NTY410AK

Nortel

Optical Metro 5100/5200

Planning Guide

Standard Release 8.0 Issue 1 April 2005

What's inside...

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Contents

About this document

This document provides an overview of the new features and enhancements for Release 8.0 of the Nortel Optical Metro 5100/5200 (identified prior to Release 7.0 as Nortel Networks OPTera Metro 5000-series Multiservice Platform).

This planning guide contains the following information:

- description of the new hardware features
- description of the operations, administration, maintenance and provisioning (OAM&P) features and enhancements
- summary of supported configurations
- planning information and technical specifications
- references for additional information

To keep the planning guide concise and to ensure minimal overlap with other documents, the following information is not included:

- detailed installation information. For information on installation, see *Installing Optical Metro 5200 Shelves and Components,* 323-1701-201 and *Installing Optical Metro 5100 Shelves and Components,* 323-1701-210 in the *Optical Metro 5100/5200 Multiservice Platform Technical Publications,* NT0H65AM.
- detailed link and network planning information. For more information see *Network Planning and Link Engineering,* 323-1701-110 in the *Optical Metro 5100/5200 Technical Publications,* NT0H65AM.
- detailed ordering information. For more information see the ordering information chapter in *Network Planning and Link Engineering,* 323-1701-110 in the *Optical Metro 5100/5200 Technical Publications,* NT0H65AM.
- detailed commissioning information. For more information see *Commissioning Procedures*, 323-1701-220 in the *Optical Metro 5100/5200 Technical Publications,* NT0H65AM.

Audience for this document

The audience for this document includes customers and groups that work with Nortel Networks in the planning, marketing, or deployment of the Optical Metro 5100/5200 Release 8.0.

Technical assistance service telephone numbers

For technical support and information from Nortel Networks, refer to the following table.

Technical Assistance Service	
For service-affecting problems: For 24-hour emergency recovery or software upgrade support, that is, for: • restoration of service for equipment that has been carrying traffic and is out of service • issues that prevent traffic protection switching • issues that prevent completion of software upgrades	**North America:** 1-800-4NORTEL (1-800-466-7835) **International:** 001-919-992-8300
For non-service-affecting problems: For 24-hour support on issues requiring immediate support or for 14-hour support (8 a.m. to 10 p.m. EST) on upgrade notification and non-urgent issues.	**North America:** 1-800-4NORTEL (1-800-466-7835) ***Note:*** You require an express routing code (ERC). To determine the ERC, see our corporate Web site at www.nortel.com. Click on the Express Routing Codes link. **International:** Varies according to country. For a list of telephone numbers, see our corporate Web site at www.nortel.com. Click on the Contact Us link.
Global software upgrade support:	**North America:** 1-800-4NORTEL (1-800-466-7835) **International:** Varies according to country. For a list of telephone numbers, see our corporate Web site at www.nortel.com. Click on the Contact Us link.

Introduction

In this chapter

Optical Metro 5100/5200 system description

The Optical Metro 5100/5200 platform includes the Optical Metro 5200 and the Optical Metro 5100 systems. Optical Metro 5200 is a high-speed system that carries up to 40 Gbit/s of protected capacity in a compact footprint that is less than two cubic feet. The Optical Metro 5100 is a less expensive alternative to the Optical Metro 5200 that provides affordable access to WDM networks supporting most of the functionality provided by the Optical Metro 5200 and supporting up to four wavelengths on each shelf. The Optical Metro 5100/5200 complies with standards published by the American National Standards Institute (ANSI), the European Telecommunications Standards Institute (ETSI), and the Network Equipment Building System (NEBS).

The Optical Metro 5100/5200 platform delivers true optical networking and reduces the need for repeated electrical-to-optical conversions through superior wavelength management and passive optical pass-through. By using Optical Metro 5100/5200 technology, you can build high availability networks that are easy to manage.

The Optical Metro 5100/5200 uses the following WDM technologies:

- ITU-T 200 GHz DWDM—offers deployment of 32 ITU-T compliant 200 GHz C-band and L-band channels with optical pass-through for high network availability. 200 GHz DWDM systems consist of Optical Metro 5200 products only.

- ITU-T 100 GHz DWDM—offers deployment of 36 ITU-T compliant 100 GHz C-band channels with optical pass-through for high network availability. 100 GHz DWDM systems consist of Optical Metro 5100/5200 terminal nodes interworking with the Common Photonic Layer product.
- CWDM—offers a cost-effective method of deploying eight channels in networks that do not require as much bandwidth or reach. CWDM systems consist of Optical Metro 5100 and Optical Metro 5200 products.
- ITU CWDM—offers a cost-effective method of deploying eight ITU CWDM compliant channels, (per ITU-T WD16-8 CWDM standard in definition). ITU CWDM systems consist of Optical Metro 5100 and Optical Metro 5200 products.

New hardware features

Release 8.0 introduces the following new hardware:

- Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

  The Muxponder 10 Gbit/s GbE/FC VCAT (also referred to as multiplexer optical transponder, or MOTR) aggregates up to nine full-rate Gigabit Ethernet, up to ten full-rate FC-100/FICON client interface signals or up to five full-rate FC-200/FICON Express client interface signals onto an STS-192/STM-64 signal that is digitally wrapped according to G.709 recommendations for transmission on a single wavelength over the Optical Metro 5100/5200 system. This card builds upon the Release 7.0 introduced Muxponder 10 Gbit/s GbE/FC circuit pack with additional functionality like V-cat support.

- OFA VGA circuit pack

  The optical-fiber amplifier/variable gain amplifier (OFA VGA) circuit pack is a three-slot circuit pack specific to the Optical Metro 5200 shelf. The OFA VGA uses an erbium doped fiber amplifier (EDFA) to amplify C-band or L-band signals. It uses an eVOA (electrically controlled variable optical attenuator) to provide amplifier band power control. The integrated eVOA along with enhanced software power control provide superior operational simplicity and improved extended reach capabilities over the Standard and High Input Power amplifiers.

- APBE Enhanced circuit pack

  The APBE Enhanced circuit pack is form, fit, and function equivalent to the APBE circuit pack with improved insertion loss.

- OCLD/OTR 2.5 Gbit/s Universal circuit packs

  The new OCLD/OTR 2.5 Gbit/s Universal circuit packs can be used in normal, extended reach and extended metro applications. The benefit of the new Universal circuit pack over the existing OCLD/OTR 2.5 Gbit/s Flex circuit pack is that it eliminates the need for three different, reach-specific circuit packs. A single Universal circuit pack also simplifies the ordering process, and provides additional optical link reach at no additional cost. The Universal circuit packs also offer increased performance in 2.5G-only designs.

- OMX 4CH CWDM with dual taps

  The OMX 4CH CWDM with dual taps is based on the existing OMX 4CH CWDM with the following new functionality:

  — 5% optical tap at the OTS IN port

  — 2% optical tap at the OTS OUT port

  — improved isolation specifications

  — new drawer providing openings on the faceplate to access the monitor ports. The drawer does not need to be opened to access the monitor ports. The monitor ports are labeled as “OTS IN MONITOR” and “OTS OUT MONITOR”.

- Patch panel 20 port

  The Patch panel 20 port is a 20-port version of the existing Patch panel 16 port. The Patch panel 20 port is used in the same applications as the Patch panel 16 port, and in the Muxponder 10 Gbit/s GbE/FC VCAT client-side connection application. The four additional ports of the Patch panel 20 port are required in this application because the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack has a total of 20 client signals (10 ports of Rx and Tx) on each circuit pack.

- Enhancement to Extended Metro DWDM Solution with DSCM

  The maximum reach of an optical span in an Optical Metro 5100/5200 Extended Metro system is increased by the introduction of new link engineering rules and the new hardware components of Release 8.0.

  The reach of the OTR 10 Gbit/s Enhanced, Muxponder 10 Gbit/s and OCLD/OTR 2.5 Gbit/s Universal circuit packs is extended by the use of Dispersion and Slope Compensating Modules (DSCM). Additionally, the improved OSNR performance available with the OFA VGA, introduced in Release 8.0, is required to obtain the maximum reach.

  The maximum reach of an optical span within an Extended Metro system is 600 km. Actual reach depends on the fiber length, the span loss between sites, and on the channel count.

- Enhancement to the dispersion specification for the OCLD/OTR 2.5 Gbit/s Flex 100 GHz circuit packs

  In Release 8.0 the dispersion specification for the OCLD/OTR 2.5 Gbit/s Flex 100 GHz circuit packs is increased from 110 km to 200 km.

New service layer topologies

Release 8.0 introduces the following network and service layer topologies:

- Muxponder 10 Gbit/s circuit packs network and service layer topologies
- SRM and ESCON SRM interoperable topologies using OTR

New site configurations

Release 8.0 offers the following new site-level configurations:

- Optical Fiber Amplifier (OFA) shelf topologies
- Dual OFA optical layer topologies
- New Extended Metro DWDM with DSCM topologies

OAM&P features

Release 8.0 offers the following new operations, administration, management, and provisioning (OAM&P) functionality.

- System Level Equalization Control (SLEC)

  With the existing APBE and the introduction of the OFA VGA, it is now possible to deliver an automated system-wide equalization system which allows you to request a complete equalization or re-equalization of a network. The System Level Equalization Control (SLEC) feature is responsible for the coordinated system-wide equalization of an amplified network.

- Mixed Shelf Type

  This features allows Optical Metro 5200 shelves to be commissioned as Mixed. This shelf type supports a mix of service circuit packs and amplification circuit packs. This helps reduce the site footprint and overall cost in some applications.

- Customer User Classes

  Two new user privilege classes are added to the existing three user privilege classes: Admin, Operator and Observer. Service providers can assign these new user privilege classes to their customers in order to observe the status of their “customer owned” network.

- Exceed support for System Manager

  Exceed permits applications that normally are only available on UNIX workstations, to be accessed from Windows-based PCs. This feature supports the ability to launch System Manager using Exceed version 9.0.

- Passive device slot numbering in Shelf Level Graphics

This feature adds the slot number next to passive devices connected to the shelf's Equipment Inventory Ports (EIP) in the System Manager Shelf Level Graphics screen. By default, the 4 Equipment Inventory Ports are displayed as EIP1, EIP2, EIP3 and EIP4.

- Band 9 support for 100 GHz circuit packs

  Release 8.0 software supports Band 9 for 100 GHz circuit packs. Although Release 7.0 introduced 100 GHz circuit packs that are compliant with the Common Photonic Layer wavelength plan, you cannot use Release 7.0 software to provision Band 9 circuit packs in an Optical Metro 5100/5200 shelf. Release 7 software only supported 32 wavelengths (Bands 1-8 and channels 1-4). Release 8.0 software supports all 36 wavelengths (Bands 1-9 and channels 1-4) in the wavelength plan.

- Additional Troubleshooting Info

  This feature provides you with additional information to better troubleshoot Optical Metro 5100/5200 network problems. You can view data from Optical Metro 5100/5200 routing and interface statistic tables using System Manager. The additional routing and interface statistic information is provided in accordance with standard MIB-2.

- Alarm Severity Provisioning

  This feature allows nodal-based alarm severity provisioning for each individual alarm using System Manager. Once the alarm severity is provisioned, alarms are raised with the provisioned alarm severity. Also, the behavior of the shelf lamps (Critical, Major, Minor) and ACO (Alarm Cut Off) are consistent with the provisioned alarm severity.

- Alarm Indication Detail

  This feature provides additional detailed information in alarm, event and log messages. The additional information includes sub card type and signal layer information.

- OM Binning

  With this feature, the OM (Operational Measurement) counters are put into 15-minute, 1-day and untimed bins similar to performance parameters. In previous releases, OMs (Operational Measurements) only supported an untimed counter bin.

- Provisionable PM Bin Zero Suppression

  The Optical Metro 5100/5200 Performance Monitoring (PM) system maintains history bins. There are 32 history bins for 15 minute bin readings. Normally the current 15 minute bin rolls over into the history bin and is cleared to begin counting for the next 15 minute period. With zero suppression, the current bin is not rolled over into history if the bin has no count (equal to 0) and the bin does not have an Invalid Data Flag (IDF). In this way the history bins contain only the last 32 time periods with non-zero counts and not simply the last eight hours of data (32 x 15 minutes). In previous releases, zero suppression was always on for SDH PMs and always off for SONET PMs.

- Security Enhancements

  This feature lets you change the centralized user password through RADIUS protocol using System Manager or TL1. It also provides the ability to provision the idle timeout for individual user accounts, and adds idle-timeout functionality to System Manager sessions.

- OC-3/STM-1 support on OTR 2.5 Gbit/s Flex 100 GHz 1310 nm circuit pack

  OC-3 and STM-1 protocol support is added to the OTR 2.5 Gbit/s Flex 100 GHz 1310 nm circuit pack.

- DMIF protocol support

  DMIF protocol support is added to the OTR 2.5 Gbit/s Flex/Universal 1310 nm circuit packs.

- Orion protocol support

  Orion protocol support is added to the OTR 2.5 Gbit/s Flex/Universal 1310 nm DWDM circuit packs.

- SRM and ESCON SRM interoperable topologies using OTR

  This feature expands upon the interoperable topologies supported by the OCI SRM 1310 nm, OCI SRM 1310 nm LC and OCI ESCON SRM circuit packs.

- OCI SRM GbE, OCI SRM GbE/FC and OCI SRM GbE/FC Enhanced circuit pack enhancements

  GFP Frame Check Sequence (FCS) occupies 4 bytes in the GFP frame. In previous releases, the GFP FCS was always included in the GFP frame. With this feature, users can provision the GFP FCS to be included in the GFP frame (provisioned as Enable) or excluded from the GFP frame (provisioned as Disable). This allows interoperability with GFP equipment that does not support the FCS field.

  AOC (Automatic Output Control) provisionable conditioning holdoff functionality is also added. The holdoff time is implemented to prevent Optical Metro 5100/5200, OTS or ETS protection switches from impacting the subtending equipment. During an Optical Metro 5100/5200, OTS or ETS protection switch, the subtending equipment is unaware that a switch occurred at the physical level protocol. This prevents the subtending equipment from bringing down the link and causing extended outage times during protection switching.

  These parameters can be provisioned on the OCI SRM GbE, OCI SRM GbE/FC, OCI SRM GbE/FC Enhanced and Muxponder 10 Gbit/s circuit packs.

- Inventory support for OADM ITU CWDM OMXs

  This feature introduces inventory support, provisioning and deprovisioning operations support and alarming support for the OADM ITU CWDM OMXs.

- Inventory support for DSCMs

  This feature introduces inventory support, provisioning and deprovisioning operations support and alarming support for the DSCMs.

- New OFA and APBE Locations

  In previous releases, OFA and APBE/APBE Enhanced circuit pack provisioning required you to provision the OFA and APBE/APBE Enhanced location as either Pre, Post, or Thru. This feature introduces two new OFA and APBE/APBE Enhanced locations: Pre2 and Thru2. These new OFA and APBE/APBE Enhanced locations support the dual OFA topologies when two OFAs are placed back-to-back in a pre-amplifier or a thru-amplifier topology.

- APBE associated equipment attributes

  In previous releases, you could provision the type of device the APBE physically connects to. The possible provisioning values were OFA Standard or OFA HIP. Once provisioned, the APBE sets a maximum output power target that software uses when the individual band facilities are put in-service to ensure that Rx overload values on the OFA are not exceeded. With this feature, users can now also provision OFA VGA or DSCM as valid equipment that connect to an APBE.

- New Component Level Power Equalization System Manager screens

  In previous releases, System Manager supported component-level power equalization on APBE circuit packs using a menu item selection. It did not monitor the equalization progress status except for the generation of events. With this feature, equalization is started when you click on the Equalize power button. Once equalization is started, you can monitor the equalization status using the Power Control Status field and the Refresh button. Equalization status events are also generated.

Network Modeling Tool support

A new Optical Metro 5100/5200 Network Modeling Tool (NMT) is introduced to model Optical Metro 5100/5200 Release 7.0 and 8.0 systems.

For link engineering guidelines related to links containing OCLD 2.5 Gbit/s Flex 100 GHz, OTR 2.5 Gbit/s Flex 100 GHz, OTR 10 Gbit/s Enhanced 100 GHz, Muxponder 10 Gbit/s GbE/FC 100 GHz and Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz circuit packs for Common Photonic Layer interworking, refer to the *Optical Modeler User Guide*.

Link engineering of Extended Metro DWDM systems is not supported in NMT nor is it supported using manual calculations. Contact Nortel Networks for custom link engineering and to obtain the Nortel Networks Custom Equalization Report for your Extended Metro system.

Optical Manager Element Adapter

Optical Manager Element Adapter (OMEA) Release 3.1 supports Optical Metro 5100/5200 Release 8.0 systems.

With Optical Metro 5100/5200 Release 8.0, OMEA Release 3.1 provides:

- support for new hardware
- support for all OAM&P features introduced in Release 8.0

For more information on OMEA Release 3.1 refer to the OMEA Release 3.1 documentation.

Hardware features

In this chapter

This chapter describes all new Release 8.0 hardware components. For a complete description of all Optical Metro 5100/5200 hardware components, see *Hardware Description,* 323-1701-102 in the *Optical Metro 5100/5200 Technical Publications,* NT0H65AM.

Muxponder 10 Gbit/s GbE/FC VCAT

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack builds upon the Muxponder 10 Gbit/s GbE/FC circuit pack introduced in Release 7.0.

> ***Note:*** The Muxponder 10 Gbit/s GbE/FC circuit pack and Muxponder 10 Gbit/s GbE/FC VCAT circuit pack are not interchangeable. You cannot replace one circuit pack type with the other unless you delete the circuit pack from the shelf.

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack is a dual-slot multiplexer optical transponder (Muxponder) circuit pack that multiplexes and demultiplexes up to ten client ports. The client ports can be a mixture of the following 8B/10B encoded protocols.

- Gigabit Ethernet (1.25 Gbit/s physical)
- FC-100, FICON (1.0625 Gbit/s physical)
- FC-200, or FICON Express (2.125 Gbit/s physical)

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack aggregates the client ports to STS-192/STM-64 using frame/transparent GFP. The STS-192/STM-64 signal is digitally wrapped within an ITU-T G.709-compliant signal. The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack supports all 200 GHz wavelengths in the Optical Metro 5100/5200 DWDM grid, and all 100 GHz wavelengths for compatibility with the Common Photonic Layer system architecture.

Client interfaces to the Muxponder 10 Gbit/s GbE/FC VCAT are provided by the Small Form Factor Pluggable (SFP) module, which you must equip in a Muxponder 10 Gbit/s GbE/FC VCAT circuit pack. Two types of SFPs are supported:

- a 1310 nm SFP (NTTP06CF) interface which requires hybrid single-mode (SMF)/multimode fiber (MMF) cables (NT0H4320 or NT0H39AB) to connect to the Tx and Rx ports of the client device
- a 850 nm SFP (NTTP06AF) interface which requires multi-mode fiber (MMF) cables (NT0H4319 or NT0H39AA) to connect to the Tx and Rx ports of the client device.

You can equip up to ten SFP modules in one Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

Table 2-1 lists the Muxponder 10 Gbit/s GbE/FC VCAT circuit packs introduced in Release 8.0.

Table 2-1
Muxponder 10 Gbit/s GbE/FC VCAT circuit pack types introduced in Release 8.0

Circuit pack type	Bidirectional GbE, FC, FICON connections	Uni-add GbE connections	Uni-drop GbE connections	DWDM spacing
Muxponder 10 Gbit/s GbE/FC VCAT	√	√	√	200 GHz
Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz	√	√	√	100 GHz
Muxponder 10 Gbit/s GbE Uni-add	Not supported	√	Not supported	200 GHz
Muxponder 10 Gbit/s GbE Uni-add 100 GHz	Not supported	√	Not supported	100 GHz
Muxponder 10 Gbit/s GbE Uni-drop	Not supported	Not supported	√	200 GHz
Muxponder 10 Gbit/s GbE Uni-drop 100 GHz	Not supported	Not supported	√	100 GHz

Table 2-2 lists the functions available with the Muxponder 10 Gbit/s GbE/FC circuit pack with Release 7.0 and Release 8.0 software and those available with the new Muxponder 10 Gbit/s GbE/FC VCAT circuit pack and Release 8.0 software.

Table 2-2
Muxponder Release 7.0 and 8.0 Hardware and Software Functionality Support

Functionality	Release 7.0 software	Release 8.0 software	
	Muxponder 10 Gbit/s GbE/FC	Muxponder 10 Gbit/s GbE/FC	Muxponder 10 Gbit/s GbE/FC VCAT
Number of supported services per circuit pack	8	8	10
Bookended topologies	√	√	√
Interoperability topologies	Limited	Limited	√
Protection schemes	1+1	1+1	1+1
Fibre Channel GFP mappings	GFP-T	GFP-T	GFP-T
Gigabit Ethernet GFP mappings	GFP-T	GFP-T	GFP-F (default) or GFP-T
Path mappings (provisioning and alarming)	Fixed	Fixed	Flexible
Contiguous concatenation	√	√	√
Virtual concatenation (provisioning and alarming)	Not supported	Not supported	√
Gigabit Ethernet sub-rate support	Not supported	Not supported	√ (when using GFP-F)
Gigabit Ethernet Uni-add and Uni-drop channel assignments	Full-rate (GFP-T)	Full-rate (GFP-T)	Full-rate (when using GFP-T) and Full-rate or sub-rate (when using GFP-F)
AN/Pause support	Not supported	Not supported	√ (when using GFP-F)
GFP-T MTU settings	Any frame size passed (see Note)	Any frame size passed (see Note)	Any frame size passed (see Note)
GFP-F MTU settings	Not applicable	Not applicable	1600 (default) or 9600

Table 2-2 (continued)
Muxponder Release 7.0 and 8.0 Hardware and Software Functionality Support

Functionality	Release 7.0 software	Release 8.0 software	
	Muxponder 10 Gbit/s GbE/FC	Muxponder 10 Gbit/s GbE/FC	Muxponder 10 Gbit/s GbE/FC VCAT
Detailed Defect Queries	Not supported	√	√
Detailed Event Queries	Not supported	√	√
Digital Wrapper PMs	√	√	√
Client PMs	√	√	√
Path PMs	Not supported	Not supported	√
Section PMs	√	√	√
Line PMs	√	√	√
Generic and Ethernet Operational Measurements	Not supported	Not supported	√
AOC (Automatic Output Control) provisionable conditioning holdoff (0 to 1000 ms in 100 ms granularity)	Not supported	√	√
Signal fail switching	Not supported	√	√
GbE Preamble and Start of Frame Delimiter transparency (GFP-T)	√	√	√
GbE Preamble and Start of Frame Delimiter transparency (GFP-F)	Not supported	Not supported	√ (provisionable)
GFP FCS inclusion/exclusion for all supported protocols	Not supported	√	√

Note: When using GFP-T, the MTU value cannot be set. The circuit pack passes frames with any frame size. However, a frame with frame size greater than 9600 bytes is considered a FrameTooLong and increments the FrameTooLong Ethernet OM counter on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack. The Muxponder 10 Gbit/s GbE/FC circuit pack does not support OMs.

Application overview

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack is an ideal solution for applications requiring:

- Network convergence
- High-density Gigabit Ethernet services
- Storage Application Network application extensions

Network convergence

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack transports residential and business services for converged network applications on the Optical Metro 5100/5200 platform. Network convergence eliminates multiple overlay networks for different digital traffic streams. Convergence combines new and existing services (voice, video, and data) on a common digital transport infrastructure. The layered approach of network convergence starts with a unified digital transport network that delivers the following:

- Layer 1 convergence through flexible switched-DWDM or next-generation SONET/SDH technology that supports voice, video, and data in their native protocols.
- Flexible physical infrastructure that supports higher-layer protocols such as Multi-Protocol Label Switching (MPLS) and Internet Protocol (IP).

  Note: The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack is transparent to higher-layer protocols.

Figure 2-1 on page 2-6 shows the residential and business services transport solutions available with the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

High-density Gigabit Ethernet services

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack enables high-density, high-bandwidth, Gigabit Ethernet services. These types of high-density, high-bandwidth, Gigabit Ethernet services are designed for video-on-demand (VOD) applications.

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack can transport a large number of Gigabit Ethernet services across long distances between the head-end equipment and numerous hybrid fiber/coaxial head-ends located near residential subscribers. See Figure 2-2 on page 2-7 for an illustration of Gigabit Ethernet transport for VOD applications.

Storage Application Network application extensions

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack also provides Storage Area Networks (SAN) application extensions through Fibre Channel and FICON links.

The new Muxponder 10 Gbit/s GbE/FC VCAT circuit pack reduces network costs and increases transport density for FC-100/FC-200, FICON/FICON Express services. See Figure 2-3 on page 2-8 for an example of a Storage Area Networks (SAN) application extension using the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

The significant number of applications in a SAN application extension has increased the need for a high-density Gigabit Ethernet, Fibre Channel and FICON multiplexer on the Optical Metro 5100/5200 platform. The

Muxponder 10 Gbit/s GbE/FC VCAT circuit pack meets this need by multiplexing Gigabit Ethernet, FC, FICON or FICON Express services on a single circuit pack.

Figure 2-1
Converged services transport enabled with Muxponder 10 Gbit/s GbE/FC VCAT

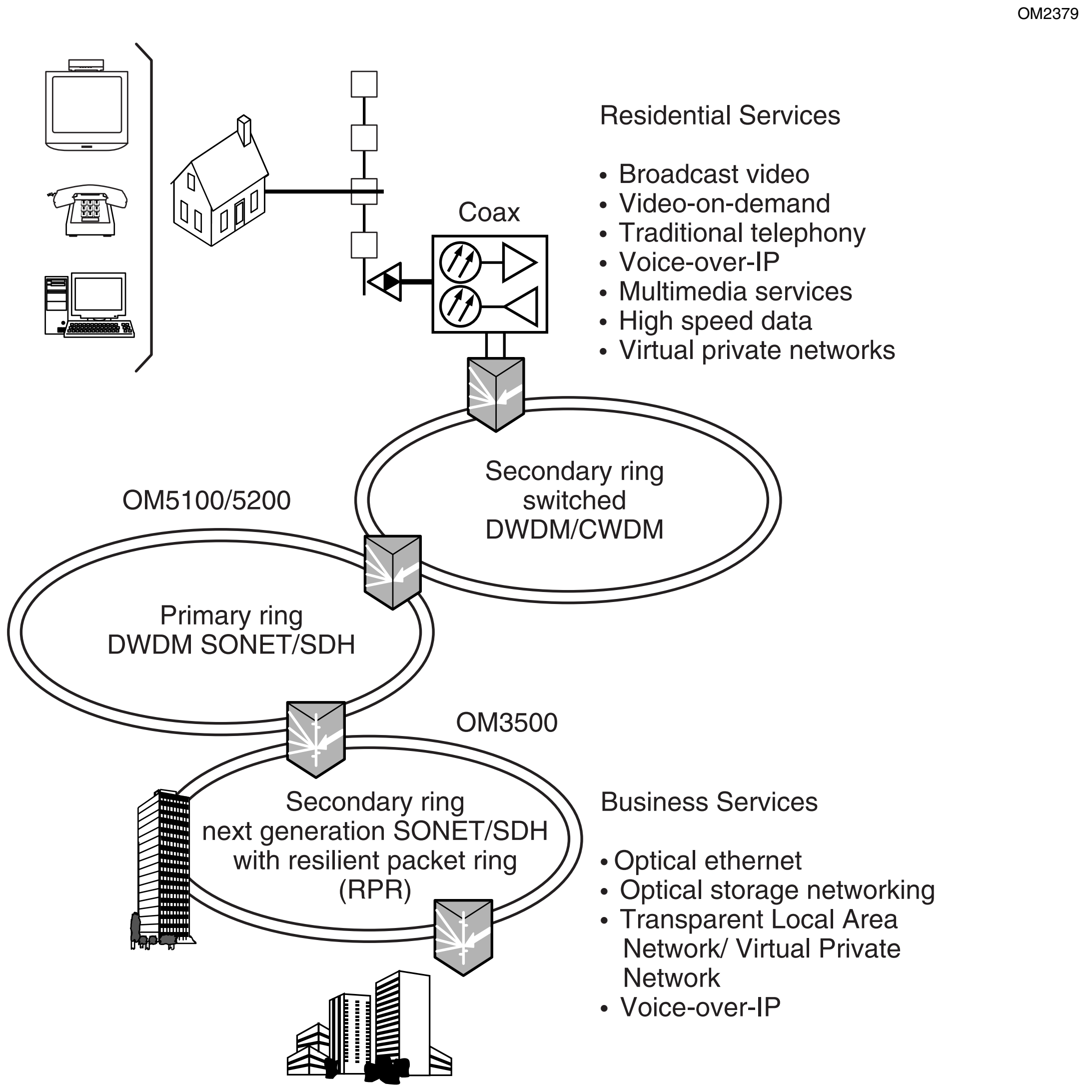


Figure 2-2
Gigabit Ethernet transport for Video-on-Demand applications

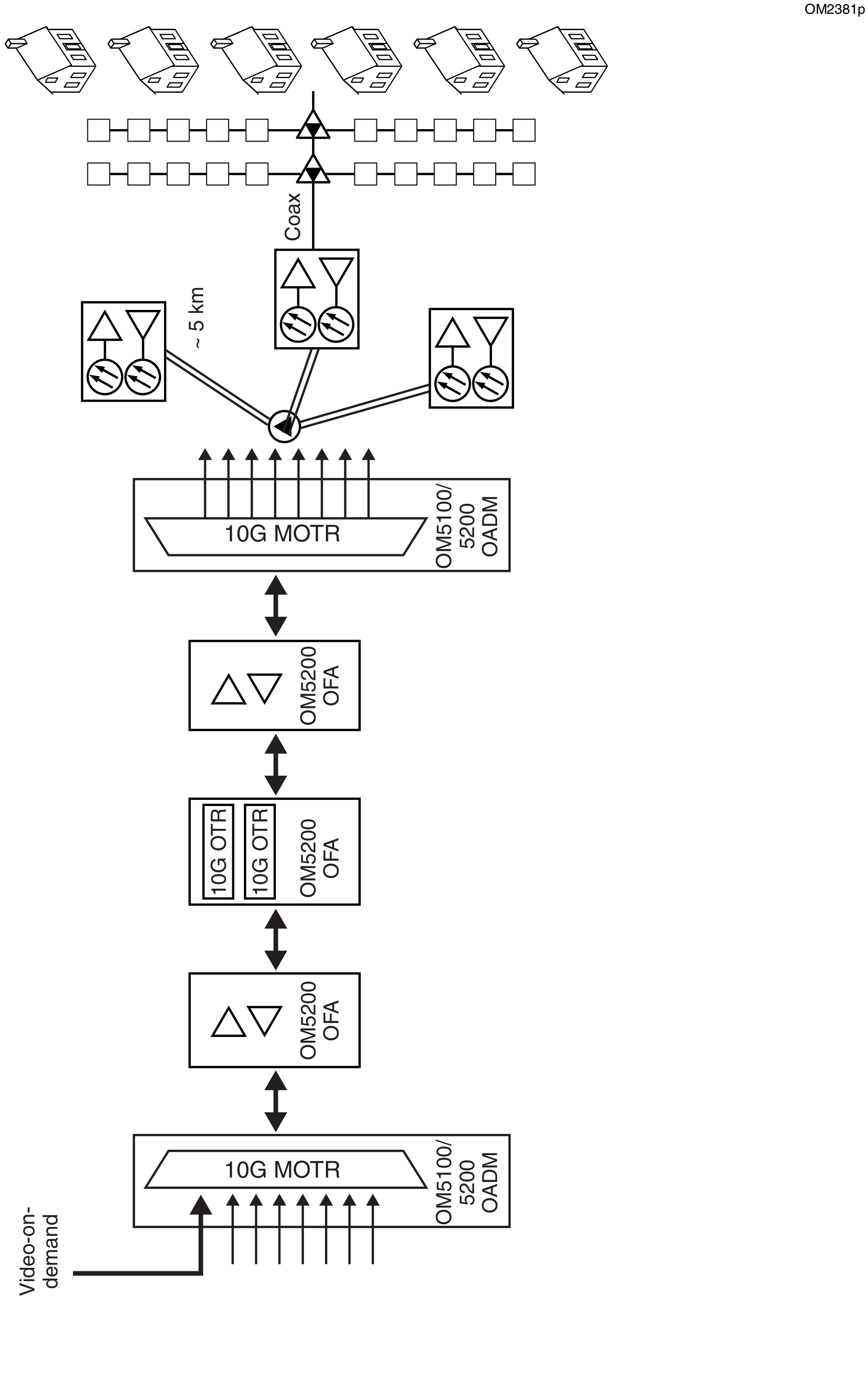
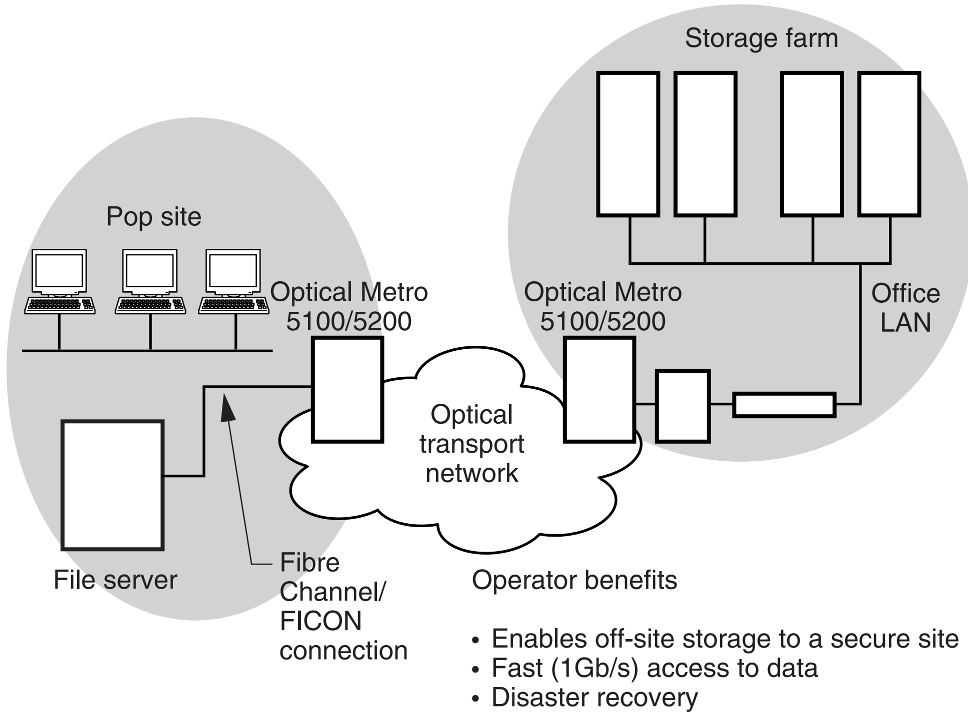


Figure 2-3
Fibre Channel/FICON transport for Network Access Storage application extensions

OM2380p



Because applications that use the Muxponder 10 Gbit/s GbE/FC VCAT transport client services over long distances, there is often a need for optical amplification and regeneration. The Muxponder 10 Gbit/s GbE/FC VCAT is compatible with the Optical Fiber Amplifier (OFA) circuit packs supported on the Optical Metro 5200 platform. Regeneration is provided by back-to-back Optical Transponder (OTR) 10 Gbit/s Enhanced circuit packs.

Network configuration

Refer to Chapter 3,"Supported configurations and topologies" for supported configurations and topologies of the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

Physical description

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack takes two slots in an Optical Metro 5100 or Optical Metro 5200 shelf. The circuit pack faceplate includes:

- one line-side LC duplex connector for connecting to the DWDM optical line
- SFP module receptacles, where up to ten SFP optical transceivers can be equipped to connect to the subtending equipment

Indicator lamps

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack has the following lamps on the faceplate:

- 10 Loss of Signal (LOS) indicator lamp for the client interfaces
- 10 Active (ACT) lamp for the client interfaces
- one LOS lamp for the line interface
- one Active (ACT) lamp for the line interface
- one STATUS lamp for the circuit pack

Table 2-3 provides a summary of the visual indicator lamps available on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

Table 2-3
Indicator lamps on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

LED type	Color	Description
STATUS	Red/Green (bi-color)	Indicates the operational state of the equipment. This lamp has the following states: • Green — the circuit pack is in-service and operating. • Red — a circuit pack or equipment failure exists. • OFF — the circuit pack is out-of-service and no faults are detected on the circuit pack. • Flashing — the circuit pack is the active database-carrying circuit pack during a database copy operation. ***Note:*** Do not remove the active database-carrying circuit pack during the database copy to the standby circuit pack.
Client ACTIVE	Red/Green (bi-color)	Indicates a client port's ability to carry traffic. This lamp has the following states: • Green — a channel assignment is provisioned on a client port and the client port facility is in-service. • Red — an SFP module equipment failure. • OFF — no channels are provisioned, the client port is out-of-service or the SFP is missing. • The Green state does not necessarily indicate that the circuit pack is carrying live traffic.
Client LOS	Yellow	Indicates the status of the received client optical signal. This lamp has two states: • ON — no optical signal is present, or an invalid signal condition is present at the client port. • OFF — the client port is receiving a valid signal.

Table 2-3 (continued)
Indicator lamps on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

LED type	Color	Description
DWDM Line ACTIVE	Green	Indicates the ability of the DWDM line to carry traffic. This lamp has the following states: • ON — a channel assignment is provisioned on at least one client port, and the line port facility is in-service. • OFF — the line port facility is out-of-service, or no channel assignment was provisioned. ***Note:*** The Green state does not necessarily indicate that the circuit pack is carrying live traffic.
DWDM Line LOS	Yellow	Indicates the status of the received line optical signal. • ON — no optical signal is present, or an invalid signal condition is present at the line port. • OFF — the line port is receiving a valid signal.
Note: The Client LOS and Client ACTIVE lamps are only active on a client interface when the SFP module is present in the circuit pack		

Generic Framing Procedures

The ITU-T recommendation G.7041 standardizes the Generic Framing Procedure (GFP), and coordinates its standardization effort with ANSI T1.105. This procedure provides a uniform mapping structure for packet, storage, and future services to the global transport network to minimize the cost of interfaces that support multiple packet data formats. GFP ensures efficient data transport through deterministic, low-overhead, high-integrity mapping, and flexible mapping schemes.

The GFP standard defines two implementations: Transparent GFP (GFP-T), for byte-oriented data streams that require low latency transmission, and Framed-mapped GFP (GFP-F), which maps one frame or packet of client signal in one GFP frame.

With the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack, FC-100, FICON, FC-200, and FICON Express services are mapped using GFP-T. For Gigabit Ethernet services, users can provision the mapping to either GFP-T or GFP-F. With the Muxponder 10 Gbit/s GbE/FC circuit pack, FC-100, FICON, FC-200, FICON Express and Gigabit Ethernet services are mapped using GFP-T.

Table 2-4 lists the various GFP UPI (User Payload Identifier) codes used.

Table 2-4
GFP UPI codes and handling

Circuit pack type	Client protocol	UPI code	Encapsulation	Transports
Muxponder 10 Gbit/s GbE/FC	FC-100	0x03	GFP-T	STS-24c, VC-4-8c
	FICON	0x04	GFP-T	STS-24c, VC-4-8c
	FC-200	0x03	GFP-T	STS-48c, VC-4-16c
	FICON Express	0x04	GFP-T	STS-48c, VC-4-16c
	GbE	0x06	GFP-T	STS-24c, VC-4-8c
Muxponder 10 Gbit/s GbE/FC VCAT	FC-100	0x03	GFP-T	STS-24c, STS-48c, STS-3c-6v and 7v VC-4-8c, VC-4-16c, VC-4-6v and 7v
	FICON	0x03	GFP-T	STS-24c, STS-48c, STS-3c-6v and 7v VC-4-8c, VC-4-16c, VC-4-6v and 7v
	FC-200	0x04	GFP-T	STS-48c, STS-3c-12v and 13v VC-4-16c, VC-4-12v and 13v
	FICON Express	0x04	GFP-T	STS-48c, STS-3c-12v and 13v VC-4-16c, VC-4-12v and 13v
	GbE	0x06	GFP-T	STS-24c, STS-48c, STS-3c-6v and 7v VC-4-8c, VC-4-16c, VC-4-6v and 7v
		0x01 (see Note)	GFP-F	STS-3c, STS-12c, STS-24c, STS-48c VC-4-1c, VC-4-4c, VC-4-8c, VC-4-16c STS-3c-1v through 7v VC-4-1v through 7v
		0xF0 (see Note)	GFP-F	STS-3c, STS-12c, STS-24c, STS-48c VC-4-1c, VC-4-4c, VC-4-8c, VC-4-16c STS-3c-1v through 7v VC-4-1v through 7v

Note: The 0x01 UPI code is meant for the standard GbE to GFP mapping (i.e., Preamble/SFD values are not preserved). The 0xF0 UPI code is meant for the proprietary mapping of GbE to GFP-F and preserving both the preamble and SFD data end-to-end.

Summary of features

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack has the features listed below.

- an optical line interface to the DWDM optical line that transmits and receives data. 32 DWDM 200 GHz ITU-T grid wavelengths are available for interworking with Optical Metro 5100/5200 systems and 36 DWDM 100 GHz ITU-T grid wavelengths are available for interworking with Common Photonic Layer systems.
- a 1+1 line-side APS protection for SONET/SDH protected hand-off that prevents link disruption during protection switching events. Refer to Chapter 3,“Supported configurations and topologies” for information on protected and unprotected network topologies.
- support for bookended and SONET/SDH network interoperable models. Refer to Chapter 3,“Supported configurations and topologies” for information on network topologies.
- supports GFP-F and GFP-T encapsulation for GbE protocol and GFP-T encapsulation for FC-100, FC-200, FICON and FICON Express protocols (GFP-F is not supported on the Muxponder 10 Gbit/s GbE/FC circuit pack)
- supports V-cat and C-cat provisioning. For Gigabit Ethernet using GFP-F, subrate C-cat provisioning is possible (STS-3c/VC-4-1c, STS-12c/VC-4-4c) and subrate V-cat provisioning is possible in STS-3c/VC-4-1c granularity. For GFP-T, subrate is not supported. For FC-100, FC-200, FICON and FICON Express protocols using GFP-T, subrate is not supported.
- supports interworking with the Muxponder 10 Gbit/s GbE/FC when protocols are GFP-T mapped (sub-rate is not supported and must use fixed path/port provisioning). See “Network interoperability” on page 2-79 for more information.
- support for both unidirectional and bidirectional Gigabit Ethernet client service applications. Refer to “Unidirectional and bidirectional Gigabit Ethernet traffic support” on page 2-53 for information on unidirectional and bidirectional network topologies.
- support for ten 850 nm multimode or 1310 nm single mode SFP client interfaces that can be removed and added in service without affecting other client channels carried by the circuit pack
- each client interface can be independently configured as FICON, FICON Express, FC-100, FC-200 or Gigabit Ethernet
- each client interface can be independently configured as C-cat or V-cat
- supports flexible path/port provisioning at each client interface

- supports user configurable sub-rate bandwidth for each Gigabit Ethernet when using GFP-F. Bandwidth resolution is STS-3/VC-4 for all supported protocols. Sub-rate for FC-100, FC-200, FICON and FICON Express protocols is not supported.
- supports auto-negotiation and pause capabilities for each Gigabit Ethernet provisioned port
- supports Gigabit Ethernet Maximum Transmission Unit (MTU) provisioning of 1600 or 9600 bytes when using GFP-F, allowing jumbo frame support. When using GFP-T, the Muxponder 10 Gbit/s circuit packs pass any size frame.
- Gigabit Ethernet client interface is designed to interwork with equipment compliant to IEEE 802.3 CSMA/CD access method and physical layer specifications, 2000
- Fibre Channel client interface is designed to interwork with equipment compliant to ANSI Fibre Channel Physical Interfaces (FC-PI) Revision 13, 2001

  Note: Vendor-defined flow control for Fibre Channel that is not defined within the standard is not supported. The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack does not support FC-AL or any primitives within this standard. Any Fibre Channel switch vendor's implementation that defines an alternate flow control mechanism that uses FC-AL primitives on a point to point link is not supported. Contact your Fibre Channel switch vendor to determine how to disable the use of FC-AL based flow control.

  When connected to a pair of Fibre Channel devices that support the autonegotiation (AN) of 1G and 2G link speeds, the speed of the ports connected to the

  — Muxponder 10 Gbit/s GbE/FC VCAT port provisioned as FC-100 must be manually set to 1G (FC-100)

  — Muxponder 10 Gbit/s GbE/FC VCAT port provisioned as FC-200 must be manually set to 2G (FC-200)
- a Digital Wrapper on the line side, which wraps the SONET/SDH OC-192/STM-64 signal for additional fault monitoring. The Digital Wrapper:

  — interfaces with wrapper-data domain and client-data domain through synchronous payload mapping/de-mapping functions according to ITU G.709 March 2003 for the SONET/SDH OC-192/STM-64 protocol.

  — has a bit rate of 10.709225316 Gbit/s (7% wrapped) for the OC-192 and STM-64 signal.

  — supports Reed-Solomon (255, 239) 7% Forward Error Correction as defined in ITU-T G.709 for the SONET/SDH OC-192/STM-64 protocol

- — supports Optical Transport Network (OTN) OTU-2 framing. The OC-192/STM-64 is mapped as follows:
  - – OC-192/STM-64 —> OPU-2 —> ODU-2 —> OTU-2
- — supports the insertion of client payloads in the OPU-2 Payload Type (PT) byte (PSI[0]) of the Payload Structure Identifier (PSI)
- — has payload type mapping of “Bit Synchronous STM-N mapping (0x03)”
- — supports OTN Performance Monitoring/Fault monitoring of OTU-2 BIP-8, OTU-2 BDI and ODU-2 AIS
- — supports OTN signal conditioning and the insertion of OTU-2 BDI and ODU-2 AIS conditioning signals
- — supports OTN communications with the GCC0 communication channel between the line-side interface of the Muxponder 10 Gbit/s GbE/FC VCAT circuit packs

- supports section, line and path SONET/SDH alarms (Table 2-17 on page 2-50) and section, line and path Performance Monitoring (see Table 2-11 on page 2-32)
- supports Generic and Ethernet Operational Measurements (OMs) (see Table 2-14 on page 2-40 and Table 2-16 on page 2-43) on all ten client interfaces
- supports equipment performance monitoring (i.e., TX and RX optical power levels) on the line interface and all ten client interfaces; equipment performance monitoring TCAs are only supported on the line interface
- supports Intrasite and Intersite Fault Sectionalization (IFS)
- supports Automatic Laser Shutdown (ALS)

  Note: The ALS feature on the Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz circuit pack is disabled.

- communicates with the other circuit packs in the Optical Metro 5100/5200 network through the SBUS to indicate the status of the Muxponder 10 Gbit/s GbE/FC VCAT and the status of the incoming data
- supports both local-timing and loop-timing mode. The timing mode is provisionable and defaults to local-timing. In a protection pair, the working circuit pack supports both local-timing and loop-timing mode. The protection circuit pack however must always derive its timing from the working circuit pack mate. The protection card is considered to be mate-timed. See “Clock synchronization” on page 2-60 for more information.
- regeneration is supported using a pair of OTR 10 Gbit/s Enhanced circuit packs

- in-band mixing with OCLD 2.5 Gbit/s Flex, OTR 2.5 Gbit/s, OCLD 2.5 Gbit/s Universal, OTR 2.5 Gbit/s Universal, OTR 10 Gbit/s Enhanced and Muxponder 10 Gbit/s GbE/FC circuit packs is supported
- provisionable facility loopbacks on both the client-side and line-side interfaces and provisionable terminal loopbacks on the client-side interface
- supports detailed defect and detailed event query for summary path alarms (see "Detailed defect and detailed event query for summary path alarms" on page 2-49)
- supports AOC (Automatic Output Control) provisionable hold off timer (0 ms to 1000 ms, 100 ms steps) - see "Client-side conditioning holdoff times (AOC)" on page 2-67
- supports provisionable Gigabit Ethernet preamble and start of frame delimiter transparency using a proprietary GFP-F mapping
- supports GFP FCS inclusion/exclusion for all supported protocols
- supports round trip delay measurement

Signal flow

Figure 2-4 on page 2-16 shows the signal flow and interconnection of the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack. The circuit pack connects to subtending equipment through the client interfaces and to the multiplexer unit (OMX) in Optical Metro 5100/5200 systems, to the Channel Multiplexer/Demultiplexer (CMD) in Common Photonic Layer systems or directly to the fiber plant in OMX-less systems through the line interface. The client signal is sent to downstream Optical Metro 5100/5200 network elements through the line interface.

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack supports eleven interfaces:

- 1 line interface (Tx and Rx)
- 10 client interfaces (Tx and Rx)

The line interface does optical-to-electrical conversion of the incoming signal from the line, and electrical-to-optical conversion of the signal from the mapper. The line interface sends the converted signals from the line to the client side through the client interfaces.

The client interfaces do optical-to-electrical conversion of incoming signals from the client, and electrical-to-optical conversion of signals from the mapper. The client interfaces send the converted signals from the client to the line through the line interface.

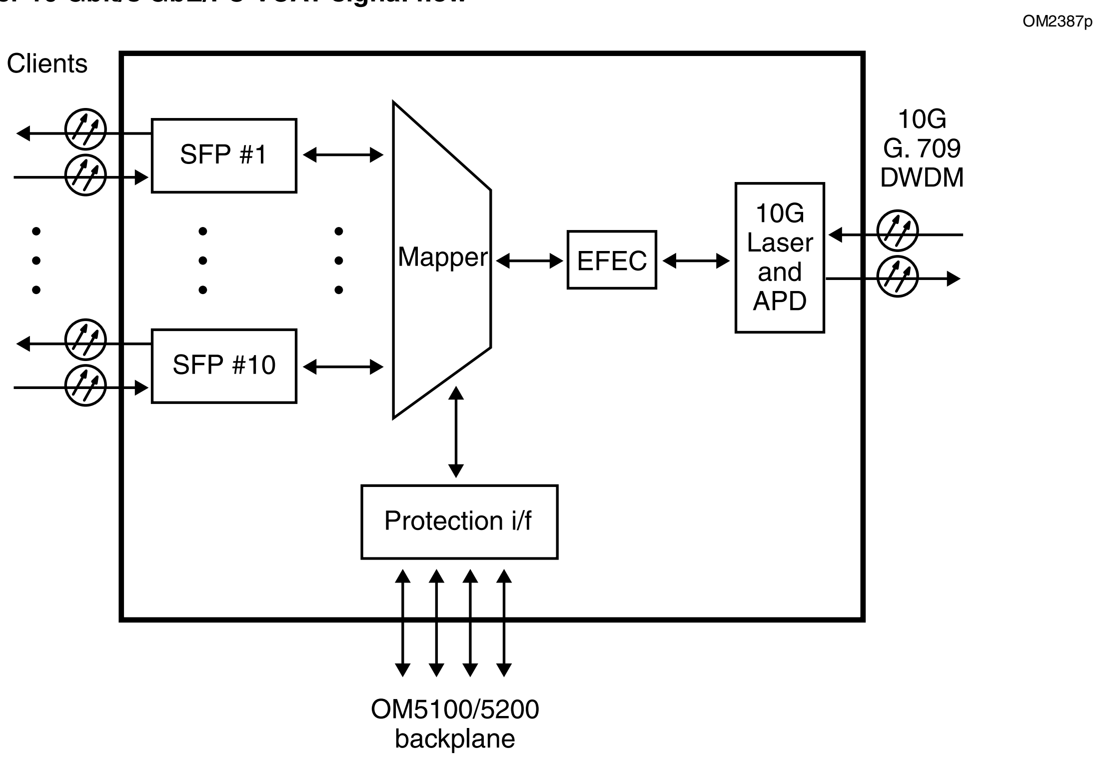
Each client port accepts one Small Form Factor Pluggable (SFP) for 1310 nm or 850 nm signals.

The mapper multiplexes client data to a SONET/SDH STS-192/STM-64 bitstream. A protection interface is also provided by the Optical Metro 5100/5200 backplane for line-side protection switching.

The EFEC module digitally wraps the STS-192/STM-64 into a G.709 bitstream.

The line side module (10 Gbit/s Laser and APD) provides a WDM interface.

Figure 2-4
Muxponder 10 Gbit/s GbE/FC VCAT signal flow



Cables and optical patch cords

Release 8.0 introduces two new optical patch cords to interconnect the ten Muxponder 10 Gbit/s GbE/FC VCAT client-side ports to the Patch Panel 20 port (NT0H43CB). These new optical patch cords can also be used to interconnect the eight client-side ports of the Muxponder 10 Gbit/s GbE/FC to the Patch Panel 16 port.

The new optical patch cords (NT0H39AA/AB) are shorter (2.4 m or 96 in.) than the Release 7.0 optical patch cords (NT0H4319/20) (3.1 m or 122 in.), because of the two additional client-side ports on the Release 8.0 Muxponder 10 Gbit/s GbE/FC VCAT. Shorter optical patch cords are required so that the fibers do not exceed the available fiber storage capacity in the Patch Panel 20 port.

