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WaveStar[®] LambdaRouter 128/256

Release 2.0

Applications and Planning Guide

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About this information product

Purpose	<p>The <i>WaveStar LambdaRouter 128/256 Release 2.0 Applications and Planning Guide</i> describes the Lucent Technologies WaveStar LambdaRouter 128/256 all optical switch.</p> <p>This guide highlights the features and benefits of the groundbreaking WaveStar LambdaRouter 128/256 technology. It provides a system description and discusses WaveStar LambdaRouter 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.</p>
Reason for reissue	<p>This issue documents the Generally Available Release 2.0 WaveStar LambdaRouter.</p>
Safety labels	<p>Not applicable.</p>
Intended audience	<p>This guide is intended for use by all network planners and engineers. It serves as an overview to the WaveStar LambdaRouter 128/256 for all administrators, operators, and technicians working with the product.</p>
Conventions used	<p>Not applicable.</p>
Related documentation and training	<p>Related documents include others in the WaveStar LambdaRouter 128/256 library, WaveStar Optical Service Manager (OSM), WaveStar</p>

SubNetwork Management System (SNMS), and WaveStar Network Management System (NMS) documentation, as well as vendor documentation for the PC used for the WaveStar CIT (Craft Interface Terminal). The WaveStar Optical Line System (OLS) 1.6T Applications and Planning Guide is also available.

Lucent Technologies offers courses in various aspects of the WaveStar product line, including the WaveStar LambdaRouter 128/256.

Refer to the Training and Documentation (8-5) section in Chapter 8, Product Support, for information on obtaining documents and registering for WaveStar LambdaRouter 128/256 courses.





1 Introduction

Overview

Purpose This chapter introduces the WaveStar LambdaRouter 128/256.

Contents This chapter includes the following sections:

System Description	1-2
Capacity and Configurations	1-5
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System Description

Introduction The WaveStar LambdaRouter 128/256 is an optical cross-connect system equipped with a completely optical switching fabric. It provides transparent interfaces that can operate at any optical layer bit rate, including 40 Gbps as well as opaque, rate-specific SONET/SDH interfaces that operate at either 10 Gbps or 2.5 Gbps. The opaque interfaces have optical-electrical-optical capabilities.

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 WaveStar LambdaRouter 128/256 optical switch fabric, and can be either unidirectional or bidirectional.

Transparent interfaces

Transparent interfaces are interfaces with bit-rate and format independence. 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 Optical Cross-Connect Interface (OXI) circuit pack.

Opaque interfaces

Opaque interfaces are interfaces that accept incoming signals of a particular bit-rate and/or format.

On the WaveStar LambdaRouter 128/256's opaque OC-192/STM-64 and OC-48/STM-16 interfaces, power monitoring is available in the egress direction only. In the ingress direction, 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.

The opaque interfaces are located on the Optical Cross-Connect Interface-10GC (OXI-10GC) and Optical Cross-Connect-2GC (OXI-2GC) circuit packs.

Operations interfaces

Access to the WaveStar LambdaRouter 128/256 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
- WaveStar Optical Service Manager (OSM)
- WaveStar CIT (Craft Interface Terminal)
- WaveStar SNMS (SubNetwork Management System)

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

Network evolution

The need for networking at the optical layer is driven by the explosive increase in the demand for and deployment of transmission capacity.

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, 2.5 Gbps interfaces on IP routers are becoming quite common, and 10 Gbps interfaces are rapidly becoming available). 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 WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 can handle the same number of inputs.

The WaveStar LambdaRouter 128/256 also offers opaque transmission interfaces that provide OEO conversion and bit monitoring functions designed for SONET/SDH network applications.

Both types of WaveStar LambdaRouter 128/256 ports provide the capability to support the future development of intelligent optical networking. With the opaque ports, the monitoring features described previously will be included in intelligent optical networking.

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 supports enterprise customers through:

- leased wavelengths
- management of their own virtual private networks (VPNs)

Additionally, intelligent optical networking offers multiple Quality of Service (QoS) levels for differentiated service based on Service Level Agreements (SLAs). With intelligent optical networking, the WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 features are aimed at automating the optical layer bandwidth management.

The features of the WaveStar LambdaRouter 128/256 are described in Chapter 3, “Features”. Future releases will provide enhanced configurations and functionality.



Capacity and Configurations

Capacity The WaveStar LambdaRouter 128/256 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.

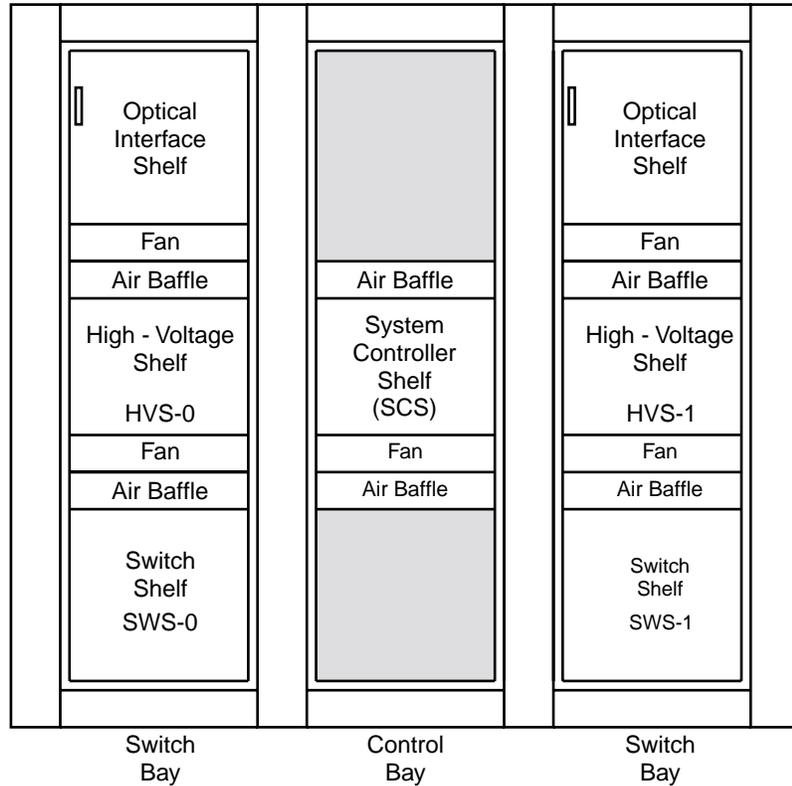
In the WaveStar LambdaRouter 256, this physical duplication is provided by the inclusion of two switch fabrics. In the WaveStar LambdaRouter 128, the duplication is provided by a logical division of a single switch fabric into two sides.

Both models of the WaveStar LambdaRouter 128/256 include a mechanism for automatic switching of a path from the active (working) fabric or side to the alternate (protection) fabric or side in the event of a failure on the active switch fabric or switch fabric side.

Basic configurations There are many possible configurations of the WaveStar LambdaRouter 128/256 depending on the types and speeds of the interfaces required.

WaveStar LambdaRouter 256

The WaveStar LambdaRouter 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 start-up configurations for the WaveStar LambdaRouter 256: transparent and transparent/opaque.

The transparent start-up configuration consists of the following:

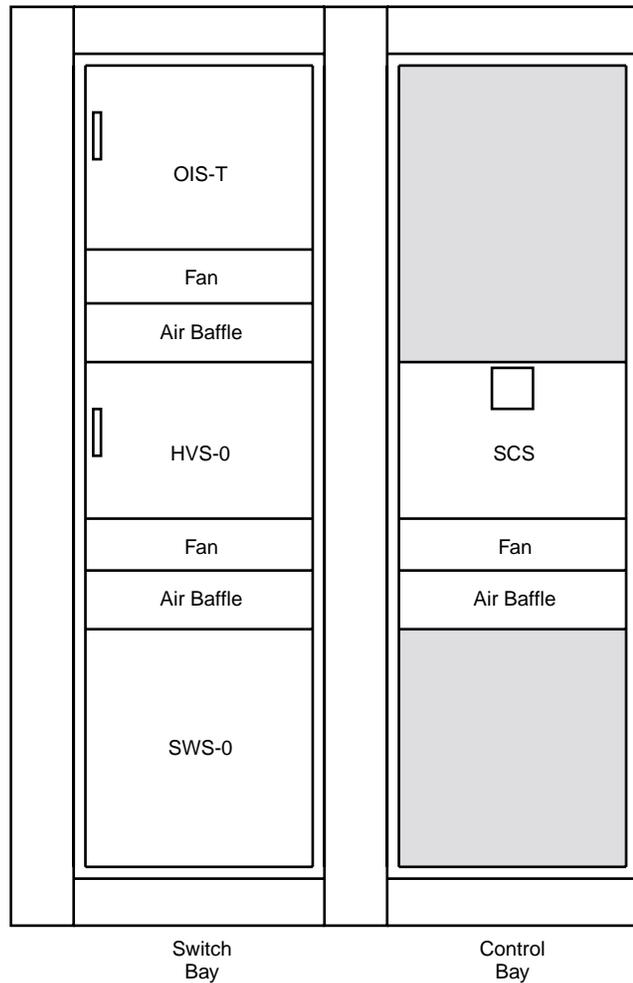
- Control Bay containing the System Controller Shelf (SCS)
- 2 Switch Bays, each with a High-Voltage Shelf (HVS), Switch Shelf (SWS), and Optical Interface Shelf -Transparent (OIS-T).

The transparent/opaque 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).

WaveStar LambdaRouter 128

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



NC-LR014

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

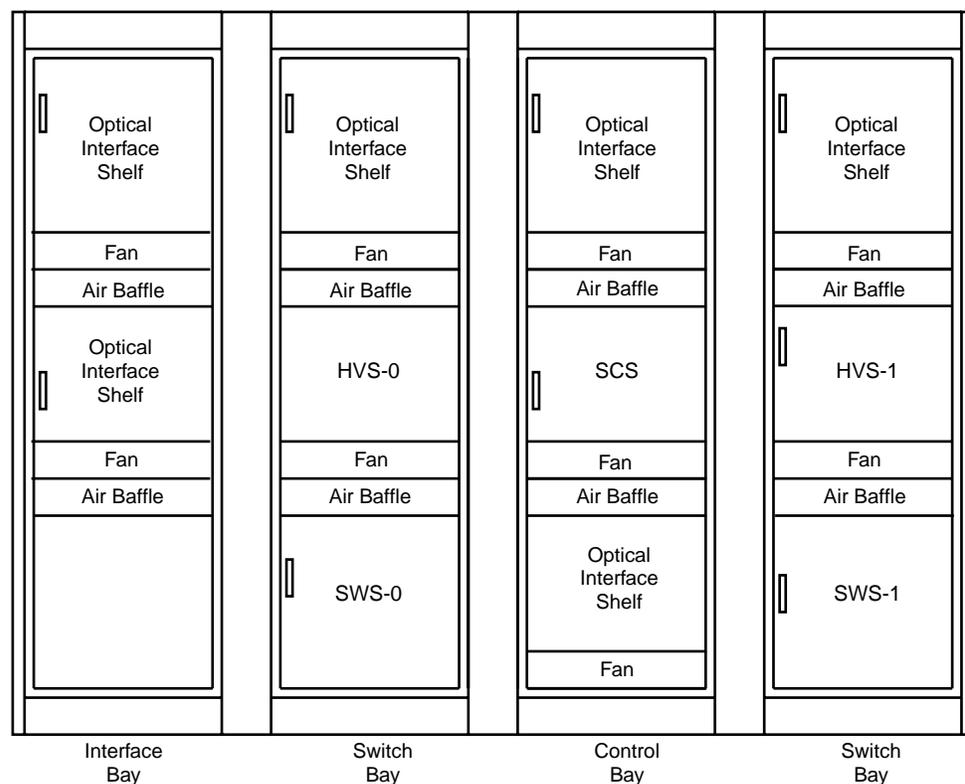
Beginning with these start-up configurations, you can build a WaveStar LambdaRouter 128/256 with a variety of interface types and speeds. Using the maximum capacity of 112 or 224 (refer to the Capacity section in Chapter 3, "Features" for capacity limitations), any mix of

transparent and OEO packs is possible. Refer to Chapter 7, “Ordering” for information on custom configurations.

Depending on the model—WaveStar LambdaRouter 128 or WaveStar LambdaRouter 256—the maximum standard configuration is housed in either two or four bays.

WaveStar LambdaRouter 256

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



NC-LR1200-040

WaveStar LambdaRouter 128

Although you can add optical interface shelves and port units in the WaveStar LambdaRouter 128, the maximum standard configuration is housed in two bays.

Note: Some non-standard configurations may call for the addition of an Interface Bay.

Configuration examples Most of the standard WaveStar LambdaRouter 128/256 installations use some transparent and some OEO 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.

WaveStar LambdaRouter 256 basic configurations

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

Bays	Optical interface shelves		Circuit packs/Ports			Notes
	OIS-T	OIS-S	OXI	OXI-10GC	OXI-2GC	
3	1	1	32/128	32/32	OR 32/64	160 or 192 total ports
3	1	2	16/64	64/64	OR 64/128	128 or 198 total ports
			32/128	64/64	OR 48/128	192 or 224 total ports
				32/32	AND 32/64	maximum port capacity 224 ports
3	1	3	16/64	96/96	OR 80/160	160 or 224 total ports
			32/128	96/96	-	maximum port capacity
				64/64	AND 16/32	
4	1	4	24/96	128/128	-	maximum port capacity
			16/64	96/96	AND 32/64	maximum port capacity
4	1	5	16/64	160/160	-	maximum port capacity
3	2	0	56/224	-	-	all transparent; maximum port capacity

WaveStar LambdaRouter 128 basic configurations

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

Bays	Optical interface shelves		Circuit packs/Ports			Notes	
	OIS-T	OIS-S	OXI	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 (using an OIS-MX shelf)
2	1	2	16/64	48/48	-	maximum capacity	

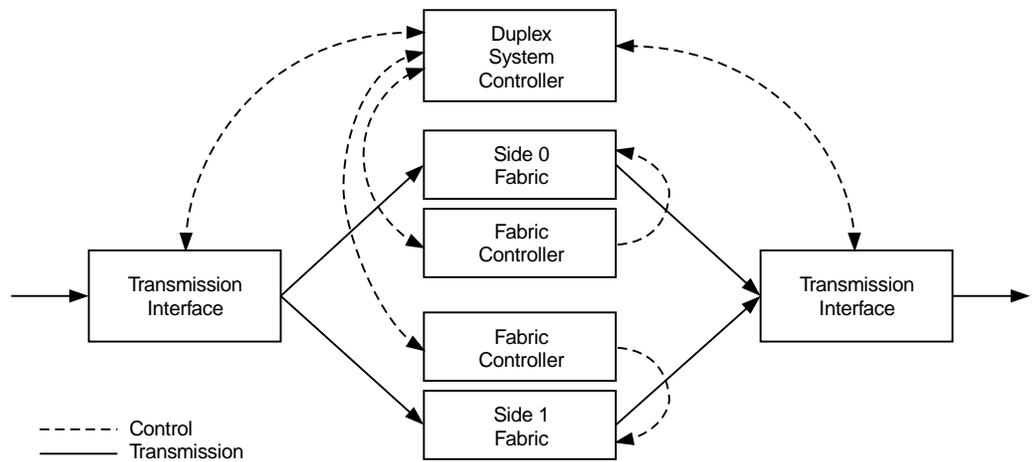
System growth The configurations can be expanded by adding growth bays, optical interface shelves, and circuit packs. The maximum configuration size depends on the model of WaveStar LambdaRouter 128/256 and the type of circuit packs used. For details on configuration sizes, refer to the “Capacity” (3-2) section in Chapter 3, “Features”.

System Architecture

Introduction This section shows the cross-connection transmission and control flow through the WaveStar LambdaRouter 128/256. There are two types of transmission interfaces provided by the WaveStar LambdaRouter 128/256: transparent and rate-specific OEO interfaces (opaque).

WaveStar LambdaRouter 256 transmission and control flow

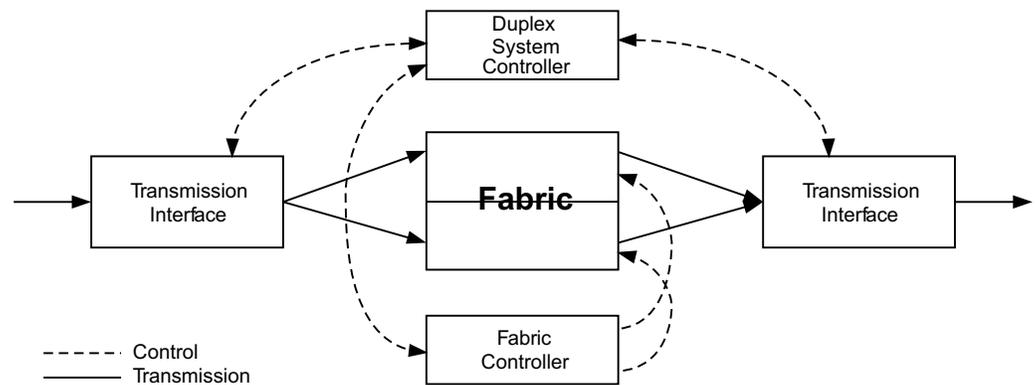
The WaveStar LambdaRouter 256 flow is shown in the following figure.



NC-LR026

WaveStar LambdaRouter 128 transmission and control flow

The WaveStar LambdaRouter 128 flow is shown in the following figure.



NC-LR027

Transmission interfaces

The transmission interfaces to the external equipment consist of the input and output ports on the OXI, 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.

Transparent interfaces

The OXI circuit pack provides power monitoring and splitting on each input signal, and power monitoring and selection on each output signal. Each OXI circuit pack has four input and four output ports.

The WaveStar LambdaRouter 128/256 transparent 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.
- Signals in the range 1260 to 1360 and 1500 to 1620 nanometers can be transported.
- Power monitoring is used to detect loss of input signals or to detect internal switch fabric failure.
- Detected failures result in switchover to the path through the alternate fabric side.

For details on the OXI pack, refer to the section, Optical parameters, in Chapter 10, “Technical Specifications”.

Opaque interfaces

The two opaque circuit packs provide splitting of each input signal, and power monitoring and selection on each output signal. Each OXI-10GC circuit pack has one input and one output port; each OXI-2GC circuit pack has two input and two output ports.

The WaveStar LambdaRouter 128/256 rate-specific interfaces are characterized by the following attributes:

- They provide OEO conversion.
- Incoming 10G OC-192 or 2.5G OC-48 signals can be processed.
- Signal defects such as LOF, AIS, and BER/EBER and maintenance signals (AIS-L) are detected.
- Detected failures result in switchover to the path through the alternate fabric side.

