.

Client

A client network interface.

Cold Standby

A standby function that does not function simultaneously with the active function. It requires a form of initialization (provisioning) before it can assume the role of the active function.

Command Echo

The ability of the LambdaRouter™ All Optical Switch to repeat the text of entered commands to a user provisioned for this feature.

Command Functional Categories

Logical groupings of LambdaRouter™ All Optical Switch commands. These include maintenance (M), provisioning (P), security (S), test (T), and performance monitoring (PM).

Command Group

An administrator-defined group that defines commands to which a user has access.

Common Alarm

A LambdaRouter™ All Optical Switch alarm message category that indicates a controller software fault, controller autonomous reset, data storage problem, software version mismatch, or security-related issue. Common alarm issue points are circuit pack, controller complex, shelf, or system.

Common Language® Equipment Identifier (CLEI™)

A Telcordia code that identifies telecommunications equipment to facilitate inventory, maintenance, investment tracking, and circuit maintenance processes. CLEI codes are stored in circuit pack EEPROM.

Configuration Management (CM)

The activities necessary to create, modify, retrieve, and delete data that controls the configuration and operation of LambdaRouter™ All Optical Switch hardware and software. These activities include equipment provisioning, alarm monitoring and fault management, cross-connection management, software management, and performance management.

Configuration Query

A user-initiated request for a report on provisioned data.

Control Bay

The LambdaRouter™ All Optical Switch frame that contains one System Controller Shelf and up to two Optical Interface Shelves. There is one Control Bay per LambdaRouter™ All Optical Switch system.

Control Communications Network (CCN)

An IP network, using Restoration Controller (RC) and Restoration Interface Processor (RIP) circuit packs, that provides the signaling method used by LambdaRouter™ Optical Network Navigation System (ONNS) to set up and tear down network paths, and to provide restoration in response to path failures.

Control Communications Network (CCN) Alarm

A LambdaRouter™ All Optical Switch alarm message category of alarms that are issued with respect to IP network, port, and process fault detection. Control Communications Network alarms are issued for a port.

Controller Reset

The capability of rebooting shelf controllers locally (manually, on equipment) and through command. An Optical Craft Interface, Navis™ Optical Element Management System, or other managing system can reset the LambdaRouter™ All Optical Switch system or shelf controllers without affecting transmission.

Craft Interface Terminal (CIT)

See Optical Craft Interface (OCI).

Critical (CR) Alarm

An indication of a severe, service-affecting condition.

Cross-Connection

A configurable optical, or optical-electrical-optical (OEO), transmission path interconnection between input and output ports within a single network element.

Cross-Connection Capacity

The total number of cross-connections, as measured by the number of fabric input and fabric output points. A fabric with N input points and N output points provides a cross-connection capacity of N. ***See also*** Non-Blocking Cross-Connection Capacity; Switch Interface Capacity.

Cross-Connection Configuration

A set of one or more associated cross-connection legs. Examples of configurations that are supported in the LambdaRouter™ All Optical Switch are one-way point-to-point (one duplex leg); two-way point-to-point (two duplex legs); one-way bridge (two simplex legs); one-way merge (two simplex legs); one-way bridge and merge (three simplex legs); and two way bridge and merge (four simplex legs).

Cross-Connection Fabric

See Switch Shelf (SWS).

Cross-Connection Leg

A one-way connection provisioned from one input port to one output port within a single network element. A leg with a transmission path through one switch fabric is called a simplex leg. A leg that has a transmission path between both fabrics is called a duplex leg.

Cross-Connection List

An Optical Craft Interface for LambdaRouter™ status report that lists current cross-connections for the following: a specific port, all ports on a specific circuit pack, all ports on a specific shelf, or all ports in the network element. The report includes the input and output AID, cross-connection type (including loopback type and test access mode), and switch fabric used.

Cross-Connection Loopback

A cross-connection, for maintenance purposes, from an input port through the switch fabric to an output port. An output port may be selected with an access identifier (AID) that is the same or different from the input AID. LambdaRouter™ All Optical Switch supports normal, forced simplex, and forced duplex loopbacks. A forced simplex loopback allows one of the transmission paths in the forward direction to remain operational.

Cross-Connection Management

The activities necessary to establish and remove cross-connections, operate and release loopback cross-connections, and retrieve cross-connection parameters.

Cross-Connection Rate

The transmission rate associated with the cross-connection, which is determined by the type of ports being used. Ports provided by transparent circuit packs allow cross-connections to be bit-rate-independent. Ports provided by optical-electrical-optical circuit packs limit cross-connections to a specific rate, such as 10 Gbps.

Cross-Connection Topology

The basic nature of a cross-connection configuration. All cross-connections can be classified into two topologies: one-way (unidirectional) and two-way (bidirectional).

Cross-Connection Type

See Cross-Connection Configuration.

Crosstalk

An unwanted signal introduced into one transmission path from another.

Cut-Through

An American Standard Code for Information Interchange (ASCII) interface to a network element (NE). It enables the user to send Transaction Language 1 (TL1) messages directly to the NE.

D

Data Communications Controller (DCC)

A LambdaRouter™ All Optical Switch circuit pack that provides the interface between the system and the operations data communications network, which is physically accessed via the LAN connection on the External Interface packs. There are two DCC packs on the System Controller Shelf, for active/active service.

Database Labeling

A LambdaRouter™ All Optical Switch feature that records system target identifier (TID), date of last database modification, date backed up from the network element, and the software generic ID, for use in subsequent download operations.

Debug Support

Maintenance activity access for Lucent personnel.

Default Provisioning

The implementation of parameter values that are preprogrammed at the factory.

Defect

A limited interruption of the ability of an item to perform a required function. It may or may not lead to maintenance action, depending on the results of additional analysis. ***See also*** Failure.

Dense Wavelength Division Multiplexing (DWDM)

The transmitting of two or more signals of different wavelengths simultaneously over a single fiber.

Deprovisioning

The inverse order of provisioning, to manually remove or delete previously provisioned parameters.

Details Screen

A text-based display of parameter settings, states, and all other information related to the detailed item on the display.

Detection of Signal (DOS)

The detection of a signal that meets provisioned threshold values, applying to both input and output ports.

Dialog Box

A secondary Optical Craft Interface graphical user interface (GUI) window designed to allow the user to enter additional information.

Dimmed State

The condition of a graphical user interface control that is not currently available to a user. This state is indicated on the Optical Craft Interface screen by a greyed image.

Discovery

The process of detecting circuit pack presence during system initialization, prior to hardware interrupt enabling.

Dispersion

The phenomenon in which different wavelengths or different polarizations of light travel at different speeds through a fiber optic cable.

Dither

In LambdaRouter™ All Optical Switch, the capability to make small adjustments to the orientation of ingress and egress switch fabric mirrors in order to minimize cross-connection signal loss.

Download

The process of transferring files from a managing system such as the Optical Craft Interface or Navis™ Optical Element Management System to a network element, such as the LambdaRouter™ All Optical Switch. Both software and data can be downloaded to the LambdaRouter™ All Optical Switch. ***See also*** Upload.

Downstream

At or toward the destination of the considered transmission stream.

Duplex Control

A control architecture that includes two controllers, one active, one standby, that protect each other; if the active one fails, the inactive takes over.

Duplex Cross-Connection

A cross-connection that has a transmission path through both switch fabrics.

Duplex Cross-Connection Fabric

A cross-connection fabric consisting of two identical subunits (Switch Shelves), which form a 1+1 protection group.

E

Egress

The direction away from the fabric.