Use the optical patch cords as follows:

- 1310 nm SFP (NTTP06CF) client-side ports require the hybrid single-mode (SMF)/multimode fiber (MMF) cables (NT0H4320 or NT0H39AB).
- 850 nm SFP (NTTP06AF) client-side ports require multi-mode fiber (MMF) cables (NT0H4319 or NT0H39AA)

Location

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack occupies two slots in the Optical Metro 5100 or Optical Metro 5200 shelf. The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack slides into the upper and lower circuit pack guides of the Optical Metro 5100/5200 shelf and connects to the shelf through backplane connectors. Table 2-5 lists shelf and slot locations for the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

Table 2-5
Slot locations for Muxponder 10 Gbit/s GbE/FC VCAT

Network element	Shelf	Supported slots	Total Muxponders supported
Optical Metro 5200 (see Note 1)	11U shelf (NT0H50BA or NT0H50BB)	1 to 7 11 to 17	8
Optical Metro 5100 (see Note 2)	4 U shelf (NTPM50AA)	1 to 3	2

Note 1: The following slots are reserved in an Optical Metro 5200 shelf configured as a terminal, OADM, or Mixed:

- Slot 9 and 10 — Optical Channel Manager (OCM). OCM circuit pack type must be OCM 2.5 Gbit/s when using Muxponder 10 Gbit/s circuit packs. OCM 1.25 Gbit/s are not compatible with Muxponder 10 Gbit/s circuit packs.
- Slot 19 — Shelf Processor (SP)
- Slot 20 — Optical Supervisory Channel (OSC)

Note 2: The following slots are reserved in an Optical Metro 5100 shelf:

- Slot 5 — Shelf Processor (SP)
- Slot 6 — Optical Supervisory Channel (OSC)

In an Optical Metro 5200 shelf, you can establish a protected connection between any four Muxponder 10 Gbit/s GbE/FC VCAT circuit packs in the East plane, and any of the four circuit packs in the West plane. In an Optical Metro 5100 shelf, you can only establish a protected connection with a Muxponder 10 Gbit/s GbE/FC VCAT circuit pack in slots 1 and 3.

Network management

Network management interfaces provide operation, administration, maintenance, and provisioning (OAM&P) functionality. The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack supports System Manager, TL1, Simple Network Management Protocol (SNMP), and Optical Manager Element Adapter (OMEA) Release 3.1.

System Manager support

System Manager supports the following capabilities on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack:

- viewing shelf level graphics
- querying equipment inventory at the circuit pack and SFP module level
- provisioning and querying of equipment and facilities
- provisioning of auto-negotiation and pause attributes
- monitoring of alarms and events in the Fault application
- detailed defect and detailed event query for summary path alarms
- performance monitoring and operational measurements with the Performance Monitor window
- path summary screen showing allocation of client-side ports to line-side paths
- client to line side path mappings screen showing allocation of client-side paths to line-side paths

For more information about System Manager, refer to *Software and User Interface*, 323-1701-101.

TL1

TL1 commands are available for provisioning and querying the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack. For more information on TL1 commands for the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack, refer to *TL1 Interface*, 323-1701-190. TL1 changes introduced in Release 8.0 for the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack are described in "TL1 changes" on page 4-90.

SNMP

An Optical Metro 5100/5200 shelf equipped with the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack can be managed with an SNMP Manager. The Optical Metro 5100/5200 shelf is an SNMP agent. SNMP version 1 and SNMP version 2c compliant with SNMP standard, RFC 1157 is supported.

Provisioning operations

Autoprovisioning

When you insert a Muxponder 10 Gbit/s GbE/FC VCAT circuit pack in an unprovisioned slot, the shelf automatically provisions the circuit pack, and brings the equipment and line facilities to an operational state. If SFP modules are equipped in the circuit pack, they are also autoprovisioned. The SFP equipment is brought in-service, but the SFP facility is left out-of-service.

Equipment provisioning

The Optical Metro Provisioning Wizard allows you to provision a slot with the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack. Use the circuit pack type MOTR and the Max Bit Rate 10.7 GB - GEFC - DWDM 100GHz or 10.7 GB - GEFC - DWDM 200GHz to provision the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack. You can also use the Provisioning Wizard to provision the SFP modules.

The Optical Metro Inventory window displays both the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack and SFP module equipment attributes. Use this screen to provision:

- the administrative state of the circuit pack and the SFP modules
- the Optical System Identifier (OSID)
- the overhead state
- the expected far-end wavelength

Facility provisioning

The following line-side facility parameters can be provisioned:

- line facility name
- the administrative state
- a facility loopback
- timing mode (local-timing and loop-timing)
- transport mode (SONET or SDH) (see Note 1)

  Note 1: Changing the Transport Mode requires all port assignments to be deleted or all path assignments be set to Nil.

  Note 2: The port number for the line facility is always port 11.

  Note 3: Mate-timing is only supported on the protection Muxponder 10 Gbit/s GbE/FC VCAT circuit pack in line-side protected configurations. You cannot provision mate timing on a Muxponder 10 Gbit/s GbE/FC VCAT circuit pack. Mate-timing is provisioned automatically on the protection Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

The following client-side facility parameters can be provisioned:

- client facility name
- the administrative state

- a terminal or facility loopback
- GFP FCS: Applicable to all protocols. GFP Frame Check Sequence (FCS) occupies 4 bytes in the GFP frame. You can provision the GFP FCS to be included in the GFP frame (provisioned as Enable) or excluded from the GFP frame (provisioned as Disable). This allows interoperability with GFP equipment that does not support the FCS field. This parameter can be provisioned on both the Muxponder 10 Gbit/s GbE/FC circuit pack and the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.
- Pause attributes: (for details, refer to “Gigabit Ethernet features” on page 2-53)
- Auto-negotiation attributes: (for details, refer to “Gigabit Ethernet features” on page 2-53)

Channel and port assignments

Using the Channel Assignments window of the System Manager, you can configure channel and port assignments.

Port Assignments are modeled to represent the individual ports on multiport circuit packs. They represent the service that is carried on that port. The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack supports up to ten port assignments.

Channel Assignments are modeled to represent the aggregate signal on multiple port cards. They also represent the protection model or scheme that is being used by the circuit pack(s).

Double-click on a channel assignment to display all port assignments for the selected channel. Table 2-6 lists the channel assignment parameters that you can provision.

Table 2-6
Muxponder 10 Gbit/s GbE/FC VCAT channel assignment parameters

Parameter (see Note 1)	**Description**
Mode	Protected or unprotected. For detail, see “1+1 line-side APS protection for Muxponder 10 Gbit/s GbE/FC VCAT” on page 2-45.
Scheme	The protection scheme for a protected Channel Assignment. The value cannot be set and is always 1+1 Protection for Muxponder 10 Gbit/s circuit packs.
Protection Mode	This field describes the 1+1 protection mode. Valid values are bi-directional and uni-directional. This field only applies to protected Muxponder Channel Assignments.
Line 1 and Line 2	Specifies the working and protection circuit packs for a Channel Assignment.

Table 2-6 (continued)
Muxponder 10 Gbit/s GbE/FC VCAT channel assignment parameters

Parameter (see Note 1)	**Description**
Client Type	The Channel Assignment type on the client-side. The valid values for this field are bi-directional, uni-add or uni-drop. For all other circuit packs, this field is not editable and the value is set to bi-directional. (see Note 2)
Bit Rate	Gigabit Ethernet, FC-100, FC-200, FICON and FICON Express
PM Mode	• SONET/DigitalWrapper, SDH/DigitalWrapper or None for Line • GigE or None for GFP-F Gigabit Ethernet End point (client) • GigEWAN or None for GFP-T Gigabit Ethernet End point (client) • 8B/10BWAN or None for FC-100, FICON, FC-200, FICON Express End point (client)
Encapsulation	• GFP Encapsulation mode: GFP-T or GFP-F • GFP-F is only provisionable on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack when the selected Bit Rate is Gigabit Ethernet, otherwise the value is set to GFP-T
Transport	• For the Muxponder 10 Gbit/s GbE/FC circuit pack, STS-24c/VC-4-8c or STS-48c/VC-4-16c (for details, see "Path assignment" on page 2-22) • For the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack, see Table 2-9 on page 2-25 and Table 2-10 on page 2-26
AOC Holdoff	• AOC (Automatic Output Control) Provisionable hold off timer (0 ms to 1000 ms, 100 ms steps) used to indicate to hold off the client laser from shutting off or injecting 8B/10B error codes or idle frames. Defaults are 0 ms for unprotected and 500 ms for protected connections. • Parameter accessible by clicking on the Advanced button.
Path PMs	• Parameter permits the enabling or disabling of path PM collection (disabled by default). Only available with the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack. • Parameter accessible by clicking on the Advanced button.
Channel name	An editable text field.
Channel description	An editable text field.
Port name	An editable text field.
Port description	An editable text field.

Note 1: Configuration of a port assignment on a client interface does not impact traffic performance on other client ports.

Note 2: Uni-add and uni-drop client types are only supported for the Gigabit Ethernet protocol.

Path assignment

The Path Assignments screen lists the paths provisioned on the ports and the paths available for provisioning. Display the Path Assignments window by clicking on the **Path Assignments** button in the Detailed Channel Assignments window of the System Manager. Use this during provisioning and querying, once the selected transport structure is not nil.

The Muxponder 10 Gbit/s GbE/FC circuit pack supports fixed path assignments and contiguous concatenation (C-cat) mode with the following rules:

- STS-24c/VC-4-8c contiguous concatenation (C-cat) mode is supported on ports 1 to 8
- STS-48c/VC-4-16c C-cat mode is supported on ports 1, 3, 5 and 7
- Client ports 1 to 8 support STS-24c/VC-4-8c for Gigabit Ethernet, FC-100, and FICON
- Client ports 1, 3, 5 and 7 support STS 48c/VC-4-16c for FC-200 and FICON Express
- Channel assignment provisioning on ports 9 and 10 is not supported on this circuit pack
- Table 2-7 lists the fixed-mapping assignments for the STS-24c/VC-4-8c and STS-48c/VC-4-16c contiguously concatenated groups

Table 2-7
Fixed mapping assignments for the Muxponder 10 Gbit/s GbE/FC circuit pack

Port #	Port assignment rate	SONET Transport Structure	SDH Transport Structure	SONET Path assignments	SDH Path assignments
1	GbE, FC-100, FICON or FC-200, FICON Express	STS-24c or STS-48c	VC-4-8c or VC-4-16c	1-24 or 1-48	1-8 or 1-16
2	GbE, FC-100, FICON or not provisioned if port 1 is provisioned as FC-200, FICON Express	STS-24c or not applicable	VC-4-8c or not applicable	25-48 or not applicable	9-16 or not applicable
3	GbE, FC-100, FICON or FC-200, FICON Express	STS-24c or STS-48c	VC-4-8c or VC-4-16c	49-72 or 49-96	17-24 or 17-32

Table 2-7 (continued)
Fixed mapping assignments for the Muxponder 10 Gbit/s GbE/FC circuit pack

Port #	Port assignment rate	SONET Transport Structure	SDH Transport Structure	SONET Path assignments	SDH Path assignments
4	GbE, FC-100, FICON or not provisioned if port 3 is provisioned as FC-200, FICON Express	STS-24c or not applicable	VC-4-8c or not applicable	73-96 or not applicable	25-32 or not applicable
5	GbE, FC-100, FICON or FC-200, FICON Express	STS-24c or STS-48c	VC-4-8c or VC-4-16c	97-120 or 97-144	33-40 or 33-48
6	GbE, FC-100, FICON or not provisioned if port 5 is provisioned as FC-200, FICON Express	STS-24c or not applicable	VC-4-8c or not applicable	121-144 or not applicable	41-48 or not applicable
7	GbE, FC-100, FICON or FC-200, FICON Express	STS-24c or STS-48c	VC-4-8c or VC-4-16c	145-168 or 145-192	49-56 or 49-64
8	GbE, FC-100, FICON or not provisioned if port 7 is provisioned as FC-200, FICON Express	STS-24c or not applicable	VC-4-8c or not applicable	145-192 or not applicable	49-64 or not applicable
9	Not supported				
10	Not supported				

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack supports both contiguous concatenation (C-cat) mode and virtual concatenation (V-cat) mode. This results in the following advantages (detailed in Table 2-8 on page 2-24):

- increases the number of services supported
- increases bandwidth utilization efficiency

Table 2-8
Full rate efficiencies with the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

Protocol	C-cat Transports		C-cat efficiency	V-cat Transports		V-cat efficiency
	SONET	SDH		SONET	SDH	
GbE	STS-24c X 8	VC-4-8c X 8	(8*21)/192=88%	STS-3c-7v X 9	VC-4-7v X 9	(9*21)/192=98%
FC-100 FICON	STS-24c X 8	VC-4-8c X 8	(8*18)/192=75%	STS-3c-6v X 10	VC-4-6v X 10	(10*18)/192=94%
FC-200 FICON Express	STS-48c X 4	VC-4-16c X 8	(4*36)/192=75%	STS-3c-12v X 5	VC-4-12v X 5	(5*36)/192=94%

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack also adds more flexibility by supporting flexible mapping assignments with the following rules:

- The circuit pack has a total of 192 STS-1s/VC-3s that can be utilized in various combinations on any of the client-side ports. This is a an STS/VC pool of paths that can be associated with any of the ten client-side ports. The smallest granularity supported is STS-3c/VC-4.
- Unlike the OCI SRM GbE/FC, OCI SRM GbE/FC Enhanced, OCI SRM GbE and Muxponder 10 Gbit/s GbE/FC circuit packs, the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack does not have any of the 192 STS-1/VC-3 paths fixed mapped to any of the client-side ports.
- Each client-side port can have up to 48 STS-1s/VC-3s (through the provisioning of an STS-48c/VC-4-16c) provisioned against it. A maximum of 4 client-side ports can be provisioned this way, rendering the remaining 6 ports unable to carry any traffic.
- Unlike the OCI SRM GbE/FC, OCI SRM GbE/FC Enhanced, OCI SRM GbE and Muxponder 10 Gbit/s GbE/FC circuit packs, provisioning STS-48c/VC-4-16c on a port does not render the subsequent port unavailable for use.
- A user can add more paths or delete existing paths as required provided the path is available in the pool of available STSs/VCs. This operation is service affecting.
- V-cat connections must be of the STS-3c/VC-4 granularity.

- Although there may be enough STS-1s/VC-3s available for a C-cat connection (in terms of number of paths or bandwidth), they must be contiguous in nature in order to provision the STS-Xc transport structure (where X can be 3, 12, 24, 48). For example, STS-1 numbers 1-9 and 16-18 may be available but this cannot be used to provision an STS-12c.
- All provisionable paths are STS-3c/VC-4 aligned. Meaning, STS-2 or STS-3 is not used to provision the start of an STS-Xc or STS-3c-Xv connection.
- All provisionable paths cannot cross their natural boundary. See Table 2-9 and Table 2-10 on page 2-26.

Table 2-9
Flexible C-cat mapping assignments for the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

Port Assignment Rate	Encapsulation	SONET Transport Structure	SDH Transport Structure	Port to Path Mapping (Flex vs Fixed)	Allowed SONET paths and rules	Allowed SDH paths and rules
GbE (bidirectional, uni-add and uni-drop connections)	GFP-F	STS-3c	VC-4-1c	Flex	3n+1, where n=0...63	n = 1 to 64
		STS-12c	VC-4-4c	Flex	1, 13, 25, 37, 49, 61, 73, 85, 97, 109, 121, 133, 145, 157, 169, 181	1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 49, 53, 57, 61
		STS-24c	VC-4-8c	Flex	1, 25, 49, 73, 97, 121, 145, 169	1, 9, 17, 25, 33, 41, 49, 57
		STS-48c	VC-4-16c	Flex	1, 49, 97, 145	1, 17, 33, 49
	GFP-T	STS-24c	VC-4-8c	Flex	1, 25, 49, 73, 97, 121, 145, 169	1, 9, 17, 25, 33, 41, 49, 57
		STS-48c	VC-4-16c	Flex	1, 49, 97, 145	1, 17, 33, 49

Table 2-9 (continued)
Flexible C-cat mapping assignments for the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

Port Assignment Rate	Encapsulation	SONET Transport Structure	SDH Transport Structure	Port to Path Mapping (Flex vs Fixed)	Allowed SONET paths and rules	Allowed SDH paths and rules
FC-100 FICON	GFP-T	STS-24c	VC-4-8c	Flex	1, 25, 49, 73, 97, 121, 145, 169	1, 9, 17, 25, 33, 41, 49, 57
		STS-48c	VC-4-16c	Flex	1, 49, 97, 145	1, 17, 33, 49
FC-200 FICON Express	GFP-T	STS-48c	VC-4-16c	Flex	1, 49, 97, 145	1, 17, 33, 49

Note 1: Note that protocols such as GbE, FC-100 and FICON only require STS-24c/VC-4-16c in order to carry the maximum capacity. STS-48c/VC-4-16c is offered for these protocols for interoperability reasons. However, FC-200 and FICON Express require a full STS-48c/VC-4-16c to do full rate.

Note 2: GbE is the only protocol allowed to be provisioned as sub-rate (provided that GFP-F is used). When provisioned as GFP-T, no sub-rate capabilities or AN / PAUSE is possible.

Table 2-10
Flexible V-cat mapping assignments for the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

Port Assignment Rate	Encapsulation	SONET Transport Structure	SDH Transport Structure	Port to Path Mapping (Flex vs Fixed)	Allowed SONET/SDH paths and rules
GbE (bidirectional, uni-add and uni-drop connections)	GFP-F	STS-3c-1v	VC-4-1v	Flex	SONET: All V-cat paths can start at 3n+1, where n=0...63 SDH: All V-cat paths can start at n, where n=1...64
		STS-3c-2v	VC-4-2v	Flex	
		STS-3c-3v	VC-4-3v	Flex	
		STS-3c-4v	VC-4-4v	Flex	
		STS-3c-5v	VC-4-5v	Flex	
		STS-3c-6v	VC-4-6v	Flex	
		STS-3c-7v	VC-4-7v	Flex	

Table 2-10 (continued)
Flexible V-cat mapping assignments for the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

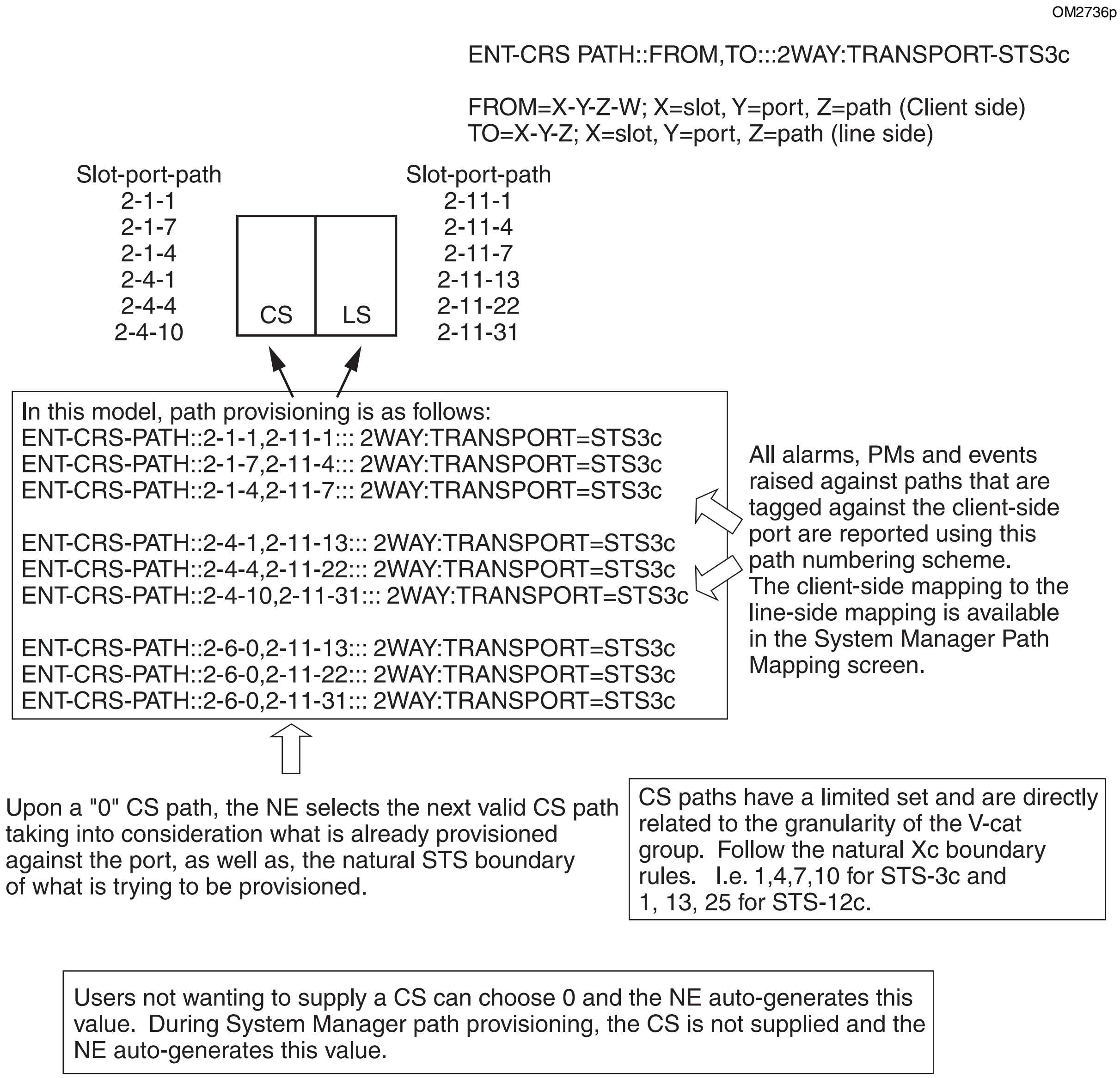
Port Assignment Rate	Encapsulation	SONET Transport Structure	SDH Transport Structure	Port to Path Mapping (Flex vs Fixed)	Allowed SONET/SDH paths and rules
GbE (bidirectional, uni-add and uni-drop connections)	GFP-T	STS-3c-7v	VC-4-7v	Flex	• SONET: All V-cat paths can start at 3n+1, where n=0...63 • SDH: All V-cat paths can start at n, where n=1...64 • When using GFP-T, must run with fullrate, no subrate transports are supported
FC-100 FICON	GFP-T	STS-3c-6v	VC-4-6v	Flex	• SONET: All V-cat paths can start at 3n+1, where n=0...63 • SDH: All V-cat paths can start at n, where n=1...64 • Must run with fullrate, no subrate transports are supported • STS-3c-6v/VC-4-6v is sufficient to carry the maximum capacity. STS-3c-7v/VC-4-7v is offered for interoperability reasons (this will however reduce the number of FC-100/FICON ports supported from 10 to 9)
		STS-3c-7v	VC-4-7v	Flex	

Table 2-10 (continued)
Flexible V-cat mapping assignments for the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

Port Assignment Rate	Encapsulation	SONET Transport Structure	SDH Transport Structure	Port to Path Mapping (Flex vs Fixed)	Allowed SONET/SDH paths and rules
FC-200 FICON Express	GFP-T	STS-3c-12v	VC-4-12v	Flex	• SONET: All V-cat paths can start at 3n+1, where n=0...63 • SDH: All V-cat paths can start at n, where n=1...64 • Must run with fullrate, no subrate transports are supported • STS-3c-12v/VC-4-12v is sufficient to carry the maximum capacity. STS-3c-13v/VC-4-13v is offered for interoperability reasons (this will however reduce the number of FC-200/FICON Express ports supported from 5 to 4)
		STS-3c-13v	VC-4-13v	Flex	
Note: When provisioning V-cat paths, the “Insufficient Link Capacity” alarm is raised until the required amount of paths have been provisioned as shown above.					

Path numbering model
The path numbering model is as shown in Figure 2-5. Since alarm and PM details are raised against a logical client-side path, the new System Manager Path Summary screen is introduced so that client-side paths can be correlated to line-side paths (see Figure 2-20 on page 2-74).

Figure 2-5
Path numbering model



Loopback provisioning

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack supports both client-port loopbacks and line-side loopbacks are supported. See Figure 2-6 on page 2-31 for an illustration of client port and line side supported loopbacks.

Client-port loopbacks can be configured as terminal or facility loopbacks. Client terminal loopbacks require channel assignment and path assignment provisioned but does not require SFP to be plugged. Client facility loopbacks require channel assignment and SFP to plugged but do not require path assignment.

When a client-facility loopback is in place, the client laser is enabled and traffic from the subtending link partner is received on the client receive port and looped back on the client transmit port. On the line-side, a Path Alarm Indication Signal (P-AIS) signal is applied to all paths associated with the port.

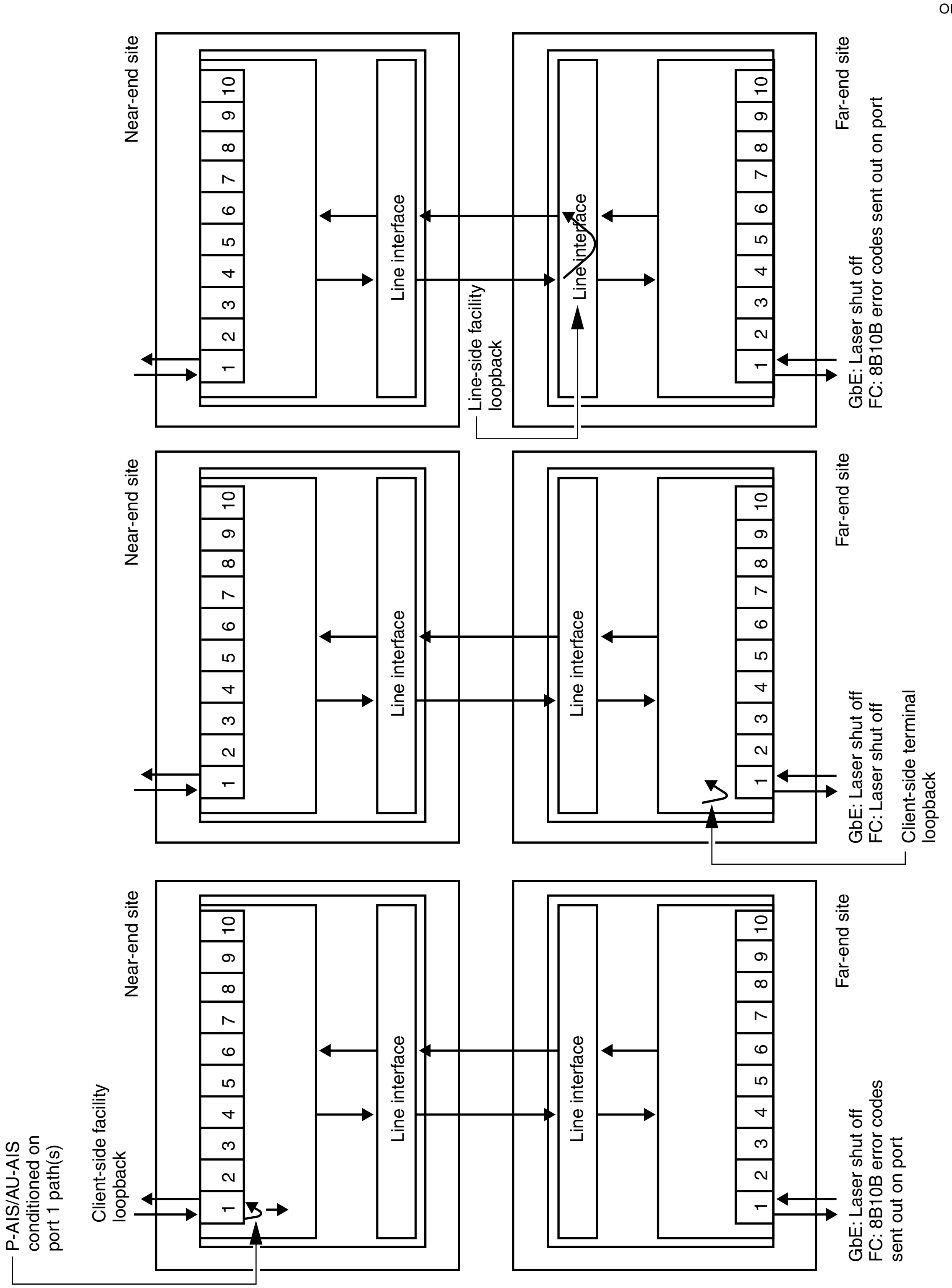
When a client-terminal loopback is in place, the corresponding client interface shuts down. Client-port terminal loopbacks do not require the pluggable modules to be equipped in the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

The Muxponder 10 Gbit/s GbE/FC circuit pack also supports line-side facility loopbacks. Before provisioning a line-side facility loopback, you must release all client terminal and facility loopbacks, provision a channel assignment, and set all client and line facilities out-of-service. If all client facilities are placed out-of-service and a line-side facility loopback is in place, the client Tx laser is shutdown for a Gigabit Ethernet connection and 8B10B error codes are sent for an FC/FICON connection. If all client facilities are left in-service and a line-facility loopback is in place, no client-side signal conditioning is applied and valid traffic is sent out on the Muxponder 10 Gbit/s GbE/FC circuit pack client ports.

With the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack, the client-side facilities do not need to be put in the out-of-service state before provisioning a line-side facility loopback since this circuit pack has the ability to condition the client-side interface (i.e., shutdown the Client Tx port) when a line-side facility loopback is active.

> ***Note:*** Client-port loopbacks and line-side loopbacks can be provisioned in both unidirectional and bidirectional Gigabit Ethernet configurations. For more information about provisioning capabilities with the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack, refer to *Provisioning and Operating Procedures*, 323-1701-310.

Figure 2-6
Supported loopback configurations for the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack



Performance Monitoring for Muxponder 10 Gbit/s GbE/FC VCAT

Facility PMs

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack supports the facility performance parameters detailed in Table 2-11. The Gigabit Ethernet and FC/FICON Facility PP definitions are included in Table 2-12 on page 2-34.

TCAs are available for each PP.

Table 2-11
Supported Facility PMs and Performance Parameters on the Muxponder 10 Gbit/s GbE/FC VCAT

Port number	Port type	Direction	PM Mode	Protocols and GFP mapping	Facility PPs
1 to 10 (Client facilities)	WAN	Tx	GigE	Gigabit Ethernet using GFP-F	ES, SES, UAS
			GigEWAN	Gigabit Ethernet using GFP-T	ES, SES, UAS
			8B/10BWAN	FC-100, FC-200, FICON and FICONEXPRESS using GFP-T	ES, SES, UAS
			None	all protocols and mappings	N/A
	Optical	Rx	GigE	Gigabit Ethernet using GFP-F	ES, SES, UAS
			GigEWAN	Gigabit Ethernet using GFP-T	ES, SES, UAS
			8B/10BWAN	FC-100, FC-200, FICON and FICONEXPRESS using GFP-T	CV, ES, SES, UAS
			None	all protocols and mappings	N/A
	Optical path	Tx	Not applicable (see Note 1)	all protocols and mappings	SONET: CVP, ESP, SESP, UASP, CV-PFE, ES-PFE, SES-PFE, UAS-PFE SDH: EBP, ESP, SESP, UASP, EB-PFE, ES-PFE, SES-PFE, UAS-PFE (see Note 2 and Note 3)

Table 2-11 (continued)
Supported Facility PMs and Performance Parameters on the Muxponder 10 Gbit/s GbE/FC VCAT

Port number	Port type	Direction	PM Mode	Protocols and GFP mapping	Facility PPs
11 (Line facility)	Optical	Rx	SONET/Digi tal Wrapper	all protocols and mappings	SONET: CVS, ESS, SESS, SEFS, CVL, ESL, SESL, UASL, CV-LFE, ES-LFE, SES-LFE, UAS-LFE Digital Wrapper: CV, ES, SES, FEC-CE, FEC-UF
			SDH/Digital Wrapper	all protocols and mappings	SDH: EBS, ESS, SESS, OFSS, EBL, ESL, SESL, UASL, EB-LFE, ES-LFE, SES-LFE, UAS-LFE Digital Wrapper: CV, ES, SES, FEC-CE, FEC-UF
			None	all protocols and mappings	N/A

Note 1: PM Mode is not applicable to path PMs. Path PMs can be enabled/disabled using the Muxponder Channel Assignment Advance Detail screen. Path PMs are disabled by default.

Note 2: SONET Path PPs are collected if the port number 11 PM Mode parameter is set to SONET/Digital Wrapper. SDH Path PPs are collected if the port number 11 PM Mode parameter is set to SDH/Digital Wrapper. No Path PPs are collected if the port number 11 PM Mode parameter is set to None even if the Path PM parameter is set to Enable in the Muxponder Channel Assignment Advance Detail screen.

Note 3: Only summary TCAs are available for path PPs. A maximum of two summary TCAs, one for current 15-min. bin and one for current 1-day bin, are raised as minor alarms or events for each direction of a facility no matter how many PPs are collected on that facility. Also, all the TCAs of the paths associated to a port are summarized.

Table 2-12
Gigabit Ethernet and FC/FICON Facility PP definitions

Port type	Direction	PM Mode	Protocols and GFP mapping	Facility PP	Definition
WAN	Tx	GigE	Gigabit Ethernet using GFP-F	ES	A second where at least one GFP InFramesErr occurred or a loss of frame delineation event occurred ***Note:*** See Table 2-14 on page 2-40 for InFramesErr definition.
				SES	A second where a loss of frame delineation event occurred
				UAS	Counts the number of one second periods of unavailability. Unavailability begins at the onset of 10 consecutive severely errored seconds (SES) and ends at the onset of 10 consecutive seconds with no SES. Other performance parameters continue to count.
		GigEWAN	Gigabit Ethernet using GFP-T	ES	A second where at least one super-block with an uncorrectable error was received or a loss of frame delineation occurred
				SES	A second where at least 2 super-blocks with uncorrectable errors were received or a loss of frame delineation occurred
				UAS	Counts the number of one second periods of unavailability. Unavailability begins at the onset of 10 consecutive severely errored seconds (SES) and ends at the onset of 10 consecutive seconds with no SES. Other performance parameters continue to count.

Table 2-12 (continued)
Gigabit Ethernet and FC/FICON Facility PP definitions

Port type	Direction	PM Mode	Protocols and GFP mapping	Facility PP	Definition
WAN	Tx	8B/10BWAN	FC-100, FC-200, FICON and FICON EXPRESS using GFP-T	ES	A second where at least one super-block with an uncorrectable error was received or a loss of frame delineation occurred
				SES	A second where at least 2 super-blocks with uncorrectable errors were received or a loss of frame delineation occurred
				UAS	Counts the number of one second periods of unavailability. Unavailability begins at the onset of 10 consecutive severely errored seconds (SES) and ends at the onset of 10 consecutive seconds with no SES. Other performance parameters continue to count.

Table 2-12 (continued)
Gigabit Ethernet and FC/FICON Facility PP definitions

Port type	Direction	PM Mode	Protocols and GFP mapping	Facility PP	Definition
Optical	Rx	GigE	Gigabit Ethernet using GFP-F	ES	A second where at least one InFramesErr occurred or a loss of signal or loss of sync event occurred ***Note:*** See Table 2-14 on page 2-40 for InFramesErr definition.
				SES	A second where InFramesErr/InFrames > 0.01 (i.e., > 1% of frames are errored) or a loss of signal or loss of sync event occurred ***Note 1:*** Seconds where InFrames = 0 shall not be considered SES unless there is a loss of signal or loss of sync event. ***Note 2:*** See Table 2-14 on page 2-40 for InFrames and InFramesErr definitions.
				UAS	Counts the number of one second periods of unavailability. Unavailability begins at the onset of 10 consecutive severely errored seconds (SES) and ends at the onset of 10 consecutive seconds with no SES. Other performance parameters continue to count.

Table 2-12 (continued)
Gigabit Ethernet and FC/FICON Facility PP definitions

Port type	Direction	PM Mode	Protocols and GFP mapping	Facility PP	Definition
Optical	Rx	GigEWAN	Gigabit Ethernet using GFP-T	ES	A second where at least one InFramesErr occurred or a loss of signal or loss of sync event occurred ***Note:*** See Table 2-14 on page 2-40 for InFramesErr definition.
				SES	A second where InFramesErr/InFrames > 0.01 (i.e., > 1% of frames are errored) or a loss of signal or loss of sync event occurred ***Note 1:*** Seconds where InFrames = 0 shall not be considered SES unless there is a loss of signal or loss of sync event. ***Note 2:*** See Table 2-14 on page 2-40 for InFrames and InFramesErr definitions.
				UAS	Counts the number of one second periods of unavailability. Unavailability begins at the onset of 10 consecutive severely errored seconds (SES) and ends at the onset of 10 consecutive seconds with no SES. Other performance parameters continue to count.

Table 2-12 (continued)
Gigabit Ethernet and FC/FICON Facility PP definitions

Port type	Direction	PM Mode	Protocols and GFP mapping	Facility PP	Definition
Optical	Rx	8B/10BWAN	FC-100, FC-200, FICON and FICON EXPRESS using GFP-T	CV	Counts the number of 8B/10B symbol errors (invalid codes) or disparity errors
				ES	A second where at least one invalid code or disparity error occurred or a loss of signal or loss of sync event occurred
				SES	For FC-100/FICON: A second where more than 1062 (10e-6 BER) invalid codes or disparity errors have occurred or a loss of signal or loss of sync event occurred. For FC-200/FICON Express: A second where more than 2125 (10e-6 BER) invalid codes or disparity errors have occurred or a loss of signal or loss of sync event occurred.
				UAS	Counts the number of one second periods of unavailability. Unavailability begins at the onset of 10 consecutive severely errored seconds (SES) and ends at the onset of 10 consecutive seconds with no SES. Other performance parameters continue to count.

Equipment PMs

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack supports the equipment performance monitoring detailed in Table 2-13.

Table 2-13
Supported Equipment PMs on the Muxponder 10 Gbit/s GbE/FC VCAT

Port number	Direction	Optical power monitoring	TCAs
1 to 10 (Client facilities)	Tx	yes	not available
	Rx	yes	not available
11 (Line facility)	Tx	yes	Tx Power High Tx Power Low
	Rx	yes	Rx Power High Rx Power Low

Operational Measurements (OMs)

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack supports the Generic and Ethernet Operational Measurements. All counters are 64-bit counters except where noted.

- See Table 2-14 on page 2-40 for Generic OMs supported for the Gigabit Ethernet protocol
- See Table 2-15 on page 2-42 for Generic OMs supported for the FC-100, FC-200, FICON and FICON Express protocols
- See Table 2-16 on page 2-43 for Ethernet OMs

Table 2-14
Generic OMs for Gigabit Ethernet protocol supported on the Muxponder 10 Gbit/s GbE/FC VCAT

Generic OM Counter	GFP-F		GFP-T	
	LAN (see Note 1)	**WAN**	**LAN** (see Note 1)	**WAN**
InFrames (see Note 2)	Total number of frames received (including errored frames)	Total number of GFP frames received (including errored frames but excluding CMFs)	Total number of frames received (including errored frames)	Not supported
InFramesErr (see Note 2)	Total number of frames with • FCS errors • fragments • jabbers	Total number of GFP frames received with FCS errors or with invalid HEC **Note:** 8-bit counter. Also, there is an overlap between the 2 counters and therefore the final count may be higher than expected.	Total number of frames with • FCS errors • fragments • jabbers	Total number of super-blocks with uncorrectable errors **Note:** 8-bit counter
InFramesDiscds	Total number of frames discarded when the ingress FIFO overflows or the WAN side is down. Ingress FIFO overflows can occur when Ethernet PAUSETX flow control is disabled and that the Gigabit Ethernet is mapped into a sub-rate WAN bandwidth. **Note:** 8-bit counter (see Note 3)	Always returns 0 since frames are not discarded at the WAN input	Total number of frames discarded when the ingress FIFO overflows or the WAN side is down. Ingress FIFO overflows can occur when Ethernet PAUSETX flow control is disabled and that the Gigabit Ethernet is mapped into a sub-rate WAN bandwidth. **Note:** 8-bit counter (see Note 3)	Not supported

Table 2-14 (continued)
Generic OMs for Gigabit Ethernet protocol supported on the Muxponder 10 Gbit/s GbE/FC VCAT

Generic OM Counter	GFP-F		GFP-T	
	LAN (see Note 1)	**WAN**	**LAN** (see Note 1)	**WAN**
InOctets (see Note 4)	Total number of frame octets received including the DA, SA, T/L, data and LAN FCS fields	Not supported	Total number of frame octets received including the DA, SA, T/L, data and LAN FCS fields	Not supported
InOctetsErr	Not supported	Not supported	Not supported	Not supported
OutFrames (see Note 2)	Total number of frames transmitted	Not supported	Not supported	Not supported
OutFramesErr (see Note 2)	Total number of errored GE frames transmitted via GFP	Always reads 0 since the hardware never forwards errored frames to the WAN	Not supported	Not supported
OutFramesDiscds	Total number of frames dropped because of an egress FIFO overflow. This occurs when the client port is operationally down while far end frames are received or when the far end data rate exceeds the near end frequency compensation capability. Note: 8-bit counter	Always reads 0	Not supported	Not supported

Table 2-14 (continued)
Generic OMs for Gigabit Ethernet protocol supported on the Muxponder 10 Gbit/s GbE/FC VCAT

Generic OM Counter	GFP-F		GFP-T	
	LAN (see Note 1)	**WAN**	**LAN** (see Note 1)	**WAN**
OutOctets (see Note 4)	Total number of frame octets transmitted including the DA, SA, T/L, data and LAN FCS fields	Not supported	Not supported	Not supported
OutOctetsErr	Not supported	Always reads 0 since the hardware never forwards errored frames to the WAN	Total number of Tx 10B_ERR	Not supported

Note 1: The LAN port is identified as optical in the System Manager Performance Monitoring interface.

Note 2: When a burst of errors are present on the WAN port of a Muxponder 10 Gbit/s GbE/FC VCAT circuit pack, the client laser shuts down. If the burst has a duration of less than 2.5 seconds the Client Service Mismatch alarm is not raised even though the client laser shuts down. Errors with a duration of more than 2.5 seconds raise the Client Service Mismatch alarm. Because the laser shuts down on the client side, there will be discrepancies between number of InFrames on the WAN side and OutFrames on the LAN side. WAN OM error counts increment as bursts of errors occur.

Note 3: InFramesDiscds (LAN) displays incorrect counts when there is an overload on the link (even if the overload is very small). Use this count as an overflow indication only.

Note 4: InOctets and OutOctets count inaccuracy is 1%.

Table 2-15
Generic OMs for FC and FICON protocols supported on the Muxponder 10 Gbit/s GbE/FC VCAT

Generic OM Counter	GFP-T	
	LAN (see Note)	**WAN**
InFrames	Not supported	Not supported
InFramesErr	Not supported	Total number of super-blocks with uncorrectable errors **Note:** 8-bit counter
InFramesDiscds	Not supported	Not supported
InOctets	Not supported	Not supported
InOctetsErr	Total number of disparity errors and symbol errors	Not supported
OutFrames	Not supported	Not supported

Table 2-15 (continued)
Generic OMs for FC and FICON protocols supported on the Muxponder 10 Gbit/s GbE/FC VCAT

Generic OM Counter	GFP-T	
	LAN (see Note)	**WAN**
OutFramesErr	Not supported	Not supported
OutFramesDiscds	Not supported	Not supported
OutOctets	Not supported	Not supported
OutOctetsErr	Total number of Tx 10B_ERR	Not supported
Note: The LAN port is identified as optical in the System Manager Performance Monitoring interface.		

Table 2-16
Ethernet OM counters supported on the Muxponder 10 Gbit/s GbE/FC VCAT

Ethernet OM Counter	LAN (see Note)
AlignErr	Since this counter does not apply to Gigabit Ethernet, a value of 0 will always be returned.
FCSErr	Total number of frames received that are an integral number of octets in length and do not pass the FCS check. This count does not include those frames that are also too short or too long.
SingleCollisionFrames	Since this counter does not apply to full duplex, a value of 0 will always be returned.
MultiCollisionFrames	Since this counter does not apply to full duplex, a value of 0 will always be returned.
SQETestErr	Since this counter does not apply to full duplex, a value of 0 will always be returned.
DeferredTrans	Since this counter does not apply to full duplex, a value of 0 will always be returned.
LateCollision	Since this counter does not apply to full duplex, a value of 0 will always be returned.
ExcessCollision	Since this counter does not apply to full duplex, a value of 0 will always be returned.
InternalMACRxErr	Not supported
CarrierSenseErr	Since this counter does not apply to full duplex, a value of 0 will always be returned.

Table 2-16 (continued)
Ethernet OM counters supported on the Muxponder 10 Gbit/s GbE/FC VCAT

Ethernet OM Counter	LAN (see Note)
FrameTooLong	Total number of frames received that exceed the maximum permitted frame size (as defined by the MTU attribute of the Ethernet facility) but have no FCS error. Note: When using GFP-T, the MTU value cannot be set. The circuit pack passes frames with any frame size. However, a frame with frame size greater than 9600 bytes is considered a FrameTooLong and increments the FrameTooLong Ethernet OM counter.
FrameTooShort	Total number of frames whose length, including FCS, is less than 64 bytes but did not have an FCS error.
InternalMACTxErr	Not supported
SymbolErr	Not supported
InPauseFrames	Not supported.
OutPauseFrames	Total number of Muxponder port originated MAC control frames transmitted with an op-code indicating a PAUSE frame.
Jabbers	Total number of frames whose length, including FCS, is greater than the maximum permitted frame size (as defined by the MTU attribute of the Ethernet facility) that have an FCS error. Note: When using GFP-T, the MTU value cannot be set. The circuit pack passes frames with any frame size. However, a frame with frame size greater than 9600 bytes is considered a FrameTooLong and increments the Jabbers Ethernet OM counter if the frame has an FCS error.
Fragments	Total number of frames whose length, including FCS, is less than 64 bytes that have an FCS error.
ControlFrames	Total number of Ethernet control frames received (T/L=8808). This includes PAUSE frames and other control frames. Note that PAUSE frame is the only currently defined control frame. This counter is operational only when the PASSCTRL parameter is set to disable.
Note: The LAN port is identified as optical in the System Manager Performance Monitoring interface.	

1+1 line-side APS protection for Muxponder 10 Gbit/s GbE/FC VCAT

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack supports line-side protection using the 1+1 line-side Automatic Protection Switching (APS) protocol. If 1+1 line-side APS protection is required, a second Muxponder 10 Gbit/s GbE/FC VCAT circuit pack must be equipped in the shelf. Both 1+1 unidirectional and 1+1 bidirectional point-to-point line-side protected configurations are supported.

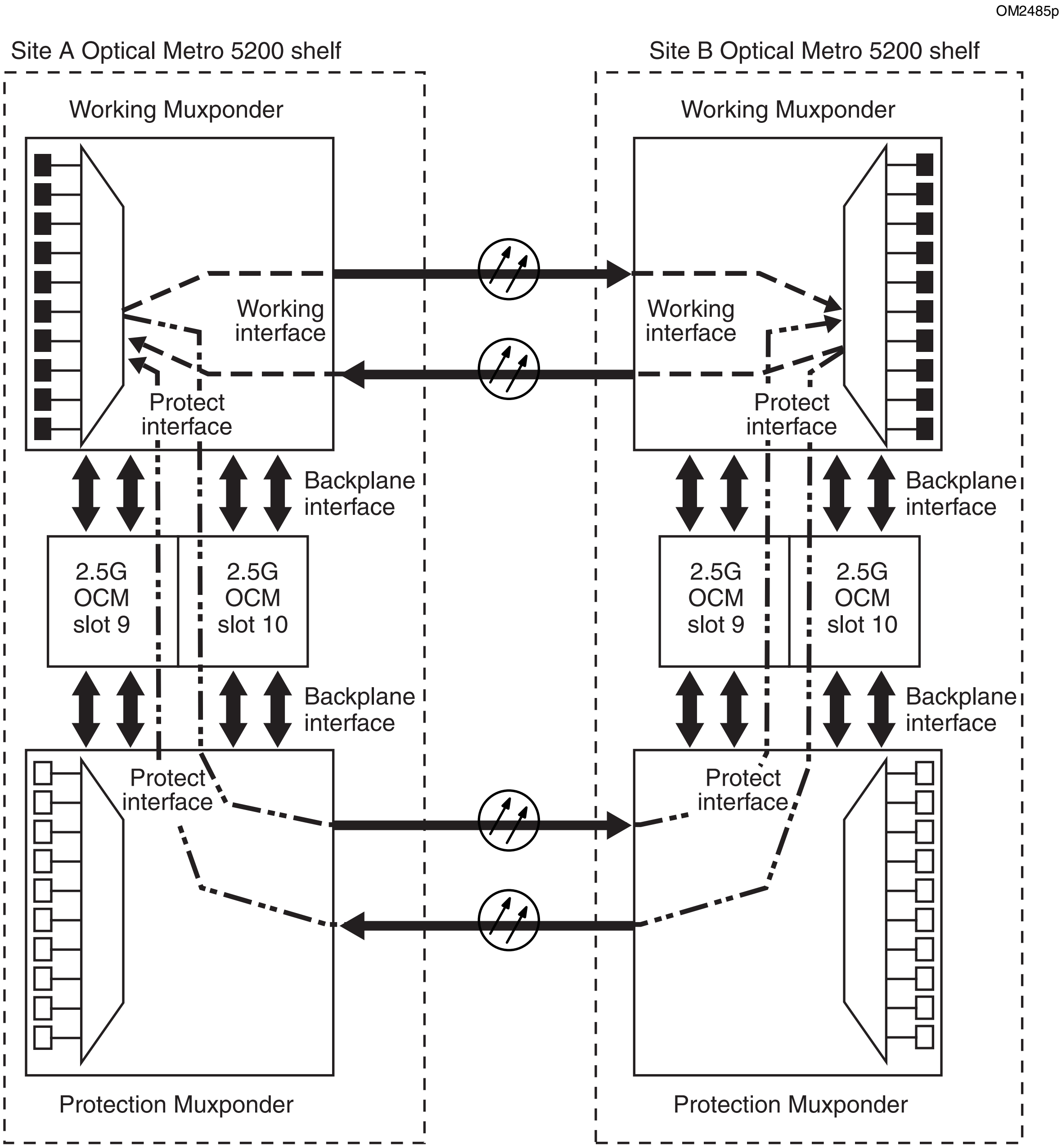
When line-side protection is configured on a Muxponder 10 Gbit/s GbE/FC VCAT connection, one Muxponder 10 Gbit/s GbE/FC VCAT circuit pack is provisioned as the protection circuit pack and the other as the working circuit pack. A protected connection is configured between the two circuit packs during channel assignment provisioning. Line-side protected connections must follow the standard East-West plane rule. Any East plane Muxponder 10 Gbit/s GbE/FC VCAT circuit pack can have a protection mate in the West plane and vice-versa. The working and protection Muxponder 10 Gbit/s GbE/FC VCAT circuit packs must be located in the same shelf.

On the Optical Metro 5200 shelf, a protected connection is established between the working and protection circuit pack through the OCM 2.5 Gbit/s circuit packs. Protection is not available if an OCM circuit pack fails or if an OCM circuit pack is removed from the shelf. On the Optical Metro 5100 shelf, a protection connection is established between the working and protection circuit pack through the backplane interface.

The working circuit pack interfaces with the line-side protected client equipment. Figure 2-7 on page 2-46 illustrates line-side protection on a Muxponder 10 Gbit/s GbE/FC VCAT circuit pack connection on an Optical Metro 5200 shelf. Figure 2-8 on page 2-47 illustrates line-side protection on a Muxponder 10 Gbit/s GbE/FC VCAT circuit pack connection on an Optical Metro 5100 shelf.

> ***Note:*** In 1+1 line-side protection, the protection Muxponder 10 Gbit/s GbE/FC VCAT circuit pack is not equipped with SFP client interfaces.