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 WaveStar LambdaRouter 256 there are two switch fabric shelves, SWS-0 and SWS-1. In the WaveStar LambdaRouter 128, there is only one switch fabric shelf, designated SWS-0. This single shelf is logically partitioned into two fabric sides (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” (3-8) in Chapter 3, “Features”.

Cross-connection

The WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 to an output port. In opaque ports, the incoming signal must also meet the following requirement: the signal must have no defects.





2 Applications

Overview

Purpose This chapter describes the WaveStar LambdaRouter 128/256 applications.

Contents This chapter includes the following sections:

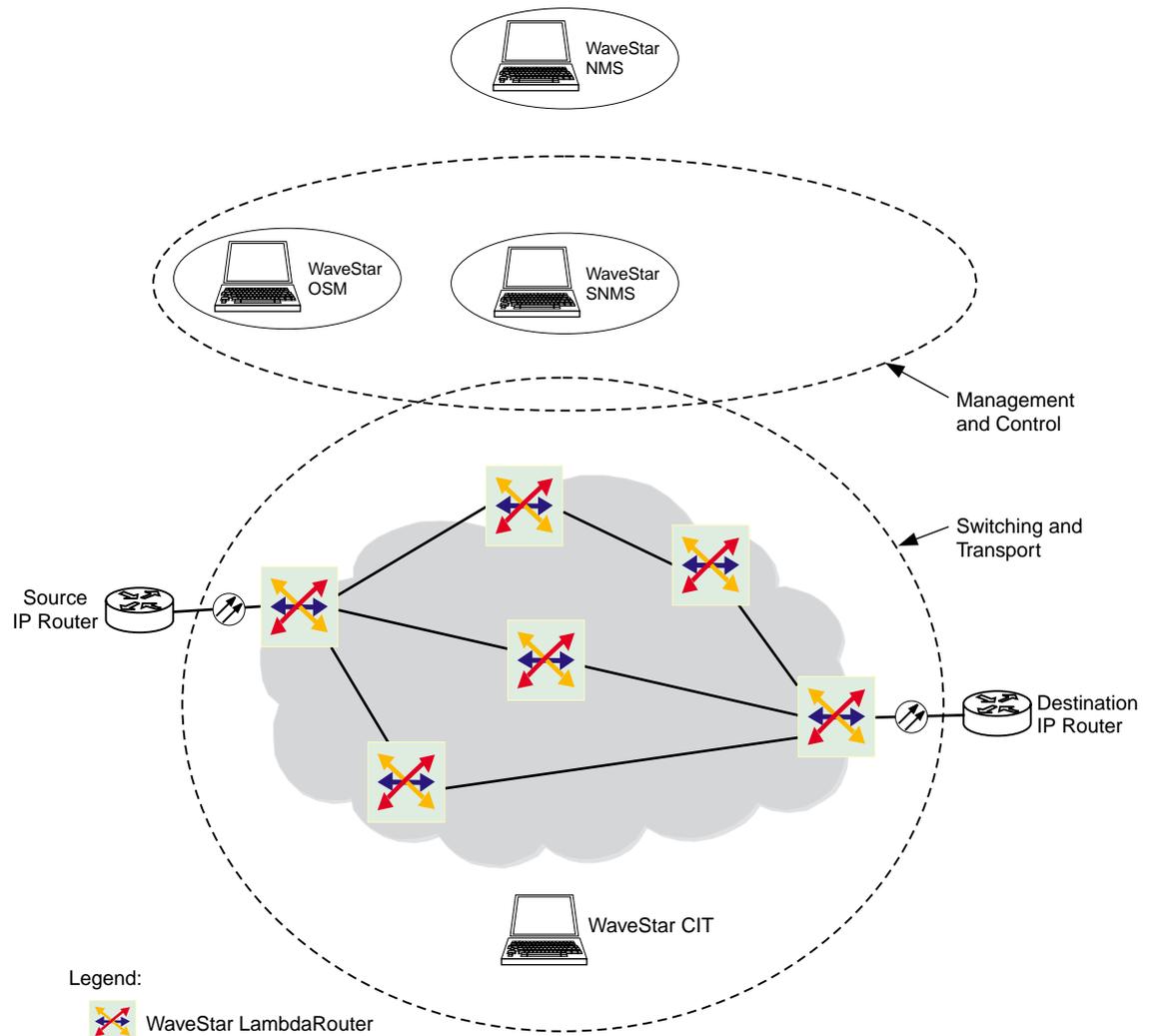
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Network View of Applications

Architecture All applications described in this chapter are facilitated by elements shown in the following figure. Illustrated in this figure are WaveStar LambdaRouter 128s and WaveStar LambdaRouter 256s deployed in intelligent optical networking in which switching and transport activities occur.

The figure shows the WaveStar LambdaRouter 128/256 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.



NC-LR1200-008

WaveStar CIT The WaveStar CIT (Craft Interface Terminal) provides the on-site craft interface to a WaveStar LambdaRouter 128/256. It supports most of the functions for the local WaveStar LambdaRouter 128/256 that are provided by the centralized SNMS.

WaveStar OSM The WaveStar Optical Service Manager (OSM) provides centralized *network-level* (that is, end-to-end) service provisioning and restoration. It communicates with all the WaveStar LambdaRouter 128/256s in the network and provides the following key capabilities:

- Automatic (point and click) end-to-end service provisioning

- Mesh restoration activation by transmission of suitable cross-connect commands in response to a failure indication received from one or more WaveStar LambdaRouter 128/256s in the network
- Provisioning of optical VPNs, which enables end customers to provision reserved bandwidth on the optical network.

In support of these features, the WaveStar OSM also contains a database of the WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256.

WaveStar SNMS

The WaveStar SNMS (SubNetwork Management System) communicates via TCP/IP with individual WaveStar LambdaRouter 128s or WaveStar LambdaRouter 256s in the network, and provides centralized management of individual WaveStar LambdaRouter 128/256s. Some key capabilities are:

- Provisioning of various WaveStar LambdaRouter 128/256 equipment such as system-level circuit packs, port units, and ports
- Node maintenance
- Alarm reporting and management
- Cross-connect management (entry and deletion).

WaveStar NMS

The WaveStar Network Management System (NMS) is part of a telecommunications management network that can be used to provide integrated management of an entire transport network. This operations system can provide provisioning and management of all network elements including the WaveStar LambdaRouter 128/256 by communication with the WaveStar SNMS.



Optical Channel Management

Benefits The WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 instantly routes optical signals from fiber to fiber without converting them to electrical signals.

The WaveStar LambdaRouter 128/256 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 WaveStar CIT for LambdaRouter 128/256 replaces this labor-intensive task.

Transparent interfaces

With the transparent OXI circuit pack, the WaveStar LambdaRouter 128/256 offers cross-connection capacity that is independent of the set of signal rates and formats that it supports. This independence, called transparency, simplifies capacity planning for two reasons:

- It is not necessary to allocate traffic to various port types.
- 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 WaveStar LambdaRouter 128/256 can accommodate them without the need for additional circuit packs.

Opaque interfaces

The WaveStar LambdaRouter 128/256 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 line and section overhead, insertion and detection of AIS.

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 WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 include the following:

- Rapid service provisioning
- 1+1 network restoration:
- Traffic grooming.

When used in conjunction with WaveStar OSM, the following applications are also supported:

- Mesh autoroute network restoration
- Optical Virtual Private Networks (VPNs).

Service provisioning speed and efficiency can be increased even more by using WaveStar OSM. Refer to the “WaveStar OSM” (2-3) earlier in this chapter.



Rapid Service Provisioning

Description The WaveStar LambdaRouter 128/256 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
- parameters based on the Service Level Agreement (SLA), such as:
 - routing requirements
 - service availability (protection implementation)



Rapid Network Restoration

Types The WaveStar LambdaRouter 128/256 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.

The WaveStar LambdaRouter 128/256 offers the following types of network restoration:

- autoroute (pre-planned), when used with WaveStar OSM
- 1+1 (pre-planned and pre-provisioned)

Autoroute When the WaveStar LambdaRouter 128/256 is used in conjunction with WaveStar OSM, autoroute 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.

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 path are always completely provisioned. A path failure will automatically trigger the restoration path.

The restoration path always carries the same signal as the service path and the egress WaveStar LambdaRouter 128/256 automatically switches over when the service path fails.



Traffic Grooming

Description The WaveStar LambdaRouter 128/256 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.



Optical Virtual Private Networks (VPNs)

Description By use of the WaveStar LambdaRouter 128/256 and WaveStar OSM, end customers may be allowed to provision reserved optical bandwidth on a network of WaveStar LambdaRouter 128/256s, thereby managing their own optical VPN.

The network provider can create VPNs and add or modify end-points and connections, as well as monitor the status of each VPN it provides to a customer.

With an optical VPN, network customers can:

- view their own network
- create connections within that network
- monitor the status of the VPN and connections
- request new end-points from the network provider
- request new optical channel connections (increased capacity).





3 Features

Overview

Purpose This chapter gives a brief description of the WaveStar LambdaRouter 128/256 features.

Contents This chapter includes the following sections:

Capacity	3-2
Synchronization	3-4
Transmission Interfaces	3-5
Bandwidth Management	3-8
Protection Switching	3-16
Fault Detection and Alarms	3-18
Shutdown and Recovery	3-19
Software Management	3-20
Upgrades	3-22

□

Capacity

Description The WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 supports transparent and opaque circuit packs, which are called port units. The supported port units are the OXI transparent circuit pack, and the opaque OXI-10GC and OXI-2GC rate-specific circuit packs.

The OXI provides four input and four output ports, the OXI-10GC provides a single input and a single output port and the OXI-2GC provides two input and two output ports.

The WaveStar LambdaRouter 128/256 consists of the following major components:

Interface shelves

There are two types of optical interface shelves available for the WaveStar LambdaRouter 128/256.

- Optical Interface Shelf-Transparent (OIS-T). Each OIS-T can house a maximum of 32 OXI circuit packs and provides up to 128 two-way transparent terminations.
- 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-64/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 WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256.

WaveStar LambdaRouter 256 capacity and connections

The WaveStar 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 6 additional input and 6 additional output fabric connections in reserve for sparing.

Failed paths, therefore, can generally be rerouted within the system using non-service affecting maintenance.

WaveStar LambdaRouter 128 capacity and connections

The WaveStar 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 3 additional input and 3 additional output fabric connections in reserve for sparing.

Failed paths, therefore, can generally be rerouted within the system using non-service affecting maintenance.



Synchronization

Description Optical signals that are passed transparently through the WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 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.



Transmission Interfaces

Overview There are two different types of transmission interfaces—transparent and opaque. These interfaces are located on the WaveStar LambdaRouter 128/256 optical cross-connect 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.

Transparent interfaces

The Optical Cross-Connect interface (OXI) circuit pack provides four input and four output ports per pack. These ports are bit-rate and format independent.

Opaque interfaces

The opaque ports will typically be used as client-side interface ports, to add or drop a network user's signal at the WaveStar LambdaRouter 128/256.

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.

Port unit functions and architecture

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

Input

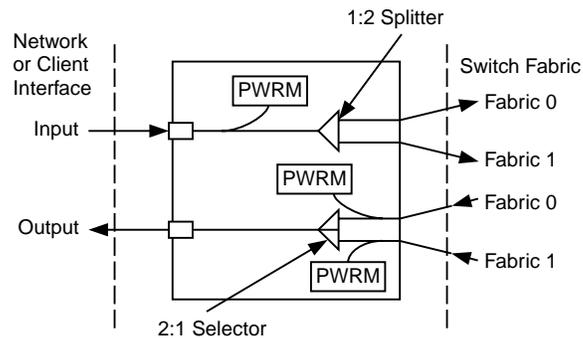
1. Physical input port
2. Monitoring (PMON) of SONET/SDH overhead (opaque only)
3. Power monitoring (PWRM)
4. Signal splitting (1:2 splitter).

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).

WaveStar LambdaRouter 128/256 transparent interface

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

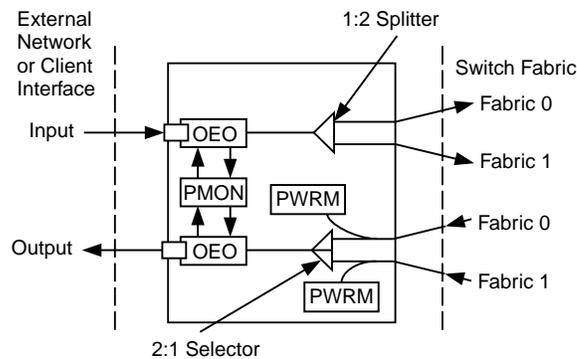


PWRM: Power Monitor

NC-LR126

WaveStar LambdaRouter 128/256 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.



PWRM: Power Monitor
PMON: SONET/SDH Overhead Monitor

NC-LR1200-017

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 WaveStar LambdaRouter 128/256 supports both long 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.



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 WaveStar LambdaRouter 128/256 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 interfaces

The WaveStar LambdaRouter 128/256 provides cross-connections that are bit-rate independent and format independent through the OXI circuit packs. In addition to this transparency, the system optionally provides 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. If this feature is activated, cross-connections will be denied on user-provisioned ports that do not match this provisioning.

Opaque interfaces

The WaveStar LambdaRouter 128/256 provides OEO client-side interfaces for traffic handling. The OEO packs provide the same splitting and selection functions as the transparent circuit packs. Additionally, OEO conversion and overhead monitoring capabilities are included in the OEO pack.

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

Bridging

In this release of the WaveStar LambdaRouter 128/256, 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 WaveStar LambdaRouter 128/256s or between a WaveStar LambdaRouter 128/256 and a client's point of access.

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

Each input signal to the WaveStar LambdaRouter 128/256 is split and the resulting two input signals are sent through one of the two switch fabrics or switch fabric sides. The resulting two output signals 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 WaveStar LambdaRouter 128/256 merges two signals at the same port unit output port, the optical 2:1 selector picks 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

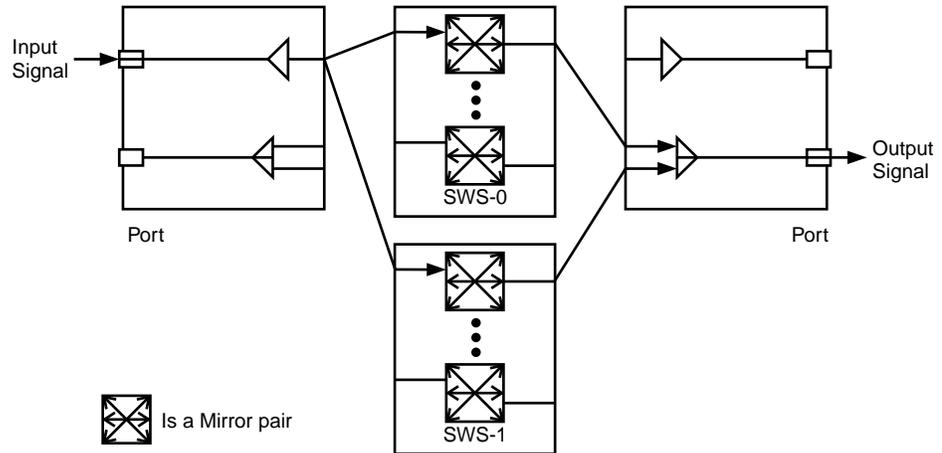
The WaveStar LambdaRouter 128/256 offers the following classes of cross-connections:

- 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 WaveStar LambdaRouter 256. Cross-connections for the WaveStar LambdaRouter 128 are the same, except a single fabric (SWS-0) is used, which is divided into sides.

One-way cross-connection

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

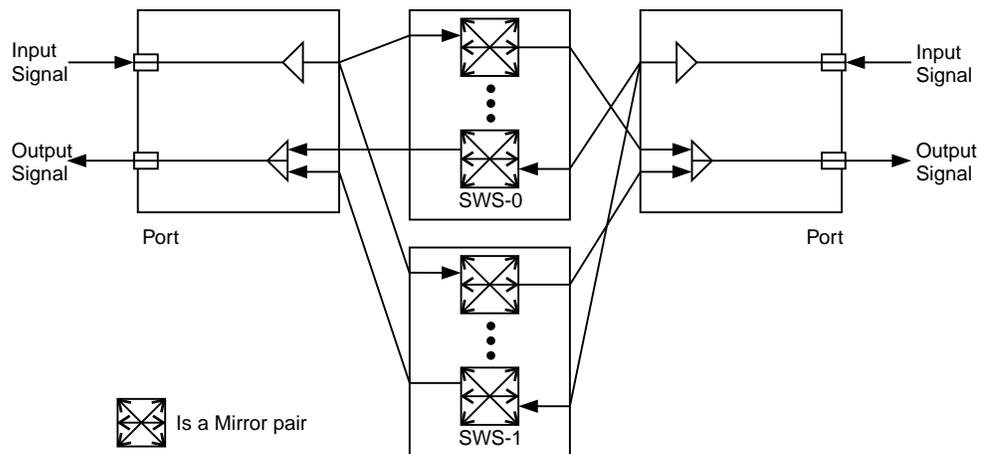


NC-LR1200-026

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

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 below. Input and output signals do not have to be on the same circuit pack.