Electromagnetic Compatibility (EMC)

The ability of equipment or systems to operate without causing or receiving degradation from electromagnetic interference (EMI).

Electromagnetic Interference (EMI)

High-energy, electrically induced magnetic fields that cause data corruption in cables passing through the fields.

Electronic Industries Association (EIA)

A trade association of the electronic industry that establishes electrical and functional standards.

Electrostatic Discharge (ESD)

A static electrical energy potentially harmful to circuit packs.

End Guard

A panel that is installed at the ends of a LambdaRouter™ All Optical Switch bay lineup; it meets ETSI standards.

Entity (Entity Type)

A physical or logical aspect of the LambdaRouter™ All Optical Switch, including the entire system, that has been assigned a name recognizable by the system. Examples include: a shelf, slot, port, switch interface point (SWIP), protection group, fan, and so on.

Entity Identifier

A particular entity, which is identified by the last portion of the access identifier (AID) pertaining to the entity. Examples include: a High-Voltage Shelf (HVS), a particular Restoration Controller (RC) slot, a particular optical channel, a particular optical interface shelf protection group, and so on.

E-Port (eport)

A LambdaRouter™ All Optical Switch input port that terminates an incoming “E-tributary”. In traditional networks, an incoming E-tributary refers to a circuit incoming to the Test Access equipment from the Central Office equipment. E-Port also refers to an idle input port to be used for establishing a one-way Test Access cross-connection.

Equipage Check

A system check of equipment that results in an alarm if there is a mismatch between a circuit pack and the provisioned slot in which it is installed.

Equipment Alarm

A LambdaRouter™ All Optical Switch alarm message category that indicates transmission and control equipment failures and service interruption owing to failures in power supply, fuse, or fan assembly, or configuration problems. Equipment alarms are issued for port, circuit pack/slot, shelf, and system.

Equipment Catalog Item (ECI)

A circuit pack identifier stored in Erasable Electrical Programmable Read Only Memory (EEPROM).

Equipment Fail (EF) State

A state in which any of the protection group’s circuit packs have failed, and no higher priority request (for example, Clear, Forced Switch) is present. The protection group leaves the EF state when all EF indications are cleared, or a higher priority request has been received.

Equipment List

A report, available through user request, that lists equipment for a selected shelf, circuit pack, or port in the LambdaRouter™ All Optical Switch. The report includes the AID for the selected entity and other information, such as CLEI code, serial number, and cabling information.

Equipment Protection

The protection switching for the redundant common transmission and control equipment in the network element.

Equipment Provisioning

The assigning of values to a set of parameters of the system, or any of its subsystems, to enable the expected use of the entity. Provisionable LambdaRouter™ All Optical Switch entities include system, shelves, slots/circuit packs, ports, cross-connections, and protection groups.

Equipped (EQ) Status

Indication that a circuit pack or interface module is in the system database and physically in the frame.

Event

Significant change detected by the system. Events in controlled network elements include signal failures, equipment failures, signals exceeding thresholds, and protection switch activity. When an event occurs, the controlled network element will generate an alarm or status message and send it to the managing system.

External Interface (EI)

The LambdaRouter™ All Optical Switch circuit pack that provides interfaces to the Data Communications Controller (DCC) circuit pack, Optical Craft Interface port (CIT port), and Intraoffice (IAO) LAN. The EI provides local office alarm relay closures and miscellaneous discrete inputs and outputs. It also provides the interface to alarm closures on the System Controller Shelf (SCS) User Panel. Duplex EIs are located on the SCS.

Extraction

Physical removal of a circuit pack from a slot, causing a system-initiated removal of an entity from service.

F

Fabric

The physical hardware that provides the switching function within the network element; a mesh of interconnections between inputs and outputs. In LambdaRouter™ All Optical Switch, the fabric is a set of mirrors that allows connection between any one of a set of inputs to any one of a set of outputs.

Fabric Wavelength Window

The allowable range of wavelengths transmitted by a given fabric. For LambdaRouter™ All Optical Switch, that range is from 1260 nm to 1360 nm, and from 1500 nm to 1620 nm.

Facility

A one-way or two-way circuit that carries a transmission signal.

Facility Interface (FI)
See Transmission Interface.

Facility Loopback
A loopback of the incoming facility signal to the output of the same facility, without going through a switch fabric. A facility loopback is not supported on LambdaRouter™ All Optical Switch.

Failure
A standing defect. ***See also*** Software Failure.

Failures in Time (FIT)
A unit of hazard rate used to measure the reliability of non-reparable equipment. A hazard rate of 1 FIT corresponds to a Mean Time to Failure (MTTF) of one billion hours.

Far End (FE, FEND)
Any network element in a maintenance subnetwork other than the one at which the user is posted. ***Also called*** remote.

Fault
A generic term for anomaly, defect, and failure.

Fault Detection
The ability to identify communications, equipment, and processing failures. LambdaRouter™ All Optical Switch provides continuous, autonomous, in-service fault detection and isolation on transmission and control equipment.

Fault Management
In LambdaRouter™ All Optical Switch, capabilities that provide fault detection, isolation, reporting and facility/equipment alarms, user/alarm displays, circuit pack LEDs, office alarms, and records provisioning.

Fiber Distribution Panel (FDP)
In LambdaRouter™ All Optical Switch, a Switch Shelf panel that contains connectors for 256 inputs and 256 outputs.

Fiber Management Unit
A LambdaRouter™ All Optical Switch duct used to control and store cables and protect them from physical damage. It is used in both overhead and underfloor installations.

Fiber Organizer
A frame between bays that is used for managing fiber cables.

File Transfer Protocol (FTP)

A protocol used by LambdaRouter™ All Optical Switch for transfer of software and data between the network element and its managing system and between network elements.

F-Port (fport)

A LambdaRouter™ All Optical Switch input port that terminates an incoming “F-tributary”. In traditional networks, an incoming F-tributary refers to a circuit incoming to the Test Access equipment from the facility side. For an existing two-way incoming signal, the input port for either direction can arbitrarily be called the “eport”, and the input port for the other direction is therefore called the “fport”. For a LambdaRouter™ All Optical Switch, an “fport” has no meaning unless a two-way cross-connection already exists.

G

General User

An Optical Craft Interface user type with access to all commands except network element (NE) security administration, software installation, system initialization, and NE access capabilities.

Generic

A collection of programs and associated static data that fully support and perform all of the designed functions of the LambdaRouter™ All Optical Switch, Optical Craft Interface, or Navis™ Optical Element Management System (EMS).

Generic Labeling

The unique identification of a software generic release so that it is recognized by the system and is available to the user upon query. The label includes the supplier name and type, version number of the generic, the date built or build number, and the date installed. The generic label information can be retrieved via the managing system or Optical Craft Interface.

H

Hard Failure

An unrecoverable nonsymptomatic (primary) failure that causes signal impairment or interferes with critical network functions.

High-Voltage Digital-to-Analog Converter (HVDAC)

The LambdaRouter™ All Optical Switch circuit pack that provides the digital-to-analog converters and high-voltage linear amplifiers used to control a subset of the Micro-electromechanical System (MEMS) mirrors in the Switch Shelf (SWS).

High-Voltage Shelf (HVS)

The LambdaRouter™ All Optical Switch shelf that houses High-Voltage Digital-to-Analog Converter (HVDAC) circuit packs.

High-Voltage Shelf/Optical Interface Shelf (HVS/OIS) User Panel

The LambdaRouter™ All Optical Switch module that receives alarm status information. It provides visual indications of shelf status through LEDs and a means for generating alarm cutoff and LED test interrupts to the shelf Switch Interface Controller (SWIC) circuit packs. ***See also*** System Controller Shelf (SCS) User Panel.