Figure 2-7
Line-side protection on an Optical Metro 5200 shelf

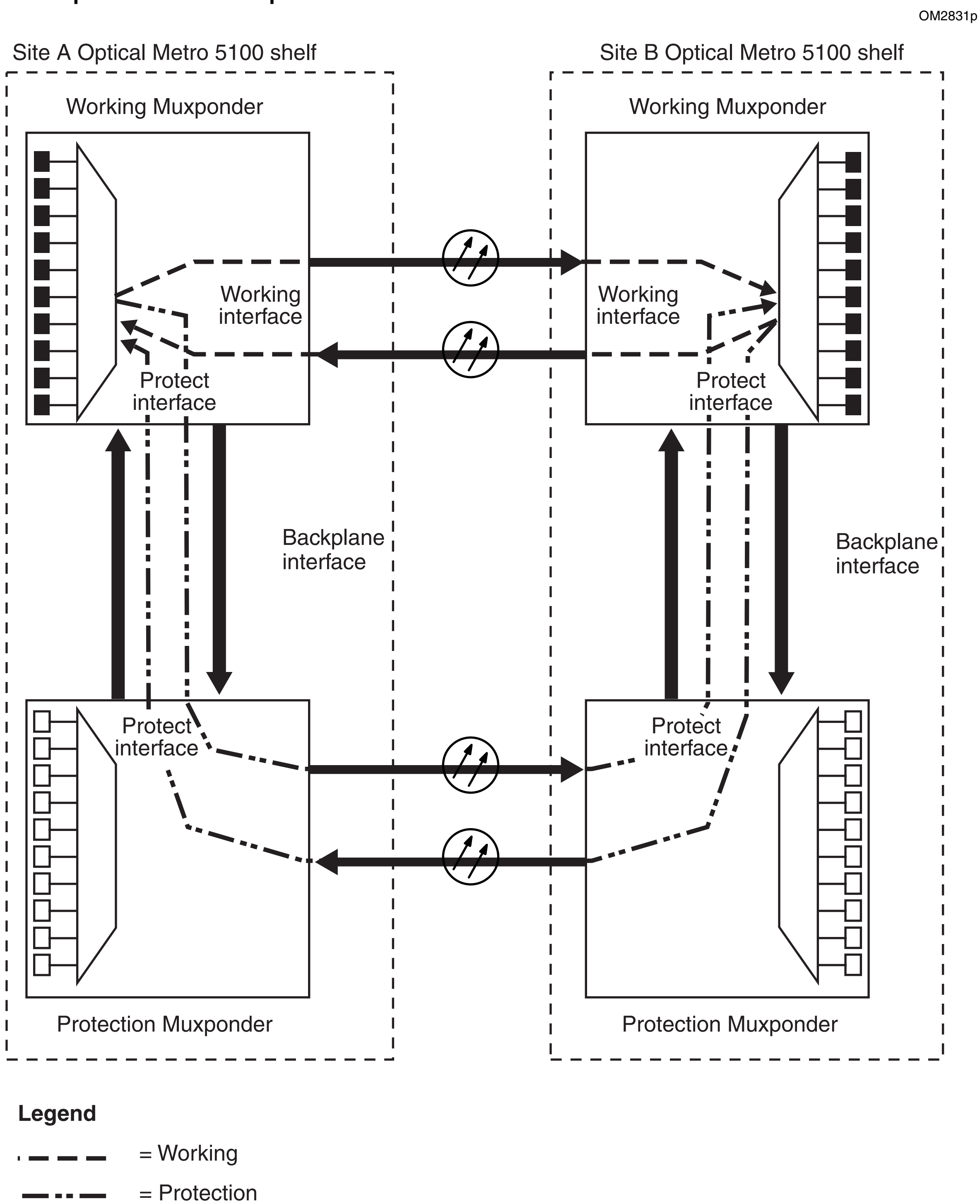


Legend

= Working

= Protection

Figure 2-8
Line-side protection on an Optical Metro 5100 shelf



Protection switching is enabled using the Automatic Protection Switching (APS) protocol. The APS protocol implementation on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack is a SONET/SDH linear APS protocol. This protocol exchanges protection switching requests and acknowledgements using the K1 and K2 bytes on the protection line.

Only revertive 1+1 APS switching is supported. Non-revertive protection switching is not supported. The “Rx reversion” parameter is enabled by default and cannot be disabled for the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack. In revertive switching, traffic switches back to the working line after it has recovered from the failure and a provisionable Wait-to-Restore (WTR) time has expired. Provisionable WTR times allow the system to reduce the number of protection switches on a working path experiencing intermittent problems. The Wait-to-Restore parameter is provisionable from 1 to 12 minutes in 1 minute increments.

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack supports both bidirectional and unidirectional protection switching modes.

In unidirectional mode, a protection switch can take place at only one end of the protection switching circuit if there is a single fiber break. In bidirectional mode, on a single fiber break, both ends switch from the working path to the protection path. Bidirectional has the added advantage that the network operator always knows whether the working and protection path is active at any point in time. In unidirectional mode, the working path can be active at one end, and the protection path at the other end.

In both protection switching modes, the working and protection signals are always the same; they are permanently bridged.

In bidirectional protection switching mode, the receiver that detects the fault requests that both the near-end and far-end switch to protection. Requests to the far-end are transmitted by the APS channel (the K1 and K2 bytes protocol).

The default protection switching mode for 1+1 APS protection switching is unidirectional.

A protection window in System Manager for the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack is available. Display the Protection window by clicking on the **Protection** button in the Detailed Channel Assignments window of the System Manager. Use this window during provisioning and querying, once the selected channel assignment mode is set to protected. The Protection screen provides options to provision the Rx Reversion parameter and performing a protection switch request.

Note: The protection button is disabled during the initial provisioning of the port assignment. The port assignment clicked on must already be provisioned before this button is enabled.

The following protection switch requests are supported on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack:

- Lockout
- Forced switch
- Manual switch

Note 1: Protection exerciser commands are not supported.

Note 2: Protection switching based on Signal Fail bit-error-rate conditions is supported.

Note 3: Protection switching based on Signal Degrade bit-error-rate conditions is not supported.

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack protection switch time complies with the Bellcore GR-253 standard.

Detailed defect and detailed event query for summary path alarms

When a path fault is detected on a path associated with a client-side facility, a summary path alarm is generated against the client-side facility. If a fault is detected on a different path associated with the same client-side facility, a new path summary alarm is not raised. However, when a user double-clicks on the path summary alarm in the Active Alarms list, the software polls the circuit pack to determine the existing faulty paths and this information is displayed in the Path field of the Alarm Details window.

By double-clicking on a path summary alarm in the System Manager Event History screen, the Event Details window is displayed. This window includes a new Show Circuit Pack Event button that provides the ability to tunnel deeper into the circuit pack to trace outstanding events against the circuit pack that may have contributed to the historical event. The events are actually stored and retrieved from the circuit pack.

Note: The Show Circuit Pack Event button is displayed no matter what event is clicked on. It does not have to be a path summary alarm event to display this button.

See System Manager Muxponder Detailed Fault screen on page 2-75 for the System Manager screens.

The new System Manager Path Summary screen is introduced so that client-side paths can be correlated to line-side paths (see Figure 2-20 on page 2-74).

Alarm reporting

Alarm reporting is enabled through the System Manager, TL1 or SNMP. Table 2-17 lists the alarms supported on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

Note: When you insert an SFP module, alarming for the client interfaces associated with that module is enabled.

Table 2-17
Alarms supported on the Muxponder 10 Gbit/s GbE/FC VCAT

Alarm type	Interface	Description
Equipment	Circuit pack	Circuit Pack Failed Circuit Pack Missing Circuit Pack Mismatch Autoprovisioning Mismatch Inter-card Communication Failure Unknown Circuit Pack Transceiver Degrade Automatic Switch to Protection Path Active Forced Switch to West (or East) Path Active Manual Switch to West (or East) path active Path Lockout Active Incomplete Provisioning Invalid Provisioning Incompatible Optical System Identifier Unassigned Optical System Identifier Optical System Identifier Mismatch
	SFP module	Circuit Pack Failed - Pluggable Circuit Pack Missing - Pluggable Circuit Pack Mismatch - Pluggable Inter-card Communication Failure - Pluggable Unknown Circuit Pack - Pluggable

Table 2-17 (continued)
Alarms supported on the Muxponder 10 Gbit/s GbE/FC VCAT

Alarm type	Interface	Description
Facility	Line facility (port 11)	Loss of Signal Signal fail Low Optical Power Warning High Optical Power High Optical Power Warning Loss of Lock Wrapper Loss of Frame Wrapper Alarm Indication Signal Backward Defect Indication Optical Receiver Overload Remote Automatic Laser Shutdown Loss of Timing Reference Loss of Frame (SONET/SDH) Alarm Indication Signal (SONET/SDH) Remote Defect Indication (SONET/SDH) Overhead Link Failure Fiber Mismatch Facility Loopback Far End Protection Line Fail Protection Scheme Mismatch Protection Mode Mismatch Automatic Protection Byte Fail Protection Channel Match Fail Working/Protection Fiber Mismatch Automatic Protection Switching Acknowledgement Time Out Protection Mate Circuit Pack Not Available

Table 2-17 (continued)
Alarms supported on the Muxponder 10 Gbit/s GbE/FC VCAT

Alarm type	Interface	Description
Facility (cont'd)	Client facilities (port 1 to 10)	Client Service Mismatch Far End Client Receive Signal Fail Loss of Signal Loss of Synchronization LAN Link Down (applies only to Muxponder 10 Gbit/s GbE/FC VCAT circuit pack when GbE GFP-F is provisioned, not supported on the Muxponder 10 Gbit/s GbE/FC circuit pack) Insufficient Link Capacity (not supported on the Muxponder 10 Gbit/s GbE/FC circuit pack) Loss of Alignment (not supported on the Muxponder 10 Gbit/s GbE/FC circuit pack) Facility Loopback Terminal Loopback Loss of Frame Delineation GFP Remote Defect Indication Summary Alarm Indication Signal Summary Loss of Pointer Summary Unequipped Summary Payload Label Mismatch Summary Remote Defect Indication Summary Loss of Multiframe (not supported on the Muxponder 10 Gbit/s GbE/FC circuit pack) Summary Loss of Sequence (not supported on the Muxponder 10 Gbit/s GbE/FC circuit pack)
	Backplane	Invalid Signal Loss of Timing Reference

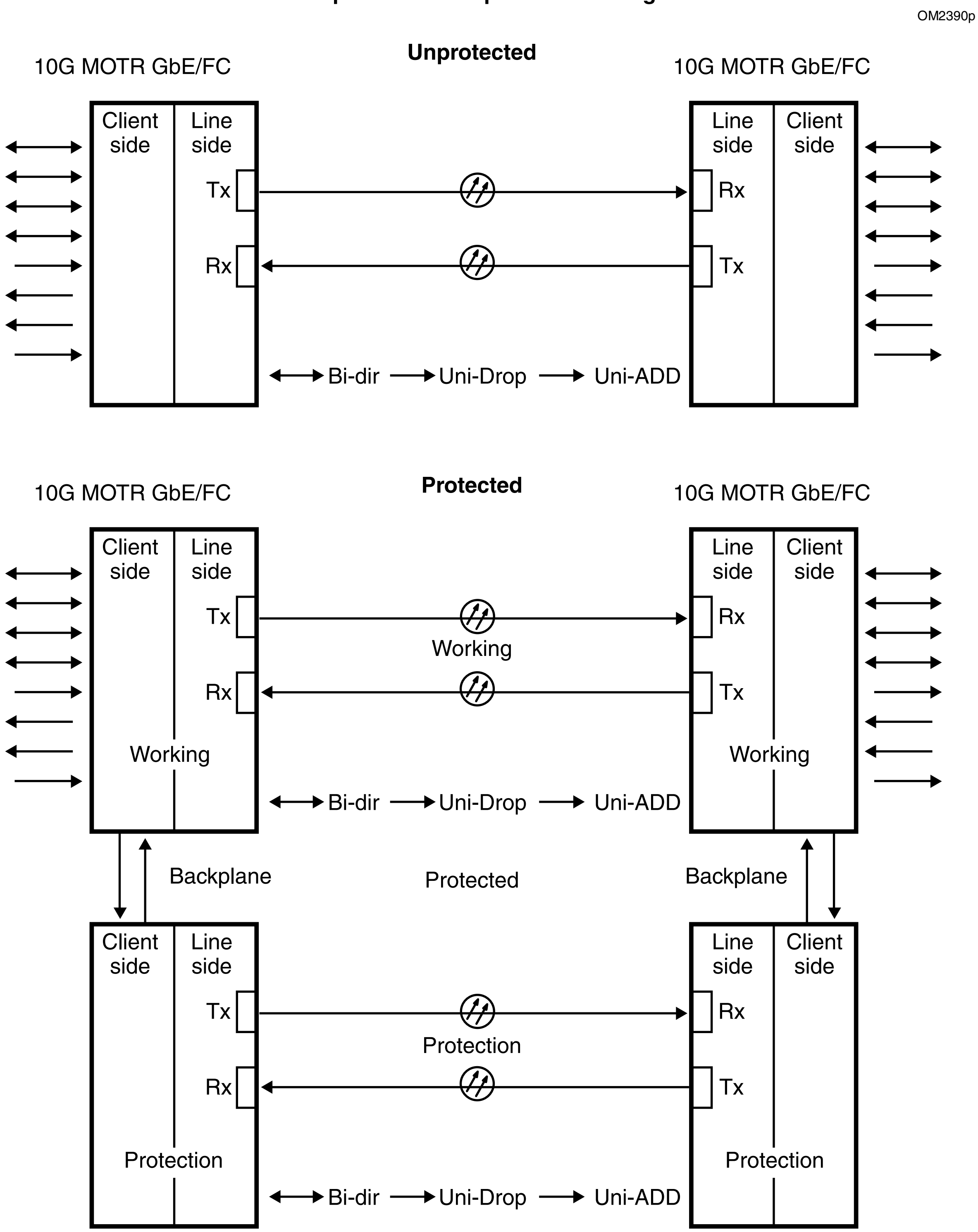
Gigabit Ethernet features

Unidirectional and bidirectional Gigabit Ethernet traffic support

Unidirectional and bidirectional Gigabit Ethernet traffic is supported on all ten client ports of the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack. To configure unidirectional or bidirectional Gigabit Ethernet traffic on a client port, you must provision the client type to uni-add, uni-drop or bi-directional. You can mix unidirectional and bidirectional traffic on the same Muxponder 10 Gbit/s GbE/FC VCAT circuit pack. See Figure 2-9 on page 2-54 for an illustration of both unidirectional and bidirectional protected and unprotected configurations.

> ***Note 1:*** Gigabit Ethernet is the only protocol to support unidirectional configurations. Bidirectional configurations are supported for both Gigabit Ethernet and Fibre Channel/FICON protocols.
>
> ***Note 2:*** The line signal of a Muxponder 10 Gbit/s GbE/FC link is always bidirectional. This is valid for unidirectional and bidirectional client traffic.

Figure 2-9
Unidirectional and bidirectional unprotected and protected configurations



In a unidirectional port assignment, an internal loopback on the corresponding path is automatically performed at the uni-drop site. This is done to suppress alarms in the unused direction. Because of this loopback at the uni-drop site, the Client Tx port at the uni-add site transmits the same Gigabit Ethernet traffic that is being received on the Client Rx port at that site.

When using the Muxponder 10 Gbit/s GbE/FC circuit pack or the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack and GFP-T encapsulation, if a link fault occurs in the unused direction, Gigabit Ethernet 8B10B error codes are sent out the uni-add Client Tx port. To ensure full traffic recovery upon fault restoration, a two-way optical splitter can be used at the local near-end node to split the client signal prior to connecting it to the SFP Client Rx uni-add port. One of the split signals can be connected to the SFP Client Rx uni-add port and the other back to the local subtending equipment.

> ***Note:*** If you do not have an optical splitter, you can use the multimode Transponder Protection Tray (NT0H59BA/BB) for 850 nm operation or the single mode Transponder Protection Tray (NT0H59AA/AB) for 1310 nm operation.

When using the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack and GFP-F encapsulation, if a link fault occurs in the unused direction, Gigabit Ethernet idle codes are sent out the uni-add Client Tx port. These idle codes do not bring down the Gigabit Ethernet link on the subtending equipment and therefore the subtending equipment's transmitter will continue to transmit frames. For this reason, a two-way optical splitter is not needed.

Alarms and PMs are masked on a Client Tx port when the port type is provisioned to uni-add. Alarms and PMs are also masked on the Client Rx port when the port type is provisioned to uni-drop.

Auto-negotiation

Auto-negotiation is a mechanism defined in IEEE 802.3 clause 37 that is designed to allow Ethernet peers that share a link segment to exchange capabilities and automatically resolve the most efficient mutually compatible configuration.

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack operates in different ways with regards to auto-negotiation. This is dependent on whether the Gigabit Ethernet signal is provisioned to be encapsulated using GFP-F or GFP-T.

- When using GFP-T, the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack behaves the same way the Muxponder 10 Gbit/s GbE/FC circuit pack operates. That is, the circuit pack is transparent with respect to auto-negotiation; incoming auto-negotiation messages are transparently passed through. However, the impacts of network delays in this end-to-end scenario can cause the auto-negotiation process to time-out before completion (this is an issue basic to auto-negotiation operation over large distances).

- When using GFP-F and bidirectional path assignments, auto-negotiation can be disabled but defaults to enabled. There is no support for WAN auto-negotiation since there is no GFP-F standard for auto-negotiation. As a result, the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack is not transparent with respect to auto-negotiation and the far-end capabilities need to be provisioned at the near-end. For a complete list of supported auto-negotiation attributes see Table 2-18 on page 2-57.
- When using GFP-F and unidirectional path assignments, auto-negotiation is disabled and cannot be provisioned.

Pause capability

Pause capability is a flow-control mechanism used to throttle overrunning edge devices. It works by having the overwhelmed node transmit a pause frame towards the overrunning node. The pause frame requests a pause in transmission for a specified period of time.

The pause capability on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack operates differently depending on whether the Gigabit Ethernet signal is encapsulated using GFP-F or GFP-T.

- When using GFP-T, the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack behaves the same way the Muxponder 10 Gbit/s GbE/FC circuit pack operates. That is, the circuit pack is transparent with respect to pause; incoming control frames (such as pause frames) are transparently passed through. However, due to the impacts of network delays, end-to-end flow control may be detrimental to network performance (this is an issue basic to Pause frame operation over large distances).
- When using GFP-F and bidirectional path assignments, pause can be provisioned. For a complete list of supported pause attributes see Table 2-18 on page 2-57.
- When using GFP-F and unidirectional path assignments, pause cannot be provisioned. As a result, if sub-rate is provisioned and the port is over subscribed, packets will be dropped.

Jumbo frame support

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack operates in different ways with regards to jumbo frame support. This is dependent on whether the Gigabit Ethernet signal is provisioned to be encapsulated using GFP-F or GFP-T.

- When using GFP-T, the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack behaves the same way the Muxponder 10 Gbit/s GbE/FC circuit pack operates. That is, any size frame is passed through the circuit pack.

Note: When using GFP-T, the MTU value cannot be set. The circuit pack passes frames with any frame size. However, a frame with frame size greater than 9600 bytes is considered a FrameTooLong and increments the FrameTooLong Ethernet OM counter.

- When using GFP-F and uni-add, uni-drop or bidirectional path assignments, the MTU can be provisioned as 1600 or 9600 (1600 is the default).

Layer 3 transparency

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack supports layer 3 transparency. IP, UDP, TCP and all other routing protocols (MPLS, RIP, OSPF, EGP, and BGP) are transparently carried across a Muxponder 10 Gbit/s GbE/FC VCAT circuit pack connection. In addition, the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack is transparent to VLAN tags (IEEE 802.1Q) and priority fields (IEEE 802.1P).

Table 2-18
Gigabit Ethernet attributes on the Muxponder 10 Gbit/s GbE/FC VCAT

Name	**Values** (See Note 1)	**Access**	**Definition**
AN	Enable, Disable* **Default**: Enable	Read/Write	Auto-negotiation
AN State	INPROGRESS, COMPLETED, DISABLED*, FAILED*	Read only	Auto-negotiation status
ETHDPX	FULL, NONE* **Default**: FULL	Read only	Advertised duplex operation capabilities if AN is enabled. If AN is disabled, this indicates the current setting.
SPEED	1000, 0* **Default**: 1000	Read only	Advertised link speed (in Mb/s) capabilities if AN is enabled. If AN is disabled, this indicates the current setting.
FLOWCTRL	NONE*, ASYM, SYM **Default**: ASYM	Read/Write	Advertised flow control capabilities. This is ignored if AN disabled.
PAUSETX	Enable, Disable* **Default**: Enable	Read/Write	Controls PAUSE transmission when AN is disabled. Ignored when AN is enabled.
PAUSERX	Disable* **Default**: Disable	Read only	Controls PAUSE reception when AN is disabled. Ignored when AN is enabled.

Table 2-18 (continued)
Gigabit Ethernet attributes on the Muxponder 10 Gbit/s GbE/FC VCAT

Name	**Values** (See Note 1)	**Access**	**Definition**
PAUSERXOVRRIDE (see Note 2)	Enable **Default**: Enable	Read only	If AN is enabled and ANPAUSERX is negotiated to enable, setting this attribute to "enable" means received PAUSE frames are not acted upon. They are either discarded or passed through transparently (based on the PASSCTRL setting).
ANETHDPX	HALF, FULL, NONE*	Read only	Negotiated duplex operation after the completion of an AN cycle when AN is enabled.
ANSPEED	1000, 0* **Default**: 1000	Read only	Negotiated speed (in Mb/s) after the completion of an AN cycle when AN is enabled.
ANPAUSETX	Enable, Disable*	Read only	Negotiated PAUSE transmit value after the completion of an AN cycle when AN is enabled.
ANPAUSERX	Enable, Disable*	Read only	Negotiated PAUSE receive value after the completion of an AN cycle when AN is enabled.
ADVETHDPX	HALF, FULL, BOTH, NONE*	Read only	Link partner advertised Duplex capabilities. Only valid when ANSTATUS is COMPLETED.
ADVSPEED	1000, 0*	Read only	Link partner advertised speed capabilities. Only valid when ANSTATUS is COMPLETED.
ADVFLOWCTRL	NONE*, ASYM, SYM, BOTH	Read only	Link partner advertised flow control capabilities. Only valid when ANSTATUS is COMPLETED.
MTU	1600, 9600, 0* **Default**: 1600	Read/Write	Maximum Ethernet frame size supported. For GFP-F the default is 1600. Value can be edited for uni-add, uni-drop and bidirectional path assignments. When using GFP-T, the MTU value cannot be set. The circuit pack passes frames with any frame size. However, a frame with frame size greater than 9600 bytes is considered a FrameTooLong and increments the FrameTooLong Ethernet OM counter.

Table 2-18 (continued)
Gigabit Ethernet attributes on the Muxponder 10 Gbit/s GbE/FC VCAT

Name	**Values** (See Note 1)	**Access**	**Definition**
PASSCTRL (see Note 3)	Enable, Disable* **Default**: Disable	Read/Write	Whether received Ethernet Control Frames (T/L=8808) are passed transparently (Enable), or removed from the flow (Disable). Note that PAUSE frame is the only currently defined control frame. Value can be edited for uni-add and bidirectional path assignments, not for uni-drop.
PHYSADDR	48-bit value	Read only	Ethernet MAC address. Used as source address in PAUSE frames.
PREAMBLECTRL (see Note 4)	Enable, Disable* **Default**: Disable	Read/Write	Whether received Ethernet frame preamble and Start of Frame Delimiter is included in the GFP frame. By default the preamble is not placed into the GFP, as it is recreated. Value can be edited for uni-add, uni-drop and bidirectional path assignments. Enable: preamble is transparently passed through Disable: preamble is processed and removed

Note 1: A value with an asterisk (*) is the displayed value when there is no protocol associated with the facility or the protocol is something other than Gigabit Ethernet.

Note 2: This attribute is needed in case the local link partner can only advertise symmetric capabilities. Since the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack does not act on received PAUSE frames, the PAUSERXOVRRIDE attribute is added to make that explicit to the user. This attribute is always enabled and received PAUSE frames are never acted upon. In Muxponder 10 Gbit/s GbE/FC VCAT circuit pack applications, receive PAUSE frames will not be seen by the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack since the circuit pack will not overflow the link partner.

Note 3: This attribute is required since some applications may start using Ethernet control frames (T/L = 0x8808). The only currently defined control frame is the PAUSE frame. The current hardware triggers on the T/L field to remove PAUSE frames from the flow. By doing so, other control frames are also removed. This option allows to passthrough all control frames (including PAUSE frames) whether PAUSERX is enabled or not.

Note 4: This attribute is required since some routers use the Gigabit Ethernet frame preamble and Start of Frame Delimiter to pass control data across the link. This field can only be provisioned on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack when the Encapsulation parameter is set to GFP-F. When this parameter is set to Enable, the Gigabit Ethernet frame preamble and Start of Frame Delimiter are transparently passed through the Muxponder 10 Gbit/s GbE/FC VCAT link.

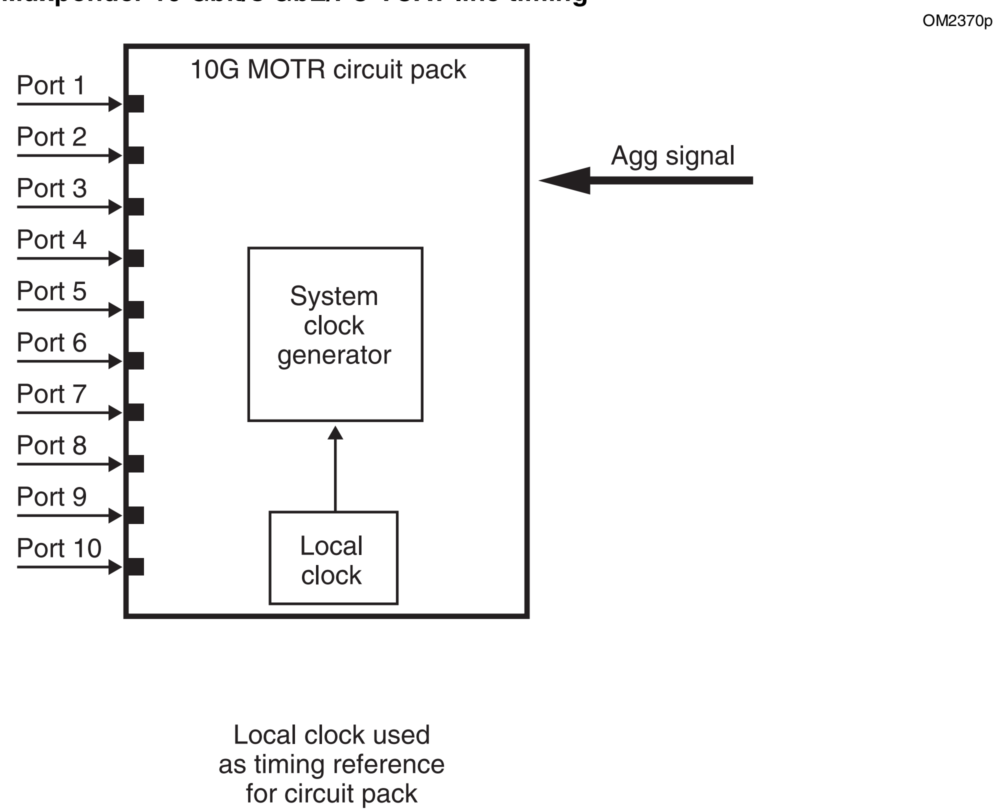
Clock synchronization

The Muxponder 10 Gbit/s GbE/FC VCAT circuit pack supports:

- local-timing reference (on working circuit pack only)
- loop-timing reference (on working circuit pack only)
- mate-timing reference (on protection circuit pack only)

Local-timing uses the on-board clock (Free Run mode) of the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack. Figure 2-10 shows an example of local timing.

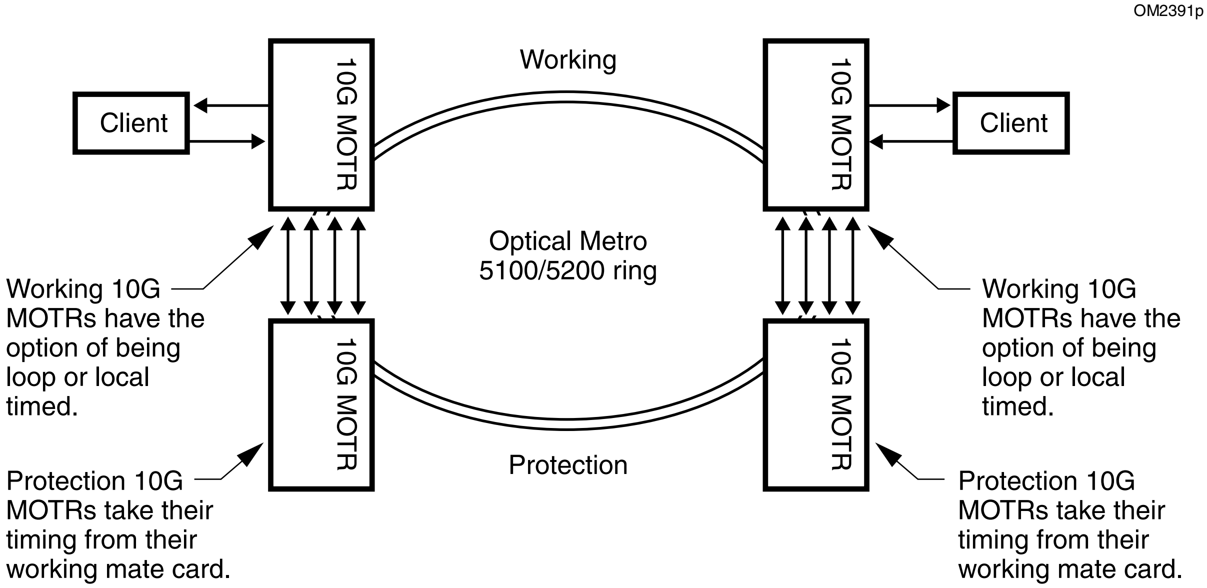
Figure 2-10
Muxponder 10 Gbit/s GbE/FC VCAT line timing



In loop-timed reference mode, the circuit pack obtains the clock from the line. This clock source is then used to clock the transmit line of the working circuit pack and the backplane signal going to the mate protection circuit pack.

The mate-timing reference is provisioned on the protection circuit pack in protected configurations and cannot be changed. A mate-timed protection Muxponder 10 Gbit/s GbE/FC VCAT circuit pack derives its timing from the working circuit pack through the backplane. See Figure 2-11 on page 2-61.

Figure 2-11
Synchronization provisioning for protected Muxponder 10 Gbit/s GbE/FC VCAT configuration



Synchronization considerations

The following synchronization considerations apply when deploying the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack:

- In a bookended configuration, at least one Muxponder 10 Gbit/s GbE/FC VCAT circuit pack in each point-to-point pair must be configured in local-timing mode (free-run).
- Synchronization Status Messaging (SSM) is not supported. The S1 byte always indicates “Synchronization Traceability Unknown”.
- BITS timing is not supported on Optical Metro 5100/5200 systems.
- In loop-timing mode, if the line received clock signal is lost, the line-side transmit clock signal enters holdover mode indefinitely, to within 20 ppm of the last locked frequency.
- If the protection circuit pack clock is lost in a mate-timed, protected configuration, the protection circuit pack enters holdover mode indefinitely, to within 20 ppm of the last locked frequency.

Client-side conditioning

Table 2-19 summarizes the client-side signal conditioning applied on the client ports of Muxponder 10 Gbit/s circuit packs upon different fault and provisioning conditions for bidirectional client types.

Table 2-20 on page 2-65 summarizes the client-side signal conditioning applied on the client ports of Muxponder 10 Gbit/s circuit packs upon different fault and provisioning conditions for unidirectional Gigabit Ethernet client types.

Client-side conditioning based on line-side faults is performed on the active Muxponder circuit pack of a protected channel assignment or on the sole Muxponder circuit pack of an unprotected channel assignment.

Table 2-19
Client-side conditioning for bidirectional client types

<table>
<tr><th>Muxponder 10 Gbit/s circuit pack type</th><th>Condition</th><th>Protocol</th><th>Encapsulation</th><th>Action</th></tr>
<tr><td rowspan="3">Muxponder 10 Gbit/s GbE/FC</td><td rowspan="2">• Line-side fault
• Loss of frame delineation
• SONET/SDH defects (LOF, L-AIS, MS-AIS LOP, P-AIS, AU-AIS)
• Client Service Mismatch
• Line-side facility OOS
• Far-end client-side fault
• Far-end client-side facility OOS
• Far-end SFP failure
• Far-end SFP OOS
• No channel assignment at far-end Muxponder</td><td>Gigabit Ethernet</td><td>GFP-T</td><td>Laser shutdown</td></tr>
<tr><td>FC-100, FC-200, FICON, FICON Express</td><td>GFP-T</td><td>8B/10B error code</td></tr>
<tr><td>• Client-side facility OOS
• Circuit pack failure
• SFP failure
• SFP OOS
• No channel assignment</td><td>Any</td><td>Any</td><td>Laser shutdown</td></tr>
</table>

Table 2-19 (continued)
Client-side conditioning for bidirectional client types

Muxponder 10 Gbit/s circuit pack type	Condition	Protocol	Encapsulation	Action
Muxponder 10 Gbit/s GbE/FC VCAT	• Line-side fault • Loss of frame delineation • SONET/SDH defects (LOF, L-AIS, MS-AIS LOP, P-AIS, AU-AIS, SF, UNEQ, LO multiframe, LO sequence, LO alignment, PLM) • Client Service Mismatch • Line-side facility OOS • Far-end client-side fault • Far-end client-side facility OOS • Far-end SFP failure • Far-end SFP OOS • No channel assignment at far-end Muxponder	Gigabit Ethernet	Any	Laser shutdown
		FC-100, FC-200, FICON, FICON Express	GFP-T	8B/10B error code
	• Client-side facility OOS • Circuit pack failure • SFP failure • SFP OOS • No channel assignment	Any	Any	Laser shutdown

Table 2-20
Client-side conditioning for unidirectional Gigabit Ethernet client types

Muxponder 10 Gbit/s circuit pack type	Condition	Encapsulation	Action at uni-drop client port	Action at uni-add client port
Muxponder 10 Gbit/s GbE/FC	• Line-side fault in used direction • Loss of frame delineation in used direction • SONET/SDH defects (LOF, L-AIS, MS-AIS LOP, P-AIS, AU-AIS) in used direction • Client-side facility OOS at uni-add client port	GFP-T	Laser shutdown	Laser shutdown
	• Line-side fault in unused direction • Loss of frame delineation in unused direction • SONET/SDH defects (LOF, L-AIS, MS-AIS LOP, P-AIS, AU-AIS) in unused direction	GFP-T	None	Laser shutdown
	• Client-side fault at uni-add client port • Client Service Mismatch in used direction • Client-side facility OOS at uni-drop client port	GFP-T	Laser shutdown	8B/10B error code

Table 2-20 (continued)
Client-side conditioning for unidirectional Gigabit Ethernet client types

<table>
<tr><th>Muxponder 10 Gbit/s circuit pack type</th><th>Condition</th><th>Encapsu lation</th><th>Action at uni-drop client port</th><th>Action at uni-add client port</th></tr>
<tr><td rowspan="5">Muxponder 10 Gbit/s GbE/FC VCAT</td><td rowspan="2">• Line-side fault in used direction
• Loss of frame delineation in used direction
• SONET/SDH defects (LOF, L-AIS, MS-AIS LOP, P-AIS, AU-AIS, SF, UNEQ, LO multiframe, LO sequence, LO alignment, PLM) in used direction
• Client-side fault at uni-add client port
• Client Service Mismatch in used direction
• Client-side facility OOS at uni-drop client port</td><td>GFP-T</td><td>Laser shutdown</td><td>8B/10B error code</td></tr>
<tr><td>GFP-F</td><td>Laser shutdown</td><td>GbE idle frames</td></tr>
<tr><td rowspan="2">• Line-side fault in unused direction
• Loss of frame delineation in unused direction
• SONET/SDH defects (LOF, L-AIS, MS-AIS LOP, P-AIS, AU-AIS, SF, UNEQ, LO multiframe, LO sequence, LO alignment, PLM) in unused direction</td><td>GFP-T</td><td>None</td><td>8B/10B error code</td></tr>
<tr><td>GFP-F</td><td>None</td><td>GbE idle frames</td></tr>
<tr><td>• Client-side facility OOS at uni-add client port</td><td>GFP-T or GFP-F</td><td>Laser shutdown</td><td>Laser shutdown</td></tr>
</table>

Client-side conditioning holdoff times (AOC)

The AOC (Automatic Output Control) Provisionable hold off timer (0 ms to 1000 ms, 100 ms steps) can be used to hold off the conditioning indicated in the Action columns of Table 2-19 on page 2-63 and Table 2-20 on page 2-65. Defaults are 0 ms for unprotected channel assignments and 500 ms for protected channel assignments.

> ***Note:*** The holdoff does not apply when the client-side facility is put in the OOS state. In this case, the laser is shutdown as soon as the facility is put OOS.

The holdoff time is implemented to prevent Optical Metro 5100/5200, OTS or ETS protection switches from impacting the subtending equipment. During an Optical Metro 5100/5200, OTS or ETS protection switch, the subtending equipment will not know that a switch actually occurred in terms of the physical level protocol. This prevents the subtending equipment from bringing down the link and causing extended outage times during protection switching.

See Table 2-21 for action during the holdoff period.

Table 2-21
Actions during the holdoff period

Muxponder 10 Gbit/s circuit pack type	Protocol	Encapsulation	Action
Muxponder 10 Gbit/s GbE/FC	Gigabit Ethernet	GFP-T	8B/10B error code
	FC-100, FC-200, FICON, FICON Express	GFP-T	8B/10B error code
Muxponder 10 Gbit/s GbE/FC VCAT	Gigabit Ethernet	GFP-T	8B/10B error code
		GFP-F	GbE idle frames
	FC-100, FC-200, FICON, FICON Express	GFP-T	8B/10B error code

System Manager changes

This section describes the System manager changes introduced in Release 8.0 for the Muxponder 10 Gbit/s circuit packs.

In the System Manager interface, the

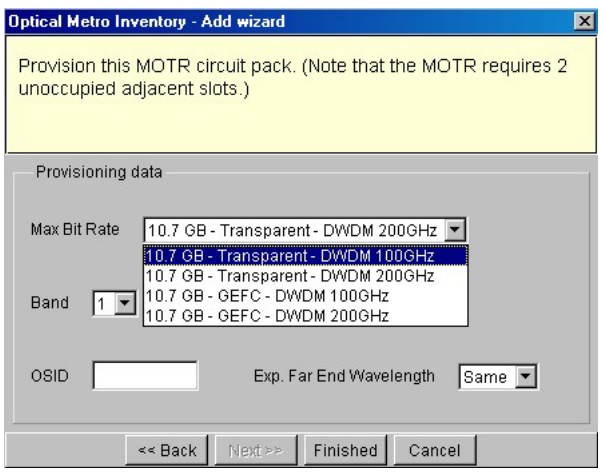
- Muxponder 10 Gbit/s GbE/FC circuit pack is identified as “MOTR 10.7 GB - Transparent”
- Muxponder 10 Gbit/s GbE/FC VCAT circuit pack is identified as “MOTR 10.7 GB - GEFC”

Muxponder provisioning wizard

The System Manager Muxponder provisioning wizard screen (see Figure 2-12) is modified to include the new Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

Figure 2-12
Muxponder Optical Metro Inventory - Add wizard screen

OM2738t



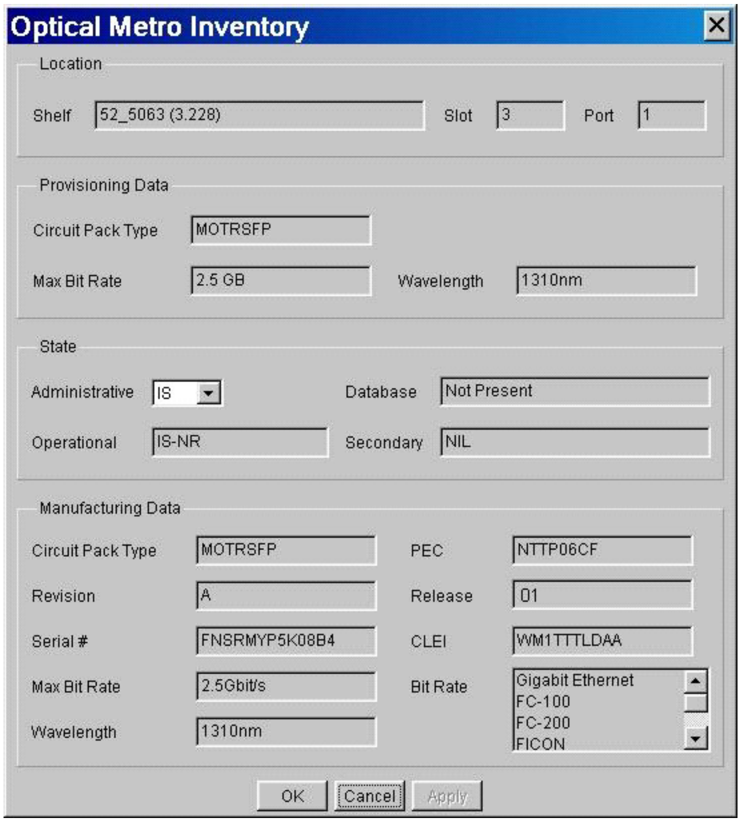
System Manager Muxponder SFP Detailed Equipment screen

The System Manager SFP Detailed Equipment screen (see Figure 2-13) is changed to include the Release field. This field is applicable to both the Muxponder 10 Gbit/s GbE/FC circuit pack and the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack. The Revision field indicates the release of all non-SFP Optical Metro 5100/5200 equipment. For SFP equipment, the Revision field is defined by the SFP Multi-source Agreement (MSA) among vendors. This information is used by SFP vendors as part of their control process. Since it is defined by each SFP vendor, the value is SFP vendor specific. The SFP release information is included in the Release field.

> ***Note:*** Some SFPs, depending on the component manufacturer, display the Release as NA.

Figure 2-13
Muxponder SFP Detailed Equipment screen

OM2739t



System Manager Muxponder Detailed Client-side Facility screen

The System Manager Muxponder Detailed Client-side Facility screen (see Figure 2-14 on page 2-70) is modified to include:

- GFP FCS field
  - — for details, refer to "Facility provisioning" on page 2-19
  - — applicable for both the Muxponder 10 Gbit/s GbE/FC circuit pack and the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack
  - — applicable for all supported protocols
- Auto Negotiation and Pause fields
  - — for details, refer to "Gigabit Ethernet features" on page 2-53
  - — only applicable to the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack
  - — only applicable to the Gigabit Ethernet protocol
  - — only applicable when encapsulation is provisioned as GFP-F
- Details button to access the Advanced Auto Negotiation and Pause screen (see Figure 2-15 on page 2-71)

— for details, refer to "Gigabit Ethernet features" on page 2-53

— only applicable to the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

— only applicable to the Gigabit Ethernet protocol

— only applicable when encapsulation is provisioned as GFP-F

— for uni-add connections, Auto Negotiation, FlowCtrl and PauseTx attributes are greyed out. For uni-drop connections, only the MTU and PREAMBLECTRL attributes are allowed to be provisioned.

Figure 2-14
Muxponder Detailed Client-side Facility screen

OM2740t

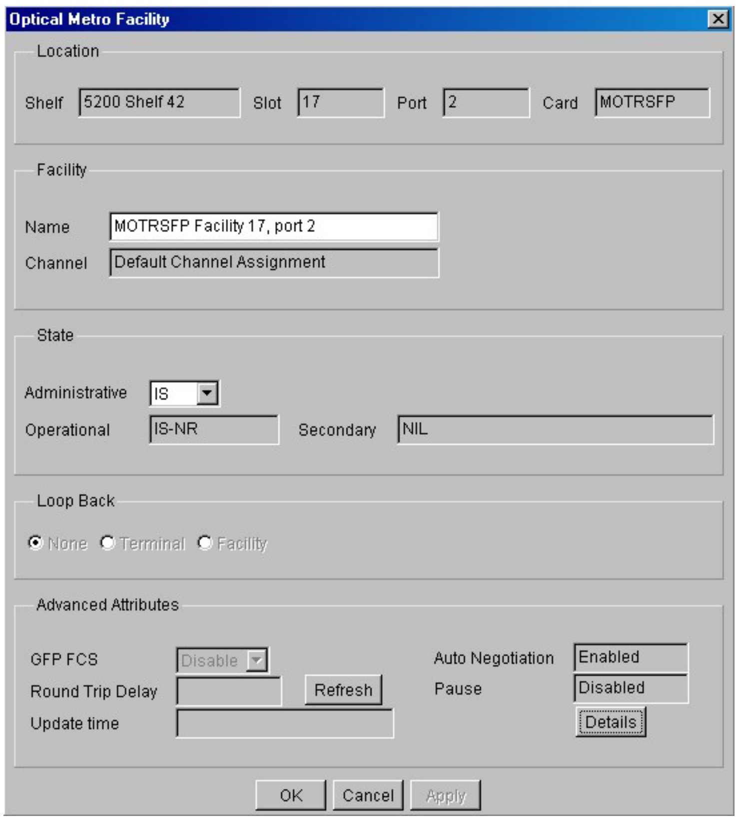
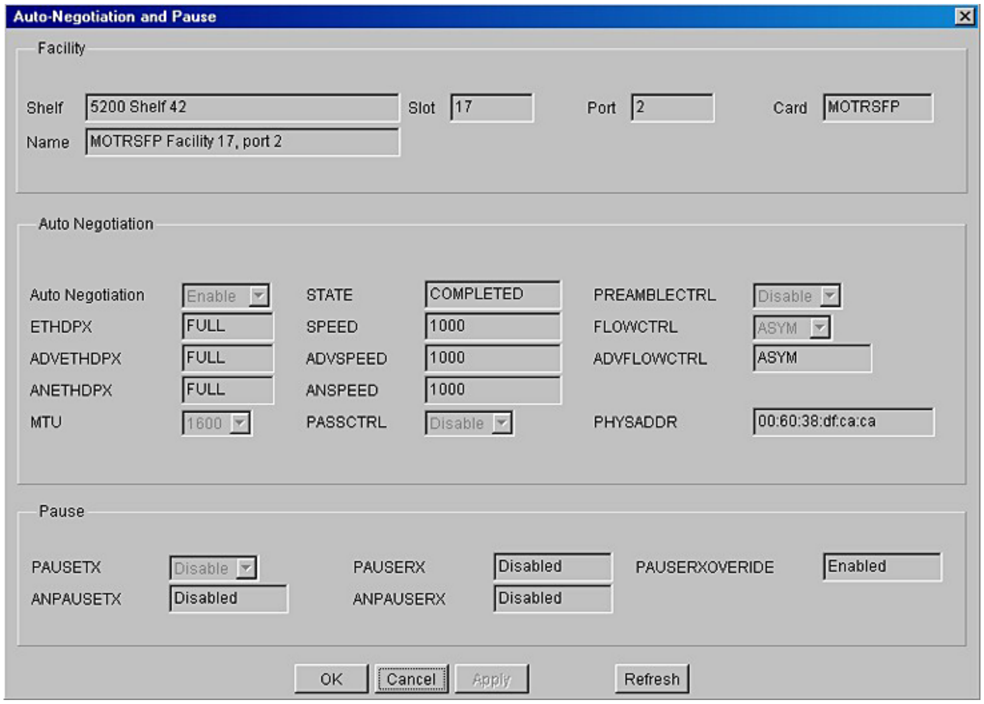


Figure 2-15
Muxponder Advanced Auto-Negotiation and Pause screen



System Manager Muxponder Detailed Channel Assignment screen
The System Manager Muxponder Detailed Channel Assignment screen (see Figure 2-16 on page 2-72) is modified to include:

- Encapsulation field:
  - — for details, refer to "Channel and port assignments" on page 2-20
  - — GFP-F is only provisionable on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack when the selected Bit Rate is Gigabit Ethernet, otherwise the value is set to GFP-T
- Advanced button to access the Channel Assignment Advance Details screen (see Figure 2-17 on page 2-72)
  - — for details, refer to "Channel and port assignments" on page 2-20
  - — the AOC Holdoff field is applicable to both the Muxponder 10 Gbit/s GbE/FC circuit pack and the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack
  - — the Path PMs field is only applicable to the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

Figure 2-16
Muxponder Detailed Channel Assignment screen

OM2742t

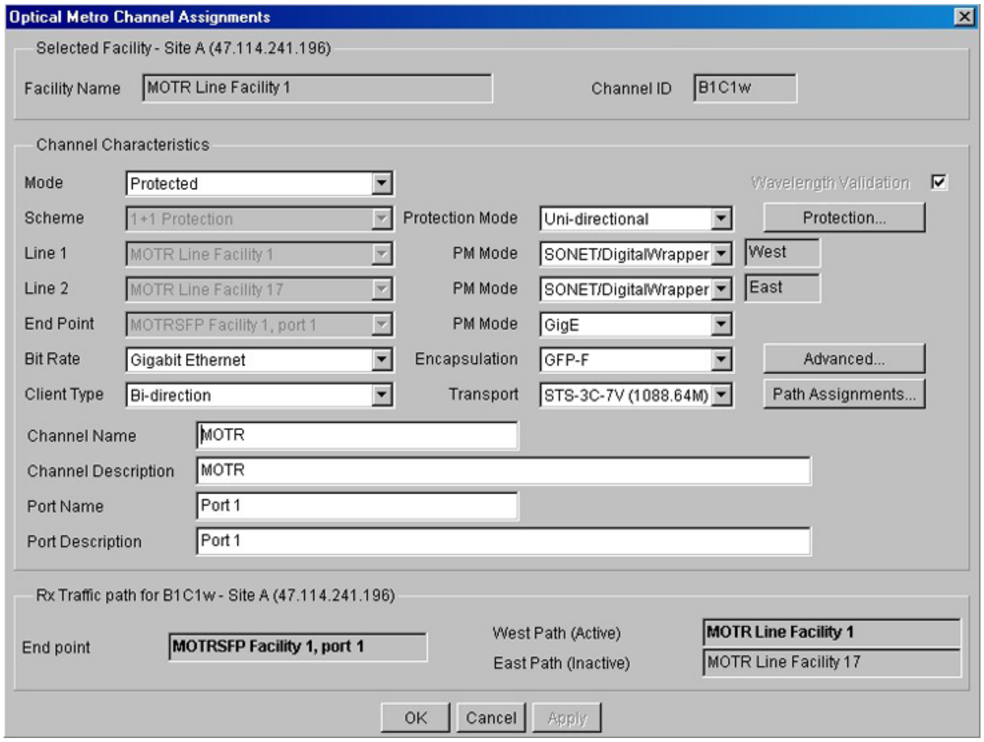
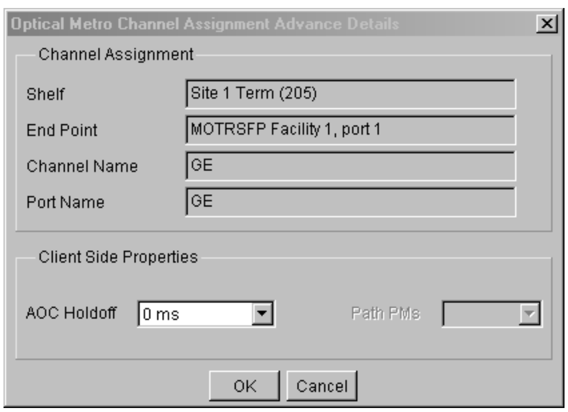


Figure 2-17
Muxponder Channel Assignment Advance Detail screen

OM2786t

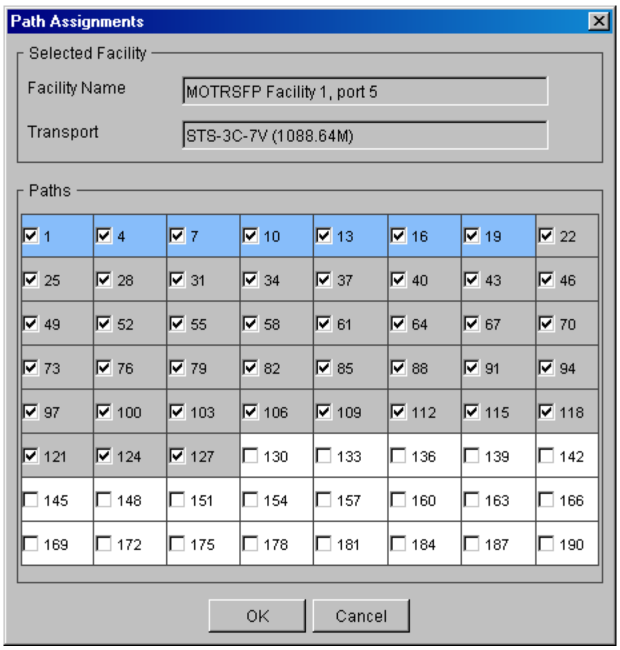


System Manager Path Assignment screen

The System Manager Path Assignment screen is modified to allow for flexible path assignments on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack (see Figure 2-18).