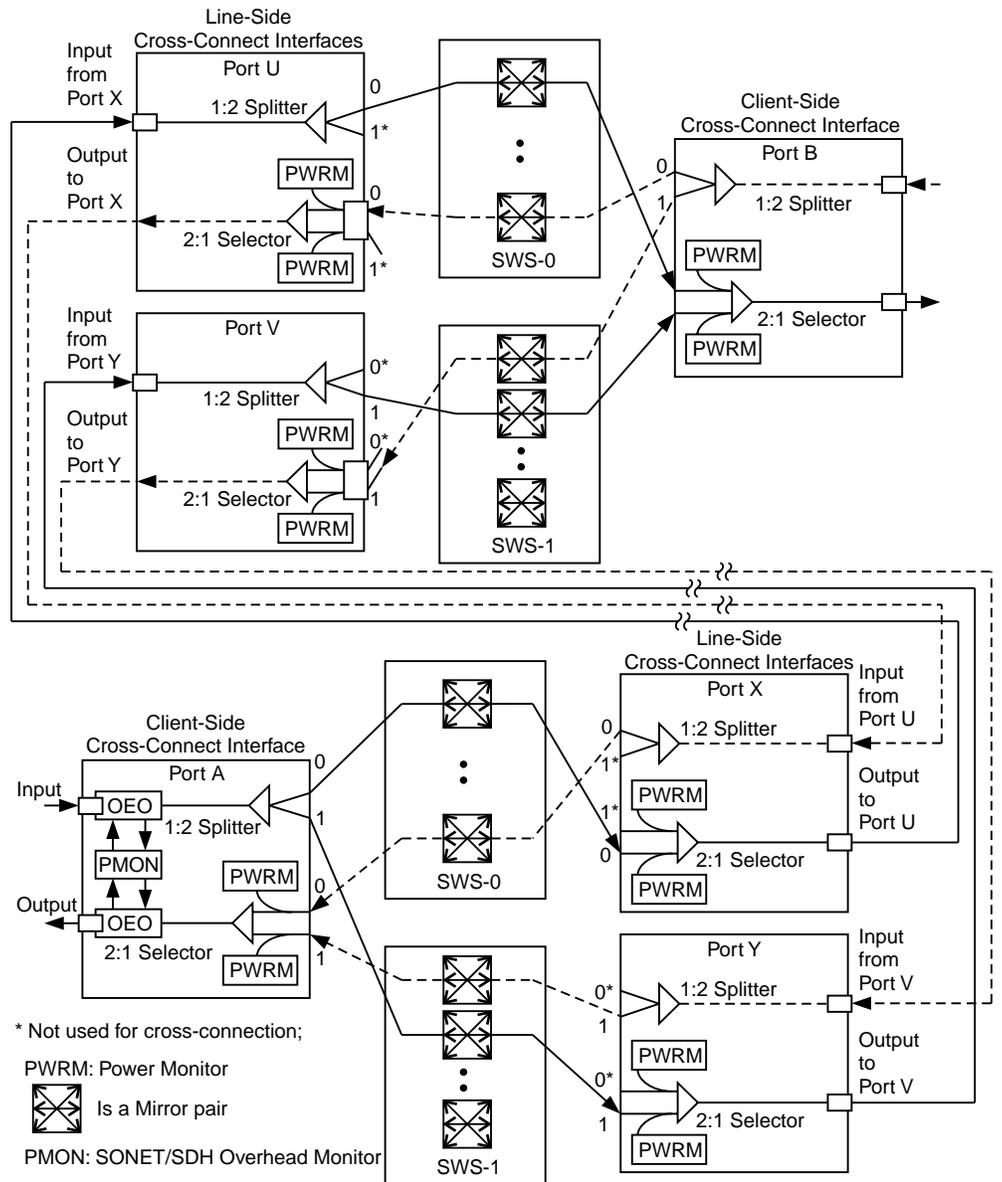


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Bridging/merging—1+1 network path protection

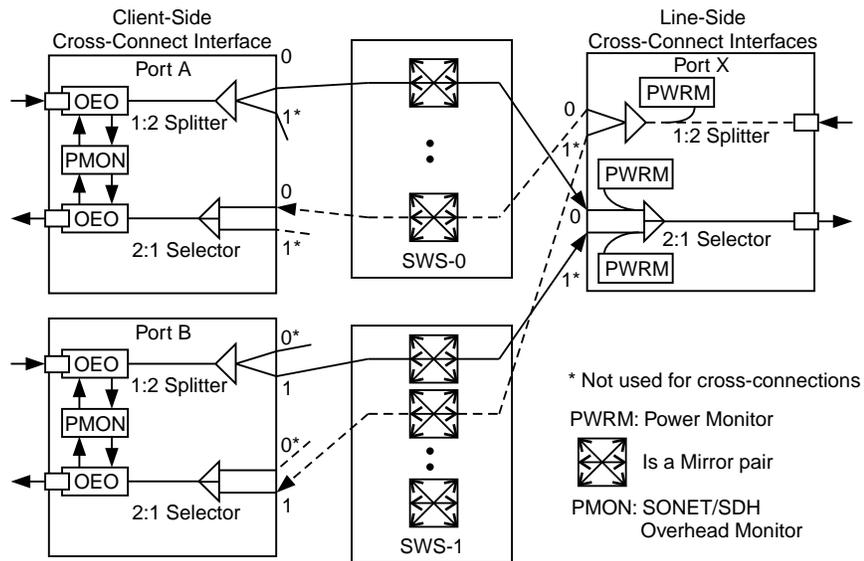
The following figure shows 1+1 network path protection using bridging and merging. One client-side uses a transparent port unit; the other uses an opaque port unit.

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.



Client-Side and Line-Side Ports may be of Either Type: Transparent or Opaque

NC-LR1200-015

When Port X's selector detects a problem with signals 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 signals provided by Port B. A similar switch is initiated if defective signals from SWS-1 are received.

Cross-connect loopbacks

The WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 provides for two types of loopbacks.

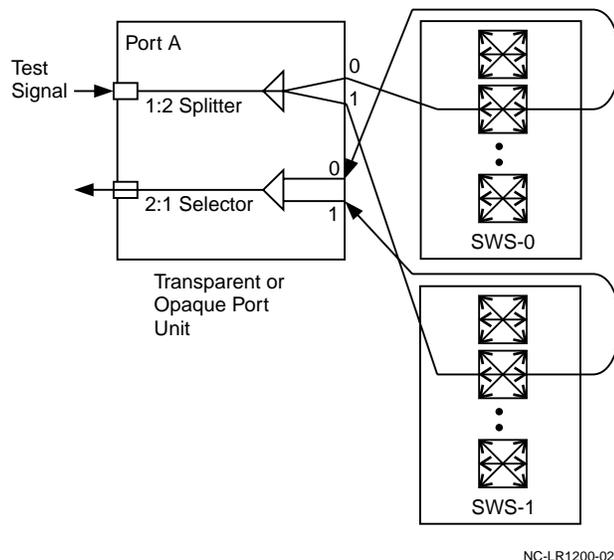
The loopbacks that follow are illustrated for the WaveStar LambdaRouter 256. Loopbacks for the WaveStar LambdaRouter 128 are the same, except the single fabric (SWS-0) is divided into sides.

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 is established by cross-connecting an incoming signal received by a port 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:



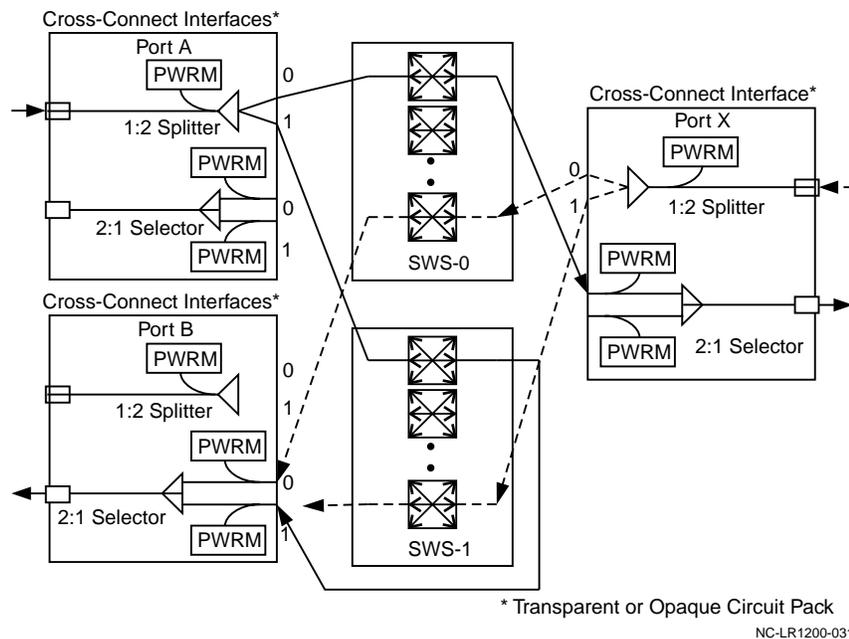
Forced loopbacks

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 WaveStar LambdaRouter 256, or both sides of the switch fabric in the WaveStar LambdaRouter 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 can interrupt the original cross-connection.

A forced simplex loopback is shown in the figure below:



Using a forced simplex loopback allows a maintenance person to establish a loopback and, thereby, monitor one branch of an incoming signal while the other branch continues downstream with no service impact with the exception of protection paths. Any pre-provisioned

protection paths on the loopback path will be unavailable during loopback.

A forced loopback request is denied if the specified output port already has the following types of cross-connections established:

- one-way cross-connect using only the output interface of the specified port
- merged cross-connect handling one-way traffic coming into the port

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



Protection Switching

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

The WaveStar LambdaRouter 128/256 provides both manual fabric side switching and automatic fabric side switching of individual paths through the system. In the WaveStar LambdaRouter 256, this protection switching is the switchover of the path from SWS-0 to SWS-1 or from SWS-1 to SWS-0. In the WaveStar LambdaRouter 128, the switch is between logical sides SWMG-0 and SWMG-1.

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.

1 + 1 restoration The WaveStar LambdaRouter 128/256 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 in 50 milliseconds.

Duplex control The WaveStar LambdaRouter 128/256 is equipped with a system controller complex which provides redundant control on the System Controller Shelf. The controllers are maintained in active/standby mode; switching completion time is about five minutes during which time transmission continues unaffected.

The WaveStar LambdaRouter has the following controller fault protection groups:

- System controller complex protection group consisting of two complexes, each composed of control circuit packs (SYS50D, CSIEX, and EI) in active/standby mode. The circuit packs are described in the section “SCS circuit packs” (4-15) 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 WaveStar LambdaRouter 128/256 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 managing systems and WaveStar CIT sessions.

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



Fault Detection and Alarms

Description The WaveStar LambdaRouter 128/256 provides continuous, autonomous, in-service fault detection and isolation on transmission and control equipment.

Office alarms and user panel circuit pack LEDs signal alarm conditions. Alarm indications also include messages through the communications interfaces to the WaveStar CIT, WaveStar OSM, and WaveStar SNMS.

There are three broad categories of failures: common, equipment and transmission.

Common failures

Common failures include system failures such as power, managing systems interfaces, and shelf fans.

Equipment failures

Equipment failures include circuit pack failures and transmission failures at internal interfaces.

Transmission failures

Transmission failures are reported as optical channel failures (facility failures), that is, signal failures at the external transmission interfaces, which are monitored by the circuit packs:

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



Shutdown and Recovery

Low-voltage shutdown The WaveStar LambdaRouter 128/256 shuts down when it detects an office DC power drop below a predefined input voltage level. The cross-connection map and other provisioned data are maintained over the power loss. 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 WaveStar LambdaRouter 128/256 automatically after a power failure, without user intervention, when the input voltage rises above the predefined level. When power is restored, the WaveStar LambdaRouter 128/256 returns to its last saved provisioned state.

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
 - Resets.

Non-Volatile Memory The WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 generic and backed-up data can be downloaded from the WaveStar SNMS or the WaveStar CIT to the primary NVM. Generic installation has no effect on transmission performance.

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 WaveStar SNMS

- Primary NVM and the WaveStar CIT.

Software and firmware updates

The user can download software generics from the WaveStar CIT or WaveStar SNMS to a primary NVM. Firmware updates can be done in the field, that is, the circuit packs do not need to be removed from the WaveStar LambdaRouter 128/256.

Resets

The controller can be reset by command (from WaveStar CIT or WaveStar SNMS/OS). 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 five minutes.

Upgrades

Description The WaveStar LambdaRouter Release 1.0 can be upgraded to the Release 2.0 WaveStar LambdaRouter 128/256 without any service interruption.

This upgrade includes the following:

- removal of all WaveStar LambdaRouter Release 1.0 hardware that is not used in the WaveStar LambdaRouter 128/256 Release 2.0 system
- addition of new WaveStar LambdaRouter 128/256 Release 2.0 hardware
- upgrade of the software generic from WaveStar LambdaRouter Release 1.0 to WaveStar LambdaRouter 128/256 Release 2.0
- maintenance of current traffic throughout the upgrade procedure.



4 Hardware Description

Overview

Purpose The purpose of this chapter is to provide a description of the WaveStar LambdaRouter 128/256 hardware.

Contents This chapter includes the following sections:

General	4-2
Bays	4-4
Shelves	4-7
Circuit Packs	4-15
Common Equipment	4-22



General

Introduction The WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 bays use a single ETSI-compliant Seismic Zone 4 bay frame suitable for both raised and non-raised floor applications.

The WaveStar LambdaRouter 128/256 has three bay types:

- Control Bay
- Switch Bay
- Interface Bay

The bay dimensions are 600 x 600 x 2200 mm [23.62 x 23.62 x 86.61 inches].

The WaveStar LambdaRouter 128/256 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 86.61 in.].

Shelf A shelf is a smaller framework, also called a shelf assembly, with cabling and slots to house circuit packs. These shelves are mounted in the WaveStar LambdaRouter 128/256 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 the circuit packs installed.

Circuit pack A circuit pack is a unit which provides a function to the WaveStar LambdaRouter 128/256. 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 cross-connect circuit packs—OXI, 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 information as well as some access and test functions. The user panels are described later in this chapter.

Power The WaveStar LambdaRouter 128/256 uses a distributed power architecture. 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”.

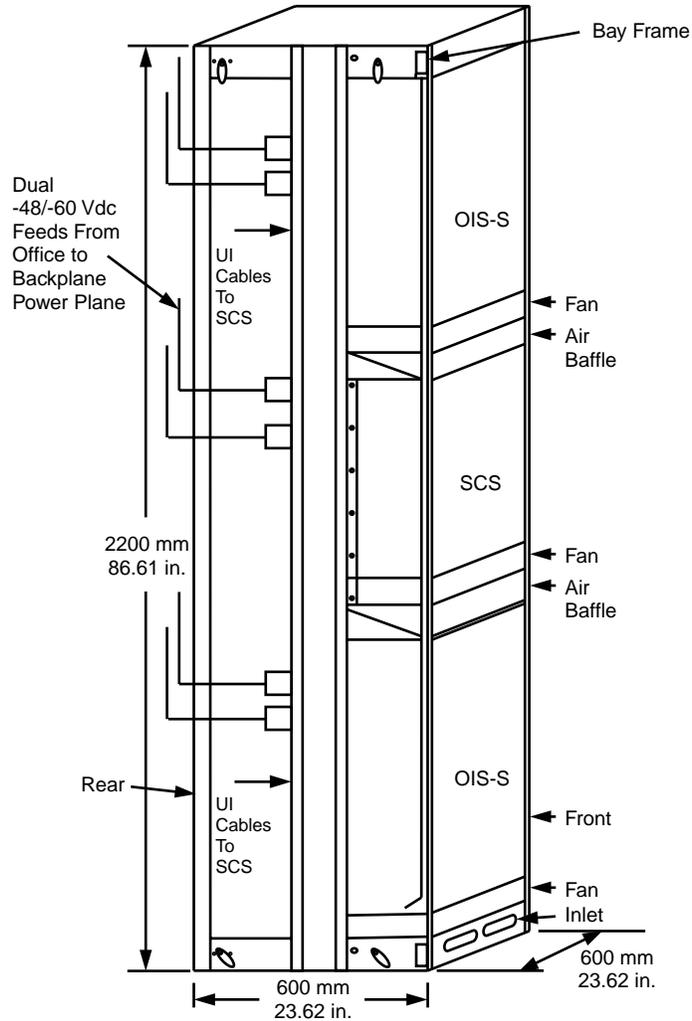
ESD grounding The SCS has an ESD jack on the user panel. For other components the ESD jacks are provided in the air baffle on the maintenance aisle and on the bay uprights on the wiring aisle.



Bays

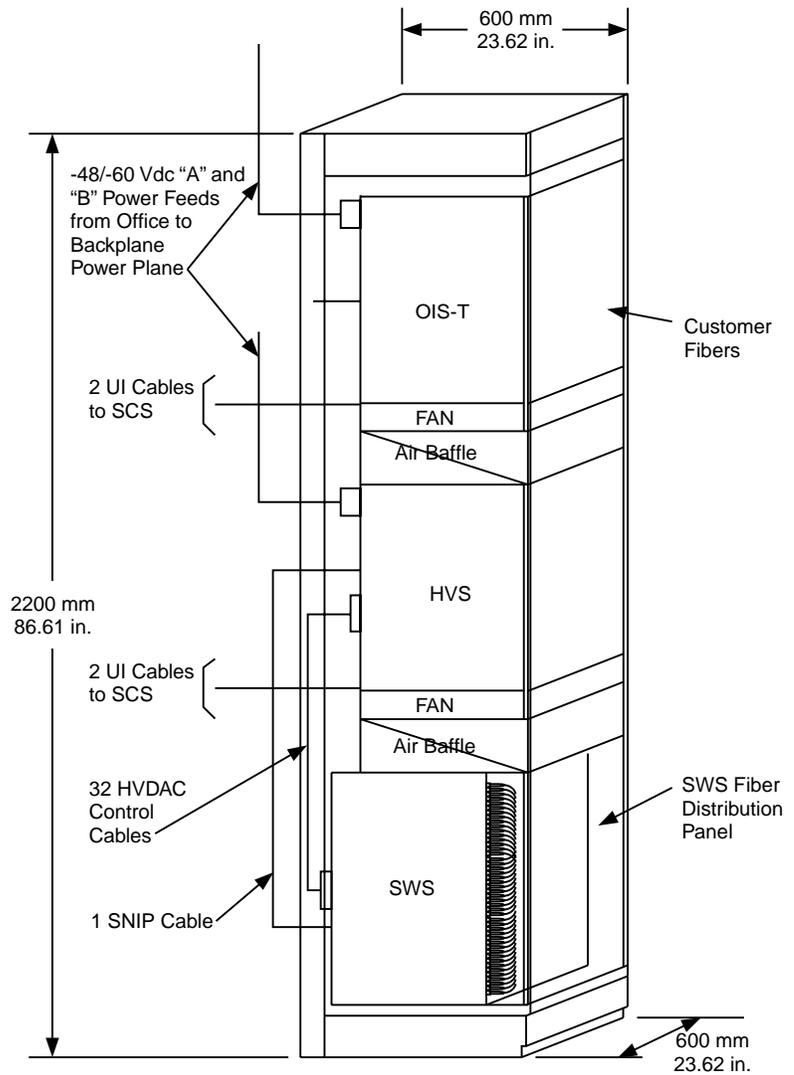
Control Bay The Control Bay contains the System Controller Shelf (SCS) and up to two optical interface shelves.

The dimensions and layout of the Control Bay (in this example, equipped with two OIS-Ss) are shown in the following figure.