Hot Standby

A standby function that is fully operational and acts in synchronism with an active function. It is able to take over the role of the active function without the need for initialization. ***See also*** Active; Cold Standby.

I

Idle State

The state of a port that is not cross-connected.

Ingress

The direction toward the fabric.

Insert

The physical insertion of a circuit pack into a slot, causing a system-initiated restoral of an entity into service and/or creation of an entity and associated attributes.

Insertion Loss

The decrease in optical signal power incurred by a signal passing through the entire system.

In-Service (IS) State

An administrative state for equipment entities (ports, circuit packs). IS indicates that the entity is fully capable and allowed to perform its specified functions.

Interface Bay

The LambdaRouter™ All Optical Switch frame that contains optical interface shelves.

Intermediate Reach (IR)

A standard for optics, concerning transmitters and receivers in a system, that insures that transmission can be maintained for intermediate distances (50 km). This standard constrains the output power of the transmitter and the sensitivity of the receiver for moderate haul applications (up to 50 km; a compromise between long and short reaches) without the need for regeneration. ***See also*** Long Reach; Short Reach; Very Short Reach.

International Telecommunications Union–Telecommunications Standards Sector (ITU-T)

One of three sectors of the ITU. The ITU-T sets global telecommunications standards.

Inventory Query

A user-initiated request for a report on all electronic equipment in the system.

J

J0 Byte Sequence

A 16-byte sequence of J0 bytes that can be inserted in the section overhead of a SONET or SDH test signal that is being generated by a LambdaRouter™ All Optical Switch OEO input port that is not detecting an incoming signal. The byte sequence will include the IP v4 address of the LambdaRouter™ All Optical Switch and the Access Identifier (AID) of the OEO input port that is generating the test signal. The sequence is transmitted in hexadecimal format, and is used by AIRP and Test Access functions.

Jitter

The short-term variation of the significant instants of a digital signal from their ideal positions in time. Jitter may cause crosstalk or distortion of the original analog signal, or both, and is potentially a source of bit errors at the input ports of digital equipment. ***See also*** Wander.

K

Keep Alive

A SONET AIS-L signal used for alarm suppression when an input signal is not present.

L

Labeling

The LambdaRouter™ All Optical Switch capability to label database and software generics. ***See also*** Database Labeling; Generic Labeling.

Lambda

The Greek letter used to signify the wavelength of a complete cycle of signal that propagates through space. Common examples of such signals are radio waves and light waves.

LambdaRouter™ All Optical Switch (AOS)

Generic term used to refer to any LambdaRouter™ All Optical Switch 128/256 configuration.

LambdaRouter™ All Optical Switch (AOS) 128

The Lucent Technologies fully optical signal switching system that uses Micro-electromechanical System (MEMS), a fabric technology consisting of arrays of electrically configurable mirrors. It provides 128x128 input and output ports with a maximum of 112 usable for cross-connections (16 are reserved as spares).

LambdaRouter™ All Optical Switch (AOS) 256

The Lucent Technologies fully optical signal switching system that uses Micro-electromechanical System (MEMS), a fabric technology consisting of arrays of electrically configurable mirrors. It provides 256x256 input and output ports with a maximum of 224 usable for cross-connections (32 are reserved as spares).

LambdaRouter™ Optical Network Navigation System (ONNS)

Software that resides on individual LambdaRouter™ All Optical Switch systems and provides networking capabilities between LambdaRouter™ All Optical Switch network nodes via the Control Communications Network (CCN).

Lamp Test (LMPTST)

A user panel button used to test LEDs.

LC Connector (LC)

A Lucent-designed small form-factor plastic optical fiber connector, designed for applications where space is limited. The LC, which is half the size of other common connectors, is ferrule-based and uses the familiar insertion/release mechanism similar to an ordinary telephone plug.

Line

See Port.

Line Protection

Backup for optical interfaces. Line protection protects against failures of line facilities, including the interfaces at both ends of a line, the optical fibers, switching failures, and any equipment between the two ends.

Link Management

The activities necessary to automatically discover, or manually provision port neighbors, verify connectivity between network elements, and coordinate the ports on the two ends of a link connection.

Location

A user-provisionable identifier of the physical positioning of a specific shelf.

Log

System-maintained data of user session activity, including changes, alarms and security activity, and protection switching.

Login ID

See User ID.

Long Reach (LR)

A standard for optics, concerning transmitters and receivers in a system, that insures that transmission can be maintained for long distances (tens of kilometers). This standard constrains the output power of the transmitter and the sensitivity of the receiver for long-haul applications (up to 80 km) without the need for regeneration. ***See also*** Intermediate Reach; Short Reach; Very Short Reach.

Loopback

A circuit configuration used to compare an original transmitted signal with the resulting received signal. LambdaRouter™ All Optical Switch supports cross-connection loopback for maintenance purposes.

Loss of Frame (LOF)

An indication of consecutive errored framing patterns in an incoming signal.

Loss of Signal (LOS)

An indication that a signal is below the provisioned threshold values for either the input or output port.

Low-Voltage Shutdown

The capability of LambdaRouter™ All Optical Switch to detect when power drops below a predefined input voltage level and to shut down gracefully. Cross-connection maps and other provisioned data are maintained through the power loss.

M **Maintenance Condition**

An equipment state in which some normal service functions are suspended, either because of a problem or for special functions (copy memory) that cannot be performed while normal service is being provided.

Maintenance User

An Optical Craft Interface user login with access to testing, retrieval of network element information, and limited service-affecting commands.

Major (MJ)

An indication of a service-affecting failure.

Manual Port Neighbor Provisioning

A process that allows craft personnel to manually specify neighbor information for each port. ***See also*** Automatic Port Neighbor Discovery.

Manual Provisioning and Deprovisioning

User-initiated provisioning or deprovisioning by the following commands or graphical user interface (GUI) equivalent actions: create, delete, modify, remove, restore.

Manual Switch State

The events that follow the issuing of the manual switch command. While in the Manual Switch state, the system may switch the active unit automatically, if required for protection switching.

Mapping

The logical association of one set of values, such as addresses on one network, with quantities or values of another set, such as devices or addresses on another network.

Mediation Device (MD)

A device that allows for exchange of management information between managing systems and network elements.

Memory (MEM)

The LambdaRouter™ All Optical Switch circuit pack that provides the non-volatile memory (NVM) necessary to store executable code and data for the system. Two primary MEMs (PRI MEMs) are located in the System Controller Shelf and serve as duplicated NVM. They communicate with the SYS50D circuit packs. A secondary MEM (SEC MEM) provides backup to the primary MEMs. Program and configuration data are stored on a PCMCIA card, which can be accessed from the faceplate of the MEM and is removable.

Merging

The use of two simplex cross-connection legs between two different input ports and one output port where a 2:1 selector chooses one of the incoming one-way signals. The use of bridging and merging at a network element provides 1+1 path protection for two-way traffic. ***See also*** Bridging.

Micro-electromechanical System (MEMS)

The LambdaRouter™ All Optical Switch fabric technology, which consists of a large number of electrically configurable mirrors, fabricated on a single substrate.

Minimum Configuration

A set of network element (NE) entities that are required to exist for the NE to be operational. These entities are created automatically by the system during initialization.

Minor (MN)

An indication of a non-service-affecting failure of equipment or facility.