- Blue checked boxes indicate used paths on currently selected port
- White unchecked boxes indicate available paths on currently selected port
- Grey checked boxes indicate used paths by other ports
- Grey unchecked boxes indicate unused and unavailable paths

Figure 2-18
Path Assignment screen for the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

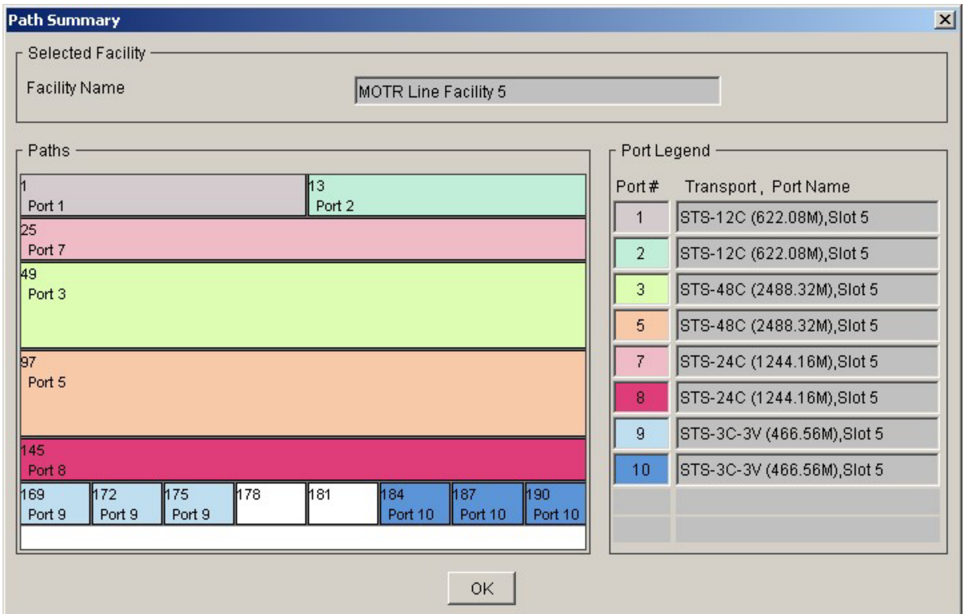


System Manager Muxponder Path Summary screen

The System Manager Muxponder Path Summary screen is modified to support V-cat channel assignments and to include Port Legend information (see Figure 2-19).

Figure 2-19
Muxponder Path Summary screen

OM2745t

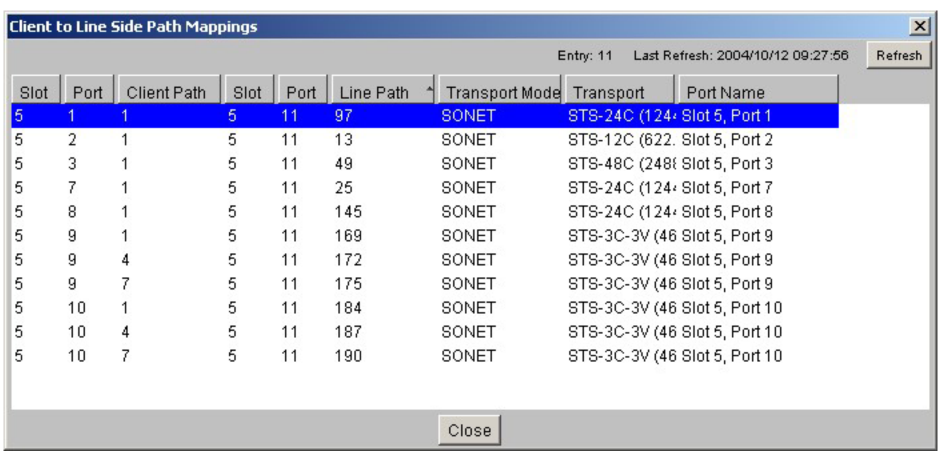


System Manager Muxponder Path Mapping screen

The System Manager Muxponder Path Mapping screen is new to Release 8.0 and includes client-side to line-side path mappings (see Figure 2-20).

Figure 2-20
Muxponder Path Mapping screen

OM2746t



Both the Path Summary and Path Mapping screens can be accessed by the pull-down menu that is accessed by right-clicking on a Muxponder 10 Gbit/s channel assignment from the Channel Assignments screen.

System Manager Muxponder Detailed Fault screen

The System Manager Muxponder Alarm Details screen (see Figure 2-21 on page 2-76) and Event Details screen (see Figure 2-22 on page 2-77) are modified to include:

- Path field (only available in the Alarm Details screen)
  - — displays the affected client-side paths and is only applicable to summary path alarms raised by the Muxponder 10 Gbit/s circuit pack. When a path fault is detected on a path associated with a client-side facility, a summary path alarm is generated against the client-side facility. If a fault is detected on a different path associated with the same client-side facility, a new summary alarm is not raised. However, when a user double-clicks on the summary alarm in the Active Alarms list, the software polls the circuit pack to determine the existing faulty paths and this information is displayed in the Path field of the Alarm Details window.
  - — next to the path field is the Mappings button. When pressed, this button brings up the Client to Line Side Path Mappings screen (see Figure 2-20 on page 2-74) so that client-side paths can be correlated to line-side paths.
- the Show Circuit Pack Event button in the Event Details screen to access the new Circuit Pack Event History window (see Figure 2-23 on page 2-77)
  - — the Circuit Pack Event button lets you tunnel deeper into the circuit pack to trace outstanding events against the circuit pack that contributed to the historical event. The events are stored and retrieved from the circuit pack.

Figure 2-21
Alarm Details window

OM2743t

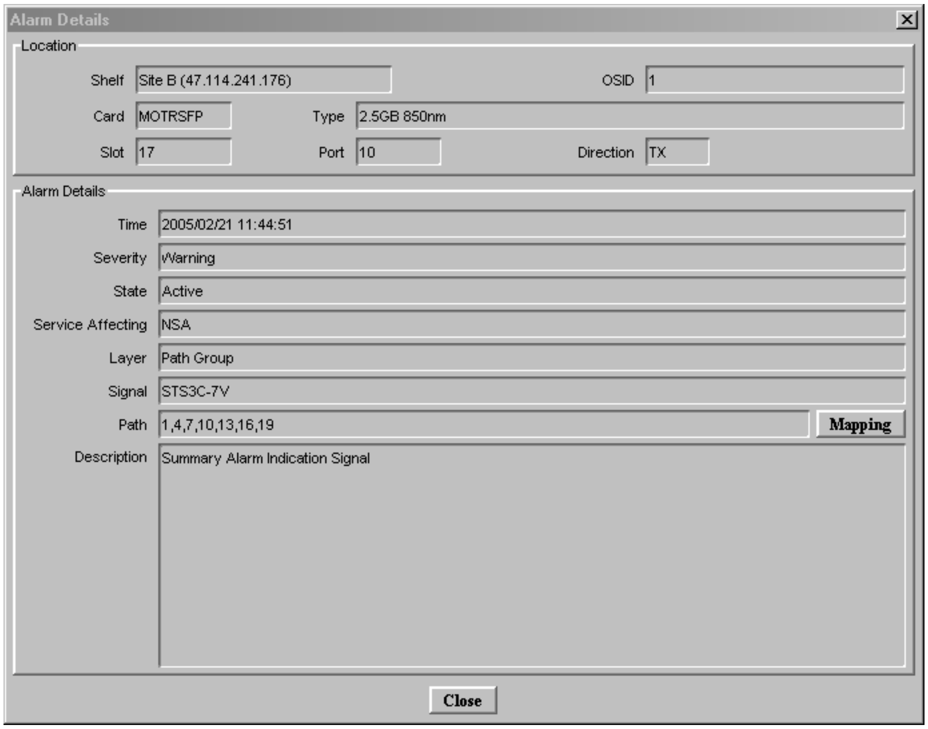


Figure 2-22
Event Details window from the Event History screen

OM2748t

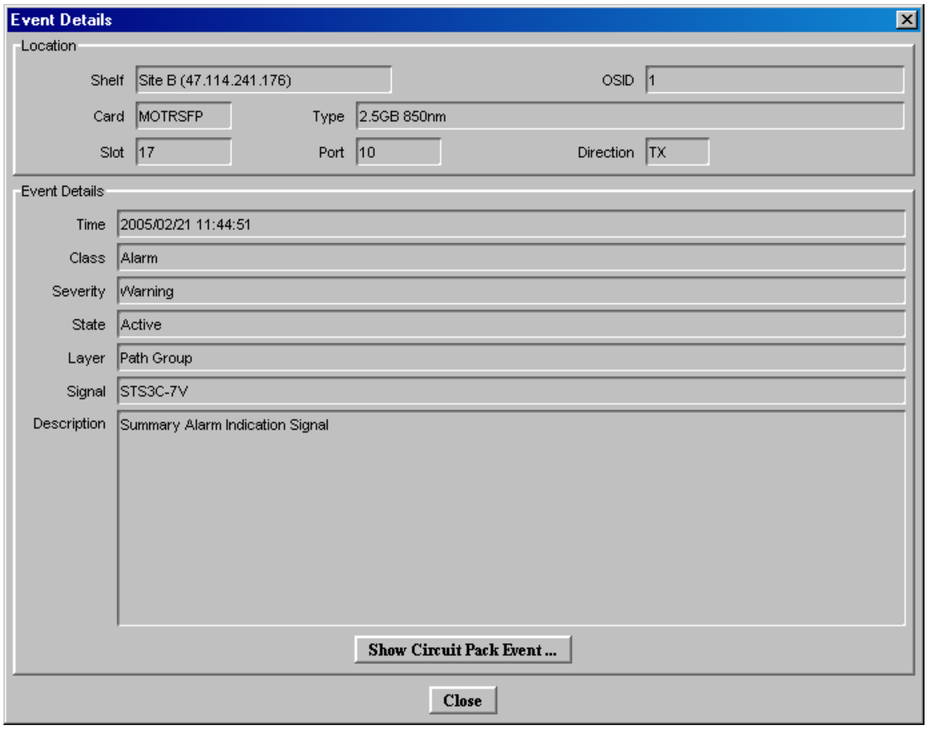
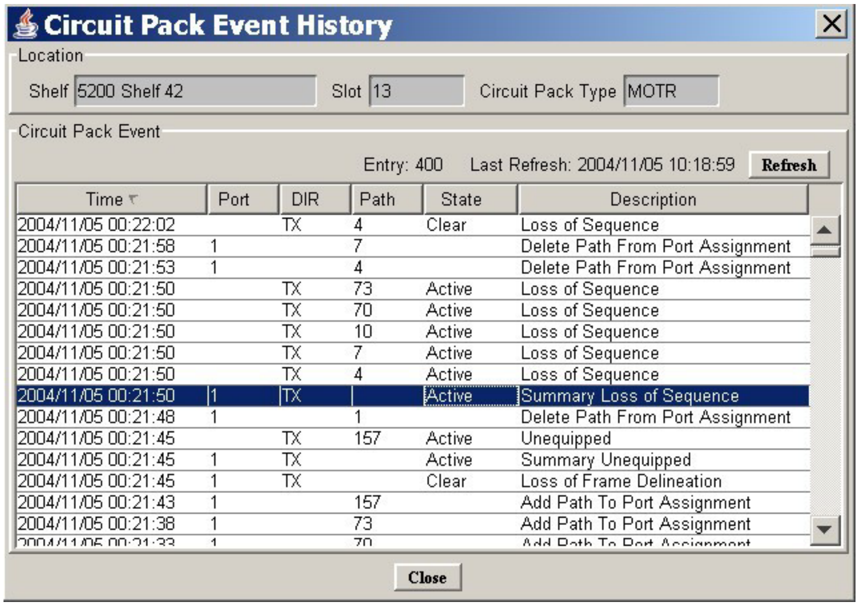


Figure 2-23
Circuit Pack Event History window

OM2749t

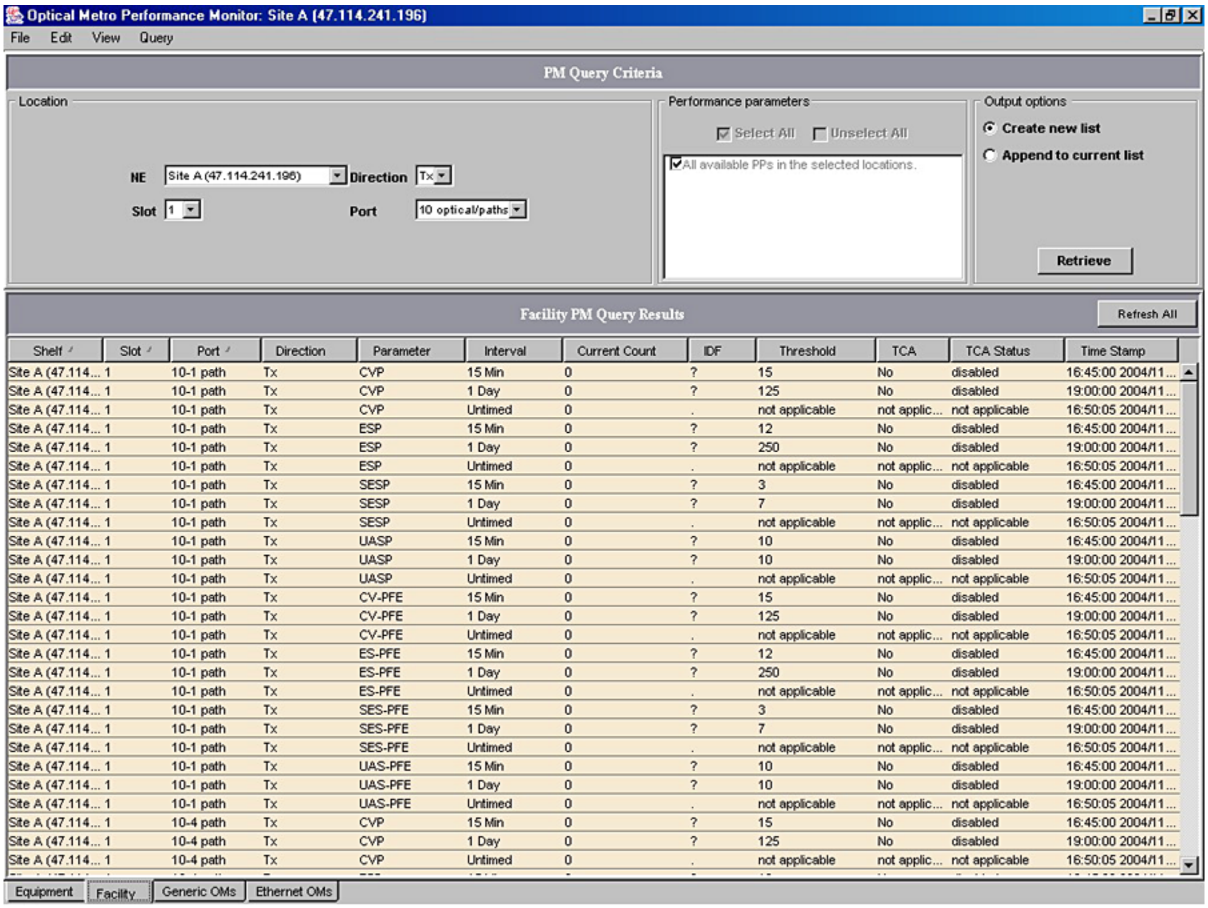


System Manager Muxponder Path PM screen

The System Manager Muxponder Performance Monitoring screen is modified to include client-side Tx interface path PMs (see Figure 2-24). This screen is only applicable to the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

Figure 2-24
Muxponder Path PM screen

OM2750p

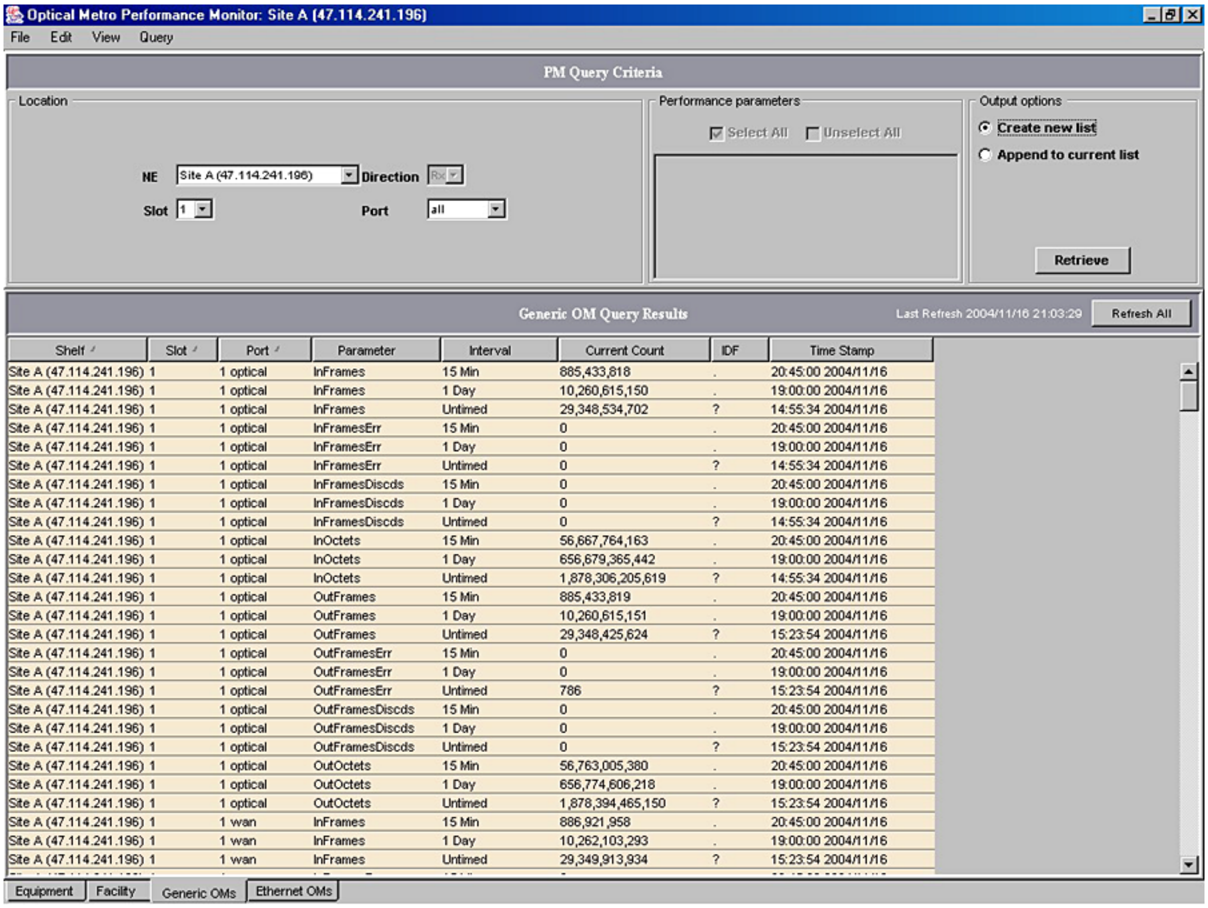


System Manager Muxponder Operational Measurement screen

The System Manager Muxponder Operational Measurement screen is introduced (see Figure 2-24 on page 2-78). This screen is only applicable to the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

Figure 2-25
Muxponder Operational Measurement screen

OM2751p



Network interoperability

The Muxponder 10 Gbit/s GbE/FC circuit pack network interoperability is described in “Supported configurations and topologies” on page 3-1.

Link engineering guidelines

The same link engineering guidelines apply for the Muxponder 10 Gbit/s GbE/FC circuit pack and the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

Refer to *Network Planning and Link Engineering*, 323-1701-110 for general link engineering rules. The following link engineering rules must be taken into consideration when deploying Muxponder 10 Gbit/s circuit packs:

- Up to 13 regenerator sites are supported for each Muxponder bidirectional channel. Two OTR 10 Gbit/s Enhanced circuit packs must be placed back-to-back at the regeneration site. Physically connect the client interface ports to establish the association between the two OTR 10 Gbit/s Enhanced circuit packs. For information on how to establish a pass-through connection between two OTR 10 Gbit/s Enhanced circuit packs, refer to "Connecting OTR 10 Gbit/s Enhanced circuit packs for pass-through connections through a patch panel", in *Connection Procedures*, 323-1701-221. You cannot provision a pass-through channel assignment on an OTR circuit pack. To create a channel assignment between two OTR 10 Gbit/s Enhanced circuit pack in a pass-through configuration, you must create an unprotected channel assignment between the OTR 10 Gbit/s Enhanced circuit packs with an OC-192 bit rate. See "Making or modifying channel assignments" in *Provisioning and Operating Procedures*, 323-1701-310. See Chapter 3,"Supported configurations and topologies" for a description of point-to-point configurations with regeneration.

- The Muxponder 10 Gbit/s circuit pack is supported with all DWDM OMXs, as well as Optical Metro 5100 OMX-less configurations. The Muxponder 10 Gbit/s circuit pack is also supported with Common Photonic Layer Channel Multiplexer/Demultiplexer (CMD). For Common Photonic Layer link engineering guidelines, refer to *Optical Modeler User Guide* (NTT840EA).
- In-band mixing with OCLD 2.5 Gbit/s Flex, OTR 2.5 Gbit/s, OCLD 2.5 Gbit/s Universal, OTR 2.5 Gbit/s Universal, OTR 10 Gbit/s Enhanced, Muxponder 10 Gbit/s GbE/FC and Muxponder 10 Gbit/s GbE/FC VCAT circuit packs is supported.
- The dispersion reach limit is typically 110 km for C-band and 95 km for L-band (2000 ps/nm) on NDSF fiber.

  Note: In some applications, it is possible to exceed the dispersion limits on NDSF fiber. To ensure that the dispersion limit of the circuit pack is not exceeded, check that either:

  — the total measured dispersion of the fiber, from the TX (add) through all spans to the RX (drop), is less than 2000 ps/nm. It is important to perform this check at the longest wavelength to be deployed, as dispersion is wavelength dependent.

  — if the characteristic dispersion per unit length (ps/nm/km) of the fiber is known, then the maximum reach can be calculated using the 2000 ps/nm dispersion limit (for example, the maximum reach over 17 ps/nm/km dispersion fiber is 2000/17 = 117 km). It is important to perform this check at the longest wavelength to be deployed, as dispersion is wavelength dependent.

Client-side link engineering rules

The same client-side link engineering guidelines apply for the Muxponder 10 Gbit/s GbE/FC circuit pack and the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

To engineer a client-side link, refer to Table 2-22 on page 2-82 and Table 2-23 on page 2-83.

When using Table 2-22 on page 2-82 and Table 2-23 on page 2-83, you must take the following into consideration:

- The attenuator and reach values refer to the client-side of the network.
- Since various fiber losses exist, the tables list both a maximum allowed loss and a maximum distance. The maximum distance is calculated from the maximum loss based on the allowed fiber loss for a given protocol.
- In most cases, a link budget does not apply to multimode fiber. If power and sensitivity values of the circuit pack meet a given standard specification, then the distance in that standard is considered to be the maximum possible distance.
- If further distance is possible with the circuit pack than that specified by a standard, then the distance specified in the standard is stated as the maximum possible distance.
- The BER for a given link is based upon the value stated in the appropriate standard.
- The attenuator values apply to the Optical Metro 5100/5200 Tx and Rx only, and are required for minimum overload protection when the subtending equipment is colocated with the Optical Metro 5100/5200 equipment. The attenuator value can be traded off for fiber loss as long as the input power to the receiver meets the minimum overload specification.
- The attenuator values provided are minimum values. For example, if the table indicates that a 7 dB pad is needed, an 8 dB pad can be used.
- In most cases, the attenuator does not limit the reach. However, there are certain cases where the attenuator will limit the reach. In this case, the reach specified is with the attenuator removed.

Table 2-22
Protocols supported by Muxponder 10 Gbit/s circuit packs using 850 nm SFP (NTTP06AF)

Protocol	Bit rate	System Manager menu name	Protection scheme	Attenuator value for colocation		Fiber type	Reach
				Tx	Rx		
Fibre Channel FC 100-M5-SN-I	1.0625 Gbit/s	FC-100	Protected or Unprotected	0	0	50 µm MM 500 MHz*km	500 m, BER=10^{-12}
Fibre Channel FC 100-M6-SN-I	1.0625 Gbit/s	FC-100	Protected or Unprotected	0	0	62.5 µm MM 200 MHz*km	300 m, BER=10^{-12}
Fibre Channel FC 200-M5-SN-I	2.125 Gbit/s	FC-200	Protected or Unprotected	0	0	50 µm MM 500 MHz*km	300 m, BER=10^{-12}
Fibre Channel FC 200-M6-SN-I	2.125 Gbit/s	FC-200	Protected or Unprotected	0	0	62.5 µm MM 200 MHz*km	150 m, BER=10^{-12}
FICON	1.0625 Gbit/s	FICON	Protected or Unprotected	0	0	50 µm MM 500 MHz*km	500 m, BER=10^{-12}
						62.5 µm MM 200 MHz*km	300 m, BER=10^{-12}
FICON Express	2.125 Gbit/s	FICON Express	Protected or Unprotected	0	0	50 µm MM 500 MHz*km	300 m, BER=10^{-12}
						62.5 µm MM 200 MHz*km	150 m, BER=10^{-12}
Gigabit Ethernet 1000Base-SX	1.25 Gbit/s	Gigabit Ethernet	Protected or Unprotected	0	0	50 µm MM 400 MHz*km	500 m, BER=10^{-12}
						50 µm MM 500 MHz*km	550 m, BER=10^{-12}
						62.5 µm MM 160 MHz*km	220 m, BER=10^{-12}
						62.5 µm MM 200 MHz*km	275 m, BER=10^{-12}

Table 2-23
Protocols supported by Muxponder 10 Gbit/s circuit packs using 1310 nm SFP (NTTP06CF)

Protocol	Bit rate	System Manager menu name	Protection scheme	Attenuator value for colocation		Fiber type	Reach
				Tx	Rx		
Fibre Channel FC 100-SM-LC-L	1.062 Gbit/s	FC-100	Protected or Unprotected	0	0	SM	10 km, BER=10^{-12}
Fibre Channel FC 200-SM-LC-L	2.125 Gbit/s	FC-200	Protected or Unprotected	0	0	SM	10 km, BER=10^{-12}
FICON	1.0625 Gbit/s	FICON	Protected or Unprotected	0	0	SM	10 km, BER=10^{-12}
FICON Express	2.125 Gbit/s	FICON Express	Protected or Unprotected	0	0	SM	10 km, BER=10^{-12}
Gigabit Ethernet 1000Base-LX	1.25 Gbit/s	Gigabit Ethernet	Protected or Unprotected	0	0	SM	5 km, BER=10^{-12}
Gigabit Ethernet 1000Base-LX	1.25 Gbit/s	Gigabit Ethernet	Protected or Unprotected	0	0	SM	5 km, BER=10^{-12}
						50 µm MM 400 MHz*km	550 m, BER=10^{-12} (see Note 1)
						50 µm MM 500 MHz*km	
						62.5 µm MM 500 MHz*km	
Gigabit Ethernet 1000Base-LX10 (see Note 2)	1.25 Gbit/s	Gigabit Ethernet	Protected or Unprotected	0	0	SM	5 km, BER=10^{-12}
						50 µm MM 500 MHz*km	550 m, BER=10^{-12} (see Note 1)
						62.5 µm MM 500 MHz*km	

Note 1: A mode-conditioning patch cord or plug is required to guarantee error-free performance if the subtending equipment is not colocated with the Optical Metro 5100/5200. Colocated means less than 30 m (100 ft.) away.

Note 2: Subtending equipment must support 1000BASE-LX10.

Technical specifications

Power consumption specifications

Table 2-24 lists the power consumption of Muxponder 10 Gbit/s circuit packs.

Table 2-24
Muxponder 10 Gbit/s circuit pack power consumption

Characteristic	Value or range	
Power consumption (see Note)	**Typical**	**Maximum**
Muxponder 10 Gbit/s GbE/FC Muxponder 10 Gbit/s GbE/FC 100 GHz	48 W	68 W
Muxponder 10 Gbit/s GbE/FC VCAT Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz	53 W	68 W
Note: Maximum power consumption values are obtained during worst-case operating conditions.		

Optical specifications

The same optical specifications apply for the Muxponder 10 Gbit/s GbE/FC circuit pack and the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

The SFP optical transceivers comply with IEEE 802.3 1000BASE-LX and 1000BASE-SX optical specifications for the Gigabit Ethernet protocol. The SFPs also comply with ANSI X3.230 FC-PH standard for the Fibre Channel protocol. FICON clients must comply with IBM specifications to interface with Nortel Networks SFP optical transceivers. Refer to Table 2-25 for SFP optical transceiver specifications for the client-side interface of the following Muxponder 10 Gbit/s circuit packs:

- Muxponder 10 Gbit/s GbE/FC
- Muxponder 10 Gbit/s GbE/FC VCAT
- Muxponder 10 Gbit/s GbE/FC 100 GHz
- Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz

Table 2-25
Specifications for Muxponder 10 Gbit/s circuit pack—client side

Characteristic	Value or range	
Bit rates	**Minimum**	**Maximum**
1310 nm SFP (NTTP06CF) 850 nm SFP (NTTP06AF)	1.0625 Gbit/s	2.125 Gbit/s
Rx wavelength		
1310 nm SFP (NTTP06CF)	1270 nm	1355 nm
850 nm SFP (NTTP06AF)	770 nm	860 nm
Tx wavelength		

Table 2-25 (continued)
Specifications for Muxponder 10 Gbit/s circuit pack—client side

Characteristic	**Value or range**	
1310 nm SFP (NTTP06CF)	1270 nm	1355 nm
850 nm SFP (NTTP06AF)	830 nm	860 nm
Tx power		
1310 nm SFP (NTTP06CF)	–9.5 dBm	–3.0 dBm
850 nm SFP (NTTP06AF)	–9.5 dBm	–1.5 dBm
Rx power (see Note 1)	**Minimum Sensitivity**	**Minimum Overload**
1310 nm SFP (NTTP06CF)	–20.0 dBm BER=10^{-12} (see Note 2)	–3.0 dBm BER=10^{-12}
850 nm SFP (NTTP06AF)	–17.0 dBm or –15.0 dBm BER=10^{-12} (see Note 3)	0.0 dBm BER=10^{-12}
Optical power monitor accuracy (see Note 4)	**TX**	**RX**
1310 nm SFP (NTTP06CF)	± 2.0 dB	± 2.0 dB
850 nm SFP (NTTP06AF)	± 2.0 dB	± 3.0 dB

Table 2-25 (continued)
Specifications for Muxponder 10 Gbit/s circuit pack—client side

Characteristic	Value or range
Applicable optical fiber types supported	
1310 nm SFP (NTTP06CF)	Protocol dependent, see Table 2-23 on page 2-83
850 nm SFP (NTTP06AF)	50/62.5 µm MM
Note 1: The Rx minimum sensitivity specifications are back-to-back and include no path power penalties. ***Note 2:*** FC-100 and FC-200 standards do not specify a sensitivity requirement (quoted values are calculated using Optical Modulation Amplitude specifications). ***Note 3:*** -17 dBm for FC-100, FICON, and Gigabit Ethernet, –15 dBm for FC-200 and FICON Express. FC-100 and FC-200 standards do not specify a sensitivity requirement (quoted values are calculated using Optical Modulation Amplitude specifications). ***Note 4:*** External power meters may differ from System Manager by up to ± 2.0 dB.	

Table 2-26 lists the specifications for the line-side interface of the Muxponder 10 Gbit/s circuit packs.

CAUTION
Risk of equipment damage
Damage to the line-side receiver (Rx) of the Muxponder 10 Gbit/s circuit pack can occur. Under no circumstances should the transmitter (Tx) be loop-backed directly to the receiver (Rx).

Table 2-26
Specifications for Muxponder 10 Gbit/s circuit pack—line side

Characteristic	Value or range		
Bit rates	**Minimum**		**Maximum**
Muxponder 10 Gbit/s GbE/FC Muxponder 10 Gbit/s GbE/FC VCAT Muxponder 10 Gbit/s GbE/FC 100 GHz Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz	10.709225 Gbit/s		10.709225 Gbit/s
Tx power	**Typical**	**Minimum**	**Maximum**
Muxponder 10 Gbit/s GbE/FC Muxponder 10 Gbit/s GbE/FC VCAT	3.3 dBm	2.6 dBm	4.0 dBm
Muxponder 10 Gbit/s GbE/FC 100 GHz Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz	3.4 dBm	2.6 dBm	4.0 dBm

Table 2-26 (continued)
Specifications for Muxponder 10 Gbit/s circuit pack—line side

Characteristic	Value or range		
Rx power (see Note 1 and Note 2)	**Minimum Sensitivity**	**Minimum Overload**	**Damage Level**
Muxponder 10 Gbit/s GbE/FC Muxponder 10 Gbit/s GbE/FC VCAT Muxponder 10 Gbit/s GbE/FC 100 GHz Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz	–25.0 dBm BER=10^{-12}	–5.0 dBm BER=10^{-12}	–2.0 dBm
Rx wavelength	**Minimum**	**Maximum**	
Muxponder 10 Gbit/s GbE/FC Muxponder 10 Gbit/s GbE/FC VCAT Muxponder 10 Gbit/s GbE/FC 100 GHz Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz	1528.773 nm	1605.744 nm	
Tx Center wavelength	**Value or range**		
Muxponder 10 Gbit/s GbE/FC Muxponder 10 Gbit/s GbE/FC VCAT	see Table 2-27 on page 2-88		
Muxponder 10 Gbit/s GbE/FC 100 GHz Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz	see Table 2-28 on page 2-89		
Tx wavelength tolerance			
Muxponder 10 Gbit/s GbE/FC Muxponder 10 Gbit/s GbE/FC VCAT Muxponder 10 Gbit/s GbE/FC 100 GHz Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz	± 0.05 nm		
Dispersion reach limit (NDSF)			
Muxponder 10 Gbit/s GbE/FC Muxponder 10 Gbit/s GbE/FC VCAT	typically 110 km for C-band and 95 km for L-band (2000 ps/nm. See Note 3)		
Muxponder 10 Gbit/s GbE/FC 100 GHz Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz	typically 110 km (2000 ps/nm. See Note 3)		

Table 2-26 (continued)
Specifications for Muxponder 10 Gbit/s circuit pack—line side

Characteristic	Value or range	
Optical power monitor accuracy (See Note 4)	**TX**	**RX**
Muxponder 10 Gbit/s GbE/FC Muxponder 10 Gbit/s GbE/FC VCAT Muxponder 10 Gbit/s GbE/FC 100 GHz Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz	± 1.0 dB	± 1.5 dB

Note 1: Rx overload and Rx sensitivity specifications are back-to-back and include no path penalties. The Network Modeling Tool (NMT) should be used to account for path penalties. If NMT is not used to design the network:

- For Rx sensitivity path penalties, see "Link engineering rules" in *Network Planning and Link Engineering,* 323-1701-110.
- For Muxponder 10 Gbit/s GbE/FC 100 GHz and Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz circuit packs, use the Common Photonic Layer Optical Modeler tool.

Note 2: In most cases, traffic continuity at high and low input power is determined by the Receive Power High Fail Threshold and Receive Power Low Fail Threshold rather than by the minimum overload and minimum sensitivity. For threshold values, *Technical Specifications,* 323-1801-180.

Note 3: In some applications, it may be possible to exceed the dispersion limits on NDSF fiber. To ensure that the dispersion limit of the circuit pack is not exceeded, it is necessary to check that either:

- The total measured dispersion of the fiber, from the TX (add) through all spans to the RX (drop), is less than 2000 ps/nm
- If the characteristic dispersion per unit length (ps/nm/km) of the fiber is known, then the maximum reach can be calculated using the 2000 ps/nm dispersion limit (for example, the maximum reach over 17 ps/nm/km dispersion fiber is 2000/17 = 117 km)

It is important to perform this check at the longest wavelength to be deployed, as dispersion is wavelength dependent.

Note 4: External power meters may differ from System Manager by up to ± 2.0 dB.

Table 2-27 lists the 200 GHz DWDM center wavelengths for the Muxponder 10 Gbit/s GbE/FC and Muxponder 10 Gbit/s GbE/FC VCAT circuit packs.

Table 2-27
200 GHz DWDM center wavelengths

Band	Center wavelength			
	Channel 1	**Channel 2**	**Channel 3**	**Channel 4**
1	1528.77 nm	1533.47 nm	1530.33 nm	1531.90 nm
2	1538.19 nm	1542.94 nm	1539.77 nm	1541.35 nm
3	1547.72 nm	1552.52 nm	1549.32 nm	1550.92 nm
4	1557.36 nm	1562.23 nm	1558.98 nm	1560.61 nm

Table 2-27 (continued)
200 GHz DWDM center wavelengths

Band	Center wavelength			
	Channel 1	**Channel 2**	**Channel 3**	**Channel 4**
5	1570.42 nm	1575.37 nm	1572.06 nm	1573.71 nm
6	1580.35 nm	1585.36 nm	1582.02 nm	1583.69 nm
7	1590.41 nm	1595.49 nm	1592.10 nm	1593.80 nm
8	1600.60 nm	1605.73 nm	1602.31 nm	1604.02 nm

Table 2-28 lists the 100 GHz DWDM center wavelengths for the Muxponder 10 Gbit/s GbE/FC 100 GHz and Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz circuit packs.

Table 2-28
100 GHz DWDM center wavelengths

Band/Group	Center wavelength			
	Channel 1	**Channel 2**	**Channel 3**	**Channel 4**
1	1530.33 nm	1531.12 nm	1531.90 nm	1532.68 nm
2	1534.25 nm	1535.04 nm	1535.82 nm	1536.61 nm
3	1538.19 nm	1538.98 nm	1539.77 nm	1540.56 nm
4	1542.14 nm	1542.94 nm	1543.73 nm	1544.53 nm
5	1546.12 nm	1546.92 nm	1547.72 nm	1548.52 nm
6	1550.12 nm	1550.92 nm	1551.72 nm	1552.52 nm
7	1554.13 nm	1554.94 nm	1555.75 nm	1556.56 nm
8	1558.17 nm	1558.98 nm	1559.79 nm	1560.61 nm
9	1562.23 nm	1563.05 nm	1563.86 nm	1564.68 nm

Latency specifications

The latency specifications for the Muxponder 10 Gbit/s circuit pack are from the local client port to the remote client port with negligible fiber (less than 3 ft.) on the DWDM line side.

If additional fiber is used on the line side, add fiber latency to the Muxponder latency according to the following formula:

$$\text{Fiber latency } (\mu s) = 4.84 \times \text{Fiber length (km)}$$

The Muxponder typical latency specifications are detailed in Table 2-29.

Table 2-29
Muxponder 10 Gbit/s circuit pack latency

Circuit pack type	Protocol	Configuration	Typical Latency (µs)
Muxponder 10 Gbit/s GbE/FC Muxponder 10 Gbit/s GbE/FC 100 GHz	GbE	GFP-T, C-cat	17 (see Note 1, 2, 4)
	FC-100 FICON	GFP-T, C-cat	17 (see Note 1, 3, 4)
	FC-200 FICON Express	GFP-T, C-cat	16 (see Note 1, 3, 4)

Table 2-29
Muxponder 10 Gbit/s circuit pack latency

Circuit pack type	Protocol	Configuration	Typical Latency (µs)
Muxponder 10 Gbit/s GbE/FC VCAT Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz	GbE	GFP-T, C-cat	19 (see Note 1, 2, 4)
		GFP-T, V-cat	67 (see Note 1, 2, 4)
		GFP-F, C-cat, STS-24c/VC-4-8c, PAUSE Disabled	13 + 0.014 x frame length (bytes)
		GFP-F, C-cat, STS-48c/VC-4-16c, PAUSE Disabled	13 + 0.011 x frame length (bytes)
		GFP-F, C-cat, PAUSE Enabled	Variable
		GFP-F, V-cat, PAUSE Disabled	60 + 0.016 x frame length (bytes)
		GFP-F, V-cat, PAUSE Enabled	Variable
	FC-100 FICON	GFP-T, C-cat	20 (see Note 1, 3, 4)
		GFP-T, V-cat	68 (see Note 1, 3, 4)
	FC-200 FICON Express	GFP-T, C-cat	16 (see Note 1, 3, 4)
		GFP-T, V-cat	68 (see Note 1, 3, 4)

Note 1: This latency value is independent of packet size and is derived using 100% throughput.

Note 2: The maximum Gigabit Ethernet packet jitter (latency variation at different throughput rates) is ± 1.0 µs. For GFP-F, V-cat the latency can be as much as 10 µs lower at throughputs less than 100%.

Note 3: The maximum FC-100/FICON and FC-200/FICON Express packet jitter (latency variation at different throughput rates) is ± 1.0 µs.

Note 4: The latency through a protected Muxponder path is typically 1.0 µs higher than that of a working Muxponder path for all client traffic types. Packet jitter is the same on the protection and working paths.

OFA VGA

Release 8.0 introduces a new amplifier type called OFA VGA. Two variants are available:

- OFA VGA C-band
- OFA VGA L-band

The optical-fiber amplifier/variable gain amplifier (OFA VGA) circuit pack is a three-slot circuit pack specific to the Optical Metro 5200 shelf. The OFA VGA uses an erbium doped fiber amplifier (EDFA) to amplify C-band or L-band signals. It uses an eVOA (electrically controlled variable optical attenuator) to provide amplifier band power control.

The integrated eVOA along with enhanced software power control provide the following advantages over the Standard and High Input Power amplifiers:

- superior operational simplicity
- improved extended reach capabilities

Superior operational simplicity

Operational simplicity is achieved at two main levels:

- Component-level power control
  - — provides support similar to APBE style power control. Although the APBE/APBE Enhanced provides per-band power control, the OFA VGA provides amplifier-band power control. That is, all 4 C-bands carried by the OFA VGA C-band circuit pack or all 4 L-bands carried by the OFA VGA L-band circuit pack are equally adjusted. The OFA VGA controls the aggregate power level.
    - – enter the amplifier average target output power per channel and the number of channels present
    - – equalize by adjusting the gain of the OFA VGA to meet the target (possible gain provided is from 7-17 dB)
    - – once the target is achieved, the amplifier switches in constant gain mode to ensure optical power stability
  - — maintains networks without truck rolls. Remote equalization has increased benefit in extended reach networks and avoids requiring the user to visit sites that do not have any add/drop wavelengths (e.g., line amplifier sites)
  - — eliminates the need for an optical power meter or an optical spectrum analyzer since amplifier-band power control and amplifier power level monitoring is available from System Manager and TL1. When using other OFA types, the amplifier band power control is done using passive VOAs or pads requiring an optical power meter or an optical spectrum analyzer to set the power level into the amplifier.

  - removes restrictions by the topology rules imposed by system level equalization control (SLEC), and gives you the ability to add wavelengths without impact to others, and simplifies operations
- System Level Equalization Control (SLEC)
  - removes human error from the power control equation, current system complexities include:
    - computation of average per channel power levels
    - user's ability to use an optical spectrum analyzer to measure the power levels and adjust screwdriver VOAs to appropriate levels with accuracy
    - user's ability to determine fiber connectivity of the amplifiers, PBEs, APBEs to ensure that the correct device is being adjusted
    - ensure that the system is adjusted in the proper order (hop from PBE to PBE in order through the network and VOA to VOA in the network and balance power - then come back in the reverse direction for the return path)
  - reduces the amount of time required for installation of services for the following reasons:
    - no truck roll to all amplifier locations
    - less special equipment required (no Optical Spectrum Analyzer needed, for example)
    - channel turn up from a PC in front of shelf housing equipment
    - less likelihood of human error
  - reduces the amount of time to recover the system in the event of a failure
    - replacement of equipment currently warrants re-equalization (e.g., OMX replacement would have different loss characteristics) this can now be done with the push of a button from the NOC and no truck rolls to the location in which the equipment was replaced
  - reduces the amount of time to get the system up and running on installation

Improved extended reach capabilities

Since the OFA VGA is lower gain than the Standard and High Input Power amplifiers, allowance for higher input power is afforded and accordingly higher OSNR is maintained when signals pass through a given amplifier. Although the gain of the individual amplifier is lower, the system level gain that can be achieved through extensive chaining of the amplifier provides higher system level gain. This added gain allows for higher fiber reach on the system.

Optical Performance Differences

The OFA VGA circuit pack's capability to accept higher input power (up to –2 dBm compared to –7 dBm for the OFA HIP circuit pack and –11 dBm for the OFA Standard) reduces the OSNR hit caused by the presence of the amplifier (less noise injected due to the presence of the amplifier). As a result, the number of amplifiers that can be cascaded can be increased.

To prevent the introduction of new penalties due to non-linear effects and to remain within the same safety standard, the output power of the OFA VGA circuit pack is the same as that of the OFA HIP circuit pack.

Since the amplifier allows a higher input power and has the same output power, the gain has to be smaller (up to 17 dB) than the OFA HIP circuit pack or the OFA Standard circuit pack (23 dB). Where the spans are too long for the gain of the OFA VGA, it is possible to cascade two OFA VGA circuit packs at the same amplifier site allowing higher gain.

To improve operational functionality, an eVOA has been added to allow the gain to be adjusted to the right level to meet the required output power target (gain can be between 7 to 17 dB). This can be done from a remote location (APBE-like control scheme).

The OFA VGA circuit pack adds value in the following applications:

- post-amplifier configurations (since the input power to the amplifier is normally high in this configuration)
- in systems where many amplifiers need to be cascaded
- in systems where the operational functionality of the eVOA is required

Due to the smaller gain, a solution using OFA VGA circuit packs will generally require more amplifiers than a solution using OFA HIP circuit packs. The value of the OFA VGA circuit pack comes into play when not enough OFA HIP circuit packs can be cascaded to reach the receivers with acceptable OSNR.

It is important to mention that the OFA VGA circuit pack is an additional asset of the Optical Metro 5200 platform and is not an improvement over the OFA HIP circuit pack in all cases. It is important to use the correct amplifier type to optimize the network design and reduce overall equipment cost.

Mechanical Differences

This section describes the mechanical differences between the OFA VGA and the Standard and High Input Power amplifiers.

- The OFA VGA is 3 slots wide, while the Standard and High Input Power amplifiers are 4 slots wide

- The OFA VGA has an extra faceplate connector for the output optical monitor tap
- The OFA VGA uses LC connectors for the optical monitor taps

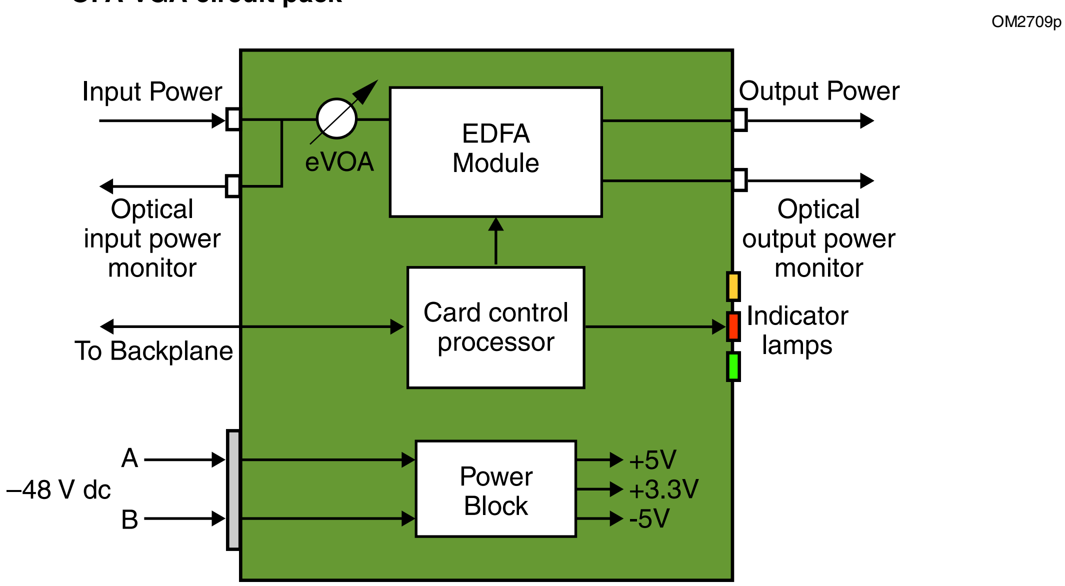
Network configuration

Refer to Chapter 3,“Supported configurations and topologies” for supported configurations and topologies of the OFA VGA circuit pack.

Signal flow

Figure 2-26 shows the signal flow through the OFA VGA circuit pack.

Figure 2-26
OFA VGA circuit pack



Indicator lamps

The OFA VGA has the same indicator lamps as the Standard and High Input Power amplifier circuit packs. The following indicator lamps are available on the faceplate:

- LOS
- ACTIVE
- STATUS

Connectors

The following connectors are on the faceplate of the OFA VGA circuit pack:

- two SC connectors: one connector for IN and one for OUT
- two LC connectors: one for optical input monitor tap and one for optical output monitor tap

Note: When a connection is made to an optical monitor tap on the faceplate of the OFA VGA circuit pack, the front cabinet door cannot close.

Cables and optical patch cords

No new cables and optical patch cords are required for the OFA VGA circuit pack. Use the same cables and optical patch cords as those required for the Standard and High Input Power amplifier circuit packs.

Location

The OFA VGA circuit pack occupies three slots in the Optical Metro 5200 shelf. The three slot wide design does not allow the user to put more amplifiers in a shelf, however, it does allow APBE/APBE Enhanced circuit packs to be inserted into a shelf with four OFA VGA circuit packs. Table 2-30 lists shelf slot locations for the OFA VGA circuit pack.

Table 2-30
Circuit pack equipping rules for an Optical Metro 5200 OFA shelf

Type of circuit pack	Quantity required	Qualified slots	Notes
SP	1 per shelf	19	Mandatory
OCM	2 per shelf	9, 10	Mandatory
OFA Standard C-band OFA Standard L-band OFA High Input Power C-band OFA High Input Power L-band	Up to 4 per shelf (see Note)	4 to 8, 14 to 18 Recommended slots: 4, 8, 14, 18	• Each OFA circuit pack occupies four slots, the qualified slot and 3 slots to the left of the qualified slot • Use the recommended slots (4, 8, 14, 18) in order to maximize the number of OFAs that can be equipped in a shelf • Use the following qualified slots when using ECTs: 4, 8, 14, 18
OFA VGA C-band OFA VGA L-band	Up to 4 per shelf (see Note)	3 to 8, 13 to 18	Each OFA circuit pack occupies three slots, the qualified slot and 2 slots to the left of the qualified slot
APBE C-band APBE L-band APBE Enhanced C-band APBE Enhanced L-band	Up to 8 per shelf	2 to 8, 12 to 18	Each APBE/APBE Enhanced occupies two slots, the qualified slot and 1 slot to the left of the qualified slot
OSC	Up to 1 per site	20	Optional Used with the OSC tray

Table 2-30 (continued)
Circuit pack equipping rules for an Optical Metro 5200 OFA shelf

Type of circuit pack	Quantity required	Qualified slots	Notes
OFA filler card	Up to 4 per shelf	1, 5, 11, 15	Mandatory for unused OFA slots when ECTs are used
Blank filler card	1 for each slot not occupied with a circuit pack or an OFA filler card	1 to 18, 20	Mandatory for empty slots
Note: Software prevents provisioning two OFAs with the same location and direction; where the location can be Pre, Post, Thru and the direction can be Eastbound or Westbound. For example, software prevents provisioning two Pre Eastbound OFAs or two Post Westbound OFAs.			

Network management

Network management interfaces provide operation, administration, maintenance, and provisioning (OAM&P) functionality. The OFA VGA circuit pack supports System Manager, TL1, Simple Network Management Protocol (SNMP), and Optical Manager Element Adapter (OMEA) Release 3.1.

System Manager support

System Manager supports the following capabilities on the OFA VGA circuit pack:

- viewing shelf level graphics
- querying equipment inventory
- provisioning and querying of equipment and facilities
- monitoring of alarms and events in the Fault application
- performance monitoring with the Performance Monitor window
- ability to provision the number of wavelengths passing through the amplifier
- ability to provision an average per channel target output power of the amplifier
- ability to initiate component level power control

For more information about System Manager, refer to *Software and User Interface*, 323-1701-101.

TL1

The OFA VGA circuit pack utilizes the existing TL1 commands used for Standard and High Input Power amplifiers with the following additions:

- ability to provision the number of wavelengths passing through the amplifier
- ability to provision an average per channel target output power of the amplifier
- ability to initiate component level power control

For more information on TL1 commands for the OFA VGA circuit pack, refer to *TL1 Interface*, 323-1701-190. TL1 changes introduced in Release 8.0 for the OFA VGA circuit pack are described in section “TL1 changes” on page 4-90.

SNMP

An Optical Metro 5200 shelf equipped with the OFA VGA circuit pack can be managed with an SNMP Manager. The Optical Metro 5200 shelf is an SNMP agent. SNMP version 1 and SNMP version 2c compliant with SNMP standard, RFC 1157 is supported.

Provisioning operations

Autoprovisioning

When you insert an OFA VGA circuit pack in an unprovisioned slot, the shelf automatically provisions the circuit pack, and brings the equipment to the in-service state and the facility to the out-of-service state.

Equipment provisioning

The Optical Metro Provisioning Wizard allows you to provision a slot with the OFA VGA circuit pack. Use the circuit pack type Variable Gain to provision the OFA VGA circuit pack.

The Optical Metro Inventory window displays the OFA VGA equipment attributes. Use this screen to provision:

- the administrative state of the circuit pack
- the amplifier Optical System Identifier (OSID)
- the amplifier direction
- the amplifier location

Facility provisioning

The following line-side facility parameters can be provisioned:

- line facility name
- the administrative state
- number of wavelengths passing through the amplifier
- average per channel target output power of the amplifier

Also, the facility screen allows users to initiate component level power control.