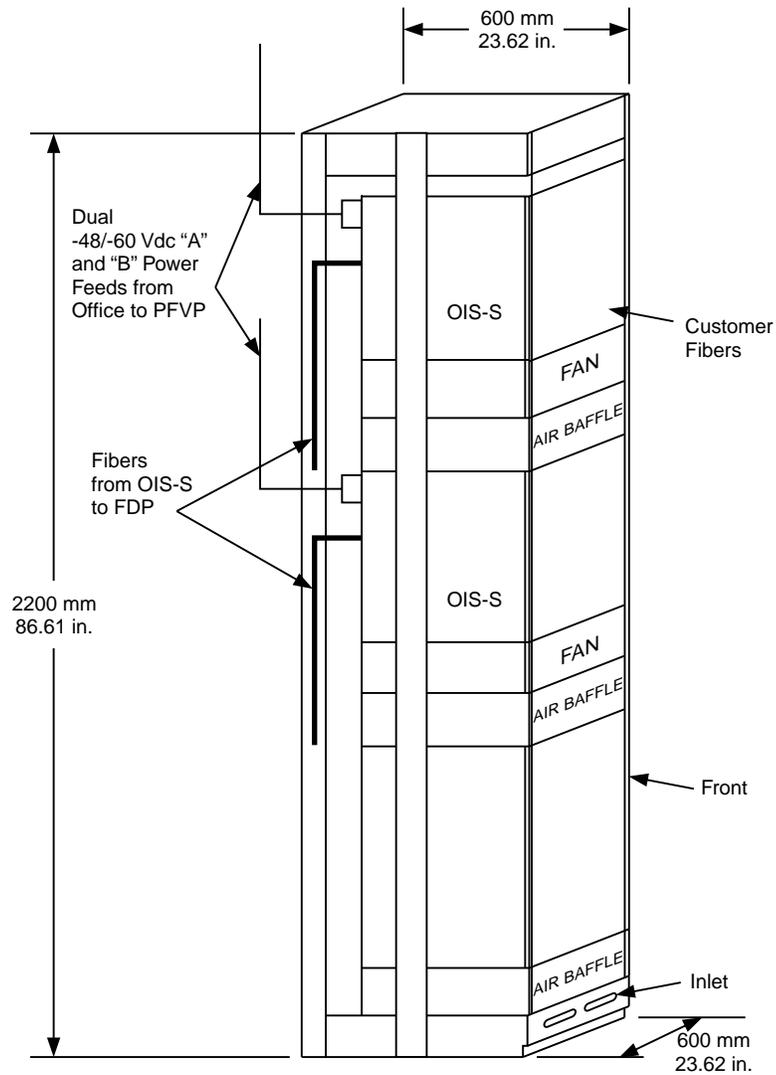
NC-LR1200-007

Switch Bay The Switch Bay provides the optical switch with its control circuitry and some of the I/O ports for the WaveStar LambdaRouter 128/256. 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.



NC-LR023

Interface Bay The Interface Bay houses the optical interface shelves—OIS-T and OIS-S. The OIS-T contains the transparent OXI 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.



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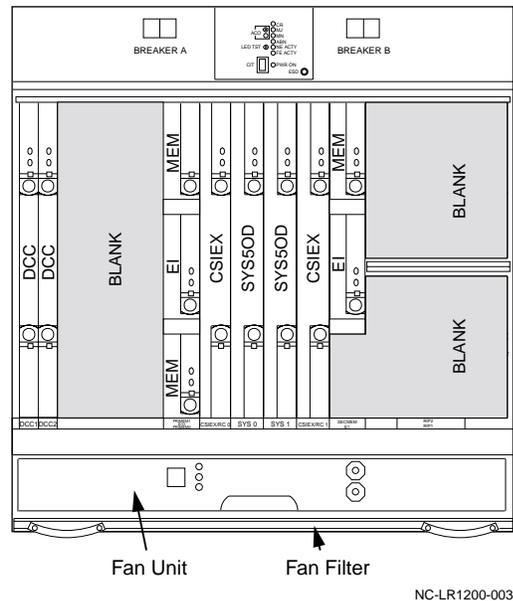
In this example, the Interface Bay is shown with two OIS-Ss. Any of the optical interface shelves can occupy any of the three shelf locations within the bay.



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 WaveStar LambdaRouter 128/256.

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
- CSIEX
- SYS50D

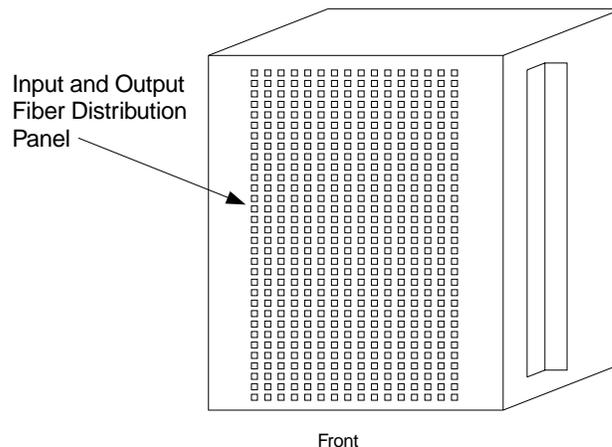
SWS The Switch Shelf (SWS) is located in the Switch Bay and contains the optical switch fabric and Fiber Distribution Panel (FDP).

The connections to the MEMS mirrors are done at the FDP, which provides connections for the I/O fibers to and from the port units.

In the WaveStar LambdaRouter 256, the two SWSs provide for spatially diverse paths through the system. In the WaveStar LambdaRouter 128, the single SWS provides logically diverse paths through the system. The two fabrics or 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.

FDP

The Fiber Distribution Panel (FDP) is shown in the next figure.



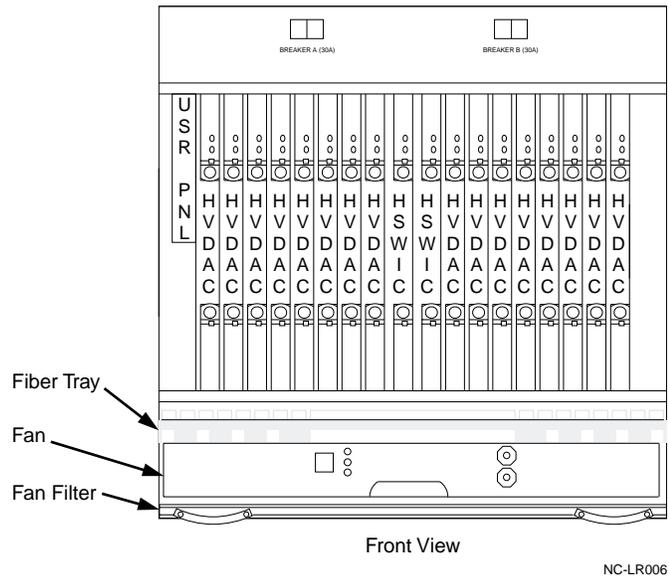
NC-LR022

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

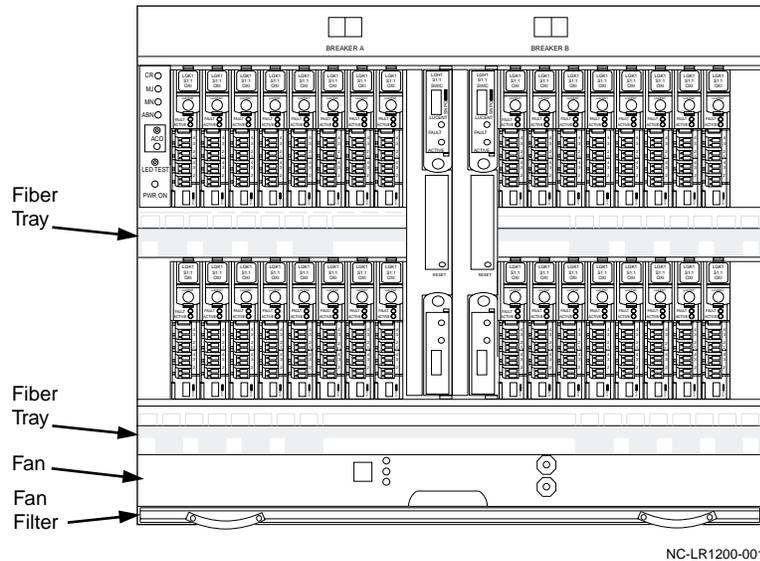
Each HVS contains 16 High-Voltage Digital-to-Analog Converter (HVDAC) circuit packs. Each of these circuit packs supports 128 high-voltage control leads and controls 32 MEMS mirrors (16 in the input array; 16 in the output array).

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.

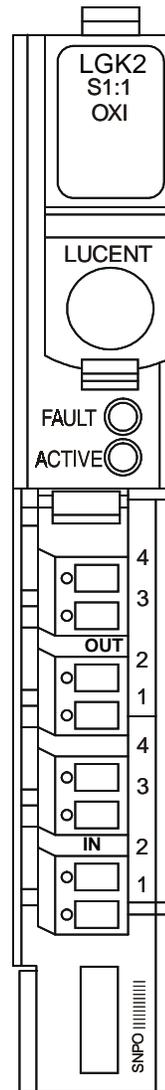


OIS-T The Optical Interface Shelf-Transparent (OIS-T) houses the OXI circuit packs that provide the bit-rate and format-independent interface between the WaveStar LambdaRouter 128/256 and the customer equipment.



Each OIS-T contains up to 32 OXI circuit packs and two OIS Switch Interface Controller (OSWIC) circuit packs, which provide control of the OXI functions and an interface to the SCS. The OIS-T faceplate is shown

The OIS-T faceplate is shown in the next figure.



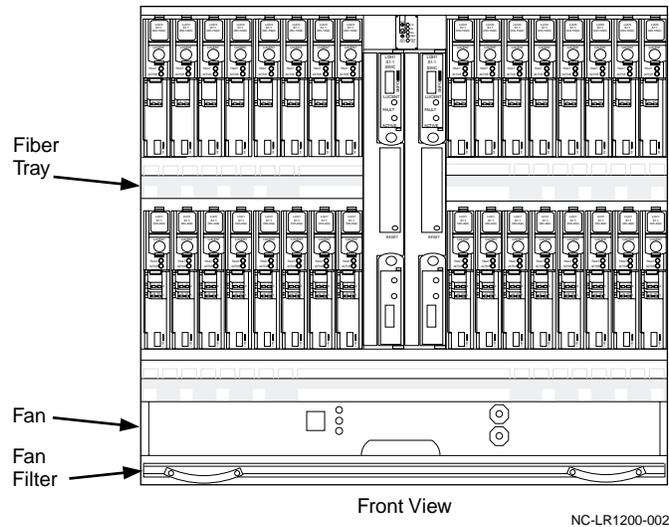
NC-LR064

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 WaveStar LambdaRouter 128/256 and the customer equipment.

Each OIS-S contains:

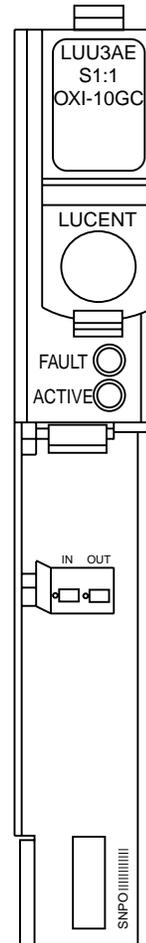
- two OIS Switch Interface Controller (OSWIC) circuit packs, which provide control of the port unit functions and a control interface to the SCS
- up to 32 opaque circuit packs.

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.



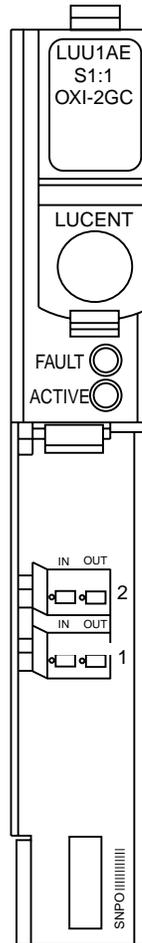
The OXI-10GC and OXI-2GC circuit pack faceplates are very similar; the main difference is in the number of ports. Refer to the next two figures.

The OXI-10GC faceplate is shown below.



NC-LR158

The OXI-2GC faceplate is shown below.



NC-LR157



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	OSWIC	OXI-2GC	HSWIC	
EI		OSWIC		
CSIEX				
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 WaveStar LambdaRouter 128/256. 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 first five shelves (HVS-1, HVS-2, and the first three optical interface shelves)
Refer to the “CSIEX” (4-17) section for the interface to additional 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 EI and MEM 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 is 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 CSIEX circuit packs.

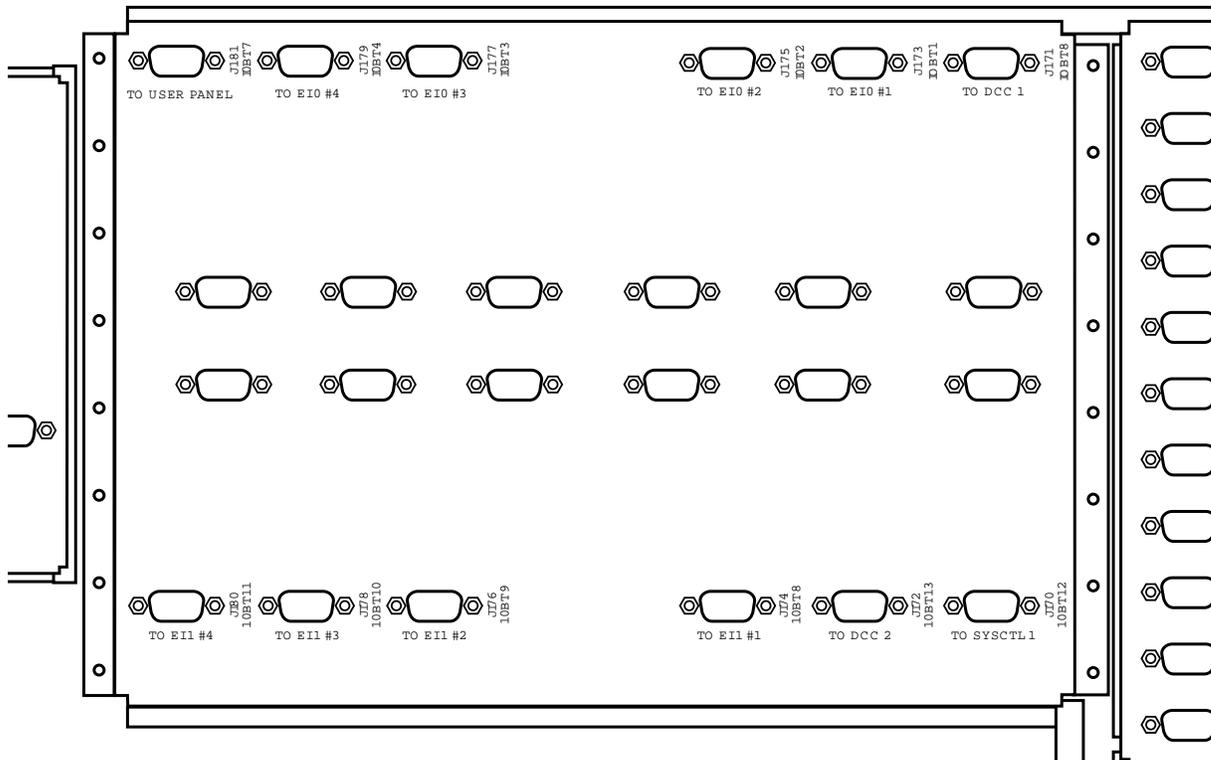
Program and configuration data on the MEM are stored on a Personal Computer Memory Card International Association (PCMCIA) flash disk card with up to 880 megabytes of memory. This card is removable and can be accessed from the faceplate of the MEM circuit packs.

EI

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

- four-port 10BaseT hub [used for the WaveStar CIT and the Intraoffice (IAO) LAN]
- 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 these EI circuit pack backplane connection ports. If an external hub is used, it is connected to EI1 port 4.

Port	EI0	EI1
1	DCC1	DCC2
2	reserved	reserved
3	EI1	EI0
4	User Panel	LAN

CSIEX

There are two Control System Interface Expander circuit packs in the SCS. The CSIEX pack interfaces to the SYS50D and SECMEM circuit packs in the SCS and to the Switch Interface Controller (SWIC) circuit packs in the HVSs or optical interface shelves. This circuit pack provides the interface (via an internal operations network) to all optical

interfaces shelves after the first three. Refer also to the “SYS50D” (4-15) section.

When combined with the SYS50D and EI circuit packs, this pack completes the main system controller complex.

Optical interface shelf circuit packs

The circuit packs on the optical interface shelves provide the interface ports to the customer equipment.

There are four types of circuit packs on these shelves:

- OXI
- OXI-10GC
- OXI-2GC
- OSWIC

OXI circuit pack

The OXI circuit pack provides the bit-rate and format-independent transmission interface for the WaveStar LambdaRouter 128/256. The OXI pack supports 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 OXI packs.

This pack performs the following functions:

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

The OXI 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 OXI circuit pack functions.

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

OXI-10GC and OXI-2GC 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.

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 OXI functions. There are two OSWIC packs on the optical interface shelf, one designated as working; 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 feeders from the backplane. The SWIC monitors feeds on the shelf and reports loss of a single feed. The SYS50D/CSIEX monitors the double feed 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” (4-19) 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 feeders from the backplane.



Common Equipment

General The following equipment is common to all WaveStar LambdaRouter 128/256 shelves:

- 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 *WaveStar LambdaRouter 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 the optical interface shelves, HVS, and SCS. 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.

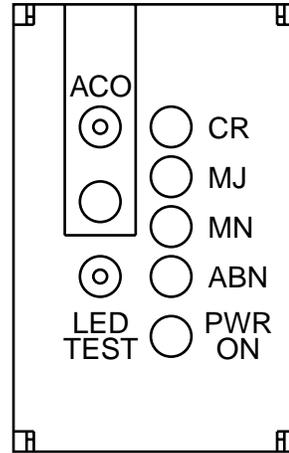
HVS and optical interface shelf user panels

The user panels on the HVS and optical interface shelves 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)
- 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 is slightly different in the OIS-T and HVS user panels but the LEDs and buttons are the same.



Office Alarms

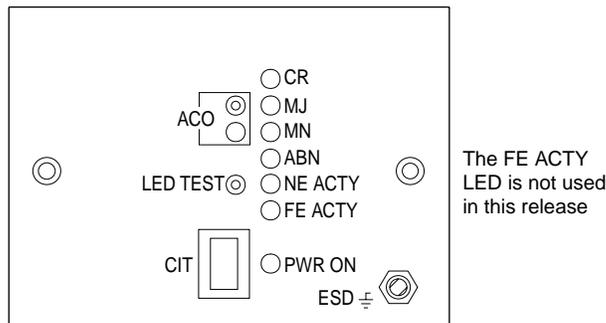
The WaveStar LambdaRouter 128/256 supports audible CO alarm states—critical, major, minor—which can be silenced by means of the user panel ACO button. The SCS supports a local office alarms connector, which contain the audible and visual alarms.