MONE Test Mode

Test Access cross-connection mode. In the MONE test mode, the quality of the optical signal [either being received at or being injected by the E-tributary input port (eport)] is being monitored at a Test Access Monitoring (TAM) output port. ***See also*** MONEF Test Mode; MONF Test Mode.

MONEF Test Mode

Test Access cross-connection mode. In the MONEF test mode, the quality of the optical signals [either being received at or being injected by the E-tributary input port (eport) and F-tributary input port (fport)] are being monitored simultaneously at two different Test Access Monitoring (TAM) output ports. ***See also*** MONE Test Mode; MONF Test Mode.

MONF Test Mode

Test Access cross-connection mode. In the MONF test mode, the quality of the optical signal [either being received at or being injected by the F-tributary input port (fport)] is being monitored at a Test Access Monitoring (TAM) output port. ***See also*** MONE Test Mode; MONEF Test Mode.

N

Navis™ Optical Element Management System (EMS)

A Lucent product that provides element management functionality for a variety of networking products, including LambdaRouter™ All Optical Switch. ***Formerly called*** WaveStar® SNMS (SubNetwork Management System).

Navis™ Optical Network Management System (NMS)

A Lucent product that provides comprehensive and integrated network management functionality for an entire transport network. Navis™ Optical NMS can provide provisioning and maintenance management for the LambdaRouter™ All Optical Switch, and other network elements in the LambdaRouter™ All Optical Switch network. ***Formerly called*** WaveStar® NMS (Network Management System).

Network Element (NE)

A telecommunications network node that supports network transport services and is directly manageable by a managing system.

Network to Network Interface (NNI)

A LambdaRouter™ All Optical Switch to LambdaRouter™ All Optical Switch interface within a network. Ports configured as NNI are able to participate in automatic port neighbor discovery.

Network View

The Optical Craft Interface screens and menu options used to set up an association with network elements or to administer the Optical Craft Interface GUI itself.

Node

All equipment that is controlled by one system controller. A node is not always directly manageable by a managing system.

Non-Blocking Cross-Connection Capacity

The service cross-connection capacity guaranteed to the user to be free from blocking.

Non-Blocking Fabric

The characteristic that no cross-connection request will be denied because of a lack of a path through the fabric, when the desired input and output ports are available.

Non-Revertive Protection Switching

A process in which an active and standby line exist. When a protection switch occurs, the standby line is selected to support traffic, thereby becoming the active line. The original active line then becomes the standby line. This status remains in effect even when the fault clears (there is no automatic switch back to the original status). ***See also*** Revertive Protection Switching.

Non-Volatile Memory (NVM)

Memory that retains its stored data after power has been removed; for example, a hard disk.

No Request State

The state in which no protection switching activities are occurring.

Not Monitored (NMON)

A provisioning state for equipment that is not equipped with monitors or alarms.

O

Off-Board Devices

Transmission devices that are associated with a controller but are located on another circuit pack. ***See also*** On-Board devices.

Office Alarm Interface

An interface to the Office Alarm System for each alarm level that leads to audible or visible Central Office alarms. Audible alarm cutoff (ACO) is provided locally on the equipment and remotely through user command. Critical, Major, and Minor audible and visible alarms are supported.

On-Board Devices

Transmission devices associated with a controller and located on the same circuit pack. ***See also*** Off-Board devices.

One-Way Bridge and Merge Cross-Connection

A complex one-way cross-connection configuration that consists of two concatenated basic bridge and merge cross-connection configurations that share a common simplex leg.

One-Way Double Merge Cross-Connection

A complex one-way cross-connection configuration that consists of two merge cross-connections that share the same source (input) ports. It can also be considered as two bridge cross-connections that share the same destination (output) ports.

One-Way Point-to-Point Cross-Connection

A one-leg duplex interconnection between an input port and an output port. It can be set up and taken down by a single command to the network element.

One-Way Simplex Cross-Connection

A cross-connection leg with a transmission path through a single switch fabric. A simplex cross-connection leg can be added to or deleted from an existing cross-connection to form another type of cross-connection configuration. For example, a simplex leg can be deleted from an existing bridge or merge cross-connection to form a one-way point-to-point cross-connection.

Opacity

Bit-rate and format dependence. The LambdaRouter™ All Optical Switch opaque interfaces are the OXI-10GC and OXI-2GC.

Open Shortest Path First (OSPF) Protocol

A routing protocol used by LambdaRouter™ All Optical Switch to perform Control Communications Network (CCN) topology discovery. The topology information is used to determine routes between the Restoration Interface Processor (RIP) circuit packs in adjacent LambdaRouter™ All Optical Switch nodes.

Open Systems Interconnection (OSI)

A seven-layer reference model, a logical structure for network operations standardized by the International Standards Organization (ISO).

Operations Interface

Any interface providing information on the system behavior or control. In LambdaRouter™ All Optical Switch, operations interfaces include equipment LEDs, user panels, Optical Craft Interface, and office alarms.

Operations System (OS)

A central-computer-based system used to provide operations, administration, and maintenance functions. An example of an OS is the Navis™ Optical Element Management System (EMS).

Operator

User of the system with operator-level user privileges.

Optical Channel Alarms

A LambdaRouter™ All Optical Switch alarm message category that reports input signal failures and are issued against an input port.

Optical Channel Management

A LambdaRouter™ All Optical Switch application that enables adding, dropping or connecting of services traffic through the network, through optical line systems (OLSs).

Optical Craft Interface (OCI)

The user interface terminal used by craft personnel to communicate with the network element. The Optical Craft Interface runs on a PC with Windows NT® or Windows 2000 and provides graphical user interface (GUI) functionality and Transaction Language 1 (TL1) command entry through cut-through. ***Formerly called*** WaveStar® CIT (Craft Interface Terminal).

Optical Cross-Connect Interface (OXI)

A LambdaRouter™ All Optical Switch circuit pack that performs optical splitting, power monitoring, and rate- and format-independent transport for signals to an from the network element. OXIs are located in the Optical Interface Shelf-Transparent. Each transparent OXI pack provides four input ports (without optical amplifiers) and four output ports.

Optical Cross-Connect Interface-2.5 Gbps Client (OXI-2GC)

A LambdaRouter™ All Optical Switch circuit pack that supports 2.5 Gbps SONET/SDH signals (OC-48/STM-16). OXI-2GCs are located in the Optical Interface Shelf-2Gbps (OIS-2G) and the Optical Interface Shelf-Mixed (OIS-MX). Each OXI-2GC provides two input and two output ports.

Optical Cross-Connect Interface-10 Gbps Client (OXI-10GC)

A LambdaRouter™ All Optical Switch circuit pack that supports 10 Gbps SONET/SDH signals (OC-192/STM-64). OXI-10GCs are located in the Optical Interface Shelf-10Gbps (OIS-10G) and the Optical Interface Shelf-Mixed (OIS-MX). Each OXI-10GC provides one input and one output port.

Optical Cross-Connect Interface-4A13 (OXI-4A13)

A LambdaRouter™ All Optical Switch circuit pack that performs optical splitting, power monitoring, and rate- and format-independent transport for signals to an from the network element. OXI-4A13 circuit packs are located in the Optical Interface Shelf-Transparent. Each OXI-4A13 pack provides four input ports (optical amplifiers in the 1310 nm band) and four output ports.

Optical Cross-Connect Interface-4A15 (OXI-4A15)

A LambdaRouter™ All Optical Switch circuit pack that performs optical splitting, power monitoring, and rate- and format-independent transport for signals to an from the network element. OXI-4A15 circuit packs are located in the Optical Interface Shelf-Transparent. Each OXI-4A15 pack provides four input ports (optical amplifiers in the 1550 nm band) and four output ports.