Performance Monitoring for OFA VGA

The OFA VGA supports the same performance monitoring attributes as the Standard and High Input Power amplifiers.

The Signal Failure Count (SFC) facility performance parameter (PP) is available for the OFA VGA in the Rx direction. A user provisionable threshold crossing alert/alarm for this PP is also available.

The OFA VGA circuit pack supports the equipment performance monitoring detailed in Table 2-31.

Table 2-31
Supported Equipment PMs on the OFA VGA

Port number	Direction	Optical power monitoring	TCAs
1	Tx	yes	Tx Power High Tx Power Low
	Rx	yes	Rx Power High Rx Power Low

Alarm reporting

Alarm reporting is enabled through the System Manager, TL1 or SNMP.

The OFA VGA supports the same alarms and events as the Standard and High Input Power amplifiers with the following additions:

New alarms:

- Power Out of Range High
  - — raised if the gain control has succeeded and the actual output power is more than 2.1 dB above the target power, cleared when the actual output power is less than 1.1 dB above the target power (this is called the 1.1 dB clear threshold)
  - — raised if the gain control has failed and the power target is above the 1.1 dB clear threshold
  - — raised if the output power is above 16.2 dBm, cleared when the output power is less than 15.7 dBm
- Power Out of Range Low
  - — raised if the gain control has succeeded and the actual output power is less than 2.1 dB below the target power
  - — cleared when the actual output power is more than 1.1 dB below the target power (this is called the 1.1 dB clear threshold)

— raised if the gain control has failed and the power target is below the 1.1 dB clear threshold

New events:

- Gain Control Failed: Cannot converge: raised if the OFA VGA target power cannot be reached in 120 seconds
- Gain Control Failed: Power Unattainable Low: raised when the OFA VGA circuit pack does not have enough attenuation range to reach the target output power. This event occurs if the eVOA is at minimum attenuation and the output power target cannot be achieved. Also raised if the OFA VGA declares a LOS during the power control process.
- Gain Control Failed: Power Unattainable High: raised when the OFA VGA circuit pack does not have enough attenuation range to reach the target output power. This event occurs if the eVOA is at maximum attenuation and the output power target cannot be achieved.
- Gain Control Failed: Unexpected Power Change: raised if the input power changes by more than 2 dB during a 10 second sliding window, which begins 10 seconds before the equalization start request, and ends when the equalization completes successfully.
- Gain Control Started: raised when the power controller starts adjusting the power
- Gain Control Failed: raised when the power controller stops adjusting the power because an alarm has been raised or a time-out has occurred
- Gain Control Succeeded: raised when the power controller successfully completes adjustment of the output power

Table 2-32 on page 2-101 lists the complete list of alarms supported on the OFA VGA circuit pack.

Table 2-32
Alarms supported on the OFA VGA amplifier

Alarm type	Interface	Description
Equipment	Circuit pack	Autoprovisioning Mismatch Circuit Pack Mismatch Circuit Pack Failed Circuit Pack Failed warning Circuit Pack Missing Incomplete Provisioning Invalid Provisioning Inter-card Communication Failure Performance Monitoring Timer Failed Temperature Out of Range Unknown Circuit Pack
Facility	Facility (port 1)	Band Alarm Indication Signal Facility Out of Service—Optical Signal Failure High Optical Power High Optical Power warning Loss of Signal Low Optical Power warning Optical Signal Failure Tx Optical Signal Failure Rx TCA - Optical Power Rx High TCA - Optical Power Rx Low TCA - Optical Power Tx High TCA - Optical Power Tx Low Power Out of Range High Power Out of Range Low

System Manager changes

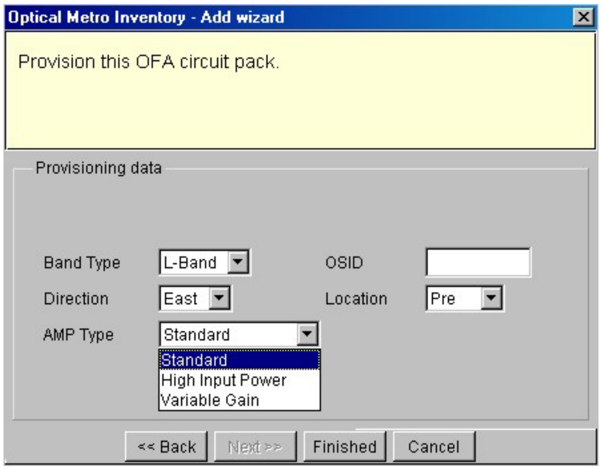
This section describes the System manager changes introduced in Release 8.0 for the OFA VGA circuit pack.

OFA provisioning wizard

The System Manager OFA provisioning wizard screen (see Figure 2-27) is modified to include the new OFA VGA circuit pack, identified as Variable Gain.

Figure 2-27
OFA Optical Metro Inventory - Add wizard screen

OM2752t



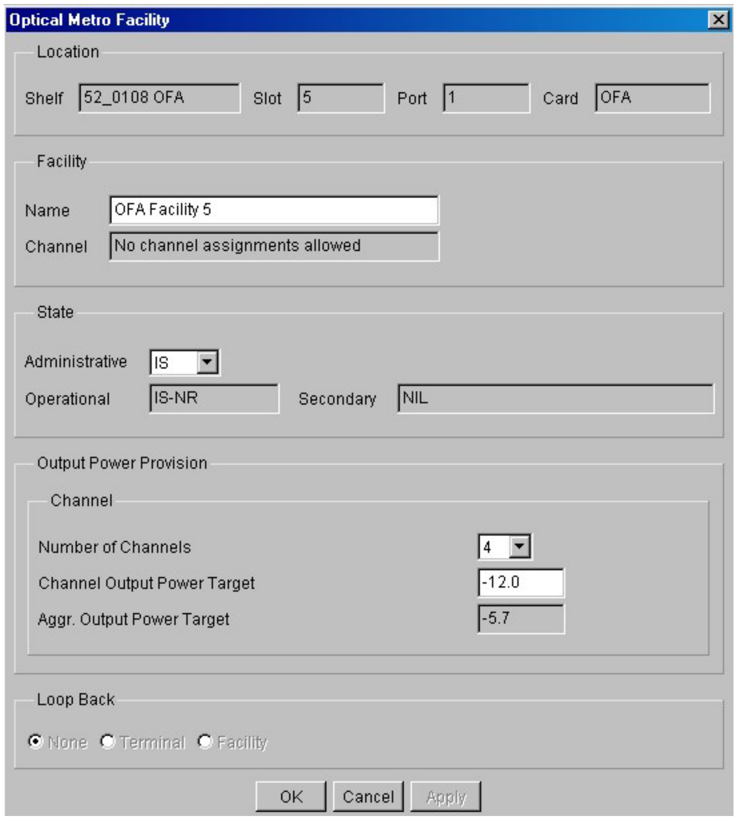
OFA VGA facility screen

The System Manager OFA VGA facility screen (see Figure 2-28 on page 2-103) is modified compared to other OFA type facility screens to include the Output Power Provision attributes:

- Number of Channels: user enters the number of wavelengths passing through the amplifier (value range 1 to 16)
- Channel Output Power Target: user enters average per channel target output power of the amplifier
- Aggr. Output Power Target: Read only field. Software calculates the aggregate output power target based on the user entered number of channels, channel output power target data and any noise compensation, if required, to compensate for ASE on low channel count amplifiers.

Figure 2-28
OFA VGA facility screen

OM2753t

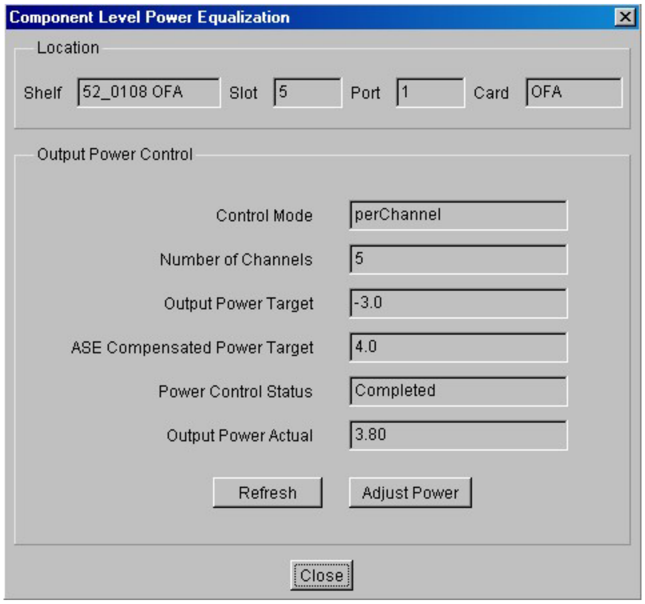


To start OFA VGA component level power control, select the OFA VGA facility from within the System Manager Equipment Facilities screen and right-click the selection to bring up the menu item.

After selecting the Equalize menu item, the Component Level Power Equalization screen is displayed as shown in Figure 2-29. Component Level Power Equalization is started by clicking on the Adjust Power button.

Figure 2-29
OFA VGA Component Level Power Equalization screen

OM2757t



Link engineering rules

The OFA VGA supports the same link engineering rules as the Standard and High Input Power amplifiers described in *Network Planning and Link Engineering*, 323-1701-110 except for the following changes:

Amplifier receive power

The optical power into the OFA VGA must be within the limits listed in Table 2-33.

Table 2-33
Receive powers into OFA VGA

Amplifier type		Minimum input power		Maximum input power	
		Aggregate	Per channel	Aggregate	Per channel (see Note:)
OFA VGA	17 dB gain	–28 dBm	–28 dBm	–2 dBm	–14 dBm
	7 dB gain	–18 dBm	–18 dBm	+8 dBm	–4 dBm
Note: The maximum per channel input power is derived to allow for full channel count (16 channels).					

The per channel power needs to be considered in conjunction with the OSNR rule (the OSNR rule is documented in *Network Planning and Link Engineering*, 323-1701-110).

Cascaded amplifiers

You must use the Network Modeling Tool to verify all amplified network designs.

A maximum of ten OFA VGAs can be cascaded providing that the OSNR requirements stated in the OSNR rule are met and that the maximum input power limits are not exceeded (the OSNR rule is documented in *Network Planning and Link Engineering*, 323-1701-110). This rule applies to all bit rates.

Technical specifications

Table 2-34 lists the specifications for the OFA VGA circuit packs.

Table 2-34
OFA VGA circuit pack specifications

Characteristic		Value or range	
Power consumption (see Note 1)		**Typical**	**Maximum**
	C-band	25 W	30 W
	L-band	25 W	30 W
		Minimum	**Maximum**
Average optical gain (see Note 2)		7 dB (see Note 3)	17 dB
Gain stability (see Note 4)		—	± 0.3 dB
Total Rx power (see Note 5)		–28.0 dBm	9.0 dBm
	17 dB gain	–28.0 dBm	–2.0 dBm (see Note 6)
	7 dB gain	–18.0 dBm (see Note 7)	8.0 dBm
Total Tx power		–11.0 dBm	15.1 dBm (see Note 8)
Tx level per channel		—	3.0 dBm (see Note 8)
Rx optical power monitor accuracy		—	± 0.6 dB down to –12 dBm ± 0.7 dB down to –26 dBm ± 0.9 dB down to –32 dBm

Table 2-34 (continued)
OFA VGA circuit pack specifications

Characteristic		Value or range	
Tx optical power monitor accuracy		—	± 0.6 dB up to 17 dBm ± 1.0 dB up to 5 dBm ± 1.5 dB up to –9 dBm
Wavelength		**Minimum**	**Maximum**
	C-band	1528.52 nm	1562.48 nm
	L-band	1570.17 nm	1606.98 nm
Noise figure (see Note 9)			
	C-band	—	6.3 dB
	L-band	—	6.3 dB

Note 1: Maximum power consumption values are obtained during worst-case operating conditions (for example, temperature, humidity).

Note 2: Gain is automatically adjusted by software to the value required to achieve the target output power given by the user. Once the target power is achieved, the circuit pack switches into constant gain mode.

Note 3: Although the minimum gain quoted is 7 dB, in order to have some margin, the circuit pack gain can go down to 5 dB.

Note 4: The gain stability is given relative to the System Manager power reading.

Note 5: In most cases, traffic continuity at maximum and minimum input power is determined by the Receive Power High Fail Threshold and Receive Power Low Fail Threshold. For threshold values, see Table 2-35 on page 2-107.

Note 6: At high input power, the gain has to be reduced in order to prevent saturation. For each dB of input power greater than –2 dBm, the gain will decrease by one dB to prevent saturation.

Note 7: At lower gain setting, the minimum Rx input power has to increase in order to prevent Loss Of Signal. For each dB of gain reduction, the maximum input power has to be increased by one dB.

Note 8: Tx power levels are independent of the gain setting of the module. Even though the amplifier can support a total output power of +17 dBm, in order to have margin, System Manager will enforce a maximum aggregate target output power of +15.1 dBm, i.e. +3 dBm/ch if 16 channels are present.

Note 9: The quoted noise figure is for a maximum gain of 17 dB. As the gain decreases, the noise figure increases by 1 dB for each dB of gain reduction.

Optical power threshold values

Table 2-35 lists the optical power threshold values for the OFA VGA circuit pack alarms. If the value is within the ranges listed in the table, a threshold crossing alarm is raised.

Table 2-35
OFA VGA optical power threshold values for alarming

OFA Type	Threshold	Default User Threshold (dBm)	Degrade Threshold (dBm)	Fail Threshold (dBm)	Clear Threshold (dBm)
OFA VGA	Rx Power High	9.50	10.00	11.00	9.00
	Rx Power Low (see Note:)	–28.50 + (P_{in} – P_{out}) + 17	–29.00 + (P_{in} – P_{out}) + 17	–31.00 + (P_{in} – P_{out}) + 17	–28.00 + (P_{in} – P_{out}) + 17
	Tx Power High	17.90	18.00	19.00	17.00
	Tx Power Low	–11.90	–12.00	–13.00	–11.00

Note: P_{in} is the input power and P_{out} is the output power in dBm after power adjust (or equalization) successfully completes.

APBE Enhanced

The APBE Enhanced circuit pack is equivalent to the APBE circuit pack with improved insertion loss. Two variants of the APBE Enhanced circuit pack are available:

- APBE Enhanced C-band
- APBE Enhanced L-band

The APBE and APBE Enhanced are interchangeable. Use the procedure detailed in *Maintenance and Replacement Procedures,* 323-1701-546 to replace one APBE circuit pack type with the other. Although the two APBE types have different loss specifications, the APBEs are re-equalized as a result of the steps executed in the replacement procedure.

Technical specifications

Table 2-36 lists specifications for the APBE Enhanced circuit pack.

Table 2-36
APBE Enhanced circuit pack specifications

Characteristic		**Value or Range**	
Maximum power consumption		14 W	
Typical power consumption		10 W	
Maximum total input power - for correct operation		14 dBm	
Maximum total input power - damage level		18 dBm	
Minimum return loss		35 dB	
Attenuation for each band		0.0 dB to 30.0 dB	
Insertion Loss		**Maximum**	**Typical**
	C-band	4.6 dB	4.1 dB
	L-band	4.6 dB	4.1 dB

Optical power threshold values

Table 2-37 lists the optical power thresholds for alarming. If the value is within the ranges listed in the table, a threshold crossing alarm is raised.

Table 2-37
APBE Enhanced optical power threshold values for alarming

Facility Type	Threshold	Default User Threshold (dBm)	Degrade Threshold (dBm)	Fail Threshold (dBm)	Clear Threshold (dBm)
Band - Port 1, Port 2, Port 3, or Port 4	Rx Power High	not supported	not supported	not supported	not supported
	Rx Power Low	–26.50	–27.00	–28.00 (See Note 1)	–25.00 (for degrade) –26.00 (for fail)
	Tx Power High	not supported	not supported	not supported	not supported
	Tx Power Low	–29.90	–30.00	–31.00 (See Note 2)	–28.00 (for degrade) –29.00 (for fail)

Table 2-37 (continued)
APBE Enhanced optical power threshold values for alarming

Facility Type	Threshold		Default User Threshold (dBm)	Degrade Threshold (dBm)	Fail Threshold (dBm)	Clear Threshold (dBm)
Aggregate - Port 5 (Standard OFA)	Rx Power High		not supported	not supported	not supported	not supported
	Rx Power Low		not supported	not supported	(See Note 1)	not supported
	Tx Power High	When associated equipment provisioned as OFA Standard	–10.10	–10.00	–9.00	–10.00
		When associated equipment provisioned as OFA HIP	–6.10	–6.00	–5.00	–6.00
		When associated equipment provisioned as OFA VGA	0.90	1.00	2.00	1.00
		When associated equipment provisioned as DSCM	10.90	11.00	12.00	11.00
	Tx Power Low		not supported	not supported	(See Note 2)	not supported

Note 1: When the receive power of all ports have dropped below their fail thresholds, the Rx Loss of signal alarm is raised against the aggregate port.

Note 2: When the transmit power of all In-Service ports have dropped below their fail thresholds, the Tx Low Optical Power alarm is raised against the aggregate port.

OCLD/OTR 2.5 Gbit/s Universal

Release 8.0 introduces the new OCLD/OTR 2.5 Gbit/s Universal circuit packs. The new OCLD/OTR 2.5 Gbit/s Universal circuit packs can be used in normal, extended reach and extended metro applications. The benefit of the new Universal circuit pack over the existing OCLD/OTR 2.5 Gbit/s Flex circuit pack is that it eliminates the need for three different, reach-specific circuit packs. A single Universal circuit pack also simplifies the ordering process, and provides additional optical link reach at no additional cost. The Universal circuit packs also offer increased performance in 2.5G-only designs.

Although the new OCLD/OTR 2.5 Gbit/s Universal circuit packs are not line-side compatible with the OCLD/OTR 2.5 Gbit/s Flex circuit packs and no longer have the same name (Flex), the Universal is the replacement for the Flex. Each Flex circuit pack (with the exception of CWDM, ITU CWDM and 100 GHz) has an equivalent Universal circuit pack. Table 2-38 shows the relationship between Flex and Universal circuit packs.

Table 2-38
Relationship between Flex and Universal circuit packs

Flex circuit pack		Equivalent Universal circuit pack	
PEC	**Description**	**PEC**	**Description**
NT0H03AA-HD	OCLD 2.5 Gbit/s Flex	NT0H05AA-HD	OCLD 2.5 Gbit/s Universal
NT0H04AA-HD	OCLD 2.5 Gbit/s Flex Extended Reach		
NT0H04AE-HH	OCLD 2.5 Gbit/s Flex Extended Metro		
NTPM03AB-HD	OCLD 2.5 Gbit/s Flex CWDM	None	None
NTPM04AA-AH	OCLD 2.5 Gbit/s Flex ITU CWDM	None	None
NT0H80AA-JD	OCLD 2.5 Gbit/s Flex 100 GHz	None	None
NT0H16AA-HD	OTR 2.5 Gbit/s Flex 1310 nm	NT0H06AA-HD	OTR 2.5 Gbit/s Universal 1310 nm
NT0H17AA-HD	OTR 2.5 Gbit/s Flex Extended Reach 1310 nm		
NT0H17AE-HH	OTR 2.5 Gbit/s Flex Extended Metro 1310 nm		
NTPM16AB-HD	OTR 2.5 Gbit/s Flex CWDM 1310 nm	None	None
NTPM17AA-AH	OTR 2.5 Gbit/s Flex ITU CWDM 1310 nm	None	None

Table 2-38 (continued)
Relationship between Flex and Universal circuit packs

Flex circuit pack		Equivalent Universal circuit pack	
PEC	**Description**	**PEC**	**Description**
NT0H81AA-JD	OTR 2.5 Gbit/s Flex 1310 nm 100 GHz	None	None
NT0H16JA-RD	OTR 2.5 Gbit/s Flex 850 nm	NT0H07AA-HD	OTR 2.5 Gbit/s Universal 850 nm
NT0H17JA-RD	OTR 2.5 Gbit/s Flex Extended Reach 850 nm		
NT0H17JE-RH	OTR 2.5 Gbit/s Flex Extended Metro 850 nm		
NTPM16JB-RD	OTR 2.5 Gbit/s Flex CWDM 850 nm	None	None
NTPM17BA-BH	OTR 2.5 Gbit/s Flex ITU CWDM 850 nm	None	None
NT0H82AA-JD	OTR 2.5 Gbit/s Flex 850 nm 100 GHz	None	None

The new OCLD/OTR 2.5 Gbit/s Universal circuit packs:

- support the same protocols as the existing OCLD/OTR 2.5 Gbit/s Flex circuit packs with the addition of the OC-3/STM-1 protocol for the OTR 2.5 Gbit/s Universal 1310 nm circuit pack
- support the same features as the OCLD/OTR 2.5 Gbit/s Flex circuit packs with the following additions:
  - High Speed SPS (Surrogate Payload Signal): The OCLD/OTR 2.5 Gbit/s Flex circuit packs inject a proprietary Surrogate Payload Signal (SPS) to the far-end circuit pack to indicate to the far-end that a fault has occurred at the near-end or that the near-end line-side facility is not in-service or no near-end channel assignment is provisioned. The frequency of the SPS is 8 MHz. The new OCLD/OTR 2.5 Gbit/s Universal circuit packs inject and detect a High Speed SPS (approximately 500 MHz) while the OCLD/OTR 2.5G Flex circuit packs always inject and detect the 8 MHz SPS. The High Speed SPS is important to reduce non-linearities due to SRS crosstalk, especially in Extended Metro networks.
  - new line-side Tx and Rx interfaces
  - noise performance improvements
  - Overhead modulation suppression upon disabling overhead

Note: Improper use of the overhead disabling feature can cause loss of communications between network elements and loss of contact, resulting in the inability to properly manage the network. Also, features like Remote Fault Notification, Automatic Laser Shutdown, Correct Alarm Severity for protected and passthrough channel assignments, Fiber Mismatch alarming, OSID mismatch alarming and Far end circuit pack mismatch alarming which use the overhead, are no longer operational when the overhead is disabled.

- are a replacement for the OCLD/OTR 2.5 Gbit/s Flex circuit packs but are not compatible on the line-side with the OCLD/OTR 2.5 Gbit/s Flex circuit packs. They can however interface with these circuit packs on the backplane (regenerator, passthrough, and protection). The reasons for the line-side incompatibility are:
  - — Universal circuit packs use High Speed SPS and Flex circuit packs use Low Speed SPS on the line-side
  - — Flex circuit packs do not suppress overhead modulation when the overhead is disabled, they terminate PPP (point-to-point protocol) communications between circuit packs
  - — new transmitter and receiver on the new Universal circuit packs
  - — noise performance improvements can be achieved with the new Universal circuit packs
- are not compatible on the line-side or on the backplane (for regenerator, passthrough, and protection) with the OCLD 2.5 Gbit/s or OCLD 1.25 Gbit/s circuit packs
- can be used in Optical Metro 5200 and Optical Metro 5100 shelves

Alarm strategy

The new Far end circuit pack mismatch alarm is raised when a Universal circuit pack is connected to a Flex circuit pack on the line-side since fault detection (based on SPS) and Link Engineering cannot be guaranteed on this link. The overhead signal detects and alarms this condition. This is done by adding a new tag to the overhead channel information which is sent between link mates. This new tag has two valid entries, “standard” and “universal” and resolves to “standard” for the undefined state. The data communications software modifications consist of:

- Add Universal/Standard tag to the overhead channel information
- Received tag validation (must be same as previous received value before changing the alarm status)
- Assert Far end circuit pack mismatch alarm when received tag does not match transmitted tag
- Mask Far end circuit pack mismatch alarm when overhead is disabled

The Circuit pack minor mismatch alarm is raised when a Universal circuit pack is inserted in a slot that has been provisioned as a Flex circuit pack. The same applies when a Flex circuit pack is inserted in a slot that has been provisioned as a Universal circuit pack.

The Far end circuit pack mismatch alarm and Circuit pack minor mismatch alarm are raised during the exercise of upgrading Flex links to Universal links. To ease the upgrade process, the circuit pack does not need to be unprovisioned and reprovisioned. Instead the Flex Type in the Equipment Details screen (see Figure 2-32 on page 2-116 and Figure 2-33 on page 2-117) can be changed.

System Manager changes

This section describes the System manager changes introduced in Release 8.0 for the Universal circuit packs.

OCLD/OTR circuit pack provisioning wizard

The System Manager OCLD/OTR circuit pack provisioning wizard screen (see Figure 2-30 and Figure 2-31 on page 2-115) is modified to include the new Universal circuit packs.

Figure 2-30
OCLD circuit pack Optical Metro Inventory - Add wizard screen

OM2754t

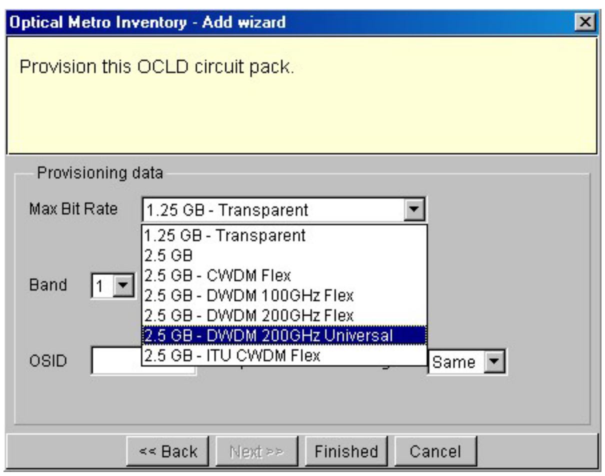
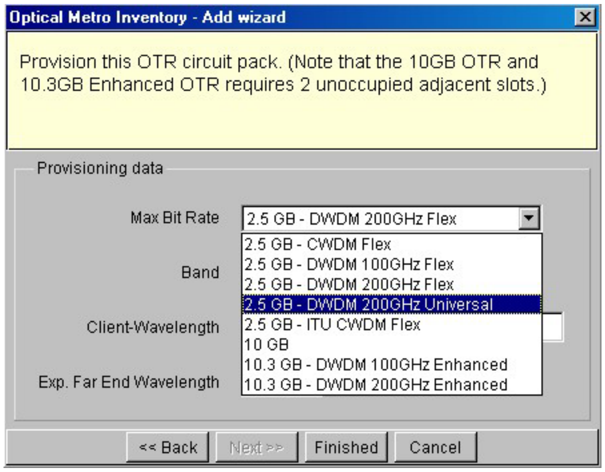


Figure 2-31
OTR circuit pack Optical Metro Inventory - Add wizard screen

OM2755t



OCLD/OTR Equipment Details screen

The System Manager OCLD/OTR circuit pack Equipment Details screen (see Figure 2-32 and Figure 2-33 on page 2-117) is modified to include the new Flex Type field.

Figure 2-32
OCLD 2.5 Gbit/s Flex and Universal Equipment Details screen

OM2760p

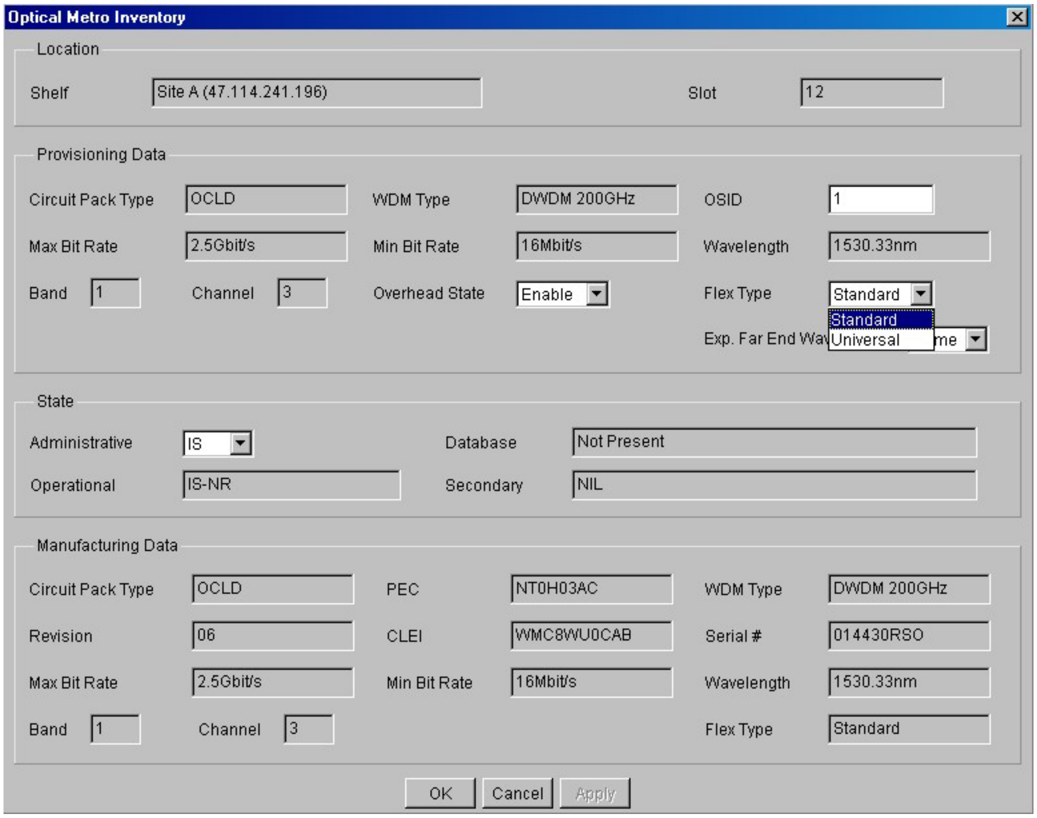
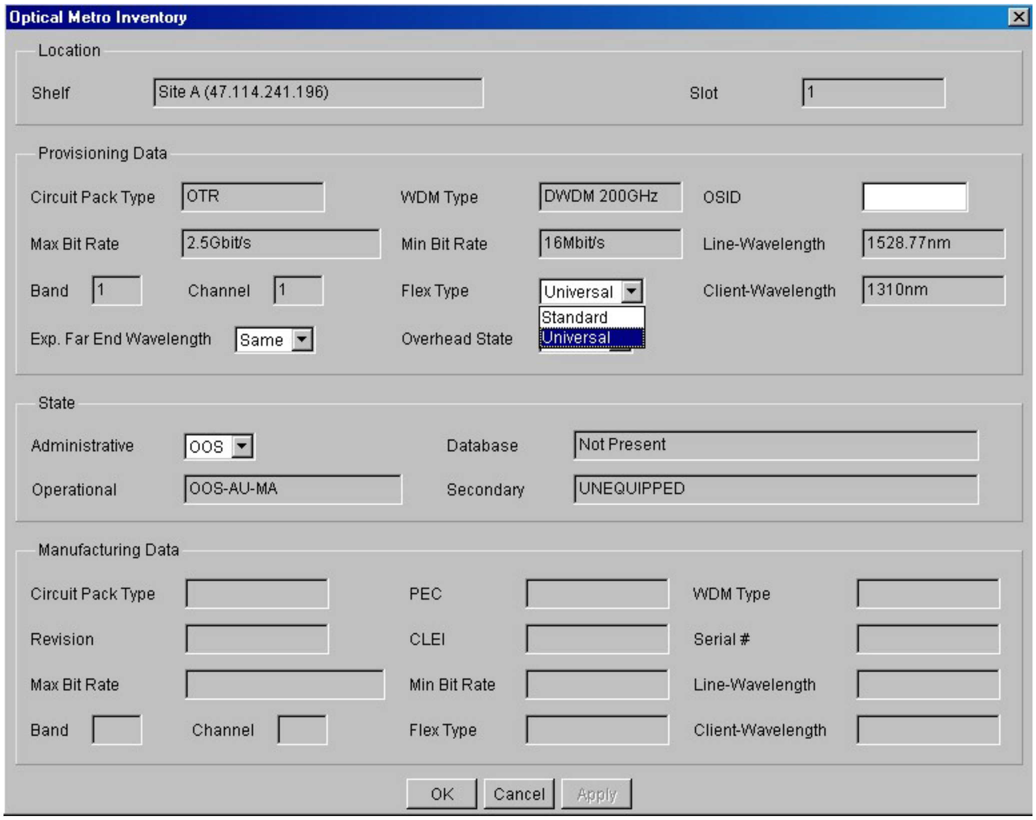


Figure 2-33
OTR 2.5 Gbit/s Flex and Universal Equipment Details screen

OM2761t



TL1 changes

TL1 changes introduced in Release 8.0 for the OCLD/OTR 2.5 Gbit/s Universal circuit pack are described in section “TL1 changes” on page 4-90.

Technical specifications

Table 2-39 lists the OCLD 2.5 Gbit/s Universal circuit pack specifications.

Table 2-39
OCLD 2.5 Gbit/s Universal circuit pack specifications

Characteristic	Value or range			
	Typical		**Maximum**	
Power consumption	16 W		22 W	
	Minimum		**Maximum**	
Bit rates	16 Mbit/s (See Note 1)		2.48832 Gbit/s	
	Typical	**Minimum**	**Maximum**	
Tx power	3.5 dBm	2.8 dBm	4.2 dBm	
	Minimum Sensitivity at BER = 10^{-12}		**Minimum Overload at BER = 10^{-12}**	**Damage Level**
Rx power (see Note 2 and Note 4)	–27.5 dBm		–5.0 dBm (see Note 3)	–2.0 dBm
	Minimum		**Maximum**	
Rx wavelength	1500 nm		1610 nm	
Tx Center wavelength	see Table 2-27 on page 2-88			
Tx wavelength tolerance	± 0.25 nm			
Dispersion reach limit (NDSF)	350 km for C-band and 200 km for L-band			
	TX		**RX**	
Optical power monitor accuracy (See Note 5)	± 1.2 dB		± 1.5 dB	

Note 1: ETR/CLO at 8 Mbit/s Manchester encoded (16 Mbit/s) is supported outside nominal range of bit rates for Optical Metro 5100/5200 because of the nature of the traffic type.

Note 2: Rx overload and Rx sensitivity specifications are back-to-back and include no path penalties. The Network Modeling Tool (NMT) should be used to account for path penalties. If NMT is not used to design the network:

- For Rx sensitivity path penalties, see “Link engineering rules” in *Network Planning and Link Engineering,* 323-1701-110.

Note 3: A 3 dB path penalty needs to be added to the Rx minimum overload, resulting in a value of –8 dBm.

Note 4: In most cases, traffic continuity at high and low input power is determined by the Receive Power High Fail Threshold and Receive Power Low Fail Threshold rather than by the minimum overload and minimum sensitivity. For threshold values, see Table 2-43 on page 2-122.

Note 5: External power meters may differ from System Manager by up to ± 2.0 dB.

Table 2-40 lists the power consumption of the OTR 2.5 Gbit/s Universal circuit packs.

Table 2-40
OTR circuit pack power consumption

Characteristic	Value or range	
Power consumption (see Note)	**Typical**	**Maximum**
OTR 2.5 Gbit/s Universal 1310 nm OTR 2.5 Gbit/s Universal 850 nm	17 W	23 W
Note: Maximum power consumption values are obtained during worst-case operating conditions (for example, temperature, humidity).		

Table 2-41 lists the specifications for the client-side interfaces of the OTR 2.5 Gbit/s Universal circuit packs.

Table 2-41
Specifications for OTR 2.5 Gbit/s Universal circuit packs—client side

Characteristic	Value or range			
Bit rates	**Minimum**		**Maximum**	
OTR 2.5 Gbit/s Universal 1310 nm	155.52 Mbit/s		2.48832 Gbit/s	
OTR 2.5 Gbit/s Universal 850 nm	1.0625 Gbit/s		2.125 Gbit/s	
Tx power	**Typical**	**Minimum**	**Maximum**	
OTR 2.5 Gbit/s Universal 1310 nm	—	–5.0 dBm	0.0 dBm	
OTR 2.5 Gbit/s Universal 850 nm	—	–9.5 dBm	–1.5 dBm	
Rx power (see Note 2 and Note 3)	**Minimum Sensitivity**		**Minimum Overload**	**Damage Level**
OTR 2.5 Gbit/s Universal 1310 nm	–18.0 dBm BER=10^{-10}		0.0 dBm BER=10^{-10}	+3.0 dBm
OTR 2.5 Gbit/s Universal 850 nm	–17.0 dBm or –15.0 dBm BER=10^{-12} (see Note 1)		0.0 dBm BER=10^{-12}	+3.0 dBm
Rx wavelength	**Minimum**		**Maximum**	
OTR 2.5 Gbit/s Universal 1310 nm	1260 nm		1570 nm	
OTR 2.5 Gbit/s Universal 850 nm	770 nm		860 nm	
Tx wavelength	**Minimum**		**Maximum**	
OTR 2.5 Gbit/s Universal 1310 nm	1260 nm		1360 nm	

Table 2-41 (continued)
Specifications for OTR 2.5 Gbit/s Universal circuit packs—client side

Characteristic	Value or range	
OTR 2.5 Gbit/s Universal 850 nm	830 nm	860 nm
Optical power monitor accuracy (See Note 4)	**TX**	**RX**
OTR 2.5 Gbit/s Universal 1310 nm	± 1.8 dB	± 1.6 dB, –5 dBm to –18 dBm (See Note 5)
OTR 2.5 Gbit/s Universal 850 nm	not supported	not supported
Applicable optical fiber types supported		
OTR 2.5 Gbit/s Universal 1310 nm	SM and 50/62.5 µm MM - Protocol dependent	
OTR 2.5 Gbit/s Universal 850 nm	50/62.5 µm MM	

Note 1: -17 dBm for FC-100, FICON, and Gigabit Ethernet, –15 dBm for FC-200 and FICON Express. FC-100 and FC-200 standards do not specify a sensitivity requirement (quoted values are calculated using Optical Modulation Amplitude specifications).

Note 2: In most cases on OTR circuit packs that support equipment PMs (that is, optical power monitoring) on the client-side, traffic continuity at high and low input power is determined by the Receive Power High Fail Threshold and Receive Power Low Fail Threshold rather than by the minimum overload and minimum sensitivity. For threshold values, see Table 2-44 on page 2-122.

Note 3: The Rx minimum sensitivity specifications are back-to-back and include no path power penalties.

Note 4: External power meters may differ from System Manager by up to ± 2.0 dB.

Note 5: The Rx power monitor is only accurate in the stated range.

Table 2-42 lists the specifications for the line-side interfaces of the OTR 2.5 Gbit/s Universal circuit packs.

Table 2-42
Specifications for OTR 2.5 Gbit/s Universal circuit packs—line side

Characteristic	Value or range		
Bit rates	**Minimum**		**Maximum**
OTR 2.5 Gbit/s Universal 1310 nm	155.52 Mbit/s		2.48832 Gbit/s
OTR 2.5 Gbit/s Universal 850 nm	1.0625 Gbit/s		2.125 Gbit/s
Tx power	**Typical**	**Minimum**	**Maximum**
OTR 2.5 Gbit/s Universal 1310 nm OTR 2.5 Gbit/s Universal 850 nm	3.5 dBm	2.8 dBm	4.2 dBm

Table 2-42 (continued)
Specifications for OTR 2.5 Gbit/s Universal circuit packs—line side

Characteristic	**Value or range**		
Rx power (see Note 1 and Note 3)	**Minimum Sensitivity**	**Minimum Overload**	**Damage Level**
OTR 2.5 Gbit/s Universal 1310 nm OTR 2.5 Gbit/s Universal 850 nm	–27.5 dBm BER=10^{-12}	–5.0 dBm BER=10^{-12} (see Note 2)	–2.0 dBm
Rx wavelength	**Minimum**	**Maximum**	
OTR 2.5 Gbit/s Universal 1310 nm OTR 2.5 Gbit/s Universal 850 nm	1500 nm	1610 nm	
Tx Center wavelength			
OTR 2.5 Gbit/s Universal 1310 nm OTR 2.5 Gbit/s Universal 850 nm	see Table 2-27 on page 2-88		
Tx wavelength tolerance			
OTR 2.5 Gbit/s Universal 1310 nm OTR 2.5 Gbit/s Universal 850 nm	± 0.25 nm		
Dispersion reach limit (NDSF)	**Value or range**		
OTR 2.5 Gbit/s Universal 1310 nm OTR 2.5 Gbit/s Universal 850 nm	350 km for C-band and 200 km for L-band		
Optical power monitor accuracy (See Note 3)	**TX**	**RX**	
OTR 2.5 Gbit/s Universal 1310 nm OTR 2.5 Gbit/s Universal 850 nm	± 1.2 dB	± 1.5 dB	

Note 1: Rx overload and Rx sensitivity specifications are back-to-back and include no path penalties. The Network Modeling Tool (NMT) should be used to account for path penalties. If NMT is not used to design the network:

- For Rx sensitivity path penalties, see “Link engineering rules” in *Network Planning and Link Engineering,* 323-1701-110.

Note 2: A 3 dB path penalty needs to be added to the Rx minimum overload, resulting in a value of –8 dBm.

Note 3: External power meters may differ from System Manager by up to ± 2.0 dB.

Optical power threshold values

Table 2-43 lists the optical power threshold values for OCLD 2.5 Gbit/s Universal circuit packs. Table 2-44 lists the optical power threshold values for OTR 2.5 Gbit/s Universal circuit packs. If the value is within the ranges listed in the table, a threshold crossing alarm is raised.

Table 2-43
OCLD 2.5 Gbit/s Universal circuit pack optical power threshold values for alarming

OCLD Type	Threshold	Default User Threshold (dBm)	Degrade Threshold (dBm)	Fail Threshold (dBm)	Clear Threshold (dBm)
2.5 Gbit/s Flex (See Note 1 and Note 2)	Rx Power High	–6.00	–5.50	–4.50	–6.50
	Rx Power Low	–27.00	–27.50	–28.50	–26.50
	Tx Power High	3.80	3.90	4.10	3.70
	Tx Power Low	3.10	3.00	2.90	3.10

Note 1: There is no Fail alarm for Tx power low.

Note 2: For power monitor accuracy, see Table 2-39 on page 2-118.

Table 2-44
OTR 2.5 Gbit/s Universal circuit pack optical power threshold values for alarming

OTR Type	Threshold	Default User Threshold (dBm)	Degrade Threshold (dBm)	Fail Threshold (dBm)	Clear Threshold (dBm)
OTR 2.5 Gbit/s Universal 1310 nm and OTR 2.5 Gbit/s Universal 850 nm Line-side (see Note 2)	Rx Power High	–6.00	–5.50	–4.50	–6.50
	Rx Power Low	–27.00	–27.50	–28.50	–26.50
	Tx Power High	3.80	3.90	4.10	3.70
	Tx Power Low	3.10	3.00	2.90	3.10

Table 2-44 (continued)
OTR 2.5 Gbit/s Universal circuit pack optical power threshold values for alarming

OTR Type	Threshold	Default User Threshold (dBm)	Degrade Threshold (dBm)	Fail Threshold (dBm)	Clear Threshold (dBm)
OTR 2.5 Gbit/s Universal 1310 nm Client-side (see Note 1 and Note 3)	Rx Power High	–0.50	0.00	1.00	–1.00
	Rx Power Low	–17.50	–18.00	–19.00	–17.00
	Tx Power High	0.90	1.00	2.00	0.00
	Tx Power Low	–5.90	–6.00	–7.00	–5.00

Note 1: For power monitor accuracy, see Table 2-41 on page 2-119.

Note 2: For power monitor accuracy, see Table 2-42 on page 2-120.

Note 3: Optical power thresholds are not supported on the 850 nm versions of the OTR circuit pack.

Center wavelength frequencies

Table 2-45 lists the 200 GHz DWDM center wavelengths.

Table 2-45
200 GHz DWDM center wavelengths

Band	Center wavelength			
	Channel 1	Channel 2	Channel 3	Channel 4
1	1528.77 nm	1533.47 nm	1530.33 nm	1531.90 nm
2	1538.19 nm	1542.94 nm	1539.77 nm	1541.35 nm
3	1547.72 nm	1552.52 nm	1549.32 nm	1550.92 nm
4	1557.36 nm	1562.23 nm	1558.98 nm	1560.61 nm
5	1570.42 nm	1575.37 nm	1572.06 nm	1573.71 nm
6	1580.35 nm	1585.36 nm	1582.02 nm	1583.69 nm
7	1590.41 nm	1595.49 nm	1592.10 nm	1593.80 nm
8	1600.60 nm	1605.73 nm	1602.31 nm	1604.02 nm

OMX 4CH CWDM with dual taps

The existing OMX 4CH CWDM is used with Optical Metro 5100/5200 shelves and is a stand-alone unit. The OMX 4CH CWDM multiplexes and demultiplexes four CWDM bands. There are two variants of the CWDM OMX: C-band for CWDM bands 1, 2, 3, and 4 and L-band for CWDM bands 5, 6, 7, and 8.

The Release 8.0 OMX 4CH CWDM with dual taps is based on the existing OMX 4CH CWDM with the following new functionality:

- 5% (nominal) optical tap at the OTS IN port
- 2% (nominal) optical tap at the OTS OUT port
- improved isolation specifications
- new drawer providing openings on the faceplate to access the monitor ports. The drawer does not need to be opened to access the monitor ports. The monitor ports are labeled as “OTS IN MONITOR” and “OTS OUT MONITOR”.

The OMX 4CH CWDM with dual taps assembly:

- is a 1 U high drawer that contains one C-band or L-band filter module; the drawer is field-replaceable
- adds and drops four CWDM bands at a site, and optically passes through all other traffic
- contains:
  - 12 SC/PC bulkhead connectors
  - two optical monitor ports with SC/PC connectors accessible from the front of the drawer
  - a digital identification card
  - a lamp on the digital identification card that can be used for drawer location test to verify connectivity to the Optical Metro 5100/5200 shelf maintenance panel or the Equipment Inventory Unit (EIU). It does not indicate the presence of an optical signal. One lamp is present on each OMX 4CH CWDM with dual taps drawer. The lamp is visible through the faceplate of the drawer. There is no text on the faceplate label to identify the lamp.
  - an RJ-45 connector on the digital identification card. The OMX 4CH CWDM with dual taps can be monitored if this connector is connected to the maintenance panel of an Optical Metro 5100/5200 shelf or an EIU.
  - bend radius limiters for fiber management and storage for a small amount of slack fiber

- uses SC-FC duplex patch cords to connect OCLDs (except OCLD 2.5 Gbit/s Flex) to the CWDM OMX optical filters; uses SC-LC duplex patch cords to connect OCLD/OTR 2.5 Gbit/s Flex, OTR 10 Gbit/s Enhanced and Muxponder 10 Gbit/s circuit packs to the CWDM OMX optical filters
- requires no power connections. The digital identification card receives the necessary power through the electrical connection to the maintenance panel or EIU. All other components of the OMX 4CH CWDM with dual taps are passive.
- requires a data communication cable to connect the OMX 4CH CWDM with dual taps drawer to the maintenance panel of the Optical Metro 5100/5200 shelf or the Equipment Inventory Unit for software inventory monitoring, provisioning and alarming purposes. The following existing data communication cables can be used for this purpose:
  - NT0H4345: Simplex RJ45-RJ45 1.5 m (60 in.) ID cable
  - NT0H4322: Simplex RJ45-RJ45 2.98 m (117 in.) ID cable

  Note: One NT0H4345 cable is shipped with each OMX 4CH CWDM with dual taps ordered. The longer ID cable (NT0H4322) is available from Nortel Networks and can be ordered separately, if required.
- software does not distinguish between the OMX 4CH CWDM and the OMX 4CH CWDM with dual taps OMX types. That is, the OMX type field displays Quad Band Coarse for both. The 2 OMX types can be distinguished by their PEC.

Alarm strategy

The alarming strategy for the new OMX 4CH CWDM with dual taps is the same as that for the existing OMX 4CH CWDM.

- The Optical Tray Missing alarm is raised if the monitor cable is disconnected after the OMX has been provisioned.
- The Optical Tray Mismatch alarm is raised if the data retrieved from the OMX is different from what has been provisioned.

Compatibility with existing OMX 4CH CWDM

Since software does not distinguish between the OMX 4CH CWDM and the OMX 4CH CWDM with dual taps OMX types, the new OMX 4CH CWDM with dual taps is fully backward compatible and can be inventoried in all older software releases that the original OMX 4CH CWDM can.

The OMX 4CH CWDM with dual taps optical module is equipped in the new drawer with front apertures for the monitor ports. The new OMX 4CH CWDM with dual tap drawer provides increased functionality compared with the existing OMX 4CH CWDM. The existing OMX 4CH CWDM and the new OMX 4CH CWDM with dual tap are physically interchangeable.

Since the OMX 4CH CWDM with dual taps and the OMX 4CH CWDM have very similar loss specifications, they are optically interchangeable.

Technical specifications

Table 2-46 lists the specifications for the OMX 4CH CWDM with dual taps.

Table 2-46
OMX 4CH CWDM with dual taps specifications

Characteristic		**Value or range**	
Maximum total input power		21 dBm	
Minimum return loss		40 dB	
Passband		Center wavelength ±2.68 nm (for center wavelengths, see Table 2-47 on page 2-127)	
Minimum Band isolation	Channel	35 dB	
	Thru Out	30 dB	
	Thru In	15 dB	
Insertion loss		**Maximum**	**Typical**
	Add/Drop	2.6 dB	1.8 dB
	Thru in - OTS Out	2.1 dB	1.5 dB
	OTS In - Thru out	2.4 dB	1.8 dB
Tap loss		**Maximum**	**Typical**
	OTS In	15.6 dB	14.4 dB
	OTS Out	19 dB	17.7 dB

Table 2-46 (continued)
OMX 4CH CWDM with dual taps specifications

Characteristic		Value or range
Physical Dimension	Height	43 mm (1.70 in.) (1 U rack space)
	Width (see Note)	443 mm (17.44 in.)
	Depth	279 mm (11 in.)
Note: The width specified is with the mounting brackets installed.		

Table 2-47 lists the CWDM center wavelengths.

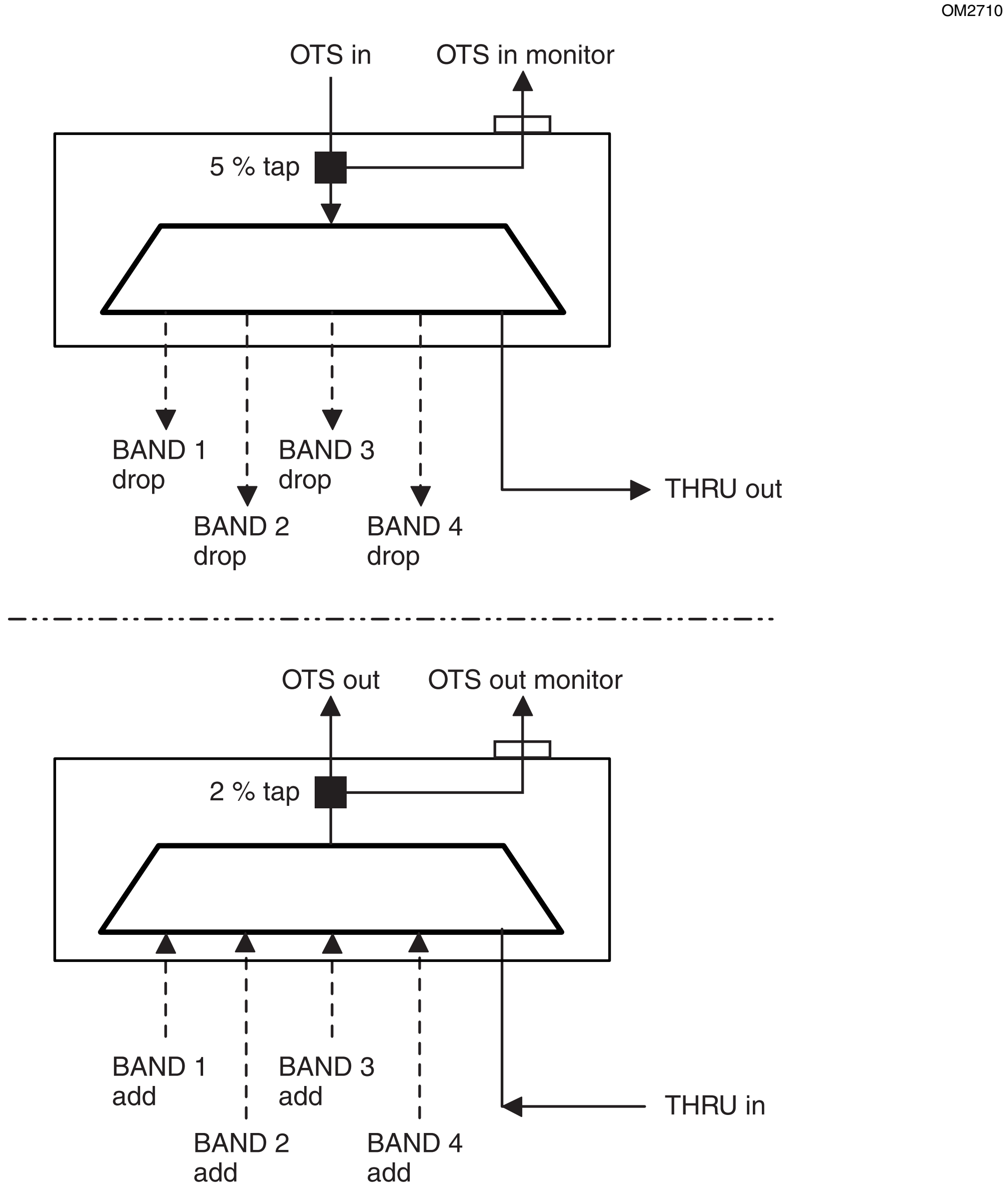
Table 2-47
CWDM center wavelengths

Band	Wavelength
1	1533.47 nm
2	1539.77 nm
3	1550.92 nm
4	1558.98 nm
5	1575.37 nm
6	1580.35 nm
7	1590.41 nm
8	1604.02 nm

Signal flow

Figure 2-34 shows the signal flow through the filter module in an OMX 4CH CWDM with dual taps.