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. Additionally, the SCS user panel NE Acty LED is used to indicate software download, loopback, or a forced or manual switch. (The FE Acty LED is 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 a WaveStar CIT to the LAN.



NC-LR1200-029

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 WaveStar LambdaRouter 128/256 installation.

Contents This chapter includes the following sections:

General Planning	5-2
Bay Layout	5-4
Provisioning and Fibering	5-8
Cabling	5-11
Fiber Management	5-15
Interworking	5-16



General Planning

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

- Power
- Interface type: transparent or opaque or combination
- Capacity
- Growth
- Floor plan layout
- Provisioning and fibering
- Cabling—equipment interconnection
- Interworking in the CO

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 WaveStar LambdaRouter 128/256 by dual –48 VDC or –60 VDC power plants. (The power supplied depends on the country in which the WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 shelf. Each of these feeders is protected by a circuit breaker which also acts as a shelf on/off switch.

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.



Bay Layout

Footprint The WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 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 WaveStar LambdaRouter 128/256 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 completely transparent WaveStar LambdaRouter 128 configuration consists of two bays housing a single OIS-T.
- A completely transparent WaveStar LambdaRouter 256 configuration consists of three bays housing a maximum of two OIS-Ts.
- A WaveStar LambdaRouter 256 configuration with 16 OXI packs and 160 OXI-10GC packs consists of four bays (including an Interface Bay), which house one OIS-T and five OIS-Ss.

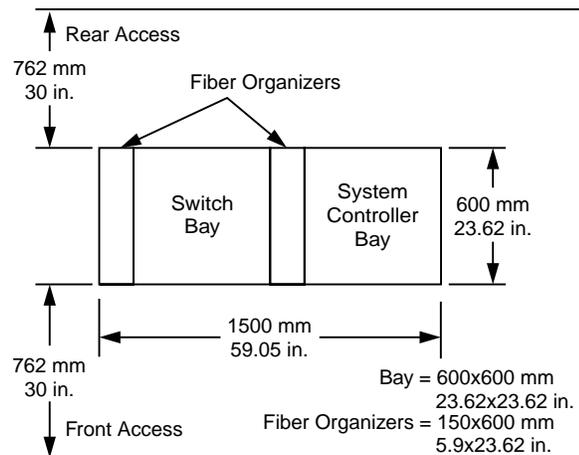
Modular growth The WaveStar LambdaRouter 128/256 capacity can be expanded because of the system modularity. Your system can grow to full capacity by the addition of an Interface Bay, optical interface shelves, and port units.

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.

Access The WaveStar LambdaRouter 128/256 is designed to give the user front access for all circuit pack maintenance, optical connections, WaveStar CIT 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.

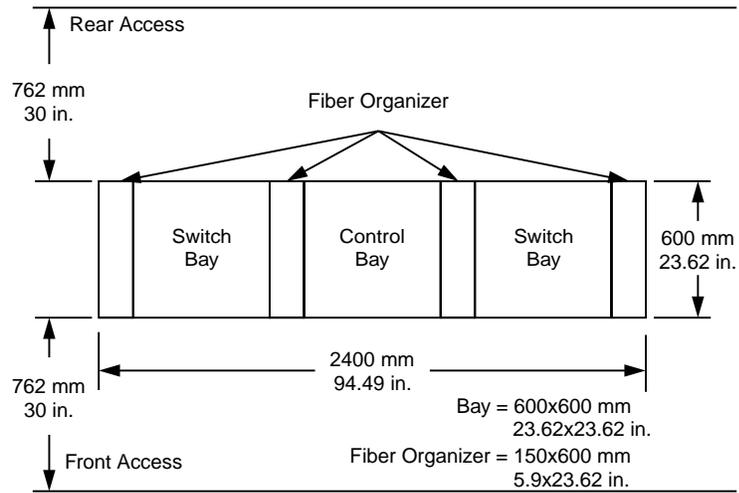
When adding the WaveStar LambdaRouter 128/256 to the CO, you must leave enough space for front and rear access to allow for maintenance and operations activities and for any upgrades that may require cable rearrangement. The general requirements are 762 mm [30 inches] in both the front and back of the unit.

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



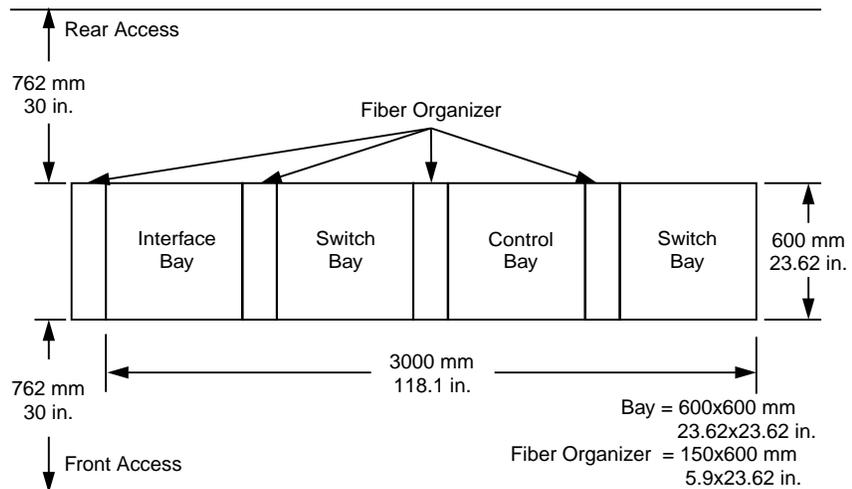
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The floor plan layout for the WaveStar LambdaRouter 256 3-bay configuration is shown in the following figure.



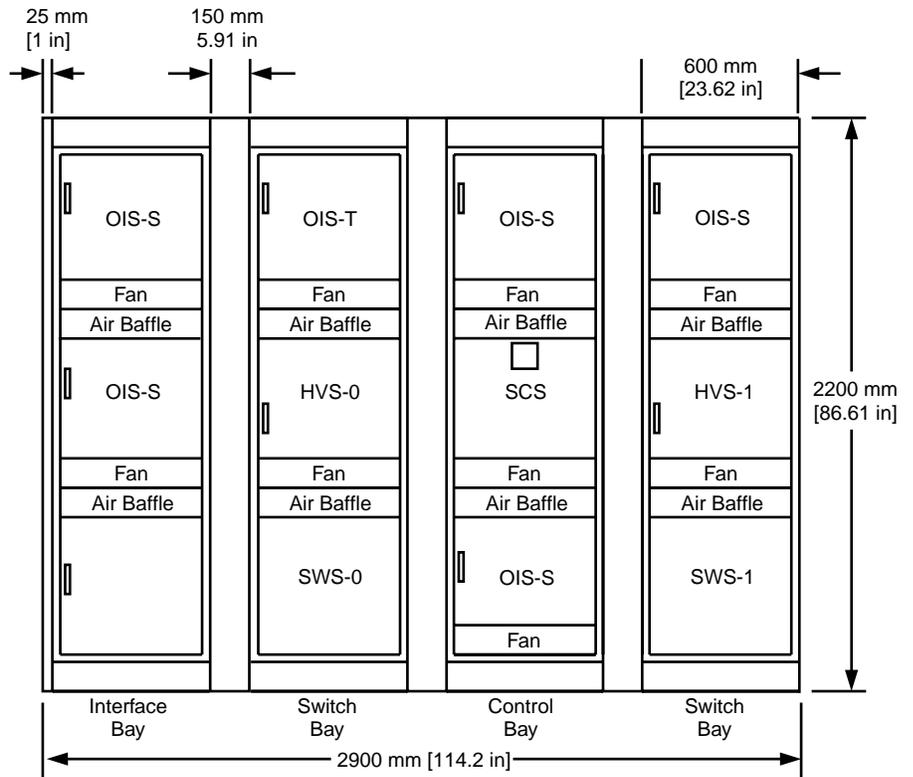
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The floor plan layout for the WaveStar LambdaRouter 256 4-bay configuration is shown in the next figure.



NC-LR1200-039

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



NC-LR1200-038



Provisioning and Fibering

Overview Because of the complexity of the many possible configurations of the WaveStar LambdaRouter 128/256, provisioning and fibering must be taken into account when planning your order.

The OIS-T is configured for only one type of port unit, namely, the transparent OXI circuit pack. 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 WaveStar LambdaRouter 256 can be provisioned for 224 input and 224 output ports. The WaveStar LambdaRouter 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.

OIS-T shelves can be partially provisioned, however, OIS-S shelves must be completely provisioned no matter how many packs will be inserted.

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 As delivered, only 1/2 of the OIS-T shelf is fibered in the start-up configuration of the WaveStar LambdaRouter 128/256. These fibers are called switch interface (SI) cables and, there are two different types: SI-Transparent (SI-T) for the transparent circuit pack, and SI-SONET/SDH (SI-S) for the opaque circuit packs. Refer to the next section, Cabling, 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-Ts.

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 WaveStar LambdaRouter 128/256 start-up configurations are:

- WaveStar LambdaRouter 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 transparent OXI packs.
- WaveStar LambdaRouter 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 transparent OXI packs; the OIS-S in this configuration does not include any fiber.
- WaveStar LambdaRouter 128. Two bays fully equipped with an SCS, HVS, SWS, and one OIS-T. The OIS-T is fibered for 16 transparent OXI packs.

OIS-T Beginning with a start-up configuration, 16 OXI 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 provisioned and, once provisioned, any of them can be populated with OXI packs and fibered with SI-T cables.

When a second OIS-T shelf is used in the WaveStar LambdaRouter 256, up to 96 ports can be provisioned to accommodate OXI packs.

OIS-S All slots in the OIS-S must be provisioned regardless of the extent of fiber. Although fiber can be field-installed incrementally, the OIS-S shelf type must be determined initially.

All shelves are provisioned in blocks of 16 ports. The first 16 slots of an OIS-S can be provisioned for OXI-10GC (16 ports) or OXI-2GC (32 ports) circuit packs.

The remaining 16 slots on the OIS-S can also be provisioned for OXI-10GC or OXI-2GC. Depending on how this provisioning is done, the resulting shelf is identified as:

- 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.



Cabling

Optical cabling The optical cabling for the WaveStar LambdaRouter 128/256 consists of connections made to the port units on the optical interface shelves. Refer to the previous section, Provisioning and Fiberling, 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 OXIs, OXI-10GCs, and OXI-2GCs are 8.3 micron single mode simplex Lucent MiniCord[®] cable or equivalent and terminated on the WaveStar LambdaRouter 128/256 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 (SI-T cables). There are two cables per OXI circuit pack and each fanout cable contains eight discrete fibers.

The fanout cable is terminated at one end with a multifiber connector, which connects to the back of the OXI 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 fanout cables (SI-S cables). Each fanout cable is a bundle of 32 discrete fibers.

The fanout cable is terminated at both ends with single-mode LC connectors. The single-connector end connects to the back of the OEO circuit pack, and at the other end, the 32 fanouts 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.

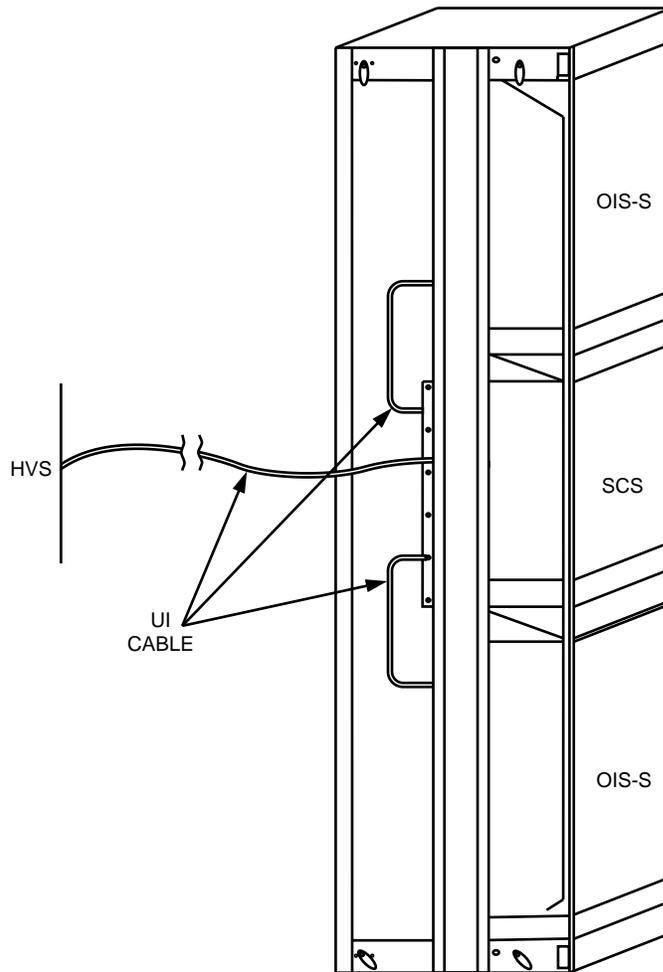
There are six cables per OIS-MX shelf; three per switch fabric side.

Electrical cabling The electric cabling for the WaveStar LambdaRouter 128/256 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 and SCS)	SCS-OIS-T SCS-OIS-S SCS-HVS	Shielded twisted pair	SCS: 2mm 5X6 Metral™ type	OIS-T/OIS-S: DSUB25 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.



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Power Cables

All shelves require power cables. The power cables provide very low loop voltage drop between the secondary power distribution point and the individual WaveStar LambdaRouter 128/256 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-Ts) or 65-amp (for OIS-Ss) 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.



Fiber Management

Fiber organizer The 150 mm [5.9 inches] spacer between 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 2200 x 600 mm [5.9 x 86.61 x 23.62 inches].

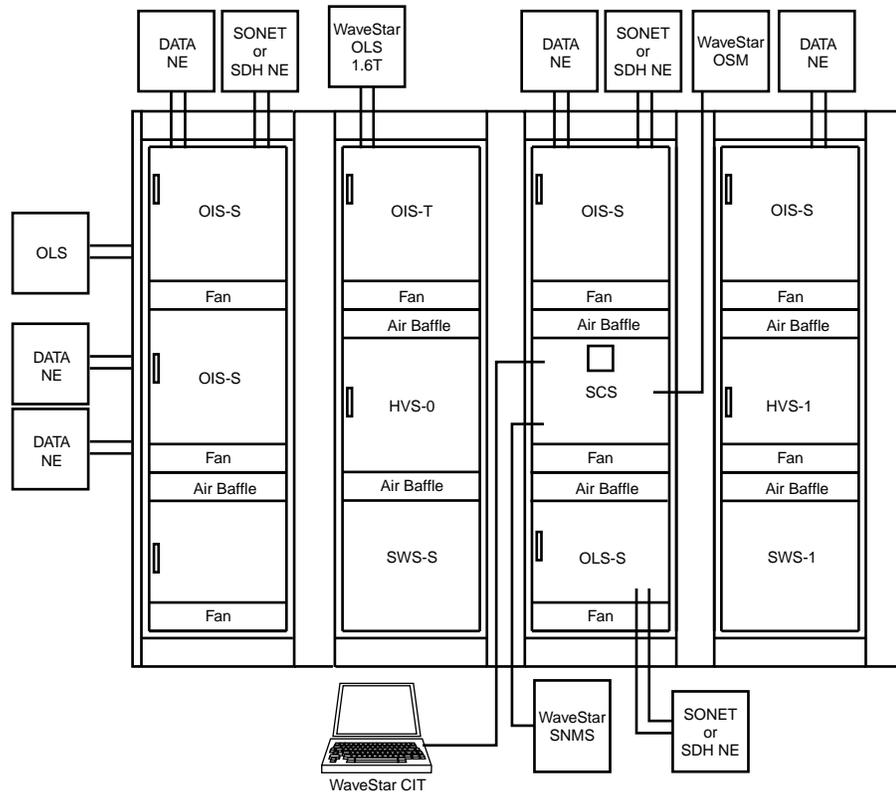
Overhead vs. underfloor cabling When planning your WaveStar LambdaRouter 128/256, you must consider the location of the equipment. Because of the number of cable connections required, customers must populate shelves that are nearest the cable source first in order to make room for subsequent equipment 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.



Interworking

Overview The WaveStar LambdaRouter 128/256 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.



NC-LR1200-037

In this view, the WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 256.

The WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 the customer signal is regenerated and then sent on to the next transmission link. Such an application is expected to occur in Intelligent Optical Networking.

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

Transparent interfaces

The transparent interfaces are purely optical and do not provide any optical to electrical to optical (OEO) conversion. On transparent interfaces, external equipment (such as an OLS) must support intermediate reach (Telcordia OC-48 IR-1/ITU S-16.1 or Telcordia OC-192 IR-2/ITU S-64.2b), very short reach (10 Gbps 12 dB as per ITU draft Rec. G.VSR), or long reach (LR) optics.

Connection of client signals to the WaveStar LambdaRouter 128/256 can be made to the transparent ports or by means of optical extensions provided by an OLS.

Opaque interfaces

The opaque interfaces provide monitoring of SONET overhead. These interfaces support short reach (Telcordia OC-48 SR/ITU I-16.1) and very short reach (Telcordia OC-192 SR-1/ITU I-64.1, 4dB) interfaces to external equipment.

Interfacing to the WaveStar LambdaRouter 128/256

The WaveStar LambdaRouter 128/256 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.

The typical transmission insertion loss (end-to-end with transparent interfaces) through the WaveStar LambdaRouter 128/256 is 8.3 dB.

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.



6 Operations Interfaces

Overview

Purpose This chapter describes the WaveStar LambdaRouter 128/256 operations interfaces.

Contents This chapter includes the following sections:

General	6-2
WaveStar CIT	6-4
WaveStar Optical Service Manager (OSM)	6-6
WaveStar SNMS	6-7
WaveStar NMS	6-8
RS-232 Terminal Access	6-9
Security Access	6-11
Application Messaging	6-13

General

Introduction There are remote and local operations interfaces supported by the WaveStar LambdaRouter 128/256, which provide for provisioning, administration, and maintenance functions.

The local operations interfaces consist of the WaveStar (CIT) Craft Interface Terminal and RS-232 terminal access. The remote operations interfaces include the WaveStar Optical Service Manager (OSM) and WaveStar SubNetwork Management System (SNMS).