Optical Interface Shelf

A generic term for any transmission interface shelf used in LambdaRouter™ All Optical Switch, including the OIS-T shelf for transparent circuit packs, the OIS-10G for OXI-10GC circuit packs, the OIS-2G for OXI-2GC circuit packs, and the OIS-MX for a combination of OXI-10GC and OXI-2GC circuit packs.

Optical Interface Shelf-2.5 Gbps (OIS-2G)

The LambdaRouter™ All Optical Switch transmission interface shelf that contains 32 OXI-2GC optical-electrical-optical circuit packs and two Switch Interface Controllers (SWICs).

Optical Interface Shelf-10 Gbps (OIS-10G)

The LambdaRouter™ All Optical Switch transmission interface shelf that contains 32 OXI-10GC optical-electrical-optical circuit packs and two Switch Interface Controllers (SWICs).

Optical Interface Shelf/High-Voltage Shelf (OIS/HVS) User Panel

The LambdaRouter™ All Optical Switch module that receives alarm status information. It provides visual indications of shelf status through LEDs and a means for generating alarm cutoff and LED test interrupts to the shelf Switch Interface Controller (SWIC) circuit packs. ***See also*** System Controller Shelf (SCS) User Panel.

Optical Interface Shelf-Mixed (OIS-MX)

The LambdaRouter™ All Optical Switch transmission interface shelf that contains a combination of 16 OXI-2GC circuit packs, 16 OXI-10GC circuit packs and two Switch Interface Controllers (SWICs).

Optical Interface Shelf-SDH/SONET (OIS-S)

The LambdaRouter™ All Optical Switch general shelf type that contains OXI-10GC or OXI-2GC circuit packs, which provide the opaque OC-192/STM-64 and OC-48/STM-16 interfaces between the LambdaRouter™ All Optical Switch and customer equipment. Each OIS-S contains opaque circuit packs and cannot contain transparent circuit packs.

Optical Interface Shelf-Transparent (OIS-T)

The LambdaRouter™ All Optical Switch shelf that contains the transparent OXI, OXI-4A13, or OXI-4A15 circuit packs. Each OIS-T contains two Switch Interface Controllers (SWICs) and as many as 32 OXI, OXI-4A13, or OXI-4A15 circuit packs.

Optical Line System (OLS)

Any system using a fiber-optic or other optical technology for transmission.

Optical Loss Budget

The allocation of allowable or necessary signal loss in a transmission system, or signal loss to connection subsections of that system.

Optical Return Loss (ORL)

The power of a signal, reflected back to its source in an optical system.

Optical Translator Unit (OTU)

The WaveStar® OLS 1.6T (400G/800G) module that provides wavelength translation and signal regeneration from or to the line system.

Out of Service (OOS)

A state in which an equipment entity is not allowed or is incapable of providing its intended function.

P

Parameter

A variable that is given a value for a specified application, or a constant, variable, or expression that is used to pass values between components.

Performance Management

The activities necessary to provision the system, ports, and profiles used in performance monitoring.

Performance Monitoring

The monitoring of signal transmission on SONET and/or SDH interfaces in order to ensure that the desired quality of service is provided. When enabled, performance monitoring data is continuously collected and processed using threshold profiles associated with each port.

Personal Computer Memory Card International Association (PCMCIA) card

Non-volatile memory in a form similar to a floppy disk. LambdaRouter™ All Optical Switch program and configuration data are stored on a PCMCIA card in the MEM circuit packs.

Personality Module (PMOD)

Modules that provide two OC-48 port connections for Restoration Interface Processor (RIP) circuit packs. Up to two Personality Modules may be mounted on each RIP circuit pack.

Point-to-Point Cross-Connection

A duplex cross-connection from a single input point to a single output point. It can be either one-way or two-way.

Polarization Mode Dispersion (PMD)

Output pulse broadening due to random coupling of the two polarization modes in an optical fiber.

Port

A physical transmission interface, comprising both an input and an output, which may be used to carry traffic between network elements. (***Also called*** line. Port emphasizes the physical interface, and line emphasizes the interconnection. Either may be used to identify the signal being carried.)

Port Link List

A list that provides the results of automatic port neighbor discovery or port neighbor provisioning parameters, including the status of the port link.

Port Pack

See Port Unit.

Port State Provisioning

A feature that allows a user to set the port state to in-service or out-of-service.

Port Unit (PU)

A transmission circuit pack that receives and transmits optical signals. The OXI, OXI-4A13, OXI-4A15, OXI-10GC, and OXI-2GC are the LambdaRouter™ All Optical Switch port units.

Power Filter Voltage Protection (PFVP) Unit

A LambdaRouter™ All Optical Switch unit that receives power supply current, suppresses high-frequency emissions, and passes current through the backplane to the circuit packs. This unit also disconnects current through the power source when input voltage falls below an acceptable level, or when a short circuit occurs. PFVPs are located on the Switch Shelf, Optical Interface Shelves, and System Controller Shelf. In the OIS-10G and OIS-2G, the PFVP has an internal circuit breaker.

Pre-provisioning

The process by which a user specifies parameter values for an entity before all of the equipment is present. These parameters are stored in non-volatile memory (NVM).

Primary Non-Volatile Memory (PRI MEM)

A non-volatile MEM circuit pack designated as the primary storage device for the LambdaRouter™ All Optical Switch. ***See also*** Memory.

Privilege Code

See User Privilege Code.

Privileged User

An Optical Craft Interface user login with access to all user capabilities, including those that are service-affecting, with the exception of security-related capabilities.

Program

The executable software code that controls the LambdaRouter™ All Optical Switch network element or Optical Craft Interface.

Protection

Extra capacity (channels, circuit packs) in power or control equipment that is intended to be used not for service but rather as backup for equipment failures. In active and standby contexts, protection is used to describe a function that at power-up becomes standby.

Protection Group

Protection switching configuration. Within a protection architecture, one working function is protected by one protection function. LambdaRouter™ All Optical Switch supports protection switching with a System Controller Protection Group, High-Voltage Shelf Controller Protection Group, and Optical Interface Shelf Protection Group. ***See also*** Revertive Protection Switching; Non-Revertive Protection Switching.

Protection Switch Activity Log

A time-stamped list of LambdaRouter™ All Optical Switch protection switching activity that has occurred within the network element. Facility, equipment, and synchronization-related switching activity is covered. The log includes the protection group ID and the type of protection switch (manual, forced, clear, or automatic).

Protection Switching

LambdaRouter™ All Optical Switch capability to automatically switch to standby or protection circuitry in the event of failure. A manual or forced protection switch may also be initiated as part of operator fault isolation procedures.

Provisioned (PROV)

Indication that a circuit pack is ready to perform its intended function. A provisioned circuit pack can be active (ACT), in-service (IS), standby (STBY), or out-of-service (OOS).

Provisioning

The process of assigning values to a set of variable parameters of the system (or any of its subsystems) to enable or facilitate the expected use of the system (or subsystem). Provisioning of system components includes the creation of a software representation of the component and/or a record of its parameter values, as well as actual modification of the component parameters. Provisioning can be automatic or initialized by manual command. ***See also*** Auto-Provisioning; Manual Provisioning and Deprovisioning; Pre-Provisioning.

Q

Quality of Service (QoS)

The performance specification of a communications channel.

Quality of Service (QoS) Alarm

A LambdaRouter™ All Optical Switch alarm message category of alarms that are issued with respect to performance monitoring threshold crossing alerts. Quality of Service alarms are issued for a port.