Figure 2-34
Signal flow through an OMX 4CH CWDM with dual taps (C-band model shown)



Patch panel 20 port

The Patch panel 20 port is a 20-port version of the existing Patch panel 16 port. The Patch panel 20 port is used in the same applications as the Patch panel 16 port, and in the Muxponder 10 Gbit/s GbE/FC VCAT client-side connection application. The four additional ports of the Patch panel 20 port are required in this application because the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack has a total of 20 client signals (10 ports of Rx and Tx) on each circuit pack.

The Patch panel 20 port replaces the existing Patch panel 16 port.

There are no software changes as a result of this new hardware introduction.

Technical specifications

Table 2-48 lists the specifications for the Patch panel 20 port.

Table 2-48
Patch panel 20 port specifications

Characteristic		Value or range
Connectors inside patch panel		20 SC female-SC female bulkheads
Physical Dimension	Height	43 mm (1.70 in.) (1 U rack space)
	Width (see Note)	443 mm (17.44 in.)
	Depth	279 mm (11 in.)
Note: The width specified is with the mounting brackets installed.		

Enhancement to Extended Metro DWDM Solution with DSCM

In Release 8.0 the maximum reach of an optical span in an Optical Metro 5100/5200 Extended Metro system is increased by the introduction of new link engineering rules and the new hardware components of Release 8.0.

The reach of the OTR 10 Gbit/s Enhanced, Muxponder 10 Gbit/s and OCLD/OTR 2.5 Gbit/s Universal circuit packs is extended by the use of Dispersion and Slope Compensating Modules (DSCM). Additionally, the improved OSNR performance available with the OFA VGA, introduced in Release 8.0, is required to obtain the maximum reach.

The maximum reach of an optical span within an Extended Metro system is 600 km. Actual reach depends on the fiber length, the span loss between sites, and on the channel count.

New Extended Metro DWDM with DSCM topologies

New Extended Metro DWDM with DSCM topologies are introduced as a result of this feature. See "New Extended Metro DWDM with DSCM topologies" on page 3-29.

Network topology deployment rules

The following deployment rules must be taken into consideration when deploying Optical Metro 5100/5200 Extended Metro networks:

- Fiber type must be NDSF (G.652)
- The following components are not supported:
  - Equalizer Coupler Trays (ECT)
  - OFA Standard circuit packs
  - Trunk Switches
  - the only OMX type supported is the OMX 4CH Enhanced
- the only line cards supported are:
  - OCLD 2.5 Gbit/s Universal
  - OTR 2.5 Gbit/s Universal 1310 nm
  - OTR 2.5 Gbit/s Universal 850 nm
  - OTR 10 Gbit/s Enhanced
  - Muxponder 10 Gbit/s GbE/FC
  - Muxponder 10 Gbit/s GbE/FC VCAT
- Inter-site fault sectionalization is supported but intra-site fault sectionalization is not
- OMX single shelf wiring is not supported

Link engineering rules

Link engineering of Extended Metro DWDM systems is not supported in NMT nor is it supported using manual calculations. Contact Nortel Networks for custom link engineering and to obtain a Nortel Networks Custom Equalization Report for your Extended Metro system.

> **ATTENTION**
> To avoid potential service interruption, indicate your initial capacity and the targeted fulfill capacity when you contact Nortel Networks for custom link engineering. The design must take into account total losses from all OMXs (those currently installed and those you plan to install) in order to derive the correct padding for your initial channels.

The Nortel Networks link engineering team provides:

- an outline schematic of the design indicating the position of amplifiers and regenerators
- the location and size of the DSCMs required
- an equipment list for each site (line equipment only)
- site fibering diagrams showing the connections for each site
- equalization report showing all necessary optical power information for provisioning

Enhancement to the dispersion specification for the OCLD/OTR 2.5 Gbit/s Flex 100 GHz circuit packs

In Release 8.0 the dispersion specification for the OCLD/OTR 2.5 Gbit/s Flex 100 GHz circuit packs is increased from 110 km to 200 km.

Supported configurations and topologies

In this chapter

This chapter describes new and enhanced configurations and topologies for Optical Metro 5100/5200 Release 8.0. For complete information on all Optical Metro 5100/5200 supported configurations, see *Network Planning and Link Engineering,* 323-1701-110 in the *Optical Metro 5100/5200 Technical Publications,* NT0H65AM.

Release 8.0 introduces the following network and service layer topologies:

- Muxponder 10 Gbit/s circuit packs network and service layer topologies on page 3-2
- SRM and ESCON SRM interoperable topologies using OTR on page 3-21

Release 8.0 offers the following new site-level configurations:

- Optical Fiber Amplifier (OFA) shelf topologies on page 3-22
- Dual OFA optical layer topologies on page 3-25
- New Extended Metro DWDM with DSCM topologies on page 3-29

Muxponder 10 Gbit/s circuit packs network and service layer topologies

This section describes the network and service layer topologies supported by the following Muxponder 10 Gbit/s circuit packs

- Muxponder 10 Gbit/s GbE/FC
- Muxponder 10 Gbit/s GbE/FC VCAT

Muxponder 10 Gbit/s circuit packs network layer topologies

Table 3-1 on page 3-2 lists the supported network layer topologies and identifies the Muxponder 10 Gbit/s circuit pack types supported for each network layer topology.

Table 3-1
Muxponder 10 Gbit/s circuit pack network layer topology support

Network Layer topologies	Muxponder 10 Gbit/s GbE/FC	Muxponder 10 Gbit/s GbE/FC VCAT
Bookended topology	√	√
SONET/SDH Section Terminal Equipment (STE) interoperable topologies	√	√
SONET/SDH Line Terminating Equipment (LTE) network interoperable topologies	Not supported	√
SONET/SDH Line Terminating Equipment (LTE) Diverse Route network interoperable topologies	Not supported	√

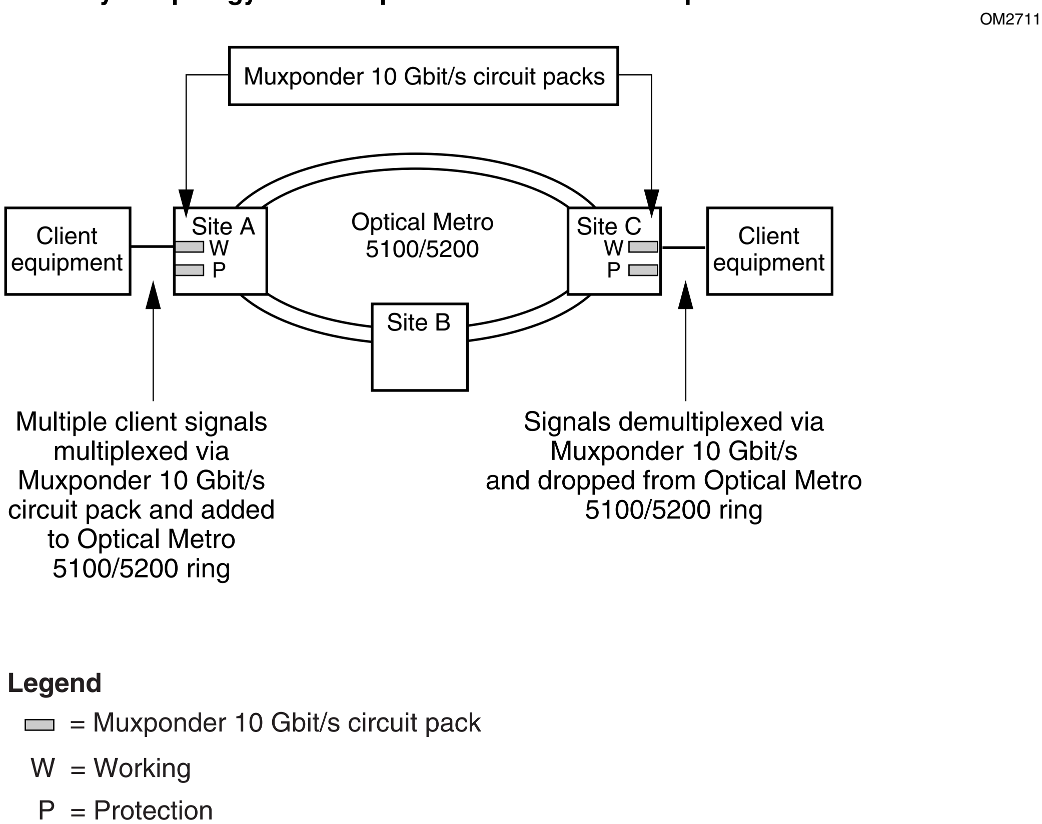
Bookended topology

In a bookended topology, the Muxponder 10 Gbit/s circuit pack at the starting point of an optical channel is paired with another Muxponder 10 Gbit/s circuit pack at the end point of the same optical channel. The individual client signals must be demultiplexed when dropped from the Optical Metro 5100/5200 network.

In a bookended topology, at least one Muxponder 10 Gbit/s circuit pack must be in local timing mode.

Figure 3-1 on page 3-3 shows an example of a bookended topology.

Figure 3-1
Bookended service layer topology with Muxponder 10 Gbit/s circuit packs



Each end of the bookended topology link can be equipped with the same Muxponder 10 Gbit/s circuit pack type or different Muxponder 10 Gbit/s circuit pack types according to Table 3-2 on page 3-4.

Table 3-2
Muxponder 10 Gbit/s circuit pack type mixing rules in a bookended topology

Site A Muxponder 10 Gbit/s circuit pack type	Site C Muxponder 10 Gbit/s circuit pack type	Support	Rules
Muxponder 10 Gbit/s GbE/FC	Muxponder 10 Gbit/s GbE/FC	√	None
Muxponder 10 Gbit/s GbE/FC VCAT	Muxponder 10 Gbit/s GbE/FC VCAT	√	None
Muxponder 10 Gbit/s GbE/FC	Muxponder 10 Gbit/s GbE/FC VCAT	√	See Table 3-3 on page 3-4
Muxponder 10 Gbit/s GbE/FC VCAT	Muxponder 10 Gbit/s GbE/FC	√	See Table 3-3 on page 3-4

The Muxponder 10 Gbit/s GbE/FC circuit pack and the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack can interwork with one another. However, the functionality is limited to that available on the Muxponder 10 Gbit/s GbE/FC circuit pack. Table 3-3 on page 3-4 lists the rules or attributes that must be followed when these two Muxponder 10 Gbit/s circuit pack types interwork with one another.

Table 3-3
Muxponder 10 Gbit/s circuit pack type mixing rules

Rules or attributes
Virtual concatenation is not supported
Both GbE and FC traffic are GFP-T mapped
No subrate transports are supported: • GbE: STS-24c/VC-4-8c only • FC-100, FICON: STS-24c/VC-4-8c only • FC-200, FICON Express: STS-48c/VC-4-16c only
Only ports 1 to 8 are provisionable (9 and 10 are not used)
Client ports are fixed mapped to the line side path (24n+1; n=0…7)
Autonegotiation and PAUSE are not supported for GbE protocol
Interoperability on the network side is restricted to LH1600 only where the SONET/SDH OC-192/STM-64 signal is not line terminated

Table 3-3 (continued)
Muxponder 10 Gbit/s circuit pack type mixing rules

Rules or attributes
Interoperability with the OCI SRM GbE/FC, OCI SRM GbE/FC Enhanced, and OCI SRM GbE circuit packs is not supported
Generic and Ethernet OMs are not supported on the Muxponder 10 Gbit/s GbE/FC circuit pack, they are supported on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack
Path PMs are not supported on the Muxponder 10 Gbit/s GbE/FC circuit pack, they are supported on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack
The Muxponder 10 Gbit/s circuit packs forming the working and protection 1+1 pair at one end of the bookended topology must be the same Muxponder 10 Gbit/s circuit pack type

SONET/SDH Section Terminal Equipment (STE) interoperable topologies

You can implement SONET/SDH STE interoperable topologies with Muxponder 10 Gbit/s circuit packs, as shown in Figure 3-2 on page 3-6, Figure 3-3 on page 3-8 or Figure 3-4 on page 3-9.

Each end of the interoperable topology link can be equipped with the same Muxponder 10 Gbit/s circuit pack type or different Muxponder 10 Gbit/s circuit pack types according to Table 3-4 on page 3-5.

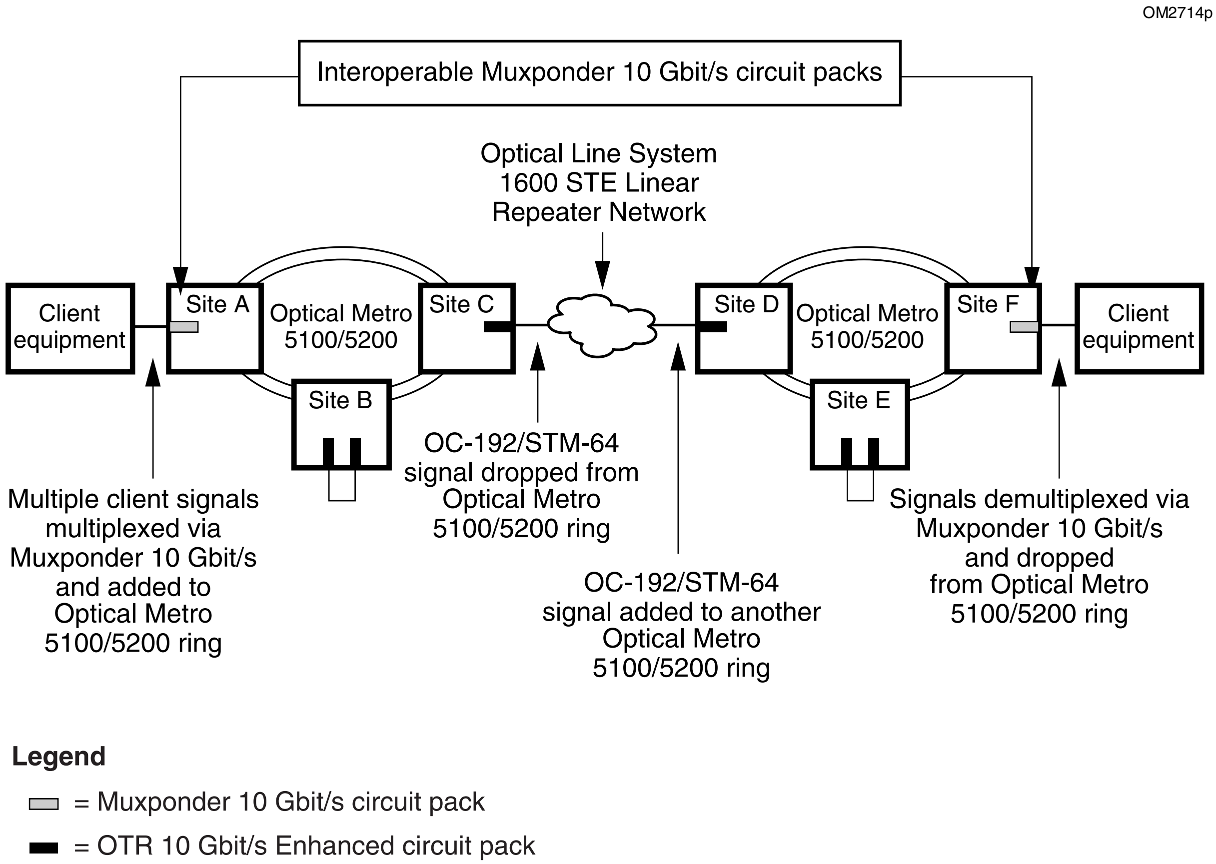
Table 3-4
Muxponder 10 Gbit/s circuit pack type mixing rules in a SONET/SDH STE interoperable topology

Site A Muxponder 10 Gbit/s circuit pack type	Site F Muxponder 10 Gbit/s circuit pack type	Support	Rules
Muxponder 10 Gbit/s GbE/FC	Muxponder 10 Gbit/s GbE/FC	√	None
Muxponder 10 Gbit/s GbE/FC VCAT	Muxponder 10 Gbit/s GbE/FC VCAT	√	None
Muxponder 10 Gbit/s GbE/FC	Muxponder 10 Gbit/s GbE/FC VCAT	√	See Table 3-3 on page 3-4
Muxponder 10 Gbit/s GbE/FC VCAT	Muxponder 10 Gbit/s GbE/FC	√	See Table 3-3 on page 3-4

In the unprotected SONET/SDH STE interoperable topology displayed in Figure 3-2 on page 3-6,

- the Muxponder 10 Gbit/s circuit packs are paired at Sites A and F
- the OTR 10 Gbit/s Enhanced circuit packs at Sites C and D provide the OC-192 or STM-64 signal hand-off to the Optical Long Haul 1600 Linear Repeater network as they unwrap the G.709 signal received from the Muxponder 10 Gbit/s circuit packs to an OC-192/STM-64 signal
- the Optical Long Haul 1600 circuit packs that interface with the Optical Metro 5100/5200 circuit packs must be WT or XR circuit packs
- the OTR 10 Gbit/s Enhanced circuit packs at Sites B and E provide a regeneration function

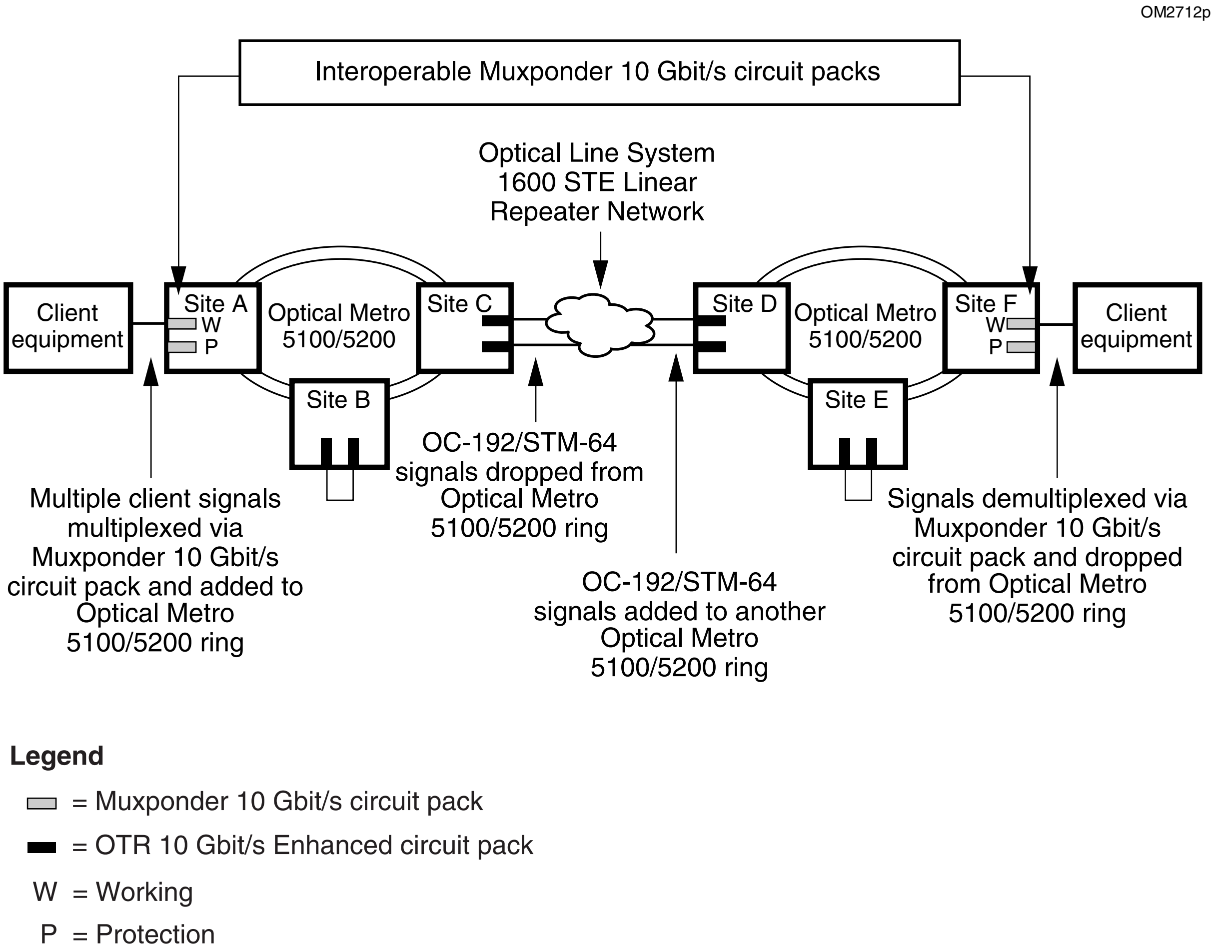
Figure 3-2
Unprotected SONET/SDH STE interoperable topology



In the protected SONET/SDH STE interoperable topology displayed in Figure 3-3 on page 3-8,

- the Muxponder 10 Gbit/s circuit packs are paired at Sites A and F. There are two Muxponder 10 Gbit/s circuit packs at each of these sites provisioned in 1+1 APS protection mode.
- the OTR 10 Gbit/s Enhanced circuit packs at Sites C and D provide the OC-192 or STM-64 signal hand-off to the Optical Long Haul 1600 Linear Repeater network as they unwrap the G.709 signal received from the Muxponder 10 Gbit/s circuit packs to an OC-192/STM-64 signal. There are two OTR 10 Gbit/s Enhanced circuit packs at Site C and two more at Site D. Two are required, one for the working signal and one for the protection signal. Each OTR 10 Gbit/s Enhanced circuit pack is configured in unprotected mode since the 1+1 APS protection is performed between the Muxponder 10 Gbit/s circuit packs equipped at Site A and F.
- the Optical Long Haul 1600 circuit packs that interface with the Optical Metro 5100/5200 circuit packs must be WT or XR circuit packs. These circuit packs are provisioned as unprotected in the Optical Long Haul 1600 Linear Repeater network.
- the OTR 10 Gbit/s Enhanced circuit packs at Sites B and E provide a regeneration function

Figure 3-3
Protected SONET/SDH STE interoperable topology

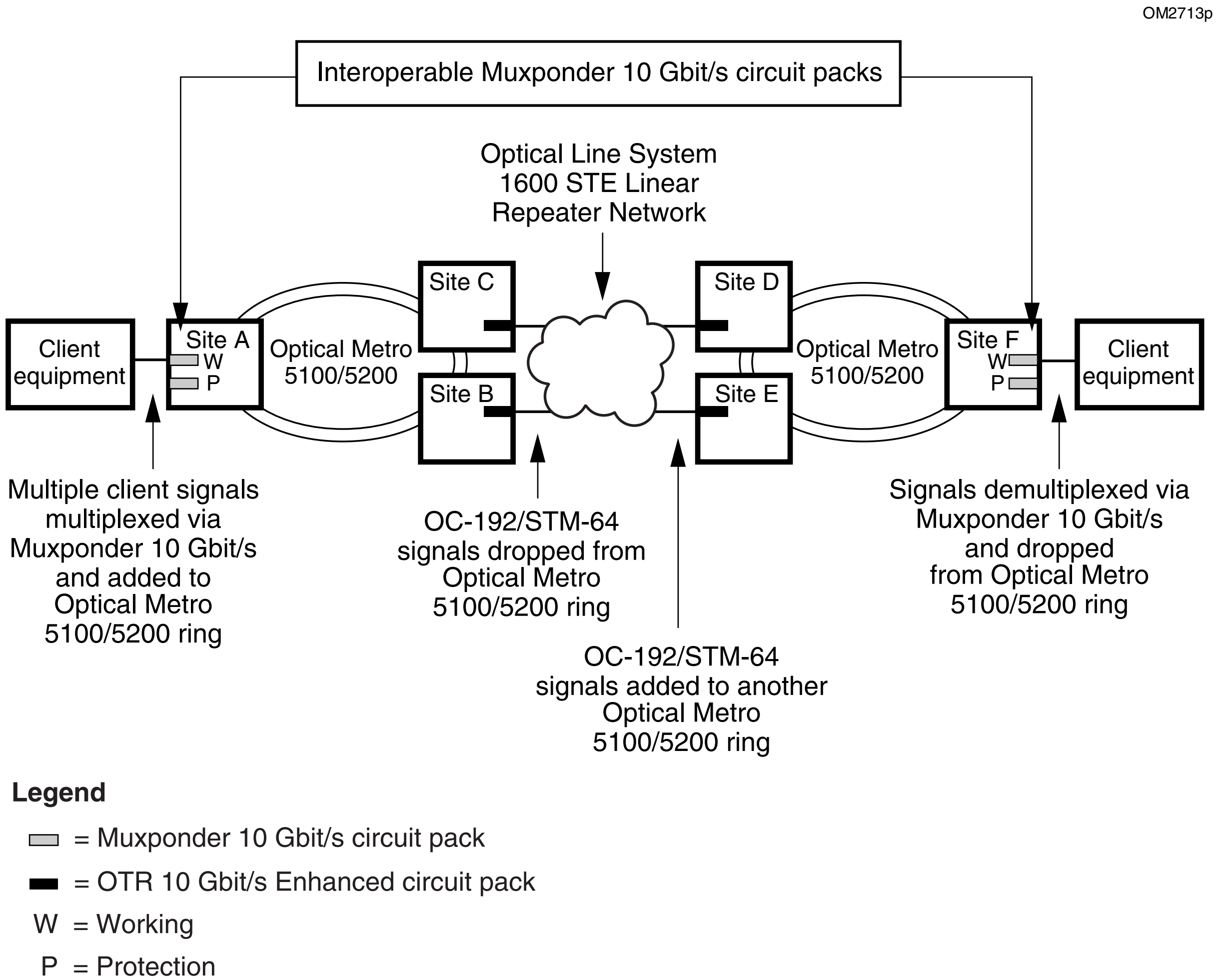


In the dual homing protection SONET/SDH STE interoperable topology displayed in Figure 3-4 on page 3-9,

- the Muxponder 10 Gbit/s circuit packs are paired at Sites A and F. There are two Muxponder 10 Gbit/s circuit packs at each of these sites provisioned in 1+1 APS protection mode.
- the OTR 10 Gbit/s Enhanced circuit packs at Sites B, C, D and E provide the OC-192 or STM-64 signal hand-off to the Optical Long Haul 1600 Linear Repeater network as they unwrap the G.709 signal received from the Muxponder 10 Gbit/s circuit packs to an OC-192/STM-64 signal. Each OTR 10 Gbit/s Enhanced circuit pack is configured in unprotected mode since the 1+1 APS protection is performed between the Muxponder 10 Gbit/s circuit packs equipped at Site A and F.

- the Optical Long Haul 1600 circuit packs that interface with the Optical Metro 5100/5200 circuit packs must be WT or XR circuit packs. These circuit packs are provisioned as unprotected in the Optical Long Haul 1600 Linear Repeater network.

Figure 3-4
Dual-homed protected SONET/SDH STE interoperable topology



SONET/SDH Line Terminating Equipment (LTE) network interoperable topologies

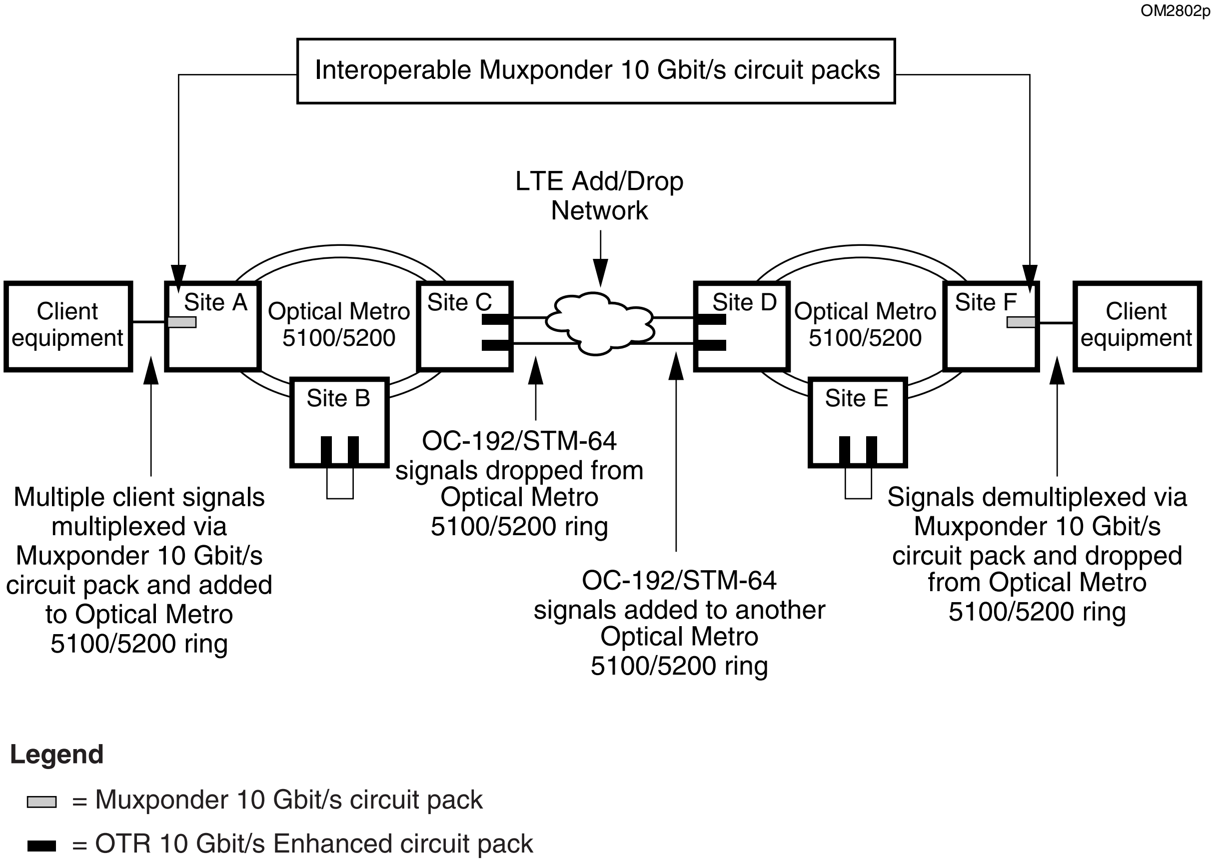
You can implement SONET/SDH LTE interoperable topologies with Muxponder 10 Gbit/s GbE/FC VCAT circuit packs, as shown in Figure 3-5 on page 3-11 or Figure 3-6 on page 3-12.

Each end of the interoperable topology link must be equipped with the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack. The SONET/SDH LTE interoperable topologies are not supported with the Muxponder 10 Gbit/s GbE/FC circuit pack.

In the unprotected SONET/SDH LTE interoperable topology displayed in Figure 3-5 on page 3-11,

- the Muxponder 10 Gbit/s GbE/FC VCAT circuit packs are paired at Sites A and F
- the entire aggregate signal between the Muxponder 10 Gbit/s GbE/FC VCAT circuit packs at Sites A and F is passed “end-to-end” through a SONET/SDH network as a contiguous STS-192/STM-64 signal
- the OTR 10 Gbit/s Enhanced circuit packs at Sites C and D provide the OC-192 or STM-64 signal hand-off to the LTE add/drop network as they unwrap the G.709 signal received from the Muxponder 10 Gbit/s GbE/FC VCAT circuit packs to an OC-192/STM-64 signal
- the OC-192/STM-64 signal can be protected within the LTE add/drop network if desired
- the OTR 10 Gbit/s Enhanced circuit packs at Sites B and E provide a regeneration function

Figure 3-5
Unprotected SONET/SDH LTE interoperable topology



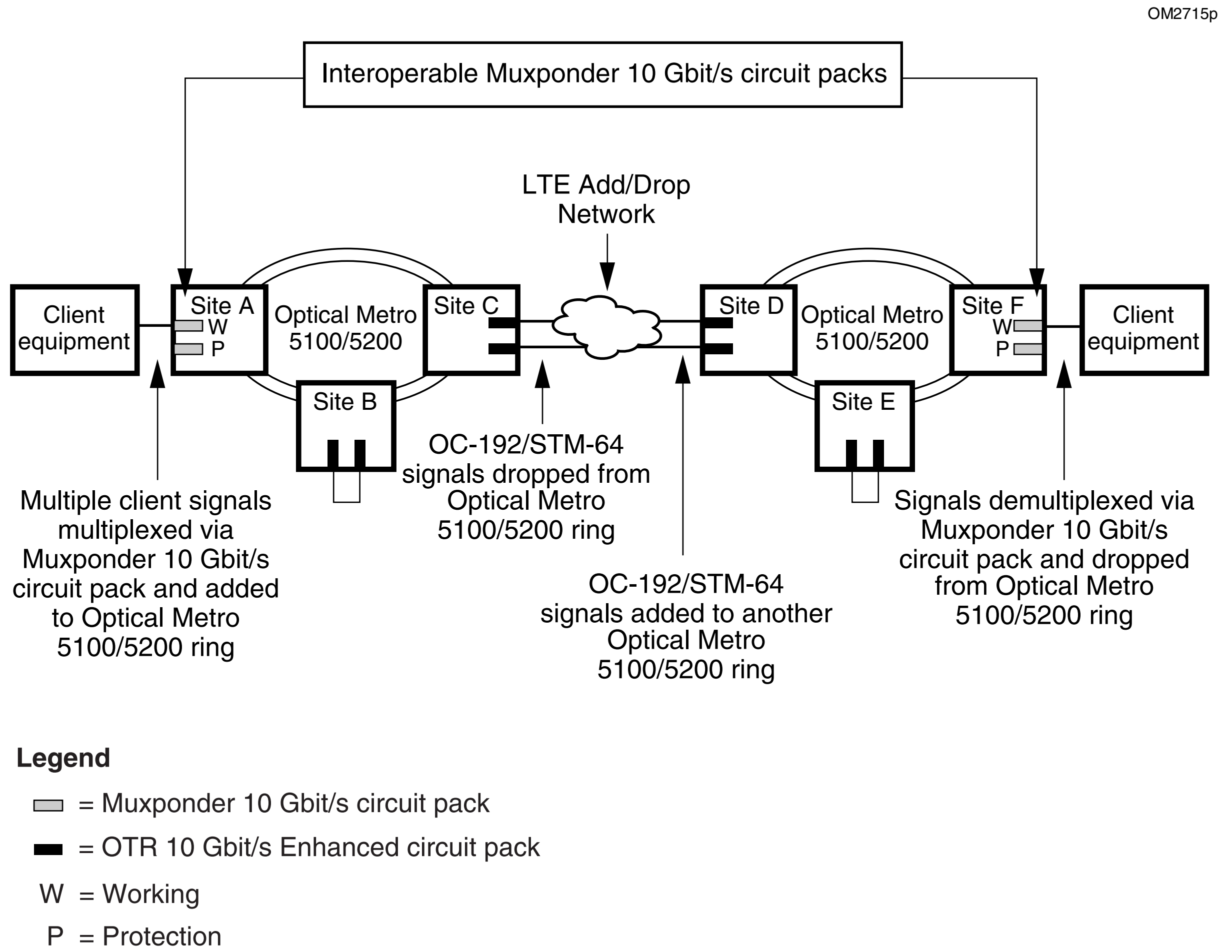
In the protected SONET/SDH LTE interoperable topology displayed in Figure 3-6 on page 3-12,

- the Muxponder 10 Gbit/s GbE/FC VCAT circuit packs are paired at Sites A and F. There are two Muxponder 10 Gbit/s GbE/FC VCAT circuit packs at each of these sites provisioned in 1+1 APS protection mode.
- the entire aggregate signal between the Muxponder 10 Gbit/s GbE/FC VCAT circuit packs at Sites A and F is passed “end-to-end” through a SONET/SDH network as a contiguous STS-192/STM-64 signal
- the OTR 10 Gbit/s Enhanced circuit packs at Sites C and D provide the OC-192/STM-64 signal hand-off to the LTE add/drop network as they unwrap the G.709 signal received from the Muxponder 10 Gbit/s GbE/FC VCAT circuit packs to an OC-192/STM-64 signal. There are two OTR 10 Gbit/s Enhanced circuit packs at Site C and two more at Site D. Two are required, one for the working signal and one for the protection signal. Each OTR 10 Gbit/s Enhanced circuit pack is configured in unprotected mode since the 1+1 APS protection is performed between the Muxponder 10

Gbit/s GbE/FC VCAT circuit packs equipped at Site A (or Site F) and the OC-192/STM-64 circuit packs (provisioned in 1+1 APS mode) interfacing with the OTR 10 Gbit/s Enhanced circuit packs at Site C (or Site D).

- the OC-192/STM-64 signal is protected within the LTE add/drop network (using BLSR protection for example)
- the OTR 10 Gbit/s Enhanced circuit packs at Sites B and E provide a regeneration function

Figure 3-6
Protected SONET/SDH LTE interoperable topology



SONET/SDH Line Terminating Equipment (LTE) Diverse Route network interoperable topologies

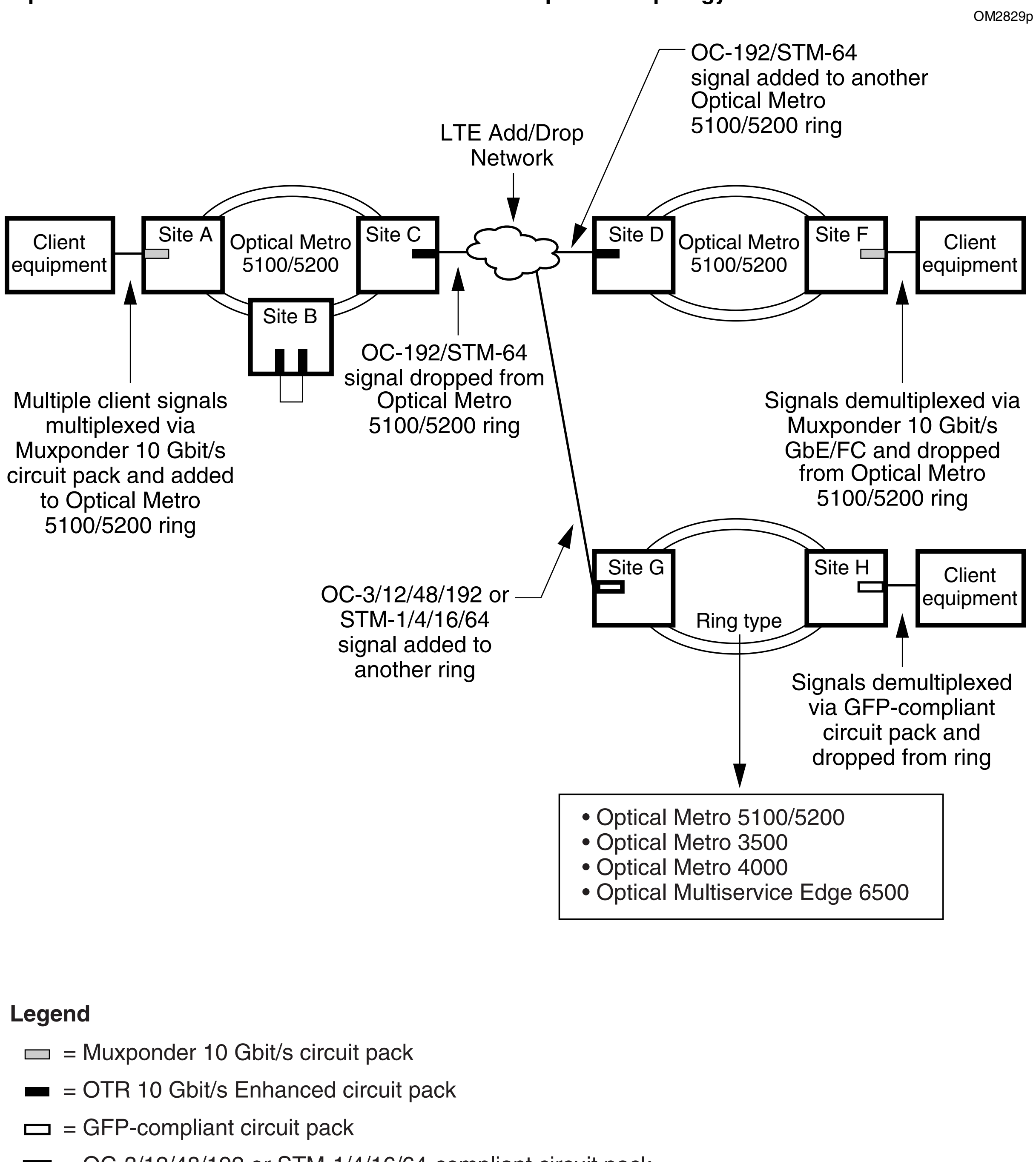
You can implement SONET/SDH LTE Diverse Route interoperable topologies with Muxponder 10 Gbit/s GbE/FC VCAT circuit packs, as shown in Figure 3-7 on page 3-14 or Figure 3-8 on page 3-16.

The SONET/SDH LTE Diverse Route interoperable topologies are not supported with the Muxponder 10 Gbit/s GbE/FC circuit pack.

In the unprotected SONET/SDH LTE Diverse Route interoperable topology displayed in Figure 3-7 on page 3-14,

- after the STS-192/STM-64 aggregate signal leaves the Optical Metro 5100/5200 network, the LTE add/drop network can break or groom the signal into smaller payloads as well as being able to route the signals to different end points. In the case of C-cat, each pipe consists of one path only. In the case of V-cat, each pipe may consist of multiple diversely routed STS-3c V-cat connections. These diverse routes can accommodate up to 14 msec of differential delay.
- the OTR 10 Gbit/s Enhanced circuit packs at Sites C and D provide the OC-192 or STM-64 signal hand-off to the LTE add/drop network as they unwrap the G.709 signal received from the Muxponder 10 Gbit/s GbE/FC VCAT circuit packs to an OC-192/STM-64 signal
- the OC-3/12/48 or STM-1/4/16 compliant circuit packs at Site G provide the signal hand-off to the LTE add/drop network
- the GFP-compliant circuit pack at Site H must support:
  - GFP-F or GFP-T encapsulation for GbE
  - GFP-T encapsulation for FC-100, FICON, FC-200, FICON Express
  - STS-3c granularity
- the STS-3c signals can be protected within the LTE add/drop network if desired
- the OTR 10 Gbit/s Enhanced circuit packs at Site B provide a regeneration function

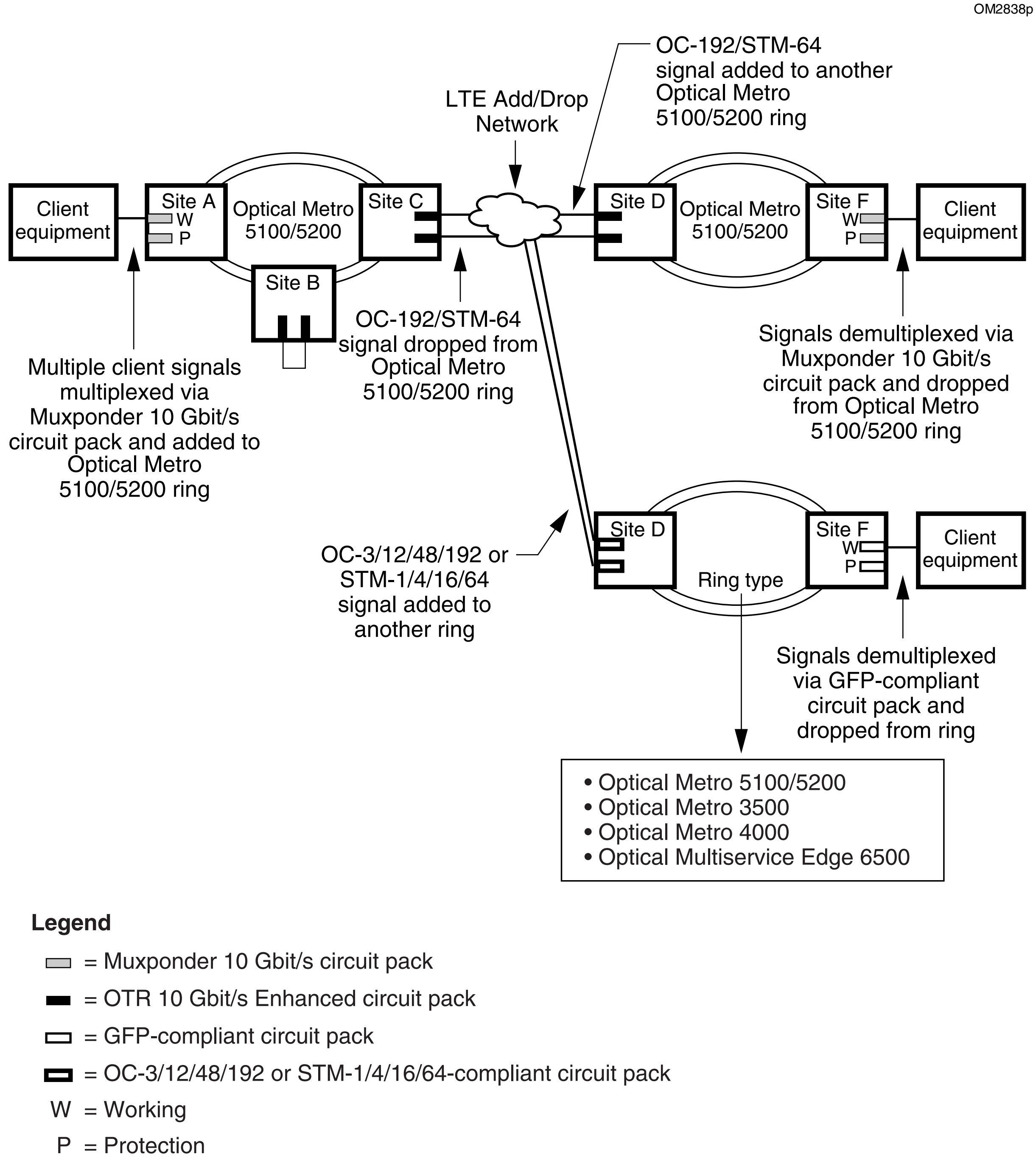
Figure 3-7
Unprotected SONET/SDH LTE Diverse Route interoperable topology



In the protected SONET/SDH LTE Diverse Route interoperable topology displayed in Figure 3-8 on page 3-16,

- after the STS-192/STM-64 aggregate signal leaves the Optical Metro 5100/5200 network, the LTE add/drop network can break or groom the signal into smaller payloads as well as being able to route the signals to different end points. In the case of C-cat, each pipe consists of one path only. In the case of V-cat, each pipe may consist of multiple diversely routed STS-3c V-cat connections. These diverse routes can accommodate up to 14 msec of differential delay.
- the OTR 10 Gbit/s Enhanced circuit packs at Sites C and D provide the OC-192/STM-64 signal hand-off to the LTE add/drop network as they unwrap the G.709 signal received from the Muxponder 10 Gbit/s GbE/FC VCAT circuit packs to an OC-192/STM-64 signal. There are two OTR 10 Gbit/s Enhanced circuit packs at Site C and two more at Site D. Two are required, one for the working signal and one for the protection signal. Each OTR 10 Gbit/s Enhanced circuit pack is configured in unprotected mode since the 1+1 APS protection is performed between the Muxponder 10 Gbit/s GbE/FC VCAT circuit packs equipped at Site A (or Site F) and the OC-192/STM-64 circuit packs (provisioned in 1+1 APS mode) interfacing with the OTR 10 Gbit/s Enhanced circuit packs at Site C (or Site D).
- the OC-3/12/48 or STM-1/4/16 compliant circuit packs at Site G provide the signal hand-off to the LTE add/drop network
- the GFP-compliant circuit pack at Site H must support:
  - — GFP-F or GFP-T encapsulation for GbE
  - — GFP-T encapsulation for FC-100, FICON, FC-200, FICON Express
  - — STS-3c granularity (not STS-1)
- the STS-3c signals are protected within the LTE add/drop network (using BLSR protection for example)
- the OTR 10 Gbit/s Enhanced circuit packs at Site B provide a regeneration function

Figure 3-8
Protected SONET/SDH LTE Diverse Route interoperable topology



Muxponder service layer topologies

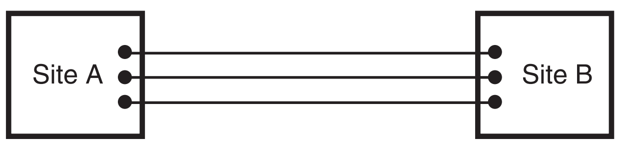
The Muxponder 10 Gbit/s GbE/FC circuit pack and Muxponder 10 Gbit/s GbE/FC VCAT circuit pack support the same service layer topologies described in this section.

The Muxponder 10 Gbit/s GbE/FC circuit pack and the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack can interwork with one another. However, the functionality is limited to that available on the Muxponder 10 Gbit/s GbE/FC circuit pack. Table 3-3 on page 3-4 lists the rules or attributes that must be followed when these two Muxponder 10 Gbit/s circuit pack types interwork with one another.

The service layer of the Optical Metro 5100/5200 defines the traffic that is carried over the optical layer. The logical view of the service layer describes the traffic patterns. Traffic patterns are governed by channel assignments, protection schemes and protocol specifics. The physical view of the service layer describes the relationships between traffic carrying circuit packs in a shelf. These relationships dictate the traffic flow.

The Muxponder 10 Gbit/s circuit pack only supports point-to-point traffic. The optical channel originates at one site and terminates at another. If all of the channels in the network originate and terminate at the same two sites, the network is a point-to-point network, as shown in Figure 3-9 on page 3-17.

Figure 3-9
Point-to-point traffic



The following types of point-to-point configurations are supported on the Muxponder 10 Gbit/s circuit pack:

- “Muxponder unprotected point-to-point configuration” on page 3-17
- “Muxponder point-to-point client protected configuration with route diversity” on page 3-18
- “Muxponder point-to-point protection configuration using a Trunk Switch” on page 3-19
- “Muxponder point-to-point 1+1 line-side APS protected configuration” on page 3-19

Muxponder unprotected point-to-point configuration

See Figure 3-10 on page 3-18 for an illustration of a Muxponder 10 Gbit/s unprotected point-to-point configuration. Unprotected configurations imply that the Muxponder 10 Gbit/s supports timely end-to-end signal conditioning to allow an upstream fault to be detected by a downstream client. Point-to-point configurations that use OTR 10 Gbit/s Enhanced circuit packs at regenerator sites are also supported. See Figure 3-11 on page 3-18.

> ***Note:*** Each Muxponder 10 Gbit/s bidirectional channel can support up to 13 regenerator sites.

Figure 3-10
Muxponder 10 Gbit/s unprotected point-to-point configuration

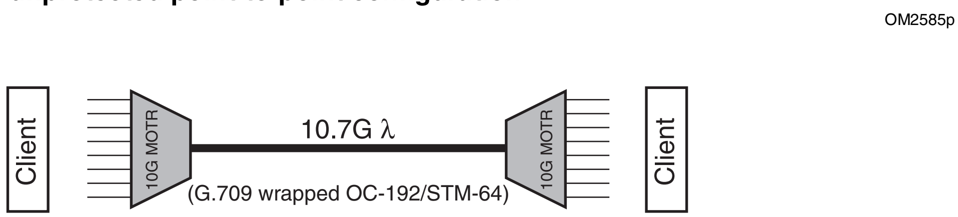
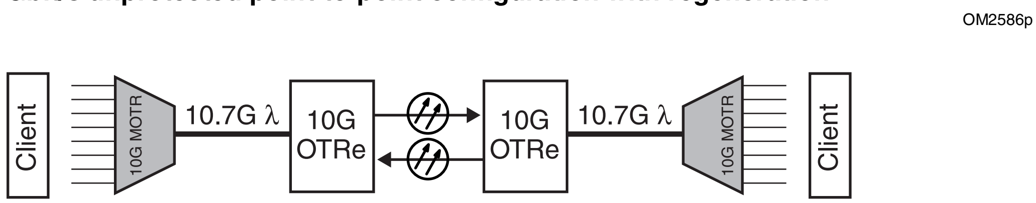


Figure 3-11
Muxponder 10 Gbit/s unprotected point-to-point configuration with regeneration

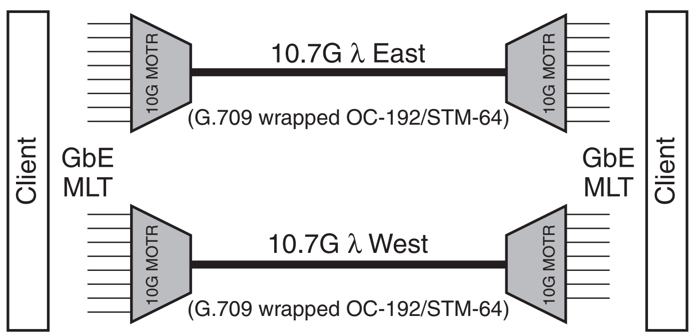


Note: Up to 13 regenerator sites are supported for each 10Gbit/s Muxponder GbE/FC optical channel.