User panels and office alarms, which may be considered as local operations interfaces, are described in the “Common Equipment” (4-22) section of Chapter 4, “Hardware Description”.

The operations interface employs 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 WaveStar LambdaRouter 128/256 supports File Transfer Protocol (FTP) for WaveStar LambdaRouter 128/256-to-Managing-System file transfers of generic and database files. The WaveStar implementation of FTP follows IETF STD 0009.

The WaveStar LambdaRouter 128/256 supports a single method of user interface accessible by the WaveStar SNMS and WaveStar CIT. These operations interfaces provide:

- a fully functional GUI through which most WaveStar LambdaRouter 128/256 tasks can be performed
- local/remote access control based on user privilege levels (password protected)
- network discovery and exploration for easy access to each network element in the local network
- displays of the WaveStar LambdaRouter 128/256 equipment and their states
- displays alarms
- support for user provisioning tasks
- support for software upgrades and backup and restore functions

- generation of equipage, cross-connection, and state reports.

Communication interface

The interface between the WaveStar LambdaRouter 128/256 and the operations environment—the WaveStar CIT, WaveStar SNMS, WaveStar OSM or other Managing System—is provided by the 802.3 compliant 10BaseT LAN.

One to three LAN connections can be used to interface to the customer's intraoffice (IAO) LAN. If an external hub is used on one of the LAN connectors, the number of possible LAN connections is increased. With external hubs, the number of possible LAN connections depends on the size and number of hubs used. For example, with a sixteen-port hub, the total number of available ports is the 15 ports in the hub plus the remaining three LAN connection ports.

If an external hub is used, it is connected to EI1 port 4 on the SCS. Refer also to the section, "EI" (4-16) in Chapter 4, "Hardware Description".



WaveStar CIT

Description The WaveStar CIT is a desktop or laptop computer loaded with the required WaveStar LambdaRouter 128/256 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 WaveStar CIT 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 WaveStar CIT user has the means for local and remote access with the CIT. Remote access uses an external WAN connection to the WaveStar LambdaRouter 128/256's LAN port.

The WaveStar CIT is generally co-located with the WaveStar LambdaRouter 128/256. The WaveStar CIT PC can be connected directly to the front of the WaveStar LambdaRouter 128/256 frame. This connection can also be made over the IAO LAN.

The WaveStar CIT provides detailed information and control of the following:

- Provisioning
- Loopback operation and testing
- Reporting
- Alarms
- Equipment view and status
- 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 WaveStar LambdaRouter 128/256.

Remote access A WaveStar CIT or other managing system connected to a WaveStar LambdaRouter 128 or WaveStar LambdaRouter 256 may remotely access other WaveStar LambdaRouter 128s and WaveStar LambdaRouter 256s on the network. The support capabilities are the same for both local and remote WaveStar LambdaRouter 128/256 systems.

Remote access requires TCP/IP connectivity from the local WaveStar LambdaRouter 128 or WaveStar LambdaRouter 256 to the remote WaveStar LambdaRouter 128 or WaveStar LambdaRouter 256. File transfers are accomplished by means of FTP.



WaveStar Optical Service Manager (OSM)

Description The WaveStar OSM communicates with all the WaveStar LambdaRouter 128/256 in a network to perform centralized end-to-end service provisioning and restoration across the network. The WaveStar OSM has a GUI and is used to set up network-wide optical paths and to calculate and assert restoration paths in response to network transmission failures.

The user logs on to the WaveStar LambdaRouter 128/256, in a fashion similar to that for the WaveStar SNMS, through the WaveStar OSM user interface. The WaveStar LambdaRouter 128/256 recognizes the user and logs session activities and performs other critical interactions.

Features The following features are available in the WaveStar OSM:

- optical cross-connect management
- multiple Quality of Service (QoS) service provisioning
- end customer GUI and service provider GUI
- end customer optical VPN management
- point-and-click, web-based user interface
- centralized restoration.



WaveStar SNMS

Description The WaveStar SNMS is an element management system (EMS) that supports the WaveStar LambdaRouter 128/256 through LAN connectivity and centralized element management functions. The WaveStar SNMS has a GUI and communicates with the WaveStar LambdaRouter 128/256 using TL1 messages. The WaveStar SNMS communicates with each WaveStar LambdaRouter 128 and WaveStar LambdaRouter 256 individually.

When used as an end-user system, WaveStar SNMS provides a Java®-based GUI for users to access and manage a WaveStar LambdaRouter 128/256 system with visibility down to the circuit pack and port levels. As an end-user system, WaveStar SNMS provides element management functions including fault, configuration, and security management.

After a successful login, the WaveStar SNMS then logs session activities and performs other critical interactions.



WaveStar NMS

Description The WaveStar Network Management System (NMS) is a management tool that provides comprehensive and integrated management of an entire transport network. WaveStar NMS can provide provisioning and maintenance management for the WaveStar LambdaRouter 128/256s and other network elements in the WaveStar LambdaRouter 128/256 network.

The WaveStar NMS interfaces with other systems, such as WaveStar SNMS, to provide complete network management from a single point.

Refer to the WaveStar NMS documentation listed in the “Documentation” (8-5) section of Chapter 8, “Product Support”.

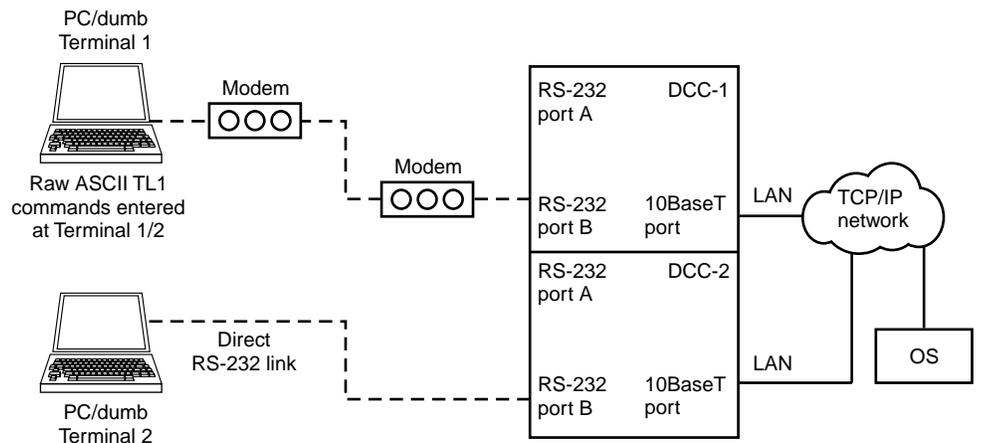


RS-232 Terminal Access

Description The RS-232 terminal access feature allows a WaveStar LambdaRouter 128/256 system to be provisioned using TL1 commands issued from a dumb terminal or 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 WaveStar LambdaRouter 128/256 dual independent RS-232 serial ports located on the System Controller Shelf (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 WaveStar LambdaRouter 128/256 using both a direct null modem link and a modem link.



NC-LR163

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 WaveStar LambdaRouter 128/256, 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.



Security Access

Introduction The following features provide security management functions for the WaveStar LambdaRouter 128/256:

- 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)

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.

WaveStar CIT user types

Predefined user types in the WaveStar CIT are used to set default values when establishing and modifying CIT user logins. These user types apply only to the CIT and not to the WaveStar LambdaRouter 128/256.

The five predefined user types are as follows:

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

□

Application Messaging

Overview The WaveStar LambdaRouter 128/256 communicates with the WaveStar CIT, WaveStar SNMS, and with other OSs using TL1 messages. TL1 messages include commands, responses, and system notifications.

A user logs into a WaveStar CIT, WaveStar SNMS, or other OS, and that system accesses the WaveStar LambdaRouter 128/256 to receive notifications and enter commands. The WaveStar LambdaRouter 128/256 is a multi-user system.

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

The WaveStar LambdaRouter 128/256 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.

The WaveStar LambdaRouter 128/256 can report database changes resulting from the entered commands to a user interface (for example, WaveStar SNMS) that has been provisioned for this feature.

System notifications

The following types of notifications are provided:

- Commands entered
- Command responses
- Protection switch changes
- Alarms
- Database changes
- System state changes.

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

Logs

The WaveStar LambdaRouter 128/256 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 *WaveStar LambdaRouter 128/256 Operations Systems Engineering Guide*.





7 Ordering

Overview

Purpose This chapter describes the WaveStar LambdaRouter 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	7-2
What You Need	7-4
Bays and Circuit Packs	7-5
Additional Equipment	7-9
Ordering Spares	7-13

How to Order

Start-up configuration In an effort to simplify the ordering process, the start-up configurations of the WaveStar LambdaRouter 128/256 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 should not be considered as complete—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 WaveStar LambdaRouter 128/256 Release 2.0 Ordering and Installation 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 WaveStar LambdaRouter 128/256 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 *WaveStar LambdaRouter 128/256 Ordering and Installation Information*, ED-9C324-10, which is available from the Lucent Technologies Customer Information Center (CIC). Refer to the Training and Documentation section of Chapter 8, “Product Support” for CIC 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 *WaveStar LambdaRouter 128/256 Software Ordering Guide* (Select Code 365-374-010), available from the CIC.

Placing your order

Contact your Lucent Account Executive to actually place your order for the WaveStar LambdaRouter 128/256 or any of its components.

What You Need

Initial ordering requirements

To obtain and install a WaveStar LambdaRouter 128/256, you will need to order the following items as a minimum:

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

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 circuit packs (including any installations with OEO circuit packs).

Spares and replacement items can also be ordered.



Bays and Circuit Packs

WaveStar LambdaRouter 256 start-up configurations

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

Transparent start-up configuration

Order the WaveStar LambdaRouter 256 transparent start-up configuration as comcode 848814786. 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 circuit packs (64 ports)
- All bay framework, including fiber organizers, for the three bays
- 32 8-fiber fanout SI-T cables (fiber bundles)
- Alarm and LAN cable
- 8 UI cables

Transparent/opaque start-up configuration

Order the WaveStar LambdaRouter 256 transparent/opaque start-up configuration as comcode 848817839. 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 circuit packs (64 ports)
- 1 Switch Bay with:
 - one fully equipped SWS
 - one fully equipped HVS
 - one OIS-S equipped with two OSWIC packs (this shelf contains no fibered)

- All bay framework, including fiber organizers, for the three bays
- 32 8-fiber fanout SI-T cables (fiber bundles)
- Alarm and LAN cable
- 8 UI cables

WaveStar LambdaRouter 128 start-up configuration

Order the WaveStar LambdaRouter 128 start-up configuration as comcode 848814778. 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 circuit packs (64 ports)
- All bay framework, including fiber organizers, for the two bays
- 32 8-fiber fanout SI-T cables (fiber bundles)
- Alarm and LAN cable
- 4 UI cables

Growth and interface equipment

To complete your WaveStar LambdaRouter 128/256 order, you must order circuit packs. Additionally, you may need to order SI cables, optical interface shelves, and an Interface Bay.

Fiberling is required for configurations using more than 64 transparent input and 64 transparent output ports, which includes any installation using OIS-Ss. Fiber bundles 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 bundle quantities:

- OIS-T requires 64 fiber bundles
- OIS-10G requires 4 fiber bundles
- OIS-2G requires 8 fiber bundles
- OIS-MX requires 6 fiber bundles

When ordering, note the provisioning rules associated with the WaveStar LambdaRouter 128/256. Refer to the section, Provisioning and Fiberling, 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 (fiberling is not included)
848748794	OIS-T growth kit which includes 2 SWICs and UI cabling (fiberling is not included)
109123059	OXI 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.
108883661	OXI-10GC circuit packs. Each circuit pack provides one input and one output port.
848523809	SI-T fiber bundle (OXI):23 ft
848748331	SI-T fiber bundle (OXI):35 ft (required only for OIS-T or OIS-S installations within an Interface Bay)
109030965	SI-S fiber bundle (OXI-10GC/OXI-2GC): 25 ft
109030973	SI-S fiber bundle (OXI-10GC/OXI-2GC): 35 ft (required only for WaveStar LambdaRouter 256 OIS-S installations within an Interface Bay)

Circuit pack codes The WaveStar LambdaRouter 128/256 circuit packs are identified by the codes listed in the following table.

Circuit Pack	CLEI Code	Apparatus Code	Comcode
MEM	WMPQABSC	LCY2AE	108730086
EI	WMC2807A	LCZ1AE	108730094
CSIEX	WMPQAB3C	LEZ1AE	108735127
SYS50D	WMPQABWC	LEY20BE	108735200
DCC	WMPQABUC	LEY2AE	108733189
HSWIC	WMPQAA3C	LGH1	108643842
OSWIC	WMPQAA3C	LGH1	108643842
	WM1CY10B	LGH1AE	109098913
HVDAC	WMW6HX0A	LGJ4	109154500
OXI	WMI7HHKA	LGK2	109123059
OXI-2GC	WMI3Y70A	LUU1AE	108883646
OXI-10GC	WMIU7TUD	LUU3AE	108883661



Additional Equipment

Software and documentation

You must order a software and documentation package for the WaveStar LambdaRouter 128/256. This package is described in the following table.

Comcode	Item
109161372	Software and documentation. This item includes the WaveStar LambdaRouter 128/256 software, the <i>WaveStar LambdaRouter 128/256 Software Release Description</i> (paper) and the user documentation on CD-ROM. The user documentation includes the following: <i>WaveStar LambdaRouter 128/256 Applications and Planning Guide</i> <i>WaveStar LambdaRouter 128/256 User Operations Guide</i> <i>WaveStar LambdaRouter 128/256 Alarm Messages and Trouble-Clearing Guide</i> <i>WaveStar LambdaRouter 128 Operations Systems Engineering Guide</i> <i>WaveStar LambdaRouter 256 Operations Systems Engineering Guide</i>

Documentation

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

Optical fiber

Fiber optic cable for WaveStar LambdaRouter 128/256 use must be 8.3 micron single-mode simplex Lucent MiniCord cable or equivalent and terminated on the WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 to remote network elements is not listed in the ordering codes provided in this chapter.

Power cables

Power cables must be ordered for the WaveStar LambdaRouter 128/256 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” (7-11).

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 (3658 mm) 6-gauge power cables	0.14 V
848773107	50 ft (3658 mm) 6-gauge power cables	0.6 V
848773115	75 ft (3658 mm) 6-gauge power cables	0.9 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 (3658 mm) power cables 6-gauge (16 mm)	0.12 V
848773081	50 ft (15240 mm) power cables 4-gauge (25 mm)	0.32 V
848773099	70 ft (22860 mm) power cables 2-gauge (35 mm)	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 (3658 mm) power cables 6-gauge (16 mm)	0.27 V
848773081	50 ft (15240 mm) power cables 4-gauge (25 mm)	0.72 V
848773099	70 ft (22860 mm) power cables 2-gauge (35 mm)	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 (15240 mm) power cables 4-gauge (25 mm)	1.02 V
848773149	50 ft (15240 mm) power cables 2-gauge (35 mm)	0.7 V
601950884	50 ft (15240 mm) power cables 6-gauge spliced to 2/0 cable	0.35 V
601950900	50 ft (15240 mm) power cables 6-gauge spliced to 4/0 cable	0.23 V
601956998	75 ft (22860 mm) power cables 6-gauge spliced to 4/0 cable	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: 2-gauge (35 mm) wire
848771853	2 45-amp connectors: 4-gauge (25 mm) wire
848771846	2 45-amp connectors: 6-gauge (16 mm) 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

Miscellaneous equipment The next table lists other orderable components (replacements) for the WaveStar LambdaRouter 128/256. Refer to the “Ordering Spares” (7-13) section for additional orderable items.

Comcode	Item
848812947	Cleaning kit refill
408549798	PCMCIA card
408280287	SCS/HVS/OIS-T fan filter (box of 25). Individual fan filters cannot be ordered.
408653046	OIS-S fan filter (box of 20). Individual fan filters cannot be ordered.
408544245	SCS circuit breaker
407838556	HVS circuit breaker
848640902	OIS-T circuit breaker

WaveStar CIT The WaveStar LambdaRouter 128/256 requires a WaveStar CIT. This is a customer-supplied PC or laptop computer on which the WaveStar CIT software is to be loaded. The requirements for this PC are given in the “WaveStar CIT requirements” (10-10) section of Chapter 10, “Technical Specifications”.

Upgrades The Release 2.0 WaveStar LambdaRouter 128 can be upgraded to a Release 2.0 WaveStar LambdaRouter 256. Order upgrade kit, 848820411.

To upgrade a WaveStar LambdaRouter R1.0 Diverse Duplex configuration to a WaveStar LambdaRouter 256 R2.0, contact your Lucent account executive.



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)
108733189 108735200 108730094 108730086 108735127	SCS circuit packs: DCC (apparatus code LEY2AE) SYS50D (apparatus code LEY20BE) EI (apparatus code LCZ1AE) MEM (apparatus code LCY2AE) CSIEX (apparatus code LEZ1AE)
109123059	OXI circuit pack (apparatus code LGK2)
108883661	OXI-10GC circuit pack (apparatus code LUU3AE)
108883646	OXI-2GC circuit pack (apparatus code LUU1AE)
408649564	SCS/HVS/OIS-T fan unit
408542231	OIS-S fan unit
848511408	OIS-T/HVS user panel
848732731	OIS-S user panel
408520765	Power filter for SCS, HVS, and OIS-T
408527851	Power filter 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 CSIEX (LEZ1AE)
OIS-T	2 SWICs (LGH1) maximum of 32 OXIs (LGK2)
OIS-S	2 SWICs (LGH1AE) maximum of 32 OXI-10GCs (LUU3AE) or 32 OXI-2GCs (LUU1AE)

Order spare interface packs (OXI/OXI-2GC/OXI-10GC) based on the number in your installation.





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	8-2
Technical Support	8-3
Training and Documentation	8-5

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 WaveStar LambdaRouter 128/256.

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

Technical Support

- Warranty** The WaveStar LambdaRouter 128/256 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 provide 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>



Training and Documentation

Course information and registration

Lucent Technologies offers courses in various aspects of the WaveStar product line, including the WaveStar LambdaRouter 128/256.

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 1-800-LUCENT8.

WaveStar LambdaRouter 128/256 courses

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

The available WaveStar LambdaRouter 128/256 courses are listed in the table below.