R

Rapid Network Restoration

A LambdaRouter™ All Optical Switch application that enables speedy restoration of services via alternate paths by removing the need for manual recabling operations. LambdaRouter™ All Optical Switch offers 1+1 pre-provisioned network restoration, and auto re-route mesh restoration when used with the LambdaRouter™ Optical Network Navigation System (ONNS).

Rapid Service Provisioning

A LambdaRouter™ All Optical Switch application that enables speedy provisioning of optical-layer service, eliminating the need to dispatch craft personnel for manual facility interconnections.

Receive-Direction

The signal direction toward the network element.

Recovery

A predefined process, in response to communication, equipment, or processing failure, that results in a return to normal operation of the network element.

Recovery after Power Failure

The LambdaRouter™ All Optical Switch capability to automatically reset the system after power failure without user intervention, when input voltage rises above a pre-set level. The system returns to its provisioned state prior to the failure.

Remote Network Element

Any network element (NE) that is connected to the NE under consideration. ***Also called*** Far End.

Remote Provisioning

A feature allowing the user to provision from a remote location through a managing system and LAN.

Reports Only User

An Optical Craft Interface user type with permissions to access only those capabilities that retrieve information from the system but do not modify the system.

Restoration Controller (RC)

The LambdaRouter™ All Optical Switch circuit pack that provides the interface between the Navis™ Optical Network Management System (NMS) and the Control Communications Network (CCN) for managing the path setup process. The RC circuit pack is also the location where path computation (routing) is performed in response either to requests for path setup and tear-down (from Navis™ Optical NMS), or in response to a path failure in order to initiate a mesh auto-reroute service restoration. Two RC circuit packs are located in the System Controller Shelf (SCS), and each provides one external 10BaseT ethernet connector, one external 100BaseT ethernet connector, and one internal four-port 10/100BaseT ethernet hub.

Restoration Interface Processor (RIP)

The LambdaRouter™ All Optical Switch circuit pack that provides Control Communications Network (CCN) connectivity between each LambdaRouter™ All Optical Switch in a domain. The CCN application runs on the RIP circuit packs. Two RIP circuit packs are located in the System Controller Shelf (SCS), and each provides one internal four-port 10/100BaseT ethernet hub and one external 10/100BaseT ethernet hub. Each RIP circuit pack may also be equipped with up to two Personality Modules.

Revertive Protection Switching

The ability of a working and protection function to revert autonomously to active and standby, respectively, upon the repair of the failure that caused a protection switch. ***See also*** Non-Revertive Protection Switching.

S

SanDisk

A vendor Personal Computer Memory Card International Association (PCMCIA) card; a pre-formatted SanDisk is used in LambdaRouter™ All Optical Switch for software installation. ***See also*** Personal Computer Memory Card International Association (PCMCIA) card.

Scripting

The Optical Craft Interface feature that supports the ability for the user to create and edit Transaction Language 1 (TL1) scripts and save them for later use.

Secondary Non-Volatile Memory (SEC MEM)

A MEM circuit pack designated as the secondary storage device for LambdaRouter™ All Optical Switch. ***See also*** Memory.

Security Administrator

1. An Optical Craft Interface or managing system user who has been assigned a security privilege level of S5 and can view existing user logins, add new users and assign user privileges, delete users, change passwords for any user, and modify user privileges. 2. A LambdaRouter™ All Optical Switch user with a privilege level of S5 who can view existing user logins, view a list of users currently logged into the network element, add new users and assign user privileges, delete users, and change passwords for any user.

Security Alarm

A LambdaRouter™ All Optical Switch alarm message category of alarms that are issued with respect to login events and managing system access, and that indicate an intruder alert condition. Security alarms are issued for the system.

Security Log

A LambdaRouter™ All Optical Switch file of all security-related events. It is stored in non-volatile memory of the network element.

Security Management

In LambdaRouter™ All Optical Switch, the administration of user accounts (login IDs, passwords, and privilege levels) and the monitoring of system security to insure that only valid users can perform allowed actions and receive authorized information.

Serial Number (SLN, SN)

A circuit pack identifier that is stored in Electrically Erasable Programmable Read-Only Memory (EEPROM).

Serial Number Identification Port (SNIP)

A Switch Shelf interface to the High-Voltage Shelf that provides the unique 16-bit serial number of the Switch Shelf.

Series Number (SSN)

A circuit pack identifier that is stored in Electrically Erasable Programmable Read-Only Memory (EEPROM).

Session

A logical connection from the Optical Craft Interface or other managing system to a network element.

Shelf

A set of circuit packs sharing a common physical housing, power source, electronic or opto-electronic backplane, and shelf controller.

Shelf View

An Optical Craft Interface graphical depiction of one shelf. Selectable objects in this view are the shelf, the slots/circuit packs, and the ports.

Short Reach

A standard for optics, concerning transmitters and receivers in a system, that ensures that transmission can be maintained for short distances (10 km). ***See also*** Long Reach; Intermediate Reach.

Signal Degrade (SD)

A condition that triggers automatic protection switching when the line bit error rate (B2) exceeds a user-provisionable threshold.

Signal Fail (SF)

Loss of signal (LOS), loss of frame (LOF), Alarm Indication Signal-Line (AIS-L), or line bit error rate (B2) greater than the user-provisionable threshold.

Signal Injection

The capability for a LambdaRouter™ All Optical Switch OEO input port to inject a test signal with a payload containing either all 1s (AIS-L) or all 0s (UNEQ) when requested by using a test access command. Signal injection is possible only when the input port is not detecting an incoming signal. A j0-byte sequence may be inserted in an injected test signal.

Signal Maintenance

In LambdaRouter™ All Optical Switch, the capability of the system to detect the presence or absence of optical power at input and output ports, monitor and react to maintenance signals, generate appropriate alarms, and perform fabric-path protection switching.

Signal Rate

An attribute that defines the bit rate and format of a signal.

Single-Mode Fiber (SM)

An 8.3-µ diameter low-loss, long-span optical fiber typically operating at either 1310 nm, 1550 nm, or both.

Site Address

The unique address for a network element.

Slip

A repetition or deletion of a block of bits in a bit-stream, caused by a sufficiently large discrepancy in the read and write rates at a receiver buffer.

Slot

A physical position in a shelf designed to hold a circuit pack and connect it to the backplane.

Slot Provisioned State

A transition state for circuit pack insertion. A slot will transition from empty to equipped when the circuit pack insertion is detected and validated, and the hardware registers are loaded. The slot remains so provisioned until the object is deprovisioned.

Slot State Provisioning

Modification of a slot state through a user command.

Software Backup

The process of saving an image of the current network element (NE) databases, which are contained in NE primary non-volatile memory (NVM, PRI MEM), to SEC MEM or remote storage.

Software Delivery

In LambdaRouter™ All Optical Switch, the delivery to a customer of network element generic software, Optical Craft Interface software, factory data, and utilities on a CD-ROM, with accompanying documentation in hard copy and on CD-ROM.

Software Failure

A data or results error detected by the software itself during execution.

Software ID

A number that provides the software version information for the system.

Software Installation

The process of interpreting and unpacking the binary data program that was downloaded to a network element non-volatile memory (NVM) and copying the constituent data items to their designated locations in the network element.

Software Management

The activities necessary to download, upgrade, install, back up, and restore the generic software and provisionable data on the Optical Craft Interface and network element.

Software Upgrade

The process that installs a new release of software.