Muxponder point-to-point client protected configuration with route diversity
The Muxponder 10 Gbit/s supports client protected configurations that provide route diversity. In such configurations, the subtending client equipment provides protection for itself, for example using the Ethernet Multi-Link Trunking functionality. In this configuration, a pair of Muxponder 10 Gbit/s circuit packs is deployed at either end of the link and traffic is routed on diverse fibers. It is then up to the client equipment to provide protection switching. This configuration is illustrated in Figure 3-12 on page 3-19.

> ***Note:*** Client side protection using the Transponder Protection Tray (TPT) is not supported on the Muxponder 10 Gbit/s circuit pack.

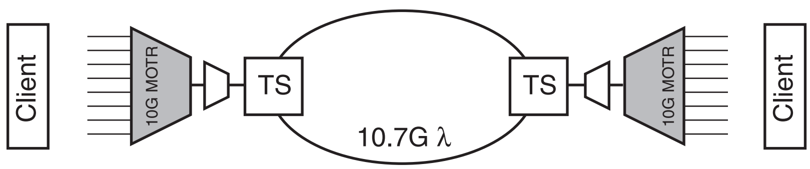
Figure 3-12
Muxponder 10 Gbit/s client protected point-to-point configuration



Muxponder point-to-point protection configuration using a Trunk Switch

The Muxponder 10 Gbit/s circuit pack supports line-side protection using the Optical Trunk Switch (OTS) or the Enhanced Trunk Switch (ETS) module. Protected configurations are restricted to the supported protected trunk switch configurations. See Figure 3-13.

Figure 3-13
Point-to-point protection using a Trunk Switch



Muxponder point-to-point 1+1 line-side APS protected configuration

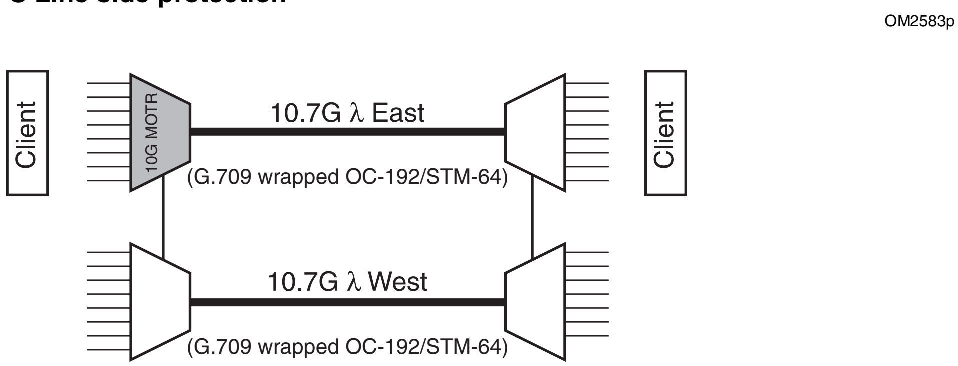
The Muxponder 10 Gbit/s circuit pack supports both 1+1 unidirectional and 1+1 bidirectional 1+1 APS protection switching for point-to-point line-side protection using a pair of Muxponder 10 Gbit/s circuit pack. 1+1 line-side protection is revertive only. One Muxponder 10 Gbit/s circuit pack is provisioned as the protection circuit pack and the other as the working circuit pack. Configure a protected connection between the two circuit packs during channel assignment provisioning. A protected connection must follow the standard East-West plane rule. Any East plane Muxponder 10 Gbit/s circuit pack can have a protection mate in the West plane and vice-versa. The working and protection Muxponder 10 Gbit/s circuit packs must be located in the same shelf.

The working circuit pack SFP client-side interfaces connect to the subtending client equipment. The protection circuit pack is not equipped with SFP client side interfaces. See Figure 3-14 on page 3-20 for an illustration of 1+1 APS line-side protection on a Muxponder 10 Gbit/s circuit pack connection.

For more information on 1+1 line-side APS protection using Muxponder 10 Gbit/s circuit packs, refer to "1+1 line-side APS protection for Muxponder 10 Gbit/s GbE/FC VCAT" on page 2-45 in Chapter 2, "Hardware features".

> ***Note:*** Although a point-to-point configuration with protection and regeneration is not illustrated, you can deploy Muxponder 10 Gbit/s protected configurations with OTR 10 Gbit/s Enhanced circuit packs at regenerator sites.

Figure 3-14
Point-to-point 1+1 APS Line side protection



Muxponder optical layer topologies

The Muxponder 10 Gbit/s GbE/FC circuit pack and Muxponder 10 Gbit/s GbE/FC VCAT circuit pack support the same optical layer topologies described in this section.

The Muxponder 10 Gbit/s GbE/FC circuit pack and the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack can interwork with one another. However, the functionality is limited to that available on the Muxponder 10 Gbit/s GbE/FC circuit pack. Table 3-3 on page 3-4 lists the rules or attributes that must be followed when these two Muxponder 10 Gbit/s circuit pack types interwork with one another.

The optical layer consists of the components that define traffic patterns independently from the signals that are being carried. At the highest level, optical topologies specify the means by which the sites are interconnected by the spans of fiber. There are no new or changed optical level topologies associated with the introduction of the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack. The Muxponder 10 Gbit/s can be deployed in ring systems, linear systems or a bridged combination of multiple ring or linear systems. For more information on the supported optical layer topologies, refer to the *Network Planning and Link Engineering*, 323-1701-110.

Optical layer topology deployment rules

You can deploy the Muxponder 10 Gbit/s circuit pack in:

- Optical Metro 5100/5200 DWDM systems
- Optical Metro 5100/5200 CWDM systems
- Optical Metro 5100/5200 ITU-CWDM systems
- Optical Metro 5100 OMX-less systems

In Optical Metro 5100/5200 CWDM systems, you must use the DWDM Muxponder 10 Gbit/s circuit packs with wavelengths that match the CWDM system wavelength plan. There is no CWDM Muxponder 10 Gbit/s circuit pack available. Refer to *Network Planning and Link Engineering*, 323-1701-110 for more information about using DWDM wavelengths in CWDM systems with Muxponder 10 Gbit/s circuit packs.

In Optical Metro 5100/5200 ITU CWDM systems, you must use specific Muxponder 10 Gbit/s circuit packs that are compatible with the ITU CWDM system wavelength plan. There is no ITU-CWDM Muxponder 10 Gbit/s circuit pack available. Refer to *Network Planning and Link Engineering*, 323-1701-110 for more information about using DWDM wavelengths in ITU-CWDM systems with Muxponder 10 Gbit/s circuit packs.

Optical layer interworking

The Muxponder 10 Gbit/s circuit pack supports both amplified and unamplified configurations.

The Muxponder 10 Gbit/s circuit pack is also compatible with the Common Photonic Layer product platform. Use the Muxponder 10 Gbit/s 100 GHz circuit packs to feed wavelengths into a Common Photonic Layer system from Muxponder 10 Gbit/s circuit packs.

SRM and ESCON SRM interoperable topologies using OTR

For details about these new interoperable topologies, see “SRM and ESCON SRM interoperable topologies using OTR” on page 4-65.

Optical Fiber Amplifier (OFA) shelf topologies

Release 7.0 relaxed the placement restrictions of C- and L-band amplifiers and Automatic Per Band Equalizer (APBE) in an OFA shelf. The software change allows amplifiers and APBEs to be placed in any slot except slots that are reserved for the OCM, the OSC and the SP in an OFA shelf. As a result, the following advantages exist:

- for 16 channel deployments (C or L band only), you can full-fill the OFA shelf with C or L band equipment for better density
- you have the option of adding L-band shelves at a later date when the wavelength count exceeds the count for only requiring C (or L where appropriate) band
- if you wish to deploy east and west shelf deployments, you can use the extra slots in either shelf to deploy APBEs when a post or preamp of the other band is not required

The OFA VGA occupies three slots in the OFA shelf. In cases where sites are likely to have both pre and post amplifiers, it is likely that an APBE/APBE Enhanced is only required for the post amp. A three slot amplifier combined with the relaxed equipping rules introduced in Release 7.0 allows a single shelf to support four amplifiers (assume pre/post in each direction) and two APBEs (one for each post amp). Since there are no hard equipping rules on the system, free slots could be used for other amplifiers or APBEs.

Figure 3-15 on page 3-23 and Figure 3-16 on page 3-24 show two OFA shelf topologies:

- separate East and West shelf: A shelf is used for east amplifiers and a separate shelf is used for west amplifiers
- separate C-band and L-band shelf: A shelf is used for C-Band only traffic and a separate shelf is used for L-band only traffic

The topologies are shown for the three-slot amplifier and for the four-slot amplifiers in the best density fill possible in either case if the APBE/APBE Enhanced is used. In the case that the APBE/APBE Enhanced is not used, the three-slot amplifier does not provide a density improvement over the four-slot amplifier since only four amplifiers can reside in a single OFA shelf.

Although deployments are not required to follow the OFA shelf topologies described above, it is recommended as a way to improve simplicity of operations. On 16 channel networks (either C-band or L-band only), the C-band and L-band shelf topology lends itself nicely to the deployments since it provides the ability to fully equip the sites using only a single amplifier shelf (assuming the site requires 2 or less APBEs). In the case that more wavelengths are added to the network, another shelf can be deployed, thus, removing the need to pre-deploy shelves without the L-band (or C-band in some cases) initially deployed.

On networks using both C and L band amplifiers and APBEs, the East and West shelf topology can be used to help ensure that fibers carrying working and protection traffic are routed separately, and to ensure that it is clear which amplifiers serve the east side of the site and the west side of the site given the physical shelf location.

Figure 3-15
Example OFA shelf topologies - Separate East and West shelf

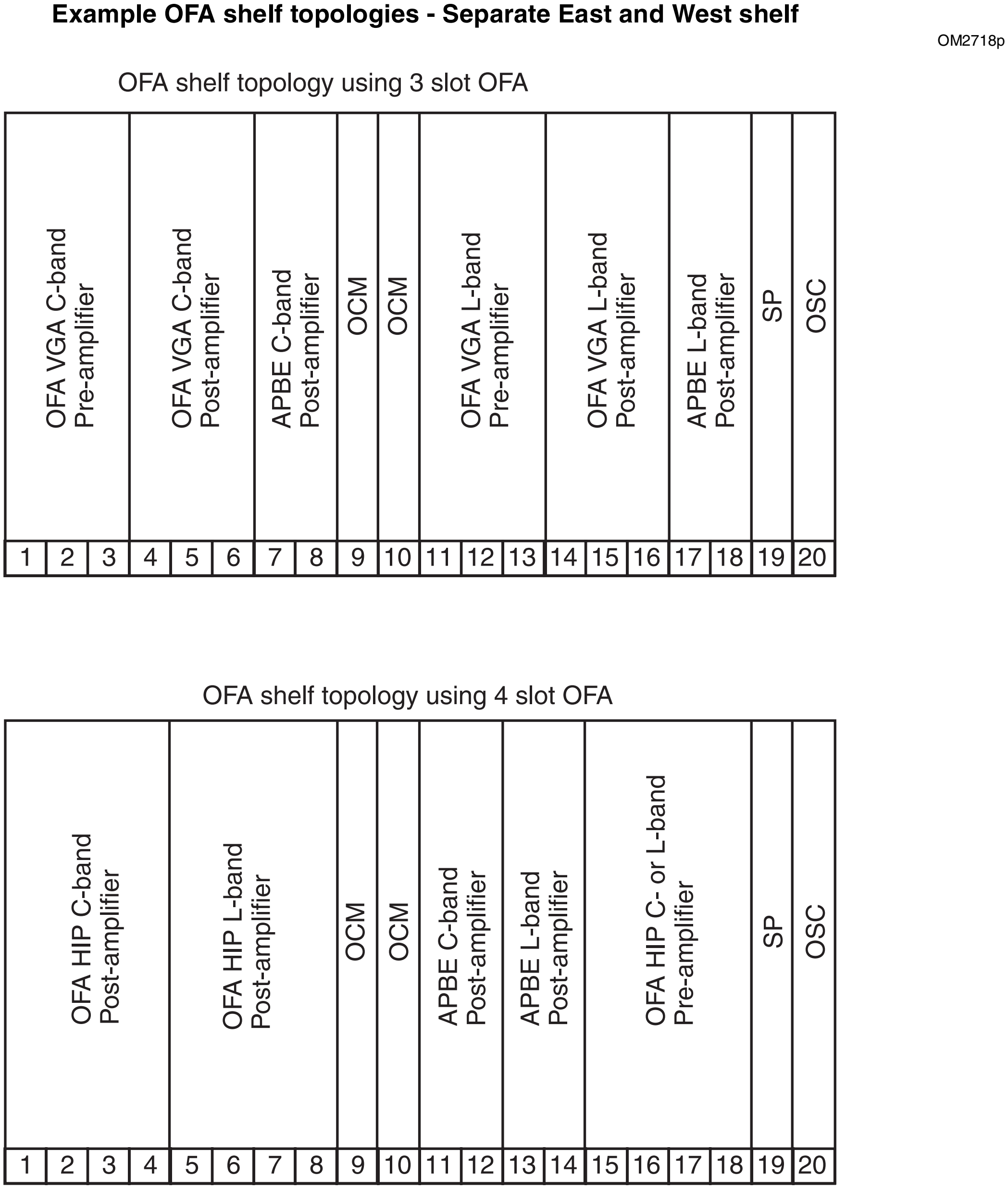
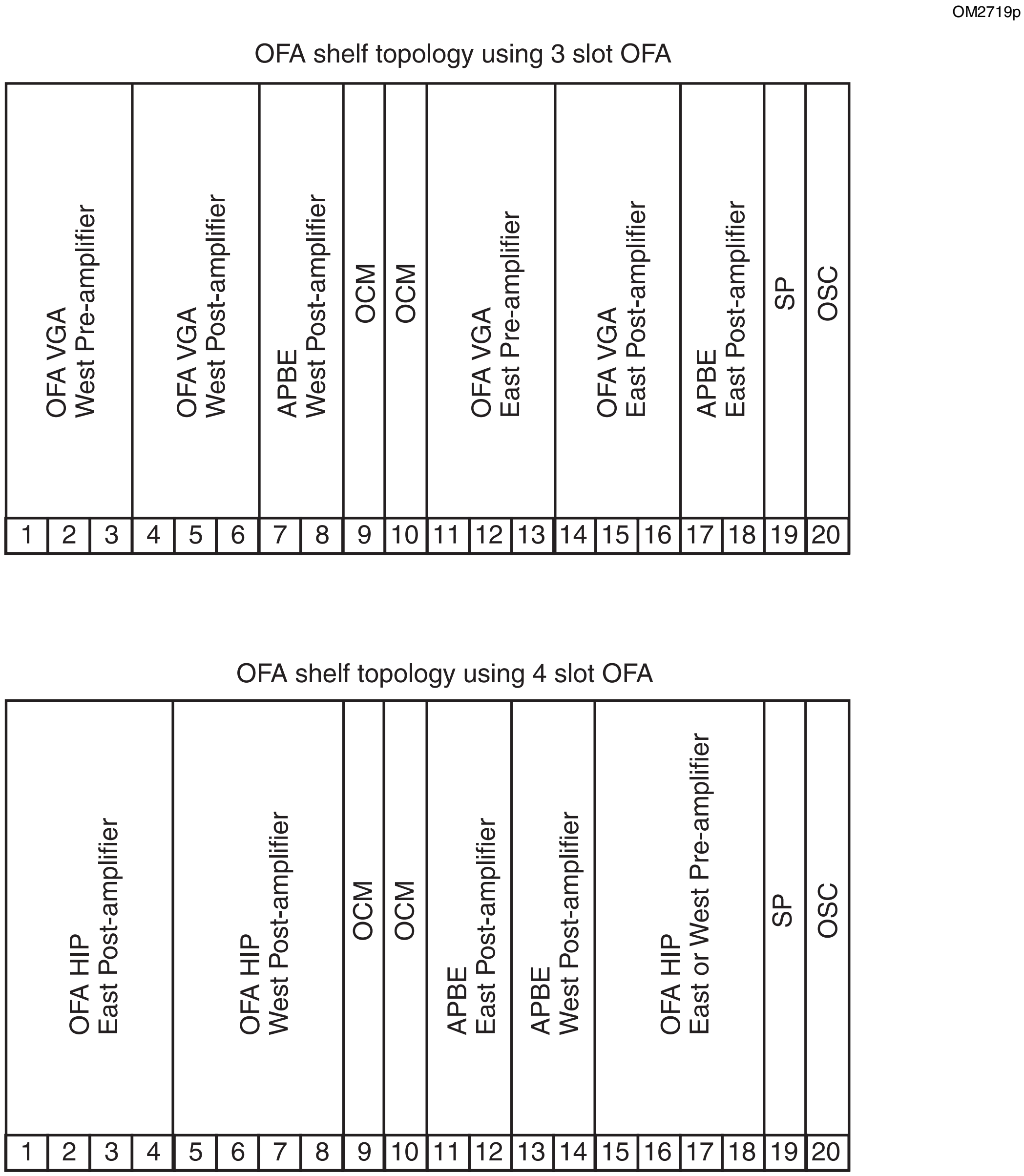


Figure 3-16
Example OFA shelf topologies - Separate C-band and L-band shelf



Dual OFA optical layer topologies

Release 8.0 introduces two new OFA optical layer topologies that use the dual OFA configuration where two OFAs are connected back-to-back at a site in a pre-amplifier or a thru-amplifier topology.

The value of these configurations is to increase the overall gain available at a site. This increased gain can be useful in the following cases:

- Since the OFA VGA only provides 17 dB gain, the site output power can be too weak if the site input power is very low. Assuming –28 dBm per channel into the amplifier, the output power will be –11 dBm per channel, well below the +3 dBm per channel optimal value. The second amplifier at the site allows the output power level to reach the optimal value.
- In Extended Metro networks, it is sometimes required to re-equalize with PBEs or APBEs to compensate for SRS tilt or to compensate for dispersion by introducing a DSCM. As these components can be quite lossy, having only one amplifier results in very low amplifier input power when the high loss components precede the amplifier or very low launch power when the high loss components follow the amplifier. With dual OFA configurations, it is possible to first amplify the input signal to a reasonable level then introduce the lossy components and then amplify again to obtain the optimal launch power.

Figure 3-17
Thru-amplifier dual OFA optical layer topology example

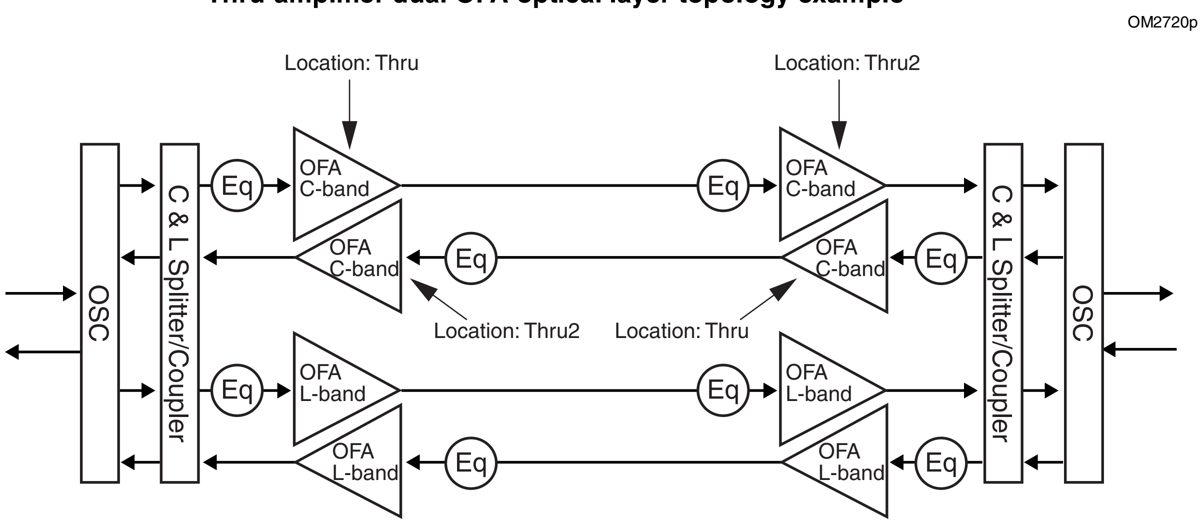


Figure 3-17 on page 3-25 shows an example site layout for the thru-amplifier dual OFA optical layer topology.

In System Manager and TL1, the OFA location “Thru” identifies the first OFA circuit pack in a dual OFA configuration, and the new Release 8.0 OFA location “Thru2” identifies the second OFA circuit pack.

Equalization components in the diagram (labeled “Eq”) are optional (for example, they may not be required in a back-to-back amplifier chain not requiring re-equalization or in the event that distributed equalization is being used). Available equalization components include:

- APBE/APBE Enhanced
- PBE

C&L coupler/splitter represents the C&L splitter/coupler module in a drawer. A C&L coupler/splitter module is not required if the system does not include both C and L band, but is optional either way.

OSC splitter/couplers are required only when the OSC is deployed at a site.

The thru-amplifier dual OFA optical layer topology is also applicable to Extended Metro networks. An example configuration is shown in Figure 3-18.

Figure 3-18
Thru-amplifier dual OFA optical layer topology example for Extended Metro networks

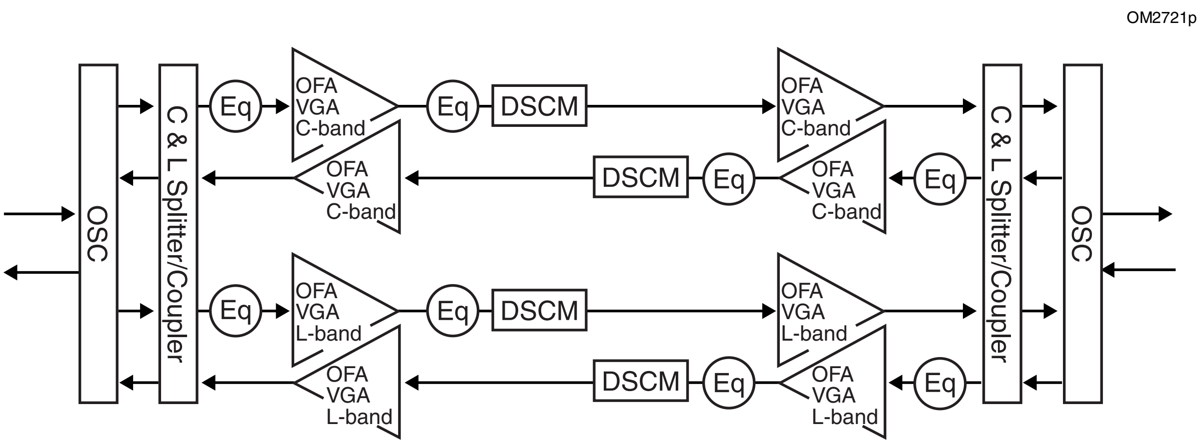


Figure 3-19 on page 3-28 shows the standard site layout for the pre-amplifier dual OFA optical layer topology. The pre-amplifier dual OFA optical layer topology is only applicable in Extended Metro networks when DSCMs are required.

In System Manager and TL1, the OFA location “Pre” is used to identify the first OFA circuit pack in a dual OFA configuration and the new Release 8.0 OFA location “Pre2” is used to identify the second OFA circuit pack.

All OFAs shown in the diagram are optional and are only placed if required by link engineering. Pre-amplifiers to the left most and right most of the site are only allowed in configurations that drop signals using OMXs.

Equalization components in the diagram (labeled “Eq”) are optional (for example, equalization may not be required in the same locations at every site and may not be required at all at some sites depending on the link engineering requirements). Available equalization components include:

- APBE/APBE Enhanced
- PBE

DSCMs are optional as required by link engineering.

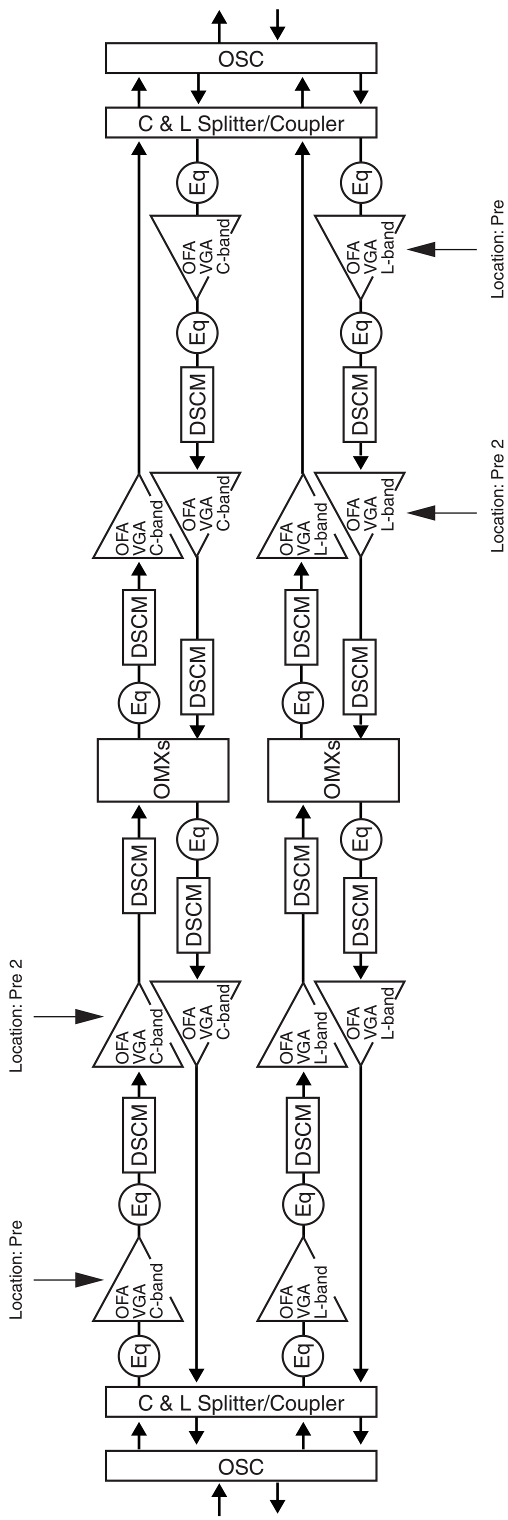
C&L coupler/splitter represents the C&L splitter/coupler module in a drawer. A C&L coupler/splitter module is not required if the system does not include both C and L band, but is optional either way.

OSC splitter/couplers are required only when the OSC is deployed at a site.

The topology can be used to support terminal sites by simply considering only the OMX onward (i.e. remove the east or west half of the site appropriately), remembering that the additional pre-amplifier is placed as necessary when a DSCM precedes the site.

Figure 3-19
Pre-amplifier dual OFA optical layer topology

OM2722p



New Extended Metro DWDM with DSCM topologies

New Extended Metro DWDM with DSCM topologies are introduced as a result of the new OFA VGA circuit pack and new OFA dual configurations.

A power control device of some type is required prior to each amplifier in a site. The exact positioning of the power control devices (equalizer or VOA) is dependant on amplifier type and the presence of a DSCM. If the OFA VGA circuit pack is used, the eVOA within the circuit pack can be used to control the total power into the amplifier but an equalizer is still needed if that functionality is required.

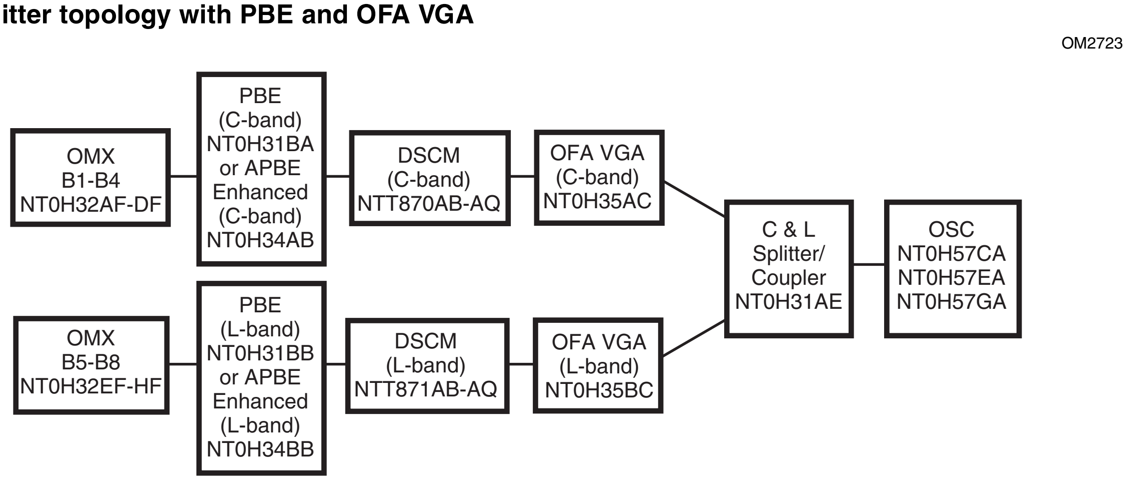
This section only illustrates example topologies. The Nortel Networks custom link engineering report provides the detailed placement of components in a site topology.

In the example illustrations below, C-band and L-band only systems use the same site topologies without the C&L Splitter/Coupler. The OSC tray and OSC circuit pack are optional but recommended.

Transmitter topologies

Figure 3-20 shows a transmitter topology with PBE/APBE Enhanced circuit packs and OFA VGA circuit packs. The PBE/APBE Enhanced is placed before the DSCM and is responsible for per-band equalization. The eVOA in the OFA VGA circuit pack is used to control the aggregate power into the amplifier.

Figure 3-20
Transmitter topology with PBE and OFA VGA



Receiver topologies

Figure 3-21 shows a receiver topology with an OFA VGA as a single pre-amplifier. A small DSCM can be placed prior to the OMXs. A fixed attenuator pad is required at the OFA output to limit the power into the DSCM.

Figure 3-21
Receiver topology with OFA VGA circuit packs in a single pre-amplifier configuration

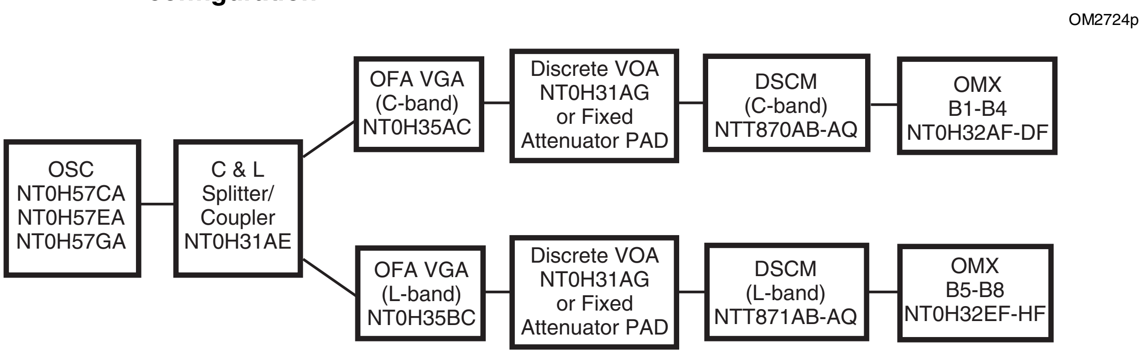


Figure 3-22 shows a receiver topology if a larger DSCM is required. An additional pre-amplifier is needed to overcome the extra loss of the DSCM. A fixed attenuator pad is required at the OFA output to limit the power into the DSCM.

Figure 3-22
Receiver topology with OFA VGA circuit packs in a dual pre-amplifier configuration

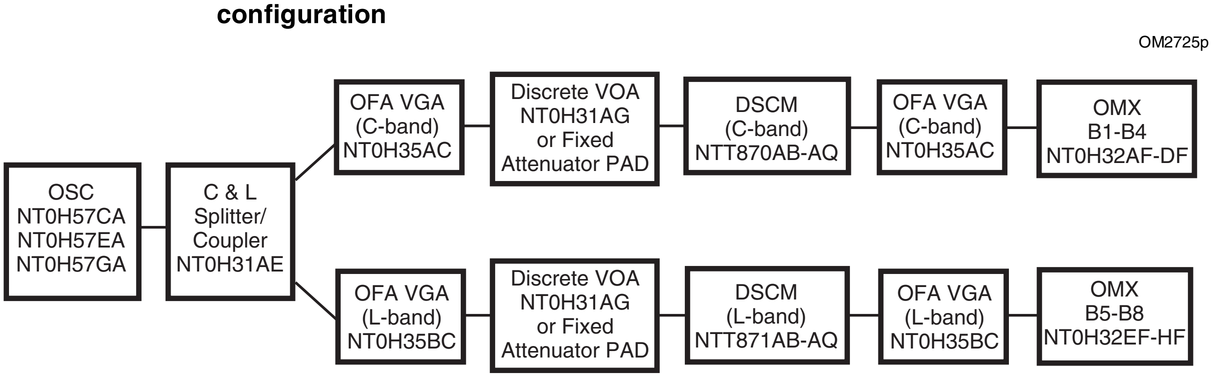
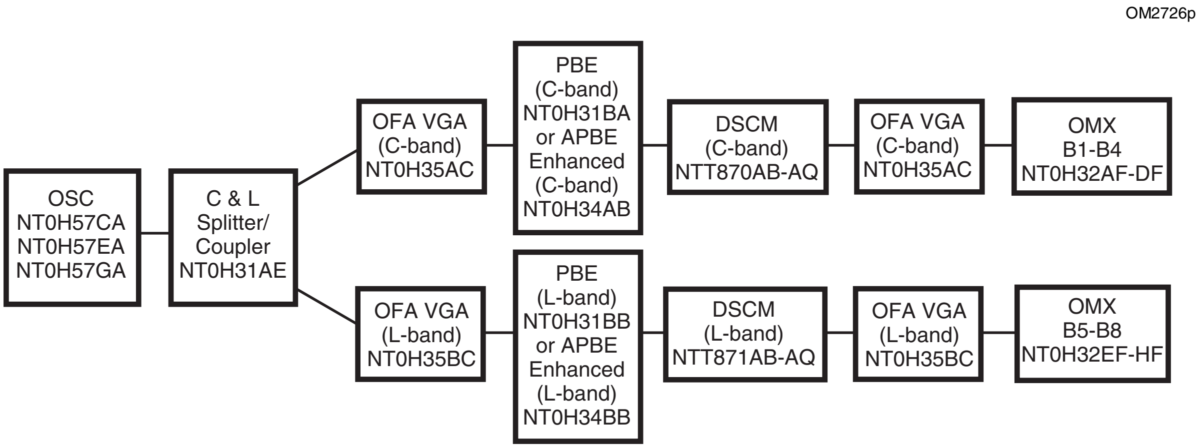


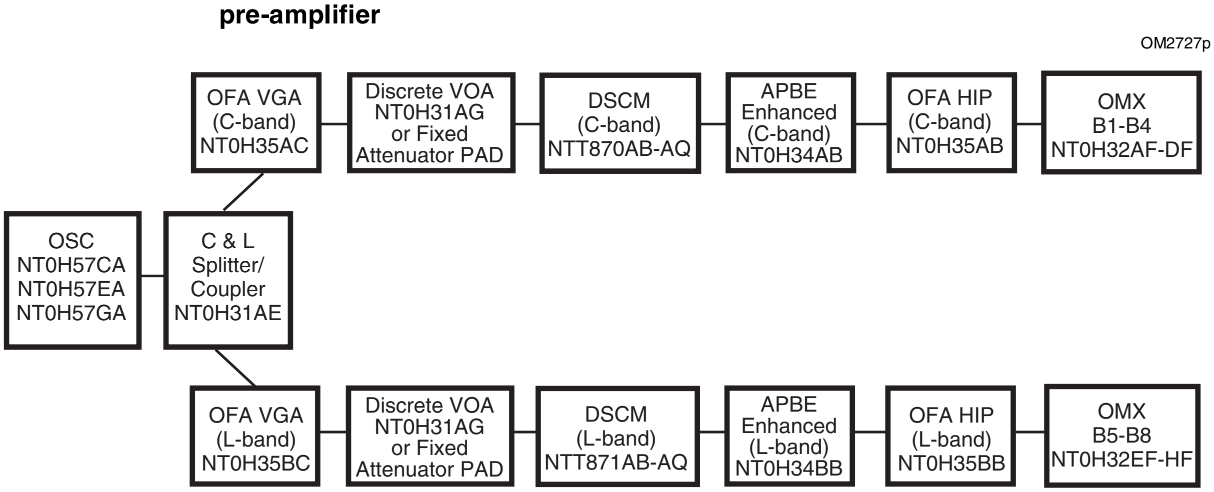
Figure 3-23 shows a receiver topology when equalization is required before the second pre-amplifier. The PBE/APBE Enhanced is used for per-band equalization and is placed before the DSCM. The eVOA in the OFA VGA circuit pack is used to control the aggregate power into the amplifier.

Figure 3-23
Receiver topology with OFA VGA circuit packs in a dual pre-amplifier configuration when equalization is required before the second pre-amplifier



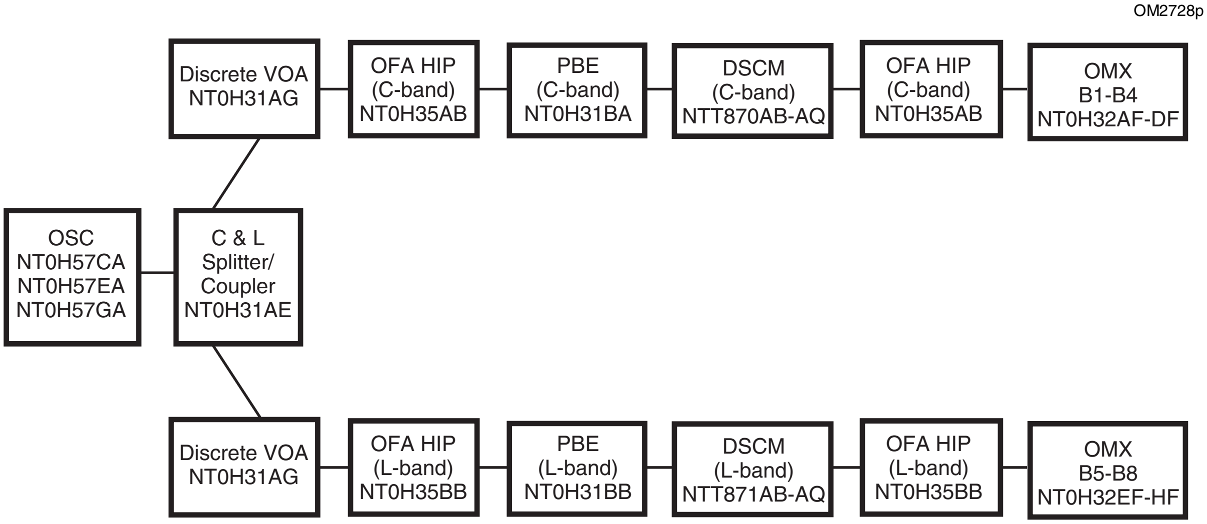
If the OFA HIP circuit pack is the second pre-amplifier then the PBE/APBE Enhanced is used to control both the per-band equalization and the aggregate power. In this case, the PBE/APBE Enhanced must be placed directly before the OFA HIP circuit pack as shown in Figure 3-24. A fixed attenuator pad is required at the OFA output to limit the power into the DSCM.

Figure 3-24
Receiver topology with OFA VGA and OFA HIP circuit packs in a dual pre-amplifier configuration when equalization is required before the second pre-amplifier



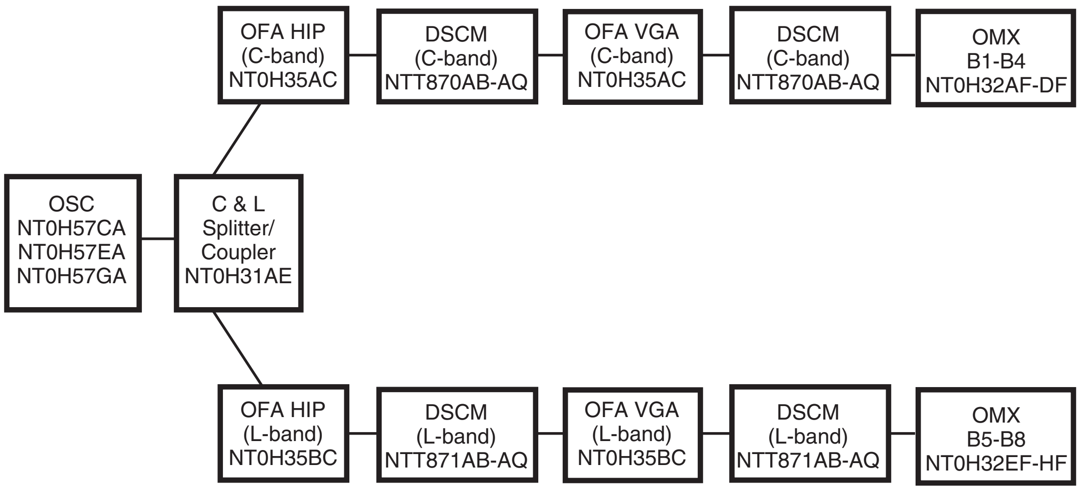
In all of the receiver topologies, the first pre-amplifier can also be a OFA HIP circuit pack as shown in Figure 3-25 on page 3-32. However, a discrete VOA is required at the input to control the aggregate power.

Figure 3-25
Receiver topology with OFA HIP circuit packs in a dual pre-amplifier configuration when equalization is required before the second pre-amplifier



In all of the receiver topologies, a second DSCM can be located after the final pre-amplifier as shown in Figure 3-26 on page 3-33. This is useful when a large amount of compensation is required which would have a high loss. If the second DSCM is placed before the second pre-amplifier, then an unacceptable OSNR hit would occur. A fixed attenuator pad is required at the OFA output to limit the power into the DSCMs.

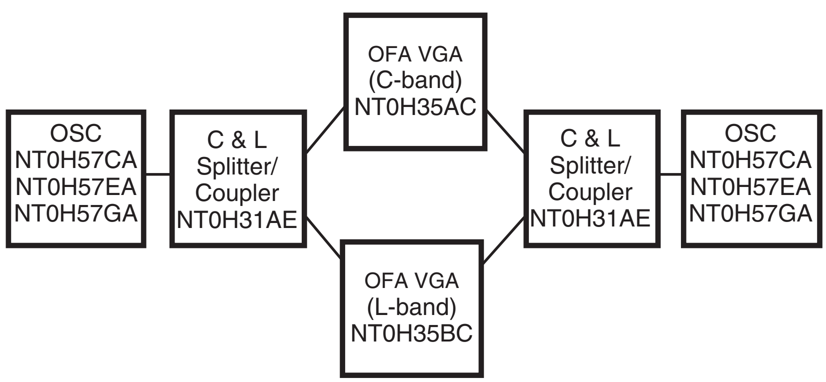
Figure 3-26
Receiver topology with OFA VGA circuit packs in a dual pre-amplifier configuration with two DSCMs



Line amplifier topologies

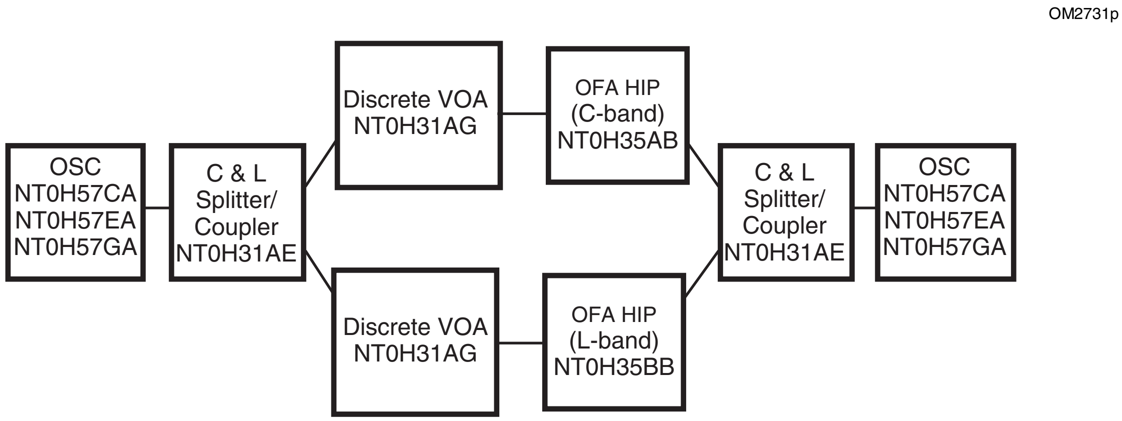
At line amplifier sites where equalization and dispersion compensation are not required, a single amplifier can be deployed as shown in Figure 3-27 on page 3-33. A fixed attenuator pad may be required at the OFA output to limit the power launched into the fiber.

Figure 3-27
Line amplifier topology with no equalization and dispersion compensation using OFA VGA circuit packs



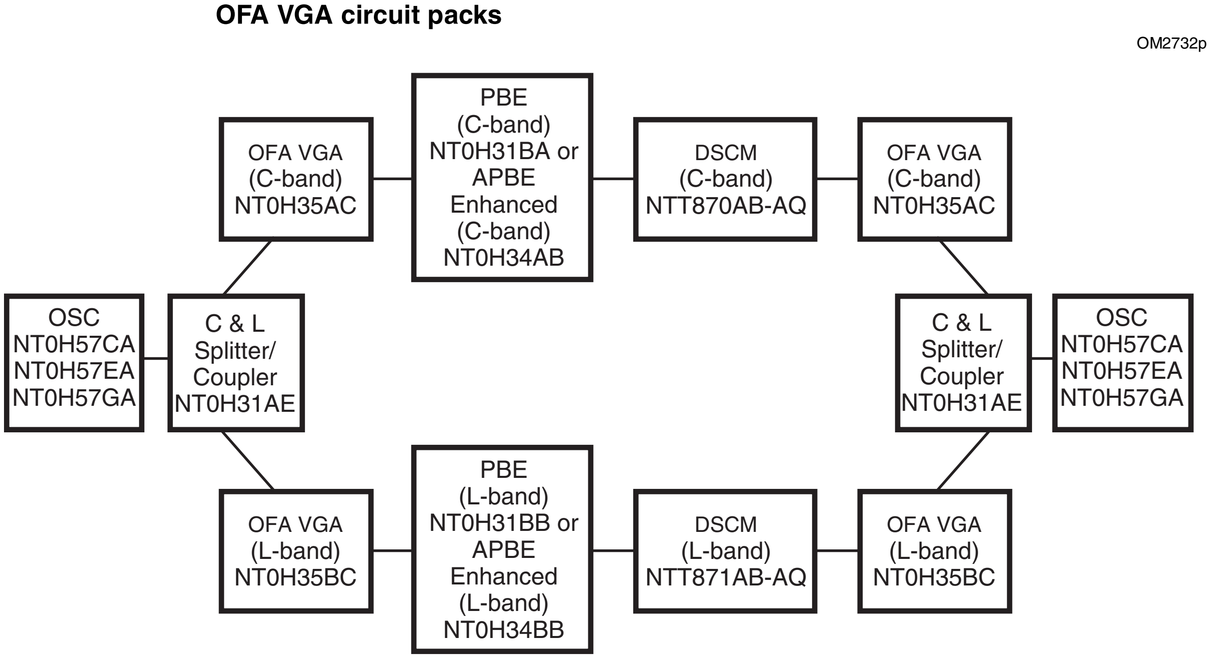
If OFA HIP circuit packs are used, then a discrete VOA is required at the input to the amplifier to control the aggregate power as shown in Figure 3-28 on page 3-34. A fixed attenuator pad may be required at the OFA output to limit the power launched into the fiber.

Figure 3-28
Line amplifier topology with no equalization and dispersion compensation using OFA HIP circuit packs



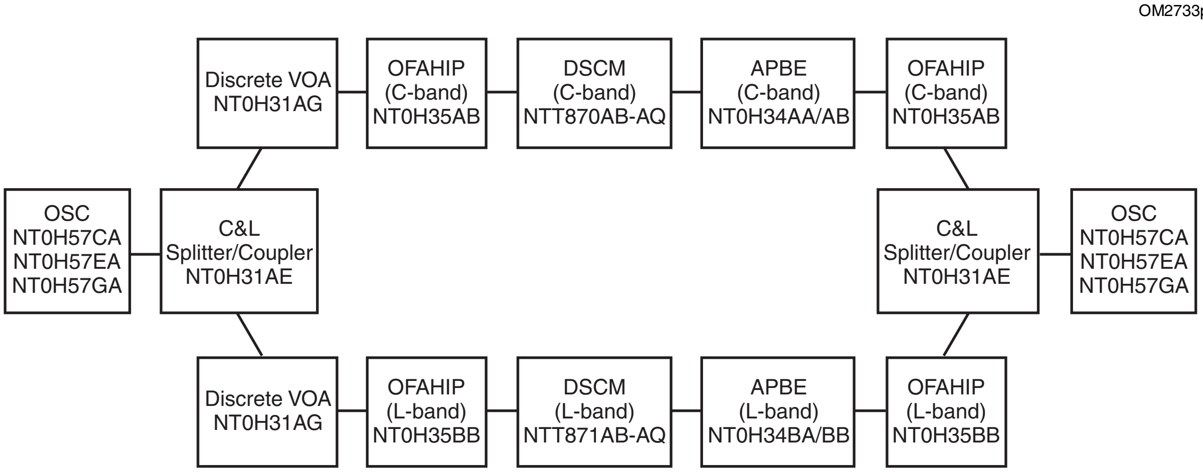
If dispersion compensation or equalization is required at a line amplifier site, a dual line amplifier configuration as shown in Figure 3-29 is required. The PBE/APBE Enhanced is connected before the DSCM and the bands are equalized at the input of the second amplifier. A fixed attenuator pad may be required at the second OFA output to limit the power launched into the fiber.

Figure 3-29
Line amplifier topology with equalization and dispersion compensation using OFA VGA circuit packs



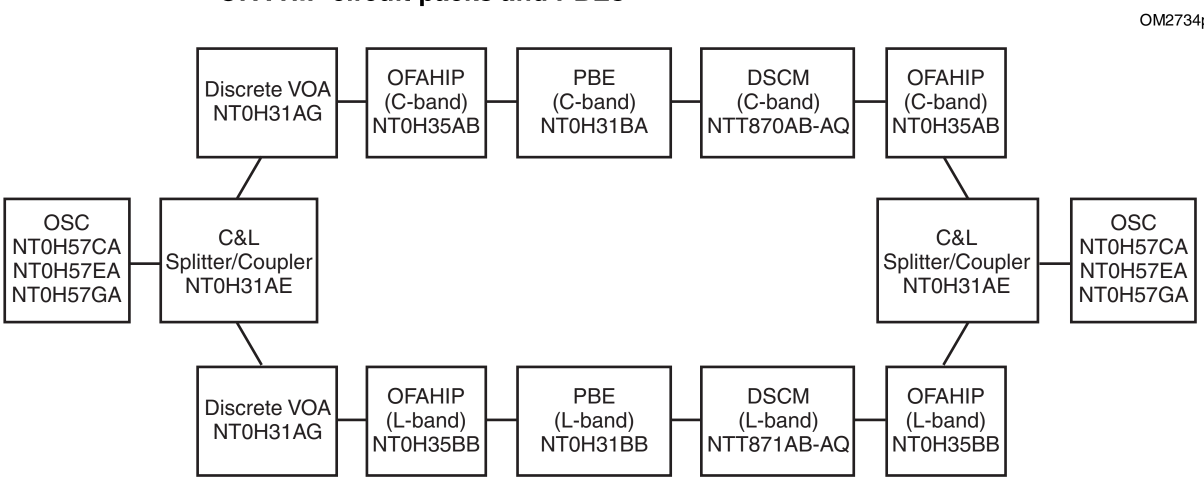
If OFA HIP circuit packs are used, then the PBE/APBE/APBE Enhanced must be connected before the second amplifier so it can control both the aggregate power and the equalization as shown in Figure 3-30. The output of the first amplifier may require attenuating to limit the power into the DSCM. A fixed attenuator pad may be required at the second OFA output to limit the power launched into the fiber.

Figure 3-30
Line amplifier topology with equalization and dispersion compensation using OFA HIP and APBE/APBE Enhanced circuit packs



If a PBE is used in conjunction with an OFA HIP circuit pack, then it should be connected before the DSCM as shown in Figure 3-31 on page 3-35. The bands are equalized at the input of the second amplifier. A fixed attenuator pad may be required at the second OFA output to limit the power launched into the fiber.