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

Documentation

Documentation supporting the WaveStar LambdaRouter 128/256 is shipped with the software, as follows:

- *WaveStar LambdaRouter 128/256 Release 2.0 Library*, CD-ROM
- *WaveStar LambdaRouter 128/256 Release 2.0 Software Release Description*, paper

Extra copies of the CD-ROM (Select Code 365-375-005) can be ordered. The CD-ROM contains the following documents, each of which can also be ordered in paper:

- *WaveStar LambdaRouter 128/256 Release 2.0 Applications and Planning Guide*, Select Code 365-375-000
- *WaveStar LambdaRouter 128/256 Release 2.0 User Operations Guide*, Select Code 365-375-001
- *WaveStar LambdaRouter 128/256 Release 2.0 Alarm Messages and Trouble-Clearing Guide*, Select Code 365-375-002
- *WaveStar LambdaRouter 128 Release 2.0 Operations Systems Engineering Guide*, Select Code 365-375-006
- *WaveStar LambdaRouter 256 Release 2.0 Operations Systems Engineering Guide*, Select Code 365-375-003

The *WaveStar LambdaRouter 128/256 Release 2.0 Installation Guide* (Select Code 365-375-004) is available to Lucent installers.

WaveStar LambdaRouter 128/256 drawings

The following WaveStar LambdaRouter 128/256 drawing is available.

- WaveStar LambdaRouter 128/256 Ordering and Installation Information, ED-9C324-10

Other documents

For customers using the WaveStar OSM, WaveStar SNMS or WaveStar NMS with the WaveStar LambdaRouter 128/256, the following documents are available:

- *WaveStar SubNetwork Management System (SNMS) Administration Guide*, Select Code 190-224-122
- *WaveStar Network Management System (NMS) Applications and Planning Guide*, Select Code 365-309-231
- *WaveStar Network Management System (NMS) Administration Guide*, Select Code 365-309-234
- *WaveStar Optical Service Manager (OSM) User Operations Guide for the Service Provider Operator*, Select Code 365-374-046
- *WaveStar Optical Service Manager (OSM) Applications and Planning Guide*, Select Code 365-374-045
- *WaveStar Optical Service Manager (OSM) User Operations Guide for the Enterprise Operator*, Select Code 365-374-047

Customers with WaveStar OLS 1.6T devices in their network may find information in the *WaveStar Optical Line Systems (OLS) 1.6T Application and Planning Guide*, Select Code 365-575-759.

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

Ordering documents

The WaveStar LambdaRouter 128/256 documents can be ordered as individual paper copies or as a set on CD-ROM from the Lucent Technologies Customer Information Center (CIC).

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 Inc. Customer Information Center Att: Order Entry Section 2855 N. Franklin Road P.O. Box 19901 Indianapolis, IN 46219	
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	1-317-322-6359
Asia/Pacific Region and Caribbean and Latin America Region	+317-322-6411	+317-322-6699
Europe, Middle East, and Africa	+441666832900	+441666832213



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	9-2
Component Sparing	9-3
System Reliability Specifications	9-6

Component Reliability Specifications

Circuit packs The table below shows the steady-state WaveStar LambdaRouter 128/256 circuit pack failure rates.

Circuit Packs	Apparatus Code	Failure Rate (FIT)
CSIEX	LEZ1AE	5900
DCC	LEY2AE	2700
EI	LCZ1AE	3900
HVDAC	LGJ4	5350
MEM	LCY2AE	1400
SWIC (OSWIC and HSWIC)	LGH1/LGH1AE	6000
OXI	LGK2	3871
OXI-10GC	LUU3AE	4223
OXI-2GC	LUU1AE	5762
SYS50D	LEY20BE	6200

MicroStar MEMS The table below shows the steady-state WaveStar LambdaRouter 128/256 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 for the WaveStar LambdaRouter 128/256.

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.

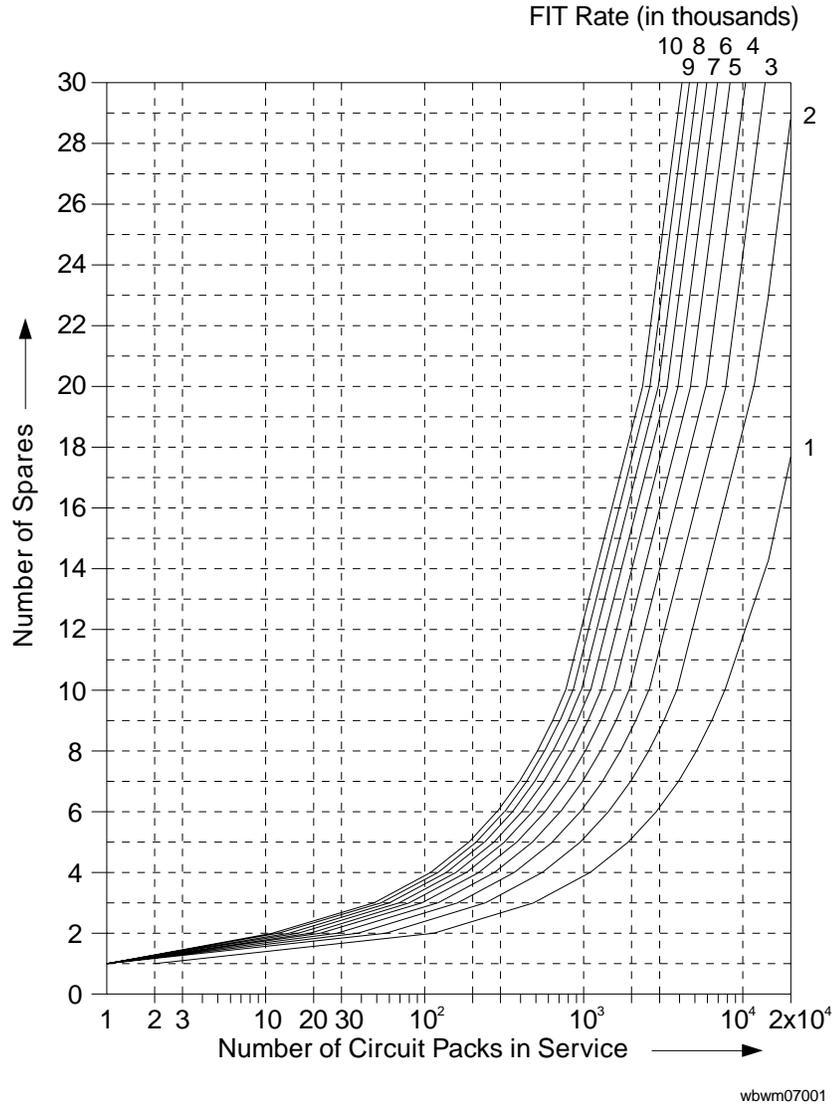
Use these graphs to determine how many spares are required for each piece of equipment (such as circuit packs and fan units) at each location to maintain 99.9 percent service continuity.

FITs are found in the tables earlier in this chapter.

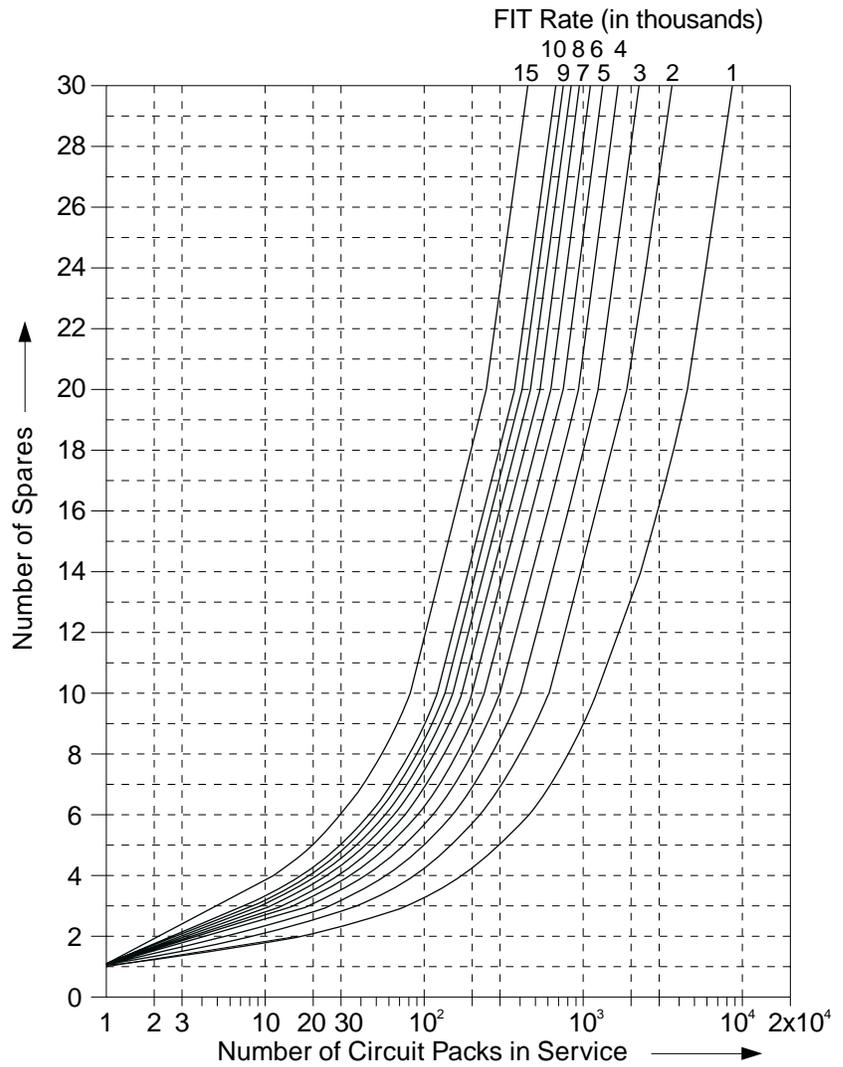
How to use the graphs To determine the number of spares, perform the following steps.

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.



wbwm07002

System Reliability Specifications

MTTR The mean time to repair (MTTR) assumption for the WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 is a maximum of 1.3. Therefore, the first-year failure rate is 1.3 times the steady-state failure rate.

Maintainability specifications The WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 due to system failures.

System Unavailability Metric	WaveStar LambdaRouter 256	WaveStar LambdaRouter 128
Total system	0.0016 min/year	1.5 min/year
Downtime per optical port (OXI)	1.6 min/year	1.6 min/year
Downtime per optical port (OXI-10GC)	3.8 min/year	3.8 min/year
Downtime per optical port (OXI-2GC)	3.4 min/year	3.4 min/year
Downtime for control and reconfiguration	2.7 min/year	2.7 min/year
Downtime for alarm visibility	2.7 min/year	2.7 min/year

MTBMA The following table shows the mean time between maintenance activities (MTBMA) for the WaveStar LambdaRouter 128/256.

Entity	MTBMA (months)
SWS	156.4
SCS	26.7
HVS	6.4
OIS-10G	8.7
OIS-2G	6.6
OIS-MX	7.5
OIS-T	9.4
System (all transparent)	3,3

Silent failures The WaveStar LambdaRouter 128/256 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.



10 Technical Specifications

Overview

Purpose This chapter provides technical specifications for the WaveStar LambdaRouter 128/256.

Contents This chapter includes the following sections:

Standards Compliance	10-2
Power	10-4
Transmission	10-6
Equipment Dimensions	10-8
Operations Interfaces	10-10
Environmental	10-11



Standards Compliance

Overview The WaveStar LambdaRouter 128/256 equipment complies with the following standards.

North America

- Safety
 - Listed to UL 1950, Third Edition
 - Certified to CSA C22.2 No. 950
- EMC
 - FCC Part 15 Class A
 - CSA 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 WaveStar LambdaRouter 128/256 transmission and control hardware meets Telcordia specification in GR-1339-CORE.

The WaveStar LambdaRouter 128/256 software and process quality are compliant with Telcordia specifications GR-282-CORE and TR-NWT-000179, respectively.

Safety The WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256.

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	OIS-S 4/0 OIS-T 2/0 HVS #2 AWG SCS #4 AWG
Voltage protection	Thresholds: -39V ± 0.5V (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 48 V	at 39.5 V	at 60 V
SCS	6.67 Amps/320 Watts	8.10 Amps/320 Watts	5.33 Amps/320 Watts
OIS-S	31.2 Amps/1496 Watts	37.9 Amps/1496 Watts	24.9 Amps/1496 Watts
HVS	9.16 Amps/440 Watts	11.46 Amps/440 Watts	7.33 Amps/440 Watts
OIS-T	8.75 Amps/420 Watts	10.6 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	1 OIS-S with 32 OXI-10GC packs	1936
Switch Bay	1 OIS-T with 32 OXI packs	860
Control Bay	2 OIS-Ss with 64 OXI-10GC packs	3312
Control Bay	1 OIS-T with 32 OXI packs (note that one shelf position is empty in this configuration)	740
Interface Bay	2 OIS-Ss with 64 OXI-10GC packs (note that one shelf position is empty)	2992

□

Transmission

Optical parameters The table below gives the optical parameters for the WaveStar LambdaRouter 128/256.

Parameter	Value
Optical pass band	1260—1360 nm and 1500–1620 nm
Maximum optical input power	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 5.6 dB Typical 8.3 dB Maximum 11.3 dB
Insertion loss (OXI ingress port to OEO internal receiver)	Minimum 5.3 dB Typical 7.8 dB Maximum 10.6 dB
Insertion loss (internal OEO transmitter to OXI egress port)	Minimum 5.0 dB Typical 7.4 dB Maximum 10.1 dB
Maximum OXI input signal level to prevent saturation of ingress power monitor	+25 dBm
Maximum OXI input signal level to prevent saturation of OXI egress power monitor	< +25 dBm (not an independent limit)
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	Telecordia SR-1/ITU I-64.1
OXI-2GC circuit pack client-side interworks with OC-48/STM-16 short reach/intra-office optics	Telecordia SR-1/ITU I-16

**Cross-connect
performance**

The WaveStar LambdaRouter 128/256 sustains a cross-connection completion rate of 20 cross-connection legs per second through the TL1 management interface.

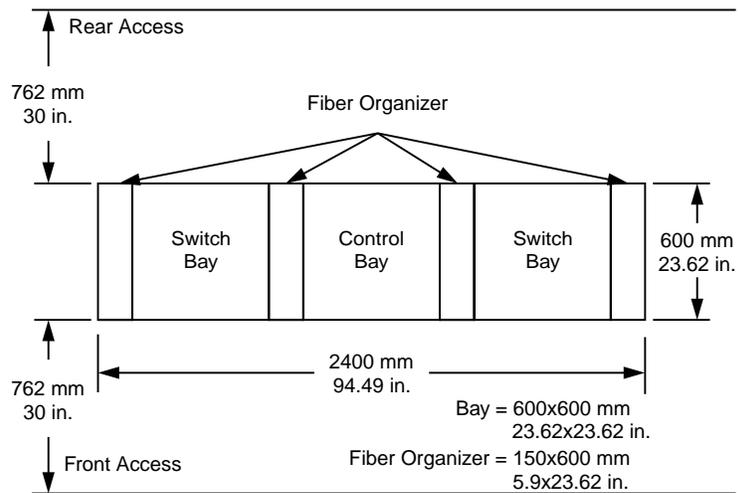


Equipment Dimensions

Circuit pack dimensions The dimensions for the WaveStar LambdaRouter 128/256 circuit packs are given in the following table.

Circuit Pack	Dimensions: mm [inches]		
	Height (board height)	Width (slot)	Depth
DCC	336 [13.23]	20 [0.79]	270 [10.63]
SYS50D	336 [13.23]	35 [1.38]	270 [10.63]
CSIEX	336 [13.23]	40 [1.57]	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-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 [86.61 in. x 23.62 in. x 23.62 in.], are identical for all of the WaveStar LambdaRouter 128/256 bays. There are also two Fiber Organizers located to the right and left of the each of the Switch Bays. The WaveStar LambdaRouter 128 has two Fiber Organizers. The WaveStar LambdaRouter 256 has four Fiber Organizers (shown in the following figure). These Fiber Organizers are 2200 mm x 150 mm x 600 mm [86.61 in. x 5.9 in. x 23.62 in.].



NC-LR1200-020

The widths for a WaveStar LambdaRouter 128/256 configurations vary depending on the number of bays in the configuration. The table below gives the widths for the WaveStar LambdaRouter 128/256 configurations. (Excluded from this table are the 1-inch end guards that may be used on the right and left ends of a WaveStar LambdaRouter 128/256 installation.)

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

Fan unit dimensions The dimensions for the WaveStar LambdaRouter 128/256 cooling equipment are given in the next table.

Equipment	Dimensions: mm [inches]		
	Height	Width	Depth
Fan (OIS-S)	57.5 [2.26]	537 [21.14]	342.7 [13.49]
Filter (OIS-S)	9.7 [0.38]	535 [21.06]	361 [14.23]
Fan	48 [1.89]	543 [21.38]	380 [14.96]
Filter	13.5 [0.53]	543 [21.38]	380 [14.96]

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 WaveStar LambdaRouter 128/256 communicates with the WaveStar CIT and WaveStar SNMS 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

WaveStar CIT requirements The following are the recommended requirements for the customer-furnished computer used for the WaveStar CIT:

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



Environmental

Floor loading The WaveStar LambdaRouter 128/256 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)	359 [806]
Control Bay (without optical interface shelves)	138 [311]
Control Bay (with 2 optical interface shelves)	216 [485]
Interface Bay (with no optical interface shelves)	102 [231]
Interface Bay (with two optical interface shelves)	180 [405]
WaveStar LambdaRouter 128 (2 bays)	497 [1117]
WaveStar LambdaRouter 256 (3 bays)	856 [1923]
WaveStar LambdaRouter 256 (4 bays)	1001 [2209]

Operating conditions The WaveStar LambdaRouter 128/256 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 WaveStar

LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 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	$30^{\circ}\text{C}/\text{hour}$ [$54^{\circ}\text{F}/\text{hour}$]
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	$30^{\circ}\text{C}/\text{hour}$ [$54^{\circ}\text{F}/\text{hour}$]
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	$30^{\circ}\text{C}/\text{hour}$ [$54^{\circ}\text{F}/\text{hour}$]
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 Base T
	10G 10 Gigabits per second
	100BT 100 Base T
	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
	AID Access Identifier
	AINS Automatic In-Service
	AIS Alarm Indication Signal
	AIS-L Alarm Indication Signal-Line

AIS-MS Alarm Indication Signal-Multiplex Section

ALM Alarm

ANR Abnormal

ANSI American National Standards Institute

APP Apparatus Code

APR Automatic Power Reduction

ARP Address Resolution Protocol

ARST Autonomous Reset

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 Base-T

C **CARES** Customer Assistance Request Entry System

CC Communication Client

CCD CTLI-D Controller Device

CIC Customer Information Center

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

CSIEX Control System Interface Expander

CSMA/CD Carrier Sense Multiple Access/Collision Detect

CSR Composite Service Request

CTL Controller

CTLI-D Control Interface to Devices

CV Coding Violation

D **DAC** Digital-to-Analog Converter

DATAFLT Database Fault

DBCHG Database Change

DCC Data Communications Controller; Data Communications Channel

DCE Data Communications Equipment

DCN Data Communications Network

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

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
- 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
- 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
 - MMIS** Memory Mismatch
 - MN** Minor
 - MON** Monitoring
 - MS** Multiplex Section
 - 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

○ **OC-n** Optical Carrier <number>

OCH Optical Channel

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

OOF Out of Frame

OOS Out of Service

OOS-MA Out of Service Management

OPI Operations Peripheral Interface

OPR Operate

OS Operations System

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

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

PMD Polarization Mode Dispersion

POR Power On Reset

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 **RS** Regenerator Section

RTAC Regional Technical Assistance Center

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

SELV Safety Extra Low Voltage

SF Signal Fail

SI Switch Interface

SID Source Identifier

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

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

UEQ Unequipped

UI Unit Interface

UIA Unit Interface Appliance

UID User Identification

UL Underwriters Laboratories

UNEQ Unequipped

UPC User Privilege Code

V **V/V** Voltage to Voltage

VPN Virtual Private Network

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 WaveStar LambdaRouter 128/256 Release 2.0 feature in which connections between WaveStar LambdaRouter 128/256 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 supported in WaveStar LambdaRouter 128/256. 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 WaveStar LambdaRouter 128/256 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.