Standby (STBY)

A state in which a circuit pack is in service but is not providing service functions. The circuit pack is ready to be used to replace a similar circuit pack either by protection or by duplex switching, in hot standby or cold standby functions. ***See also*** Active; Cold Standby; Hot Standby.

Standing Condition

The declaration type of a notification message (event or alarm) that requires a Clear message. ***See also*** Transient Condition.

State

A software parameter indicating the current autonomous and user-defined limitations on the behavior of the entity in question.

Status

The indication of the instantaneous condition of an equipment entity.

Strictly Non-Blocking Fabric (NBF)

Architecture that ensures unhindered signal throughput. Strictly NBF is a fabric architecture such that any incoming signal can be directed to any idle output port, without the need to rearrange any of the existing cross-connections, and without blocking, degrading, or otherwise affecting any of the remaining signals through the system.

Subnetwork

A group of interconnected/interrelated network elements.

Superuser

1. An Optical Craft Interface user type with highest level of permissions to access the system. Up to two superusers logins and passwords may be created on the Optical Craft Interface. 2. A LambdaRouter™ All Optical Switch user with full privileges in all functional categories. Two superuser logins and passwords are pre-installed on the system.

Suppression

A process by which alarms that have been identified as an "effect" are not displayed to a user. Alarms can be suppressed through user provisioning.

Switch Bay

In LambdaRouter™ All Optical Switch, the frame that houses the Switch Shelf, High-Voltage Shelf, and optical interface shelf, either the OIS-T, OIS-10G, OIS-2G, or OIS-MX.

Switch Interface Cable (SI cable)

Cable that connects the Optical Interface Shelf backplane and the Fiber Distribution Panel.

Switch Interface Capacity

The capacity in number of optical interconnection links between any one of the transmission interface shelves and the cross-connection fabric. This term applies to bidirectional capacity (for example, switch interface capacity of 128 corresponds to 128 optical links in each direction).

Switch Interface Controller (SWIC, LGH1 and LGH1AE)

A LambdaRouter™ All Optical Switch circuit pack that provides control functions for optical cross-connect interface or High-Voltage Digital-to-Analog Converter (HVDAC) functions, and a control interface to the Control Bay. There are two types of SWICs. The SWIC for the Optical Interface Shelf-Transparent (OIS-T) and High-Voltage Shelf (HVS) is coded LGH1 and is referred to in software as oswic when in an OIS-T and hswic when in an HVS. The SWIC for the Optical Interface Shelf-SDH/SONET (OIS-S) is coded LGH1AE and is referred to in software as oswic.

Switch Interface Point (SWIP)

A Micro-electromechanical System (MEMS) mirror, the dedicated optical interface (connector and collimator) connected to it, and the dedicated electrical control interface (electrodes, cable connectors) for its operation. Users of LambdaRouter™ All Optical Switch software will view it as a single object in the system.

Switch Interface Point (SWIP) Maintenance Group (SWMG)

A grouping of Switch Interface Points (SWIPs) that are treated as a unit for switch maintenance. This grouping is sometimes referred to as ***switch side***.

Switch Request States

State that is defined for protection groups: Forced Switch, Manual Switch Failure, and No Request.

Switch Shelf (SWS)

The LambdaRouter™ All Optical Switch component that contains the Micro-electromechanical System (MEMS) mirror arrays, optical lenses, fibers and connectors, also referred to as switch fabric.

Synchronization

The function that assures accuracy and stability of clocks used to transmit data in digital networks. In LambdaRouter™ All Optical Switch, clocking is used for 10 Gbps and 2.5 Gbps signals that go through optical-electrical-optical conversion for performance monitoring. The clocking is extracted from the ingress signal and used to transmit egress signal (through timing). An internal clock is used to transmit signal defect (AIS) when the clock from the ingress signal is not available. Synchronization is done on the OXI-10GC and OXI-2GC packs.

Synchronous Digital Hierarchy (SDH)

A hierarchical set of digital transport structures, standardized for the transport of suitable adapted payloads over transmission networks.

Synchronous Optical Network (SONET)

The North American standard for the rates and formats that define optical signals and their constituents.

SYS50D

The LambdaRouter™ All Optical Switch circuit pack that provides the main system control functions. Duplex SYS50Ds are located in the System Controller Shelf and operate as an active/standby pair.

System Controller Complex

The grouping of a SYS50D circuit pack, Restoration Controller (RC), and an External Interface (EI) circuit pack, treated as a unit for controller maintenance and protection switching.

System Controller Shelf (SCS)

The middle shelf of the LambdaRouter™ All Optical Switch Control Bay. It contains the SYS50D and other control packs.

System Controller Shelf (SCS) User Panel

The LambdaRouter™ All Optical Switch module that monitors the temperature of the shelf, receives alarm status information, and provides visual indications of shelf status through LEDs. The SCS User Panel provides an ESD wrist strap ground connector and a port used to connect an Optical Craft Interface to the system. An NE Acty LED indicates software download, loopback, or a forced or manual switch.

System Logs

Autonomous records of system events that can be retrieved by user commands. The system provides a User Session Activity Log, Database Change Log, Alarm Log, Security Activity Log, and Protection Switch Log. Each log has a capacity to store 72 hours of data.

System View

An Optical Craft Interface graphical depiction of the entire network element. Selectable objects in this view are bays and shelves in the network element.

T

Target Identifier (TID)

A provisionable parameter used to identify a particular network element within a network. The parameter is a case-insensitive ASCII character string of up to 20 characters. The allowed characters are the letters ***A*** through ***Z*** and ***a*** through ***z,*** the numbers ***0*** through ***9,*** and the special characters hyphen (**-**) and forward slash (**/**). The string must not begin or end with a hyphen.

Template

A collection of parameters that define a specific network element configuration.

Terminal Access

Accessing and provisioning a LambdaRouter™ All Optical Switch using a personal computer or dumb terminal connected to the RS-232 port located on the back of the LambdaRouter™ All Optical Switch System Controller Shelf (SCS). Provisioning is performed using TL1 commands.

Test Access Cross-Connection

A type of cross-connection that is used for maintenance purposes to monitor the transmission quality of live traffic or an injected signal. Test Access cross-connections involve temporarily cross-connecting an optical signal from an input port, through a switch fabric side, to an output port that has been selected to serve as a test access monitoring port. ***See also*** MONE Test Mode; MONEF Test Mode; MONF Test Mode.

Test Access Monitoring (TAM) Port

The output port of a Test Access cross-connection.

Threshold Crossing Alert

Used in performance monitoring. A notification that a monitored parameter has exceeded a threshold value for a port. The generation of threshold crossing alerts can be enabled or disabled independently for each parameter.

Through Timing

Timing derived by the network element from the ingress signal and used to transmit the egress signal.

Transaction Language 1 (TL1)

A machine-to-machine communications language that is a subset of ITU human-to-machine language. TL1 is the interface language between the Optical Craft Interface, Navis™ Optical Element Management System, Navis™ Optical Network Management System, and a LambdaRouter™ All Optical Switch.

Transient Condition

The declaration type of a notification message (event only) that does not require a Clear message. ***See also*** Standing Condition.

Transmission Control Protocol/Internet Protocol (TCP/IP)

Networking protocols used by LambdaRouter™ All Optical Switch to interface with a customer’s Intraoffice Local Area Network (IAO LAN).