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.

Air Baffle

A WaveStar LambdaRouter 128/256 bay component that facilitates air intake and exhaust.

Alarm

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

Alarm Correlation

A WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 status report that lists active alarms on the network element. It includes alarm level and type, affected equipment, effect on service, probably cause, and additional details of the failure, if available.

Alarm Log

A history and time sequence of the setting and clearing of alarms on the WaveStar LambdaRouter 128/256. 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 three types of WaveStar LambdaRouter 128/256 alarm messages: Optical Channel, Equipment, or Common 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 WaveStar LambdaRouter 128/256. 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.

Auto-Provisioning

The capability of the WaveStar LambdaRouter 128/256 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

In WaveStar LambdaRouter 128/256, the capability to copy and restore databases between Primary Non-Volatile Memory (NVM) and Secondary NVM, Primary NVM and WaveStar SNMS, and Primary NVM and WaveStar CIT.

Bandwidth

Throughput capacity in a transmission channel.

Bandwidth Management

The capability that allows WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256.

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 WaveStar LambdaRouter 128/256 to repeat the text of entered commands to a user provisioned for this feature.

Command Functional Categories

Logical groupings of WaveStar LambdaRouter 128/256 commands. These include maintenance (M), provisioning (P), security (S), and test (T).

Command Group

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

Common Alarm

A WaveStar LambdaRouter 128/256 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.

Compact Duplex (CD)

1. Generic term for the WaveStar LambdaRouter architecture of one logically segregated switch fabric. 2. Specific term for the WaveStar LambdaRouter Release 1.0 two-bay configuration. It comprises one Switch Shelf, one High-Voltage Shelf, one System Controller Shelf, and one Optical Interface Shelf.

Compact Duplex 2 (CD2)

Software term for the WaveStar LambdaRouter 128 Release 2.0 configuration.

Configuration Management (CM)

The activities necessary to create, modify, retrieve, and delete data that controls the configuration and operation of WaveStar LambdaRouter 128/256 hardware and software. These activities include equipment provisioning, alarm monitoring and fault management, cross-connection management, and software management.

Configuration Query

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

Control Bay

The WaveStar LambdaRouter 128/256 frame that contains one System Controller Shelf and up to two Optical Interface Shelves. There is one Control Bay per WaveStar LambdaRouter 128/256 system.

Control System Interface Expander (CSIEX)

The WaveStar LambdaRouter 128/256 circuit pack that expands the number of internal interfaces to and from the SYS50D circuit pack. It is located in the System Controller Shelf.

Controller Reset

The capability of rebooting shelf controllers locally (manually, on equipment) and through command. WaveStar CIT or WaveStar SNMS or other managing system can reset the WaveStar LambdaRouter 128/256 system or shelf controllers without affecting transmission.

Craft Interface Terminal (CIT)

See WaveStar CIT (Craft Interface Terminal).

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 WaveStar LambdaRouter 128/256 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

A WaveStar CIT 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 typology or loopback type, 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. WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 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. In WaveStar LambdaRouter 128/256 Release 2.0 there are two DCC packs on the System Controller Shelf, for active/active service.

Database Labeling

A WaveStar LambdaRouter 128/256 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.

Diagnostics

In WaveStar LambdaRouter 128/256, the capability to test a range of equipment and software entities. Some diagnostics run autonomously (for example, during boot or circuit pack insertion). Others are on-demand, on either an in-service basis (for example, LED test) or out-of-service basis (for example, cable testing).

Dialog Box

A secondary WaveStar CIT window designed to allow the user to enter additional information.

Dimmed State

The condition of a graphical user interface (GUI) control whose normal functionality is not currently available to a user. This state is indicated on the WaveStar CIT 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 WaveStar LambdaRouter 128/256, the capability to make small adjustments to the orientation of ingress and egress switch fabric mirrors in order to minimize cross-connection signal loss.

Diverse Duplex (DD)

1. Generic term for the WaveStar LambdaRouter architecture of two diverse switch fabrics separated by a bay. 2. Specific term for the WaveStar LambdaRouter [256] Release 1.0 three-bay configuration. It comprises two Switch Shelves, two High-Voltage Shelves, one System Controller Shelf, and two Optical Interface Shelves.

Diverse Duplex 2 (DD2)

Software term for the WaveStar LambdaRouter 256 Release 2.0 configuration.

Download

The process of transferring files from a managing system such as the WaveStar CIT or WaveStar SNMS to a network element, such as WaveStar LambdaRouter 128/256. Both software and data can be downloaded to the WaveStar LambdaRouter 128/256. *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.

Enabled

The state in which an equipped subsystem or component is fully capable of operation.

End Guard

A panel that is installed at ends of a WaveStar LambdaRouter 128/256 bay lineup; it meets ETSI standards.

Entity

A specific piece of hardware (usually a circuit pack, slot, or module) that has been assigned a name recognized by the system.

Entity Identifier

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

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 WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256. 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 WaveStar LambdaRouter 128/256 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 management system.

External Interface (EI)

The WaveStar LambdaRouter 128/256 circuit pack that provides interfaces to the Data Communications Controller (DCC) circuit pack, WaveStar 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 WaveStar LambdaRouter 128/256, 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 WaveStar LambdaRouter 128/256, 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 WaveStar LambdaRouter 128/256.

Failure

A persistent 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.

Fan Filter

A field-replaceable part that keeps dust and debris out of the Fan Unit. There are two types of Fan Filters in the WaveStar LambdaRouter 128/256: OIS-S Fan Filters and SCS/HVS/OIS-T Fan Filters.

Fan Unit

A field-replaceable module that provides forced air cooling for the WaveStar LambdaRouter 128/256. There are two types of Fan Unit: SCS/HVS/OIS-T Fan Unit and OIS-S Fan Unit.

Far End (FE)

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.

WaveStar LambdaRouter 128/256 provides continuous, autonomous, in-service fault detection and isolation on transmission and control equipment.

Fault Management

In WaveStar LambdaRouter 128/256, 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 WaveStar LambdaRouter [256] Release 1.0 and WaveStar LambdaRouter 128/256 Release 2.0, a Switch Shelf panel that contains connectors for 256 inputs and 256 outputs.

Fiber Management Unit

A WaveStar LambdaRouter 128/256 Release 2.0 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 WaveStar LambdaRouter 128/256 for transfer of software and data between the network element and its management system and between network elements.

G General User

A WaveStar CIT 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 WaveStar LambdaRouter 128/256, WaveStar CIT, or 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 WaveStar CIT.

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 WaveStar LambdaRouter 128/256 Release 2.0 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 WaveStar LambdaRouter 128/256 Release 2.0 shelf that houses High-Voltage Digital-to-Analog Converter (HVDAC) circuit packs.

High-Voltage Shelf/Optical Interface Shelf (HVS/OIS) User Panel

The WaveStar LambdaRouter 128/256 Release 2.0 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 WaveStar LambdaRouter 128/256 Release 2.0 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 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.

L Labeling

The WaveStar LambdaRouter 128/256 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

See WaveStar LambdaRouter; WaveStar LambdaRouter 128; WaveStar LambdaRouter 256.

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.

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. WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 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 Cross-Connection

A diagnostic tool used to evaluate the functions of WaveStar LambdaRouter 128/256 mirrors without involving ports.

Maintenance User

A WaveStar CIT 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 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 WaveStar LambdaRouter 128/256 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 and communicates with the CSIEX circuit packs. 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 WaveStar LambdaRouter 128/256 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.

Module

A self-contained entity that performs a well-defined function in the system.

N Network Element (NE)

A telecommunications network node that supports network transport services and is directly manageable by a management system.

Network View

The WaveStar CIT screens and menu options used to set up an association with network elements or to administer the WaveStar CIT GUI itself.

Node

All equipment that is controlled by one system controller. A node is not always directly manageable by a management 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 WaveStar LambdaRouter 128/256 Release 2.0 opaque interfaces are the OXI-10GC and OXI-2GC.

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 WaveStar LambdaRouter 128/256, operations interfaces include equipment LEDs, user panels, WaveStar CIT, 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 WaveStar SNMS (SubNetwork Management System).

Operator

User of the system with operator-level user privileges.

Optical Channel Alarms

A WaveStar LambdaRouter 128/256 alarm message category that reports input signal failures and are issued against an input port. Optical channel alarms include the following fault conditions: loss of monitored input power, detection of Alarm Indication Signal-Line, SONET/SDH failures (Loss of Signal [LOS], Loss of Frame [LOF], Signal Fail B2 Excessive Bit Error Rate [EBER], Signal Degrade B2 Bit Error Rate [BER], Alarm Indication Signal-Line/Multiplex Section (AIS-L/AIS-MS)), Unequipped, and Trace Mismatch.

Optical Channel Management

A WaveStar LambdaRouter 128/256 application that enables adding, dropping or connecting of services traffic through the network, through optical line systems (OLSs).

Optical Cross-Connect Interface (OXI)

1. A generic term for any transmission interface used in WaveStar LambdaRouter 128/256, including, in Release 2.0, the OXI transparent packs and the OXI-10GC and OXI-2GC opaque packs. 2. The name of the transmission interface circuit pack that performs optical splitting, power monitoring, and rate- and format-independent switching for signals to and from the network element. OXIs are located in the Optical Interface Shelf (WaveStar LambdaRouter Release 1.0) and Optical Interface Shelf-Transparent (WaveStar LambdaRouter 128/256 Release 2.0). Each transparent OXI pack provides four input and four output ports.

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

A WaveStar LambdaRouter 128/256 Release 2.0 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 WaveStar LambdaRouter 128/256 Release 2.0 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 Interface Shelf (OIS)

1. A generic term for any transmission interface shelf used in WaveStar LambdaRouter 128/256, 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. 2. The name of the WaveStar LambdaRouter [256] Release 1.0 shelf that contains the Optical Cross-Connect Interface (OXI) circuit packs. The corresponding shelf in WaveStar LambdaRouter 128/256 Release 2.0 is the Optical Interface Shelf-Transparent (OIS-T).

Optical Interface Shelf-2.5 Gbps (OIS-2G)

The WaveStar LambdaRouter 128/256 Release 2.0 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 WaveStar LambdaRouter 128/256 Release 2.0 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 WaveStar LambdaRouter 128/256 Release 2.0 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 WaveStar LambdaRouter 128/256 Release 2.0 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 WaveStar LambdaRouter 128/256 Release 2.0 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 WaveStar LambdaRouter 128/256 and customer equipment. Each OIS-S contains opaque circuit packs and cannot contain transparent circuit packs.

Optical Interface Shelf-Transparent (OIS-T)

The WaveStar LambdaRouter 128/256 Release 2.0 shelf that contains the transparent OXI circuit packs. Each OIS-T contains as many as 32 OXI circuit packs and two Switch Interface Controllers (SWICs).

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 400G/800G/1.6T 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.

Personal Computer Memory Card International Association (PCMCIA) card

Non-volatile memory in a form similar to a floppy disk. WaveStar LambdaRouter 128/256 program and configuration data are stored on a PCMCIA card in the MEM circuit packs.

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 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-10GC, and OXI-2GC are the WaveStar LambdaRouter 128/256 Release 2.0 port units.

Power Filter Voltage Protection (PFVP) Unit

A WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256. *See also* Memory.

Privilege Code

See User Privilege Code.

Privileged User

A WaveStar CIT 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 WaveStar LambdaRouter 128/256 network element or WaveStar CIT.

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. WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 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

WaveStar LambdaRouter 128/256 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.

R Rapid Network Restoration

A WaveStar LambdaRouter 128/256 application that enables speedy restoration of services via alternate paths by removing the need for manual recabling operations. WaveStar LambdaRouter 128/256 offers 1+1 pre-planned and pre-provisioned network restoration.

Rapid Service Provisioning

A WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 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.

Reliability

The ability of a software system to perform its required functions under stated conditions for a stated period of time, or the probability for equipment to fulfill its function.

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

A WaveStar CIT user type with permissions to access only those capabilities that retrieve information from the system but do not modify the system.

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 WaveStar LambdaRouter 128/256 Release 2.0 for software installation. *See also* Personal Computer Memory Card International Association (PCMCIA) card.

Scripting

The WaveStar CIT 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 WaveStar LambdaRouter 128/256. *See also* Memory.

Section Trace (J0 Byte) Mismatch

An indication of a defect that occurs when an Accepted Section Trace Identifier does not match the provisioned Expected Section Trace Identifier on an incoming signal.

Security Administrator

1. A WaveStar CIT 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 WaveStar LambdaRouter 128/256 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 Log

A WaveStar LambdaRouter 128/256 file of all security-related events. It is stored in non-volatile memory of the network element.

Security Management

In WaveStar LambdaRouter 128/256, 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)

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 WaveStar CIT 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

A WaveStar CIT 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

In WaveStar LambdaRouter 128/256 Release 2.0, the capability of the system to inject a keep-alive or test signal on any output transmission interface where electrical to optical conversion is done, for the purposes that are served by Unequipped and AIS-L signals.

Signal Maintenance

In WaveStar LambdaRouter 128/256 Release 2.0, 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 WaveStar LambdaRouter 128/256, the delivery to a customer of network element generic software, WaveStar CIT 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 WaveStar CIT 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.

Start-up Configuration

1. In WaveStar LambdaRouter 256 Release 2.0, an orderable three-bay configuration that includes one System Controller Shelf (SCS), two High-Voltage Shelves (HVS), two Switch Shelves (SWS), and either one Optical Interface Shelf-Transparent (OIS-T) and one Optical Interface Shelf-SDH/SONET (OIS-S), or two Optical Interface Shelf-Transparent (OIS-T). 2. In WaveStar LambdaRouter 128 Release 2.0, an orderable two-bay configuration that includes one System Controller Shelf (SCS), one High-Voltage Shelf (HVS), one Switch Shelf (SWS), and one Optical Interface Shelf-Transparent (OIS-T).

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. A WaveStar CIT user type with highest level of permissions to access the system. Up to two superusers logins and passwords may be created on the WaveStar CIT. 2. A WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 Release 2.0, 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 WaveStar LambdaRouter 128/256 circuit pack that provides control functions for optical cross-connect interface (OXI) 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 WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 Release 2.0, 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 WaveStar LambdaRouter 128/256 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 Bay

The WaveStar LambdaRouter [256] Release 1.0 bay that houses the system control circuit packs. The comparable WaveStar LambdaRouter 128/256 Release 2.0 bay is the Control Bay.

System Controller Complex

The grouping of a SYS50D circuit pack, Control System Interface Expander (CSIEX), 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 WaveStar LambdaRouter 128/256 Control Bay. It contains the SYS50D and other control packs.

System Controller Shelf (SCS) User Panel

The WaveStar LambdaRouter 128/256 Release 2.0 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 a WaveStar CIT 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

A WaveStar CIT 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.

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 WaveStar CIT and WaveStar LambdaRouter 128/256.

Transmission Control Protocol/Internet Protocol (TCP/IP)

Networking protocols used by WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256. The WaveStar LambdaRouter 128/256 Release 2.0 transmission interfaces are the Optical Cross-Connect Interface (OXI) transparent bidirectional ports, and the Optical Cross-Connect Interface-10 Gbps (OXI-10GC) and Optical Cross-Connect Interface-2.5 Gbps (OXI-2GC) 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 Optical Cross-Connect Interface (OXI) circuit packs are the WaveStar LambdaRouter 128/256 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 WaveStar CIT software and accesses network elements. The WaveStar LambdaRouter 128/256 UIA is a PC or laptop with 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 WaveStar LambdaRouter system to be upgraded to a higher capacity WaveStar LambdaRouter system, or an earlier version/release WaveStar LambdaRouter system to be upgraded to a later version/release WaveStar LambdaRouter system.

Upload

The process of transferring files from a network element to a management system. WaveStar LambdaRouter 128/256 can only upload data. *See also* Download.

Upstream

At or toward the source of the considered transmission stream.

User ID (UID)

A WaveStar CIT or WaveStar LambdaRouter 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 AIL, 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 Notification Registration List

A security feature that determines what messages a WaveStar LambdaRouter 128/256 user is allowed to receive.

User Panels

Components on each shelf of the WaveStar LambdaRouter 128/256 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 a WaveStar CIT to the system.

Temperature monitoring, ESD wrist strap ground connectors, and WaveStar CIT 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 WaveStar CIT or WaveStar LambdaRouter 128/256. 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 WaveStar CIT do not apply to WaveStar LambdaRouter 128/256.

User Record

Data associated with each user on a WaveStar CIT or other managing system and on the WaveStar LambdaRouter 128/256 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 WaveStar LambdaRouter 128/256 file of all user-initiated commands from login through logout.

User Type

Assigned privilege codes for WaveStar CIT 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, concerning transmitters and receivers in a system, that insures that transmission can be maintained for very short distances. *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)

The user interface terminal used by craft personnel to communicate with the network element. The WaveStar CIT 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.

WaveStar® LambdaRouter

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 supports as many as 256x256 input and output ports.

WaveStar® LambdaRouter 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 supports as many as 128x128 input and output ports.

WaveStar® LambdaRouter 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 supports as many as 256x256 input and output ports.

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)

A Lucent product that provides element management functionality for a variety of networking products, including WaveStar LambdaRouter 128/256.

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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