Transmission Interface

Also known as facility interface. The components that provide connectivity between external Optical Line Systems (OLSs) or client network elements (NEs) and the LambdaRouter™ All Optical Switch. The LambdaRouter™ All Optical Switch transmission interfaces are the OXI, OXI-4A13, and OXI4A15 circuit packs containing transparent bidirectional ports, and the OXI-10GC and OXI-2GC circuit packs containing opaque bidirectional ports. Transmission interface functions include receipt, splitting, selection, and output of signals.

Transmission Interface Shelf

See Optical Interface Shelf entries.

Transmit-Direction

The direction away from the network element.

Transparency

Bit-rate and format independence. The OXI, OXI-4A13, and OXI4A15 circuit packs are the LambdaRouter™ All Optical Switch transparent interfaces.

Trouble-Clearing

Activity to correct an alarmed condition.

Two-Way Bridge/Merge Cross-Connection

A two-way cross-connection configuration that consists of a bridge cross-connection in one direction, and a merge cross-connection in the other direction.

Two-Way Double Merge Cross-Connection

A complex two-way cross-connection configuration that consists of two one-way double merge cross-connections, one in each direction of the two-way.

Two-Way Point-to-Point Cross-Connection

Two cross-connection duplex legs that interconnect two input ports and two output ports. A pair of input and output ports used for opposite directions may or may not have the same access identifier (AID). Each of the two cross-connection legs can be established by a single command to the network element and must have a compatible transmission rate.

Two-Way Simplex Cross-Connection

Two simplex cross-connection legs that interconnect two input ports and two output ports. A pair of input and output ports used for opposite directions may or may not have the same access identifier (AID). A pair of two-way simplex cross-connection legs can be added to or deleted from an existing cross-connection to form another type of cross-connection configuration. For example, a two-way simplex cross-connection can be added to an existing two-way point-to-point cross-connection to form a two-way bridge/merge cross connection.

U

Unequipped (UNEQ) Signal

An indication that an incoming signal has valid SDH/SONET Section/Regenerator Section overhead with a Synchronous Payload Envelope (SPE) comprising all zeroes.

Unit Interface Appliance (UIA)

The physical device used by the person who runs Optical Craft Interface software and accesses network elements. The LambdaRouter™ All Optical Switch UIA is a PC or laptop with Microsoft Windows NT or Windows 2000.

Unit Interface (UI) Cable

The specified cable type used in the interface between the System Controller Shelf circuit packs and the Switch Interface Controller (SWIC) circuit packs.

Universal Coordinated Time (UTC)

Formerly called Greenwich Mean Time (GMT). A time-zone-independent indication of an event. The local time can be calculated from the Universal Coordinated Time.

Upgrade Kit

Orderable components that enable either a lower capacity LambdaRouter™ All Optical Switch system to be upgraded to a higher capacity LambdaRouter™ All Optical Switch system, or an earlier version/release system to be upgraded to a later version/release system.

Upload

The process of transferring files from a network element to a managing system. LambdaRouter™ All Optical Switch can only upload data. ***See also*** Download.

Upstream

At or toward the source of the considered transmission stream.

User ID (UID)

An Optical Craft Interface or LambdaRouter™ All Optical Switch user code that comprises one to ten alphanumeric, case-sensitive characters. Any sequence of characters is allowed, except as follows: The keyword ALL by itself, in any combination of uppercase and lowercase (that is, ALL AlL, alL, and so on), is not allowed as a valid user ID. A user ID containing ALL as a substring, however, in any combination of uppercase and lowercase (such as tallman), is allowed as a valid user ID.

User to Network Interface (UNI)

An IP network interface that allows automated network path setup and teardown to be initiated from an IP router or other client that is external to the LambdaRouter™ All Optical Switch network.

User Notification Registration List

A security feature that determines what messages a LambdaRouter™ All Optical Switch user is allowed to receive.

User Panels

Components on each shelf of the LambdaRouter™ All Optical Switch that monitor the temperature of shelves, receive alarm status information, and provide visual indications of shelf status through LEDs. These panels also provide a means for generating alarm cutoff and LED test interrupts to the shelf Switch Interface Controller (SWIC) circuit packs.

In addition to the status LEDs, the System Controller Shelf user panel provides an ESD wrist strap ground connector and a port used to connect an Optical Craft Interface to the system.

Temperature monitoring, ESD wrist strap ground connectors, and Optical Craft Interface ports are not included in the user panels for the Optical Interface Shelves and High-Voltage Shelves. They also do not support near end (NE) or far end (FE) alarms.

User Privilege Code (UPC)

Permissions assigned to each user when a login is created or modified on either the Optical Craft Interface or LambdaRouter™ All Optical Switch. The UPC is an alphanumeric code of one or two letters that identify the functional category of commands the user may access, and a single digit that indicates the user authorization level for that functional category. UPCs assigned to login IDs on the Optical Craft Interface do not necessarily apply to LambdaRouter™ All Optical Switch.

User Record

Data associated with each user on an Optical Craft Interface or other managing system and on the LambdaRouter™ All Optical Switch network element (NE). Each record (separate on the managing system and the NE) comprises a login ID, password, user type, user privilege level, user priority level (NE only), and User Notification Registration list (NE only).

User Session Activity Log

A LambdaRouter™ All Optical Switch file of all user-initiated commands from login through logout.

User Type

Assigned privilege codes for Optical Craft Interface users that determine which commands and capabilities the user may access. Predefined user types are Superuser, Privileged User, General User, Maintenance User, and Reports Only User. Users may also be assigned a type of “Other.” The default user type is “Reports Only.”

V

Very Short Reach (VSR)

A standard for optics (as defined in ITU-T Recommendation G.693), concerning transmitters and receivers in a system, that insures that transmission can be maintained for very short distances (up to 2 km). ***See also*** Long Reach; Intermediate Reach; Short Reach.

Virtual Private Network (VPN)

A leased network that is part of a larger network but operated independently.

Volatile Memory

A type of memory that is lost if electrical power is interrupted.

W

Wander

The long-term variation of the significant instants of a digital signal from their ideal positions in time. Wander is mainly generated by the variation in transmission characteristics of the media and equipment, which includes disruption in synchronization reference distribution. Wander is a potential source of slips in synchronous networks. ***See also*** Jitter.

Wavelength Division Multiplexing (WDM)

A means of increasing the information-carrying capacity of an optical fiber by simultaneously transmitting signals at different wavelengths.

Wavelength Range of Operation

A range within the infrared wavelength spectrum in which the system is designed to operate.

Wavelength Window

A standard range of wavelengths in which the intrinsic transmission loss of an optical fiber is low enough to be usable for optical transmission systems. The standard wavelength windows are approximately 850 nm (not used in telecommunications), 1310 nm, and 1550 nm.

WaveStar® CIT (Craft Interface Terminal)

See Optical Craft Interface (OCI).

WaveStar® NMS (Network Management System)

See Navis™ Optical Network Management System (NMS).

WaveStar® OLS (Optical Line System)

A Lucent Technologies lightwave transmission system, for example, WaveStar® OLS 1.6T. Using Dense Wave Division Multiplexing technology, the system combines multiple signals of different wavelengths, transmits the resulting signal over a single fiber, and then demultiplexes the signal at the receiving end.

WaveStar® SNMS (SubNetwork Management System)

See Navis™ Optical Element Management System (EMS).

Wizard

Form of user assistance that automates a task through a dialog with the user.

Working

Descriptor for a physical entity. In revertive switching, the working entity carries service under normal operation. In non-revertive switching the descriptor has no particular meaning. In active and standby operations, ***working*** indicates the function, when present and healthy, that will become active at power-up. ***See also*** Protection; Revertive Protection Switching; Non-Revertive Protection Switching.

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