Figure 3-31
Line amplifier topology with equalization and dispersion compensation using OFA HIP circuit packs and PBEs



OAM&P features

In this chapter

This chapter lists the new and enhanced OAM&P features for Optical Metro 5100/5200 Release 8.0. For complete information about Optical Metro 5100/5200 OAM&P features, see the *Optical Metro 5100/5200 Technical Publications,* NT0H65AM.

System Level Equalization Control (SLEC)

With the APBE or APBE Enhanced circuit pack and the introduction of the OFA VGA circuit pack, Optical Metro 5200 now offers automated system-wide equalization or re-equalization of a network. The System Level Equalization Control (SLEC) feature is responsible for the coordinated system-wide equalization or re-equalization of an amplified network.

SLEC can be triggered at anytime from a System Manager session. SLEC calculates the necessary information including topology and power levels, and performs the equalization activities by triggering the power control nodes to equalize in the calculated order. SLEC keeps the user updated with the current status of the equalization task.

SLEC is not supported using the TL1 interface.

Summary of features

The following features exist for SLEC capable networks:

- hitless addition and removal of wavelengths provided that the OMXs for the wavelengths are present or the stacked wiring configuration is used and the system has been pre-link engineered to support the full wavelength counts
- equalization of the entire network eliminating the need to know the topology of the network
- removes human error from the equalization process, current system complexities include:
  - computation of average per channel power levels
  - user’s ability to use an optical spectrum analyzer to measure the power levels and adjust screwdriver VOAs to appropriate levels with accuracy
  - user’s ability to determine fiber connectivity of the amplifiers, PBEs, APBEs to ensure that the correct device is being adjusted
  - ensure that the system is adjusted in the proper order and then come back in the reverse direction for the return path

- reduces the amount of time required for installation of services for the following reasons:
  - no truck roll to all amplifier locations
  - less special equipment required (i.e., no Optical Spectrum Analyzer needed)
  - less likelihood of human error
- reduces the amount of time to recover the system in the event of a failure. The replacement of equipment currently requires re-equalization (e.g., OMX replacement would have different loss characteristics). This can now be done with the push of a button from the NOC and no truck rolls to the location in which the equipment was replaced.
- reduces the amount of time to get the system up and running on installation
- automatically puts APBE/APBE Enhanced facilities and OFA facilities in-service

Overview

System level equalization is the act of adjusting per band output power and amplifier gain settings to reach power targets that have been engineered for the system. SLEC's main functions include:

- sequence through the APBE/APBE Enhanced and OFA VGA circuit packs in the proper order such that the user is not required to know system level topology
- check for fault information to ensure that topology information is accurate
- put appropriate APBE/APBE Enhanced facilities and OFA facilities in-service throughout the system when channels are added
- automatically update the channel count for every APBE/APBE Enhanced facility and OFA facility

Typically equalization is only required in the following circumstances:

- channels are being added to or deleted from the system
- fiber characteristics change causing additional (or less) loss in the system (i.e., a splice on a broken fiber)
- component changes occur in a system

The steady state mode (when not equalizing) keeps all of the components in constant gain mode such that the system remains stable much like an APBE controlled system pre-release 8.0. Upon initiation of SLEC, each of the gain controllable devices (i.e., the APBE/APBE Enhanced and OFA VGA circuit packs) are adjusted to meet their pre-engineered power targets that have been provisioned at commissioning time and obtained from NMT or the Nortel Networks Custom Equalization Report.

SLEC components

SLEC consists of two main components – a topology engine that automatically monitors and models the state of a system (OSID) and the SLEC application that uses the topology engine data to automatically instruct all gain controllable devices (i.e., the APBE/APBE Enhanced and OFA VGA circuit packs) in a system to equalize to the provisioned power target. The topology engine gathers the majority of the information required by SLEC to perform its function.

The Topology Engine

The first step in collecting topological information is to discover the site order in a system. To accomplish this, SLEC requires the deployment of OSC circuit packs at every site where SLEC is to be used. OSC not only provides a high-speed dedicated communication link between two sites, but also allows the automatic discovery of site adjacency information. Without OSC, site adjacency information is not available because the pass-through nature of WDM makes it difficult to know which site is a neighbor of another.

The topology engine at a site monitors its own configuration and communicates with other sites in the system, most often with its direct neighbors in the site order. With every site aware of which sites are its neighbors, the topology engine at a single site is then able to build a model of all components at the site, the channels that enter the site, the channels that drop at the site, the channels that are added at the site and the channels that are transmitted downstream from the site. Furthermore, the local topology model monitors site-level information such as which shelves are physically present at a site, which components are present, what channels are present and what provisioning exists. With all this information and the information from its neighbor site, a detailed model of the components can be created.

The SLEC Application

The SLEC application that handles gain control of APBE/APBE Enhanced and OFA VGA circuit packs within a system (OSID), is itself a distributed application with a hierarchical organization. At each site, a SLEC site controller extracts information from the topology engine and makes decisions regarding whether or not the next gain controllable component (i.e., APBE/APBE Enhanced and OFA VGA circuit packs) at the site can be equalized. If it is safe to adjust the power of the component, the site controller instructs a shelf level controller that resides on all OFA shelves at a site to equalize the specific component. Components are equalized in a specific order as modeled by the topology engine. The SLEC shelf controller instructs the individual component to adjust its output power and monitors the status for completion. On completion, the SLEC shelf controller reports status back to the site controller and the process is repeated for all components located at the site. Once all components at the site have been addressed, the next site downstream is instructed to begin and the process continues until all sites within the system (OSID) have been addressed.

The SLEC application always equalizes all components in one direction before equalizing components in the opposite direction. SLEC equalizes the eastbound components at all sites and then all westbound components. To equalize a system, there are two modes of operation – “One-time” equalization where the system is equalized once, and “Continuous” equalization where the system is constantly monitored and re-equalized as required.

It is important to note that SLEC is not a link budget optimizer. The application only instructs each component to reach the required power target and then switch into constant gain mode. SLEC does not change the power target of a component, which is provisioned at the time of initial installation. The power targets are obtained from NMT or the custom link engineering equalization report.

SLEC modes of operation

SLEC has slightly different behavior depending on the type of configuration (Ring or Linear system topology) and operating mode (One-time or Continuous) selected.

One-time equalization mode

In One-time equalization mode, SLEC equalizes each direction twice. The order of equalization is eastbound phase 1, eastbound phase 2, westbound phase 1 and westbound phase 2.

Two equalization passes per direction are required for mesh networks. Depending on the starting site that is chosen and network configuration, components that are equalized early in a phase may require further equalization once all components are equalized at sites preceding the starting site. The second pass per direction is especially required in networks without a full terminal site. Although this is not an issue in linear configurations, two passes are still executed for simplicity purposes.

One complete round of equalization consists of the following 7 phases:

1 System-level validation phase
2 Eastbound site-level validation phase
3 Eastbound phase 1 equalization phase
4 Eastbound phase 2 equalization phase
5 Westbound site-level validation phase
6 Westbound phase 1 equalization phase
7 Westbound phase 2 equalization phase

Continuous equalization mode

In Continuous equalization mode, SLEC visits all sites in the eastbound direction followed by all sites in the westbound direction and then does this repeatedly. If at any site it is discovered that a component is not transmitting at its aggregate output power target, SLEC commands that component to equalize. As a result of equalizing one component, other sites downstream may also require equalization, and when they are visited SLEC re-equalizes them.

If there have been no changes in system topology since the last pass of SLEC, no action will be taken as each site is visited. All components remain in constant gain mode.

One complete round of equalization consists of the following 5 phases:

1 System-level validation phase
2 Eastbound site-level validation phase
3 Eastbound equalization phase
4 Westbound site-level validation phase
5 Westbound equalization phase

Equalization phases

Table 4-1 describes the different equalization phases.

Table 4-1
Equalization phases

Equalization phases	Description
System-level validation phase	The System-level validation phase is a preliminary validation phase in which SLEC: -Verifies that all sites in the system are operational (communication paths available for all sites) -Verifies that all sites in the system are capable of participating in a round of equalization -Resets (or clears) the last SLEC status of each site and each gain controllable component at each site in both directions If everything is OK, the Eastbound direction Site-level validation phase is started.
Site-level validation phase	The Eastbound or Westbound direction Site-level validation phase is a site-level validation of all gain controllable components for the given direction within the site. In this phase the following attributes are verified: -All APBE/APBE Enhanced eVOA facilities 1 to 4 must have the eVOA Provision parameter set to Channel, not Band -All HIP OFA circuit packs are preceded by an APBE/APBE Enhanced circuit pack -All APBE/APBE Enhanced circuit packs are followed by an OFA HIP or OFA VGA circuit pack
Equalization phase	During the equalization phase for each direction, each gain controllable component within the site for the active direction is verified and then equalized, if possible. The order of component equalization within a site depends on site topology, the components present and the site chosen as the start site for the round of equalization. The order of component equalization is as follows: In each direction the start site for that direction is visited twice per phase. At the start site, the first visit only equalizes the post-side components. The pre-side components are equalized in the second visit to the site per phase. The order of component equalization is as follows. If there are no components present in the position it is skipped. 1.Post C-band components (first visit) 2.Post L-band components (first visit) 3.Pre C-band components (second visit) 4.Pre2 C-band components (second visit) 5.Pre L-band components (second visit) 6.Pre2 L-band components (second visit) At each OADM or Terminal site other than the start site, the order of component equalization is the following for each direction. 1.C-band Pre components 2.C-band Pre2 components 3.C-band Post components 4.L-band Pre components 5.L-band Pre2 components 6.L-band Post components At each OFA site, the order of component equalization is the following for each direction. 1.C-band Thru components 2.C-band Thru2 components 3.L-band Thru components 4.L-band Thru2 components At sites where the C-band is OADM or Terminal and L-band only contains line-amps, the order of component equalization is the following for each direction. 1.C-band Pre components 2.C-band Pre2 components 3.C-band Post components 4.L-band Thru components 5.L-band Thru2 components At sites where the C-band only contains line-amps and L-band is OADM or Terminal, the order of component equalization is the following for each direction. 1.C-band Thru components 2.C-band Thru2 components 3.L-band Pre components 4.L-band Pre2 components 5.L-band Post components

Deployment rules

SLEC only operates on systems that conform to the following requirements:

- OSC is equipped at every site in a system where SLEC will be used
- an Ethernet hub must be installed at sites having more than two shelves. The Ethernet hub is needed to hub together all the shelves using their Ethernet port 2. When a site has only two shelves, an RJ-45 cross-over cable can be used to connect the two shelves.
- at multi-shelf sites, all shelves at the site must have the same site identifier and the same hubbing group
- all OFA circuit packs in the system are either OFA HIP or OFA VGA. An APBE or APBE Enhanced circuit pack must be placed before all OFA HIP circuit packs.
- the first amplifier a channel encounters must be equalized using an APBE or APBE Enhanced circuit pack. That is, this amplifier cannot be equalized using fixed attenuator pads, a PBE, an ECT or a discrete VOA.
- all power targets must be obtained from NMT. For Extended Metro networks, the power targets must be obtained from the Nortel Networks Custom Equalization Report.
- circuit packs in the same band must be of the same type or must be part of this group: OCLD 2.5 Gbit/s, OCLD/OTR 2.5 Gbit/s Flex, OCLD/OTR 2.5 Gbit/s Universal, OTR 10 Gbit/s Enhanced, Muxponder 10 Gbit/s. OCLD 1.25 Gbit/s circuit packs cannot be part of this group.
- OMX type must be OMX 4CH Enhanced
- all OCLD, OTR, Muxponder circuit packs in the shelf’s west plane must be fibered to a west OMX and all OCLD, OTR, Muxponder circuit packs in the shelf’s east plane must be fibered to an east OMX
- off-power balancing (different power levels per band at an APBE) is not used

User provisioning required for SLEC to operate

Direction and location

For OFA and APBE/APBE Enhanced circuit packs, the location (pre, post, thru, pre2, thru2) and direction (eastbound, westbound) must be provisioned. The OFA and APBE/APBE Enhanced direction and location information is required even when SLEC is not used. If it is not, the “Incomplete Provisioning” alarm is raised. Also, for the APBE/APBE Enhanced circuit pack, the APBE associated equipment attributes need to be provisioned. For OCLD, OTR, Muxponder and OMX components, the direction is derived from the slot number and the location is implicit.

OSID

For interconnected rings or networks that contain more than one optical system, an Optical System Identifier (OSID) must be provisioned to associate line equipment to optical system. For consistency, all components on the same optical system should have the same OSID provisioned.

If all equipment in the system has a blank OSID then SLEC assumes it is all on the same system. If any piece of equipment is ever given a non-blank OSID then SLEC fails or halts until all equipment is given the same OSID (blank or otherwise). In other words, a blank OSID is only allowed when it is the only OSID, and other features that do not support blank OSIDs are not being used (IFS, multiple-system network, hub and spoke).

OCLD, OTR, Muxponder, OSC, APBE, APBE Enhanced, or OFA circuit packs that are seated in a shelf but are in the deleted state will prevent SLEC from running. These circuit packs must be unseated or be put in the out-of-service state with the OSID provisioned to allow SLEC to run.

Power targets

Power targets need to be provisioned for each gain controllable device (APBE/APBE Enhanced and OFA VGA). The power targets are obtained from NMT. For Extended Metro networks, the power targets are obtained from the Nortel Networks Custom Equalization Report. Even if the system requires re-equalization following a channel addition/removal, those powers targets should not have to be changed as long as the network has been validated for the channel addition/removal with the same targets.

APBE/APBE Enhanced and OFA VGA channel counts do not need to provisioned since SLEC automatically determines the channel count.

APBE/APBE Enhanced eVOA facilities 1 to 4 must have the eVOA Provision parameter set to Channel, not Band.

OSC equipment attributes for linear systems

Not Connected must be set for either the West Neighbor attribute or the East Neighbor attribute at the end-point nodes of a linear system.

Automatic Laser Shutdown

ALS must be disabled before SLEC is used to equalize a newly installed system or when SLEC is used to re-equalize a system as a result of band addition/removal. It can be turned on after SLEC completes. ALS does not need to be disabled when SLEC is used to re-equalize a system as a result of channel addition/removal.

Ethernet Port 2

The default values for the Ethernet Port 2 IP address and Ethernet Port 2 mask must be used.

At multi-shelf sites, all shelves at the site must have the same Ethernet Port 2 access control (None, Filter or Encrypt) provisioned and Ethernet Port 2 must be enabled. It is recommended to also enable Ethernet Port 2 alarming for easier troubleshooting when errors are reported.

Changes to the equalization procedure for new installations

The installation and equalization procedures for amplified networks are modified when SLEC is used.

Table 4-2 lists the high-level steps for installing and equalizing an amplified network using SLEC.

Table 4-2
High-level steps to install and equalize an amplified network using SLEC

Step	Comments
1	Ensure the network passes when run on the Network Modeling Tool. From NMT, obtain the target per-band average channel power for each port of all APBE/APBE Enhanced circuit packs and all OFA VGA circuit packs in your network as well as information with respect to fixed attenuator pads required in the network. If this is an Extended Metro system, obtain the Nortel Networks Custom Equalization Report. Determine the fixed attenuator pads required for the OSC (See OSC link engineering in *Network Planning and Link Engineering*, 323-1701-310).
2	Install Optical Metro 5200 Shelves and Components (See *Installing Optical Metro 5200 Shelves and Components*, 323-1701-201)
3	Commission Optical Metro 5200 Shelves (See *Commissioning Procedures*, 323-1701-220)
4	Provision parameters described above in section titled “User provisioning required for SLEC to operate” for the Optical Metro 5200 Shelves (See *Provisioning and Operating Procedures*, 323-1701-310)
5	Connect the optical components (See *Connection Procedures*, 323-1701-221).

Table 4-2
High-level steps to install and equalize an amplified network using SLEC

Step	Comments
6	Perform Shelf and Site testing procedures. See: "Testing the shelf lamps" "Testing an Optical Metro 5100/5200 WDM OMX" "Testing the optical continuity through the OMXs at a site" "Testing the optical continuity through the OMXs at an OADM site that uses single-shelf wiring"
7	Install fixed attenuator pads as described in the NMT report or the Nortel Networks Custom Equalization Report and install fixed attenuator pads for the OSC (See *Connection Procedures*, 323-1701-221). Do not install the fixed attenuator pads at the OMX band drop ports. This will be done in a subsequent step. Install fixed attenuator pads for the OSC as determined in step 1 (See *Connection Procedures*, 323-1701-221).
8	If the site has OMXs: Unseat from the shelf or shelves all West OCLD, OTR or Muxponder circuit packs except for the first channel in each band. Unseat from the shelf or shelves all East OCLD, OTR or Muxponder circuit packs except for the first channel in each band. For each West OMX, disconnect the patch cord connected to the first Channel Drop port (this corresponds to the channel of the seated West OCLD, OTR or Muxponder circuit packs). For each East OMX, disconnect the patch cord connected to the first Channel Drop port (this corresponds to the channel of the seated East OCLD, OTR or Muxponder circuit packs).
9	Connect the OSC to the backbone (See *Connection Procedures*, 323-1701-221).
10	Repeat step 2 to step 9 at all sites in the network.
11	Run One-time SLEC.

Table 4-2
High-level steps to install and equalize an amplified network using SLEC

Step	Comments
12	At a site that has OMXs: For each West OMX, measure the power at the first Channel Drop port using an optical power meter. Determine if an overload pad is required and if it is to determine the pad value. Once the value is determined, the pad is added to the OMX band drop port. The patch cord that was disconnected in step 8 is reconnected to the first Channel Drop port (this is the patch cord that connects to the Line Rx port of the first channel West OCLD, OTR or Muxponder circuit pack). For each East OMX, measure the power at the first Channel Drop port using an optical power meter. Determine if an overload pad is required and if it is to determine the pad value. Once the value is determined, the pad is added to the OMX band drop port. The patch cord that was disconnected in step 8 is reconnected to the first Channel Drop port (this is the patch cord that connects to the Line Rx port of the first channel East OCLD, OTR or Muxponder circuit pack). Insert in the shelf or shelves all West OCLD, OTR or Muxponder circuit packs of the other channels of each band (these correspond to the circuit packs that were unseated in step 8). Ensure that all circuit packs have their Line Tx and Line Rx patch cords connected. Insert in the shelf or shelves all East OCLD, OTR or Muxponder circuit packs of the other channels of each band (these correspond to the circuit packs that were unseated in step 8). Ensure that all circuit packs have their Line Tx and Line Rx patch cords connected.
13	Repeat step 12 at all sites in the network that have OMXs.
14	Run One-time SLEC.
15	If ALS was turned off in step 4, it can now be turned back on.

Figure 4-1 shows a typical amplified network configuration. Table 4-3 lists the high-level steps to install and equalize the network shown in Figure 4-1 using SLEC.

Figure 4-1
Typical amplified network

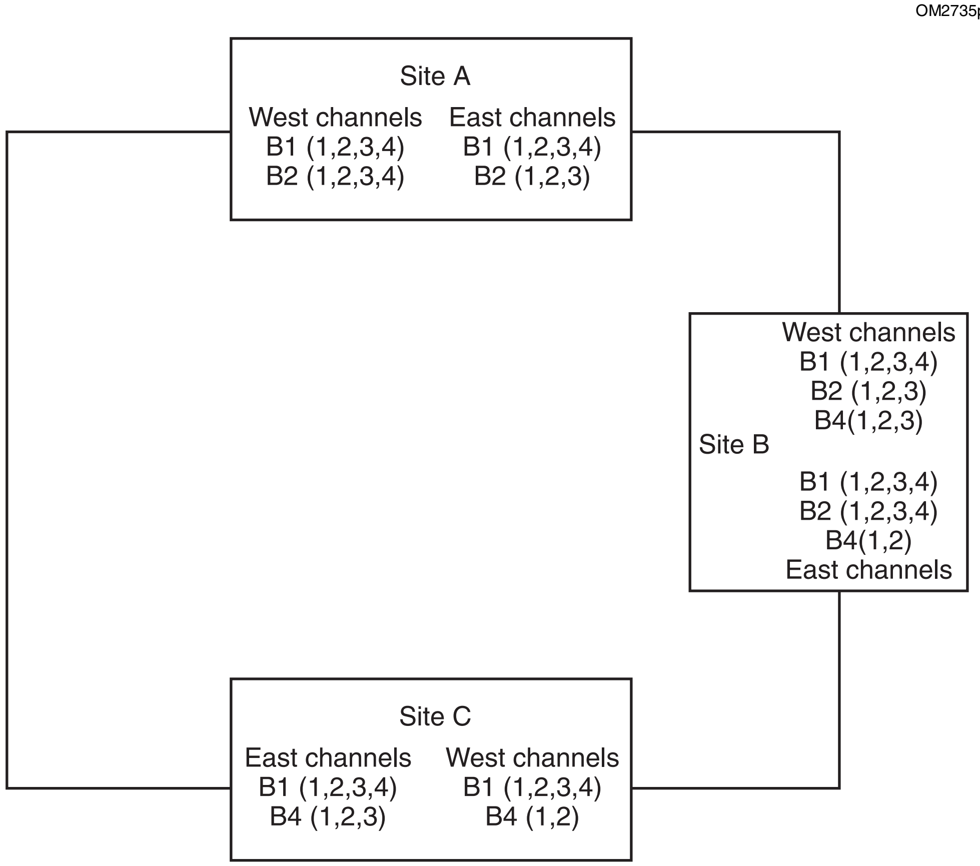


Table 4-3
High-level steps to install and equalize the network shown in Figure 4-1 using SLEC

Step	Comments
1	Ensure the network passes when run on the Network Modeling Tool. From NMT, obtain the target per-band average channel power for each port of all APBE/APBE Enhanced circuit packs and all OFA VGA circuit packs in your network as well as information with respect to fixed attenuator pads required in the network. If this is an Extended Metro system, obtain the Nortel Networks Custom Equalization Report. Determine the fixed attenuator pads required for the OSC (See OSC link engineering in *Network Planning and Link Engineering*, 323-1701-310).
2	At Site A, install Optical Metro 5200 Shelves and Components (See *Installing Optical Metro 5200 Shelves and Components*, 323-1701-201)
3	At Site A, commission Optical Metro 5200 Shelves (See *Commissioning Procedures*, 323-1701-220)

Table 4-3
High-level steps to install and equalize the network shown in Figure 4-1 using SLEC

Step	Comments
4	At Site A, provision parameters described above in section titled "User provisioning required for SLEC to operate" for the Optical Metro 5200 Shelves (See *Provisioning and Operating Procedures*, 323-1701-310)
5	At Site A, connect the optical components (See *Connection Procedures*, 323-1701-221).
6	At Site A, perform Shelf and Site testing procedures. See: "Testing the shelf lamps" "Testing an Optical Metro 5100/5200 WDM OMX" "Testing the optical continuity through the OMXs at a site" "Testing the optical continuity through the OMXs at an OADM site that uses single-shelf wiring"
7	At Site A, install fixed attenuator pads as described in the NMT report or the Nortel Networks Custom Equalization Report and install fixed attenuator pads for the OSC (See *Connection Procedures*, 323-1701-221). Do not install the fixed attenuator pads at the OMX band drop ports. This will be done in a subsequent step. Install fixed attenuator pads for the OSC as determined in step 1 (See *Connection Procedures*, 323-1701-221).
8	At Site A: Unseat from the shelf or shelves all West OCLD, OTR or Muxponder circuit packs [B1 (2,3,4) and B2 (2,3,4)] except for the first channel in each band [B1(1) and B2(1)]. Unseat from the shelf or shelves all East OCLD, OTR or Muxponder circuit packs [B1 (2,3,4) and B2 (2,3)] except for the first channel in each band [B1(1) and B2(1)]. For the Band 1 and Band 2 West OMX, disconnect the patch cord connected to the first Channel Drop port (this corresponds to the channel of the seated West OCLD, OTR or Muxponder circuit packs). For the Band 1 and Band 2 East OMX, disconnect the patch cord connected to the first Channel Drop port (this corresponds to the channel of the seated West OCLD, OTR or Muxponder circuit packs).
9	At Site A, connect the OSC to the backbone (See *Connection Procedures*, 323-1701-221).

Table 4-3
High-level steps to install and equalize the network shown in Figure 4-1 using SLEC

Step	Comments
10	Repeat step 2 to step 9 at all sites in the network. For step 8, the following applies: At Site B: Unseat from the shelf or shelves all West OCLD, OTR or Muxponder circuit packs [B1 (2,3,4), B2 (2,3) and B4 (2,3)] except for the first channel in each band [B1(1), B2(1) and B4(1)]. Unseat from the shelf or shelves all East OCLD, OTR or Muxponder circuit packs [B1 (2,3,4), B2 (2,3,4) and B4(2)] except for the first channel in each band [B1(1), B2(1) and B4(1)]. For the Band 1, Band 2 and Band 4 West OMX, disconnect the patch cord connected to the first Channel Drop port (this corresponds to the channel of the seated West OCLD, OTR or Muxponder circuit packs). For the Band 1, Band 2 and Band 4 East OMX, disconnect the patch cord connected to the first Channel Drop port (this corresponds to the channel of the seated West OCLD, OTR or Muxponder circuit packs). At Site C, Unseat from the shelf or shelves all West OCLD, OTR or Muxponder circuit packs [B1 (2,3,4) and B4 (2,3)] except for the first channel in each band [B1(1) and B4(1)]. Unseat from the shelf or shelves all East OCLD, OTR or Muxponder circuit packs [B1 (2,3,4) and B4(2)] except for the first channel in each band [B1(1) and B4(1)]. For the Band 1 and Band 4 West OMX, disconnect the patch cord connected to the first Channel Drop port (this corresponds to the channel of the seated West OCLD, OTR or Muxponder circuit packs). For the Band 1 and Band 4 East OMX, disconnect the patch cord connected to the first Channel Drop port (this corresponds to the channel of the seated West OCLD, OTR or Muxponder circuit packs).
11	Run One-time SLEC.

Table 4-3
High-level steps to install and equalize the network shown in Figure 4-1 using SLEC

Step	Comments
12	At Site A, For each West OMX, measure the power at the first Channel Drop port using an optical power meter. Determine if an overload pad is required and if it is to determine the pad value. Once the value is determined, the pad is added to the OMX band drop port. The patch cord that was disconnected in step 8 is reconnected to the first Channel Drop port (this is the patch cord that connects to the Line Rx port of the first channel West OCLD, OTR or Muxponder circuit pack). For each East OMX, measure the power at the first Channel Drop port using an optical power meter. Determine if an overload pad is required and if it is to determine the pad value. Once the value is determined, the pad is added to the OMX band drop port. The patch cord that was disconnected in step 8 is reconnected to the first Channel Drop port (this is the patch cord that connects to the Line Rx port of the first channel East OCLD, OTR or Muxponder circuit pack). Insert in the shelf or shelves all West OCLD, OTR or Muxponder circuit packs of the other channels of each band (these correspond to the circuit packs that were unseated in step 8). Ensure that all circuit packs have their Line Tx and Line Rx patch cords connected. Insert in the shelf or shelves all East OCLD, OTR or Muxponder circuit packs of the other channels of each band (these correspond to the circuit packs that were unseated in step 8). Ensure that all circuit packs have their Line Tx and Line Rx patch cords connected.
13	Repeat step 12 at Site B and then at Site C.
14	Run One-time SLEC.
15	If ALS was turned off in step 4, it can now be turned back on.

Changes to the re-equalization procedure for channel addition

The re-equalization procedure for channel addition is modified when SLEC is used. The following cases are considered:

- Add new channels
  - In this case, new channels are added to existing bands. Each existing band is equipped with at least one existing channel. If any existing band does not have at least one existing channel, then the following case (i.e., Add new bands) applies.
  - Table 4-4 lists the high-level steps to use to add new channels.
- Add new bands
  - In this case, new channels are added to existing empty channel bands. Existing bands imply that the OMXs for the bands are already installed and fibered into the network. This would be the case if the OMXs were installed during initial system installation taking into account a future channel count upgrade. If the OMXs of the new bands are not already installed and fibered in the network, contact Nortel Networks for assistance on how to add OMXs to an existing network.
  - Table 4-5 lists the high-level steps to use to add new bands.

Table 4-4
High-level steps to add new channels

Step	Comments
1	Ensure the network passes when run on the Network Modeling Tool. If this is an Extended Metro system, ensure that the network is validated by Nortel Networks.
2	This procedure can be run while Continuous SLEC is running. However, be aware that SLEC will raise the Equalization Failed event for one or multiple sites and the following status results in the SLEC System Manager screen during the procedure. — Topology error — Unexpected input power change — Detected incomplete transmit/receive pair — A component upstream failed to equalize This is expected and does not indicate any impact to existing channels. Failures occur because SLEC detects changes in the system topology. To ensure correct operation, SLEC only attempts equalization when the system topology is stable and determined to be accurate. Alternatively, to avoid the failure event generation, you can halt Continuous SLEC before proceeding to the next step.
3	Connect the Line Tx and Line Rx of the West OCLD, OTR or Muxponder circuit packs of the new channels to the corresponding OMX Channel Add and Channel Drop ports (See *Connection Procedures*, 323-1701-221). If necessary, repeat for the East OCLD, OTR or Muxponder circuit packs of the new channels.
4	Seat the circuit packs of the new channels into the shelf or shelves.
5	Provision the OSID parameter for the newly added circuit packs (See *Provisioning and Operating Procedures*, 323-1701-310). ***Note:*** If all equipment in the system has a blank OSID then SLEC assumes it is all on the same system. If any piece of equipment is ever given a non-blank OSID then SLEC fails or halts until all equipment is given the same OSID (blank or otherwise). In other words, a blank OSID is only allowed when it is the only OSID, and you are not using features that do not support blank (IFS, multiple-system network, hub and spoke).
6	Repeat step 3 to step 5 at all sites in the network where the new channels are being added.
7	If Continuous SLEC was not running or was halted before this procedure was started, run One-time or Continuous SLEC. If Continuous SLEC was running before this procedure was started, no action is required since SLEC will run once the system topology stabilizes and is determined to be accurate.

Table 4-5
High-level steps to add new bands

Step	Comments
1	Ensure the network passes when run on the Network Modeling Tool. If this is an Extended Metro system, ensure that the network is validated by Nortel Networks.
2	If Continuous SLEC is running, halt it.
3	Connect the Line Tx and Line Rx ports of the OCLD, OTR or Muxponder circuit packs of the new channels to their corresponding OMX Channel Add and Channel Drop ports (See *Connection Procedures*, 323-1701-221). For the first channel of each new band, you can route the patch cord from the Line Rx port of the circuit pack to the OMX Channel Drop port but do not connect it to the OMX Channel Drop port, leave it dangling close to the port in the OMX tray. It will be connected in a subsequent step.
4	Seat into the shelf or shelves only the first channel West OCLD, OTR or Muxponder circuit pack of each new band. All other channel West circuit packs of each new band must not be seated. Seat into the shelf or shelves only the first channel East OCLD, OTR or Muxponder circuit pack of each new band. All other channel East circuit packs of each new band must not be seated.
5	Provision parameters described above in section titled "User provisioning required for SLEC to operate" for the Optical Metro 5200 Shelves (See *Provisioning and Operating Procedures*, 323-1701-310). Note that only the OSID, Power Targets for the new band and ALS parameters need to be provisioned as the OFA and APBE/APBE Enhanced Direction and Location and the OSC equipment attributes for linear systems parameters do not need to be changed as a result of adding new bands.
6	Repeat step 3 to step 5 at all sites in the network where the new bands are being added.
7	Run One-time SLEC.
8	For each new band West OMX, measure the power at the first Channel Drop port using an optical power meter. Determine if an overload pad is required and if it is to determine the pad value. Once the value is determined, the pad is added to the OMX band drop port. The patch cord that was left dangling in step 3 is reconnected to the first Channel Drop port. For each new band East OMX, measure the power at the first Channel Drop port using an optical power meter. Determine if an overload pad is required and if it is to determine the pad value. Once the value is determined, the pad is added to the OMX band drop port. The patch cord that was left dangling in step 3 is reconnected to the first Channel Drop port. Seat the circuit packs of the remaining channels of each new band into the shelf or shelves. Ensure that the Line Tx and Line Rx patch cord are connected to the circuit packs before insertion.
9	Repeat step 8 at all sites in the network where the new bands are being added.
10	Provision parameters described above in section titled "User provisioning required for SLEC to operate" for the Optical Metro 5200 Shelves (See *Provisioning and Operating Procedures*, 323-1701-310). Note that only the OSID parameter needs to be provisioned as the OFA and APBE/APBE Enhanced Direction and Location, the Power Targets and the OSC equipment attributes for linear systems parameters do not need to be changed at this step.

Table 4-5
High-level steps to add new bands

Step	Comments
11	Repeat step 10 at all sites in the network where the new bands are being added.
12	Run One-time or Continuous SLEC.
13	If ALS was turned off, it can now be turned back on.

System Manager changes

The following new OSC equipment attributes are added to the OSC Equipment screen (see Figure 4-2):

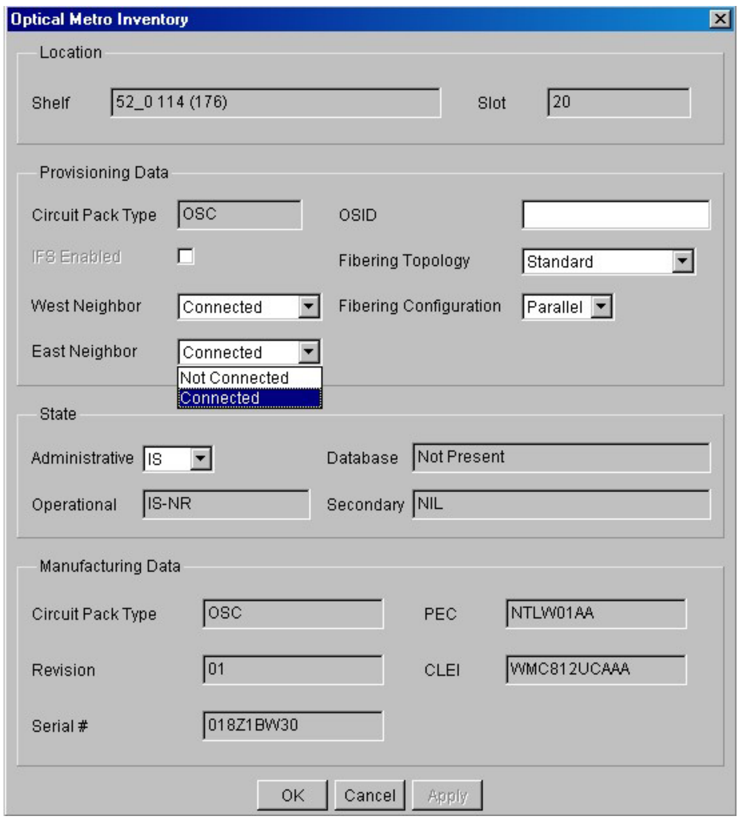
- West Neighbor
- East Neighbor

Possible values for each are: Connected or Not Connected.

These parameters default to Connected and must be set to Not Connected in linear (i.e., non-ring) systems that use SLEC. Not Connected must be set for either the West Neighbor attribute or the East Neighbor attribute at the end-point nodes.

Figure 4-2
OSC Equipment screen

OM2762t



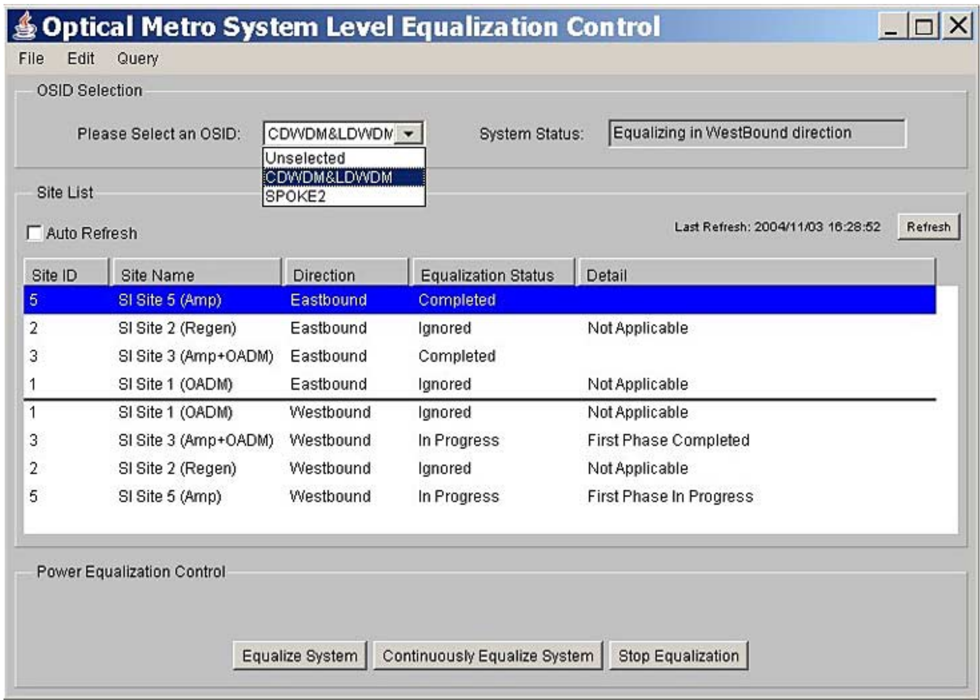
A new System Level Power Equalization interface is available to invoke SLEC and monitor SLEC progress (see Figure 4-3). This screen can be accessed from the top level menu named **Admin**.

This new interface:

- allows users to select a system to equalize using the OSID
- displays the sites associated with the OSID
- allows users to start or stop the equalization

Figure 4-3
SLEC main screen

OM2758t



This new screen provides an interface to select a desired OSID where SLEC is to take place. Once the OSID is selected, a list of sites that belong to the OSID are displayed in the Site List table.

When the “Equalize System” button is clicked, SLEC first checks that the selected system is in the correct state to perform equalization. If the validation passes, SLEC starts. If the validation fails, a descriptive reason is displayed and SLEC does not perform equalization.

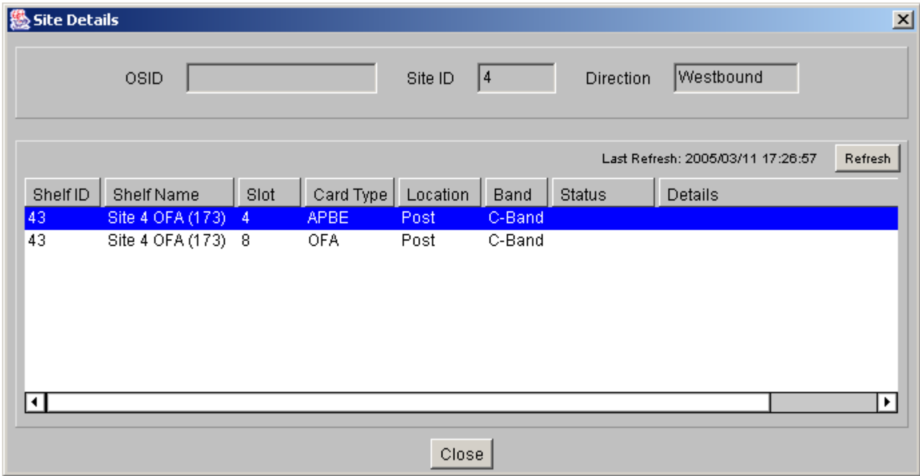
Users can obtain the current status of the equalization process at any time.

While SLEC is in progress, users can cancel the process at anytime by clicking the “Stop Equalization” button.

While SLEC is in progress, users can double-click on the site (a table entry) to view the details (see Figure 4-4) of the SLEC process down to the component level (per facility).

Figure 4-4
SLEC details screen

OM2759t



Alarm strategy

SLEC does not raise any alarms.

Mixed Shelf Type

In previous releases, Optical Metro 5200 shelves could be commissioned as either Terminal, OADM or OFA. Terminal and OADM shelf types allowed provisioning all circuit packs types except for OFA and APBE circuit pack types. The OFA shelf type allowed provisioning all circuit packs types except OCI, OCLD, OTR and Muxponder circuit pack types.

Release 8.0 allows Optical Metro 5200 shelves to also be commissioned as Mixed. The Mixed shelf type allows all circuit pack types to be provisioned. Although software allows all circuit pack types to be provisioned in a Mixed shelf, only the following circuit packs are supported in Release 8.0:

- OTR 10 Gbit/s Enhanced
- Muxponder 10 Gbit/s GbE/FC
- Muxponder 10 Gbit/s GbE/FC VCAT
- OFA (Standard, High Input Power, VGA)
- APBE and APBE Enhanced

As such, this shelf type supports a mix of service circuit packs and amplification circuit packs. This helps reduce the site footprint and overall cost in some applications.

Equipping Rules

Circuit pack equipping rules are a union of the existing Terminal, OADM and OFA shelf type rules.

Conversion Rules

The following conversion rules apply:

- Only Optical Metro 5200 shelves can be modified to be a Mixed shelf
- OFA shelf type can be changed to be a Mixed shelf type
- OADM or Terminal shelf types can be changed to be a Mixed shelf type if it is an Optical Metro 5200 shelf. It will not be allowed if it is an Optical Metro 5100 shelf.
- Mixed shelf type can be changed to be an OFA shelf type if there are no service circuit packs (i.e., OCI, OCLD, OTR or Muxponder) provisioned
- Mixed shelf type can be changed to be an OADM or Terminal shelf type if there no OFA or APBE circuit packs provisioned

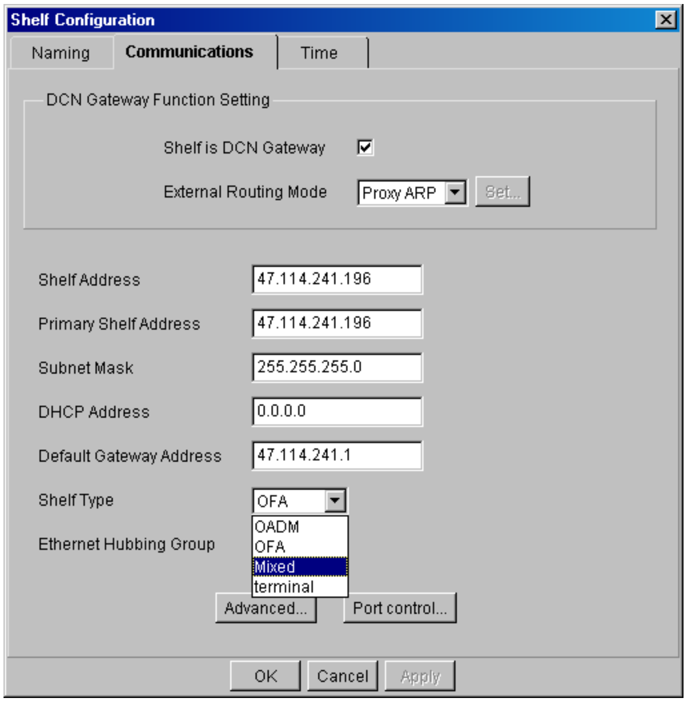
System Manager changes

All panel displays (e.g., Admin->Software Upgrade and Configuration->Communications) are modified to display the Mixed shelf type.

The Communications detail dialog (Figure 4-5 on page 4-25) is modified to include the Mixed shelf type as an option for editing the shelf type.

Figure 4-5
Communications detail dialog change

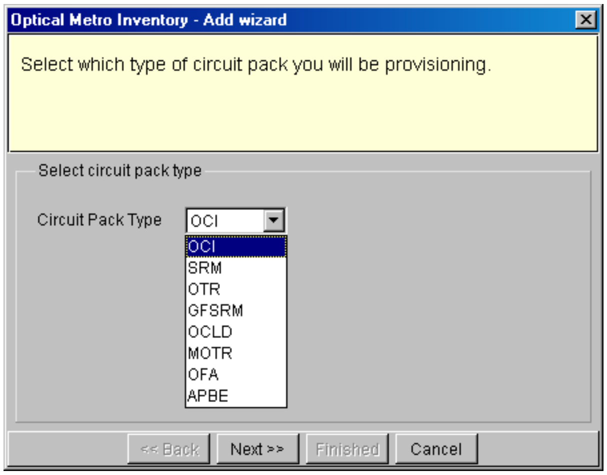
PG-200



The Inventory wizard (Figure 4-6 on page 4-26) is modified to include a circuit pack list of all available circuit packs for a given slot on a Mixed shelf type. Also, it is modified such that it invokes the circuit pack specific details wizard if the circuit pack type is chosen.

Figure 4-6
Inventory wizard change

PG-201



TL1 changes

TL1 changes introduced in Release 8.0 for this feature are described in "TL1 changes" on page 4-90.

SNMP changes

The NodeType MIB element definition is changed to include the Mixed value.

Alarm strategy

The alarm strategy remains the same except that on a Mixed shelf type, a Band Input Failure (BIF) alarm can be masked by a Site Input Failure (SIF) alarm. This is because the BIF is an OADM/Terminal shelf alarm that indicates a signal failure of all channels within a band. If the failed band is also the same as the band of an amplifier (and the OSC) then the BIF is replaced by a SIF.

Customer User Classes

This feature introduces the following new functionality:

- Addition of two new user privilege classes to the existing three user privilege classes: Admin, Operator and Observer. Service providers can assign these new user privilege classes to their customers in order to observe the status of their "customer owned" network.
- The two new user privilege classes, named Customer1 and Customer2, have less privilege than the Observer user privilege class.
- The two new user privilege classes have different access privileges, one has read access to PM data, the other does not.
- Alarm filtering for the two new user privilege classes:
  - For Customer1 user privilege class: all events, user requests and non-service affecting alarms (except AIS, RDI and PM alarms) are filtered
  - For Customer2 user privilege class: all events, user requests and non-service affecting alarms are filtered

System Manager changes

System Manager areas

Table 4-6 on page 4-27 and Table 4-7 on page 4-28 show the System Manager areas and access privileges for Customer1 and Customer2 user privilege classes.

Table 4-6
System Manager Top menu area and access privileges for Customer1 and Customer2 user privilege classes

Top menu	Customer1	Customer2
File (Save as, Print, Exit)	Enabled	Enabled
Edit (Add, Modify, Delete, Preferences, Provision alarm severity)	Disabled	Disabled
View (Network Tree, Show Details, Rediscover Network, Refresh Current Window, Sort Order)	Enabled	Enabled
Fault (Active Alarms, Event Console, Clear Event Console, Event History)	Enabled	Enabled
Configuration – Equipment (Inventory, Facilities, Telemetry, Shelf Level Graphics)	Enabled	Enabled
Configuration – Connections (Channel Assignments)	Enabled	Enabled
Configuration (Network Date and Time)	Enabled	Enabled
Configuration (Naming, Communications, External Manager, Shelf List)	Disabled	Disabled

Table 4-6 (continued)
System Manager Top menu area and access privileges for Customer1 and Customer2 user privilege classes

Top menu	Customer1	Customer2
Admin (Software Upgrade, NE Admin, Decommission Shelf, System Level Power Equalization)	Disabled	Disabled
Performance (Performance Monitor)	Enabled	Disabled
Security (Change Password)	Enabled	Enabled
Security (User Profile List, Login User List, Advanced, Authentication Provision, Clear Security Alarm)	Disabled	Disabled
Troubleshooting (IP Routing Table, Interface Statistics)	Disabled	Disabled
Help (Technical Documentation, About System Manager)	Enabled	Enabled

Table 4-7
System Manager Tabs area and access privileges for Customer1 and Customer2 user privilege classes

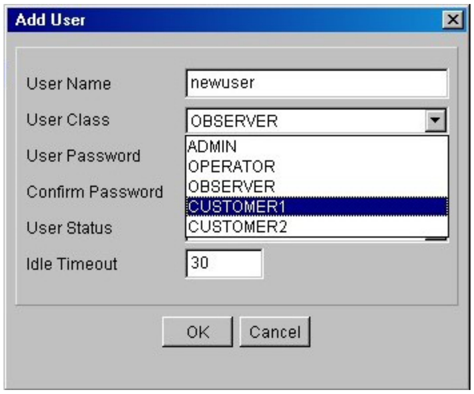
Tab	Customer1	Customer2
Fault	Visible	Visible
Equipment	Visible	Visible
Connections	Visible	Visible
Configuration	Not Visible	Not Visible
Admin	Not Visible	Not Visible
Performance Monitor	Visible	Not Visible
Troubleshooting	Not Visible	Not Visible
Security	Not Visible	Not Visible

Add User dialog

The two new user privilege classes, Customer1 and Customer2, are added to the User Class list in the Add User dialog to enable admin users to provision local users with Customer1 or Customer2 user privilege class. See Figure 4-7.

Figure 4-7
Add User dialog change

OM2763p



Change community name dialog

In order to support the new user privilege classes, two new SNMP Community Strings are added. These new Community Strings can be provisioned by any user with admin user privilege class. See Figure 4-8.

Figure 4-8
Change community name dialog change

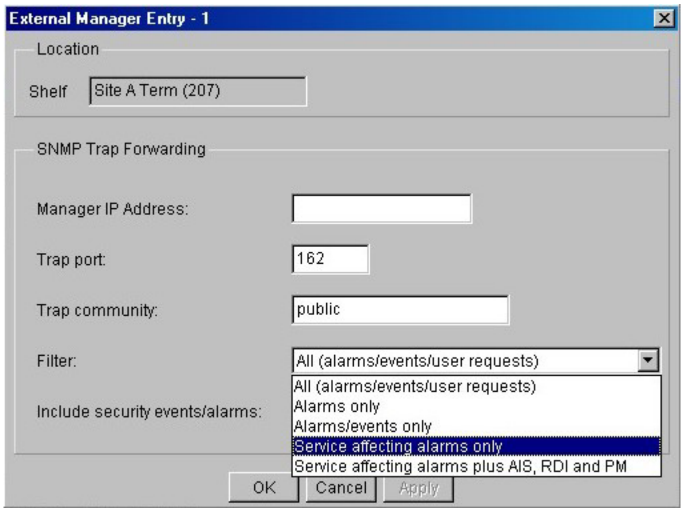
OM2764p

External Manager Entry dialog

Two new filters are added to the filter selection list on the External Manger Entry dialog. See Figure 4-9 on page 4-30.

Figure 4-9
External Manager Entry dialog change

OM2765p



TL1 changes
TL1 changes introduced in Release 8.0 for this feature are described in "TL1 changes" on page 4-90.

SNMP changes

SNMP community views
To provide more granularity of SNMP MIB views, two additional SNMP community views are added for the new Customer1 and Customer2 user privilege classes. See Table 4-8.

Table 4-8
SNMP community views

SNMP Community	Read Access to MIB Groups	Write Access to MIB Groups
Admin	All	All
Operator	Exclude security	Exclude security, DNS, enet2, TID groups and trapDestination Table
Observer	Exclude security	Include adminUserAccountTable and connQuery only
Surveillance	Exclude security, DNS, enet2, TID, admin (except adminMibVersion) and software (except swVersion) groups	None

Table 4-8 (continued)
SNMP community views

SNMP Community	Read Access to MIB Groups	Write Access to MIB Groups
Customer1	Exclude security, DNS, enet2, TID, software (except swVersion) groups and trapDestination Table	Include adminUserAccountTable and connQuery only
Customer2	Exclude security, DNS, enet2, TID, software (except swVersion), PM groups and trapDestination Table	Include adminUserAccountTable and connQuery only

SNMP Trap/Notification

The SNMP agent filters the event notification (alarm/event/user requests) based on the trap registration data. SNMP mangers are responsible for specifying the proper filter value for the different trap receiver based on the receiver's user privileges.

New trap filter for the new classes is added to the Trap Destination table

```
adminTrapDestFilter OBJECT-TYPE
  SYNTAX   INTEGER {
           all(1),
           alarmOnly(2),
           alarmAndEvent(3),
           saAlarmOnly(4),       -- service affecting alarm only
           saAlarmAndAisRdiPM(5) -- service affecting alarm plus AIS,RDI and PM
        }
  ACCESS   read-write
  STATUS   mandatory
  DESCRIPTION
         "Specifies the type of trap information to be sent to
          this manager. Default is 'all'. If set to alarmOnly(2),
          only alarm traps are sent. If set to
          alarmAndEvent(3), alarm and event traps are sent, but
          not user request traps. If set to 'all', all traps are
          sent (alarm, event, and user request traps). If set to "saAlarmOnly",
          only the service affecting alarms (including the dual
          severity alarms when it is raised as non-service affecting) are sent.
          If set to "saAlarmAndAisRdiPM" only the service affecting alarm, RDI, AIS
          and TCA alarms are sent."
  ::= { adminTrapDestinationTableEntry 5 }
```

Exceed support for System Manager

Exceed permits applications that normally are only available on UNIX workstations, to be accessed from Windows-based PCs. This feature supports the ability to launch System Manager using Exceed version 9.0. This can be done using the following methods:

- Start an Exceed session against a Solaris workstation and then use Netscape on the Solaris workstation to launch a System Manager session
- Start an Exceed session against a Preside AP workstation and then use the Graphical Network Browser to launch a System Manager session

Although this method of displaying System Manager is functionally operational, it is expected that the display is not as aesthetically pleasing as a standalone System Manager session due to inter-platform font transformations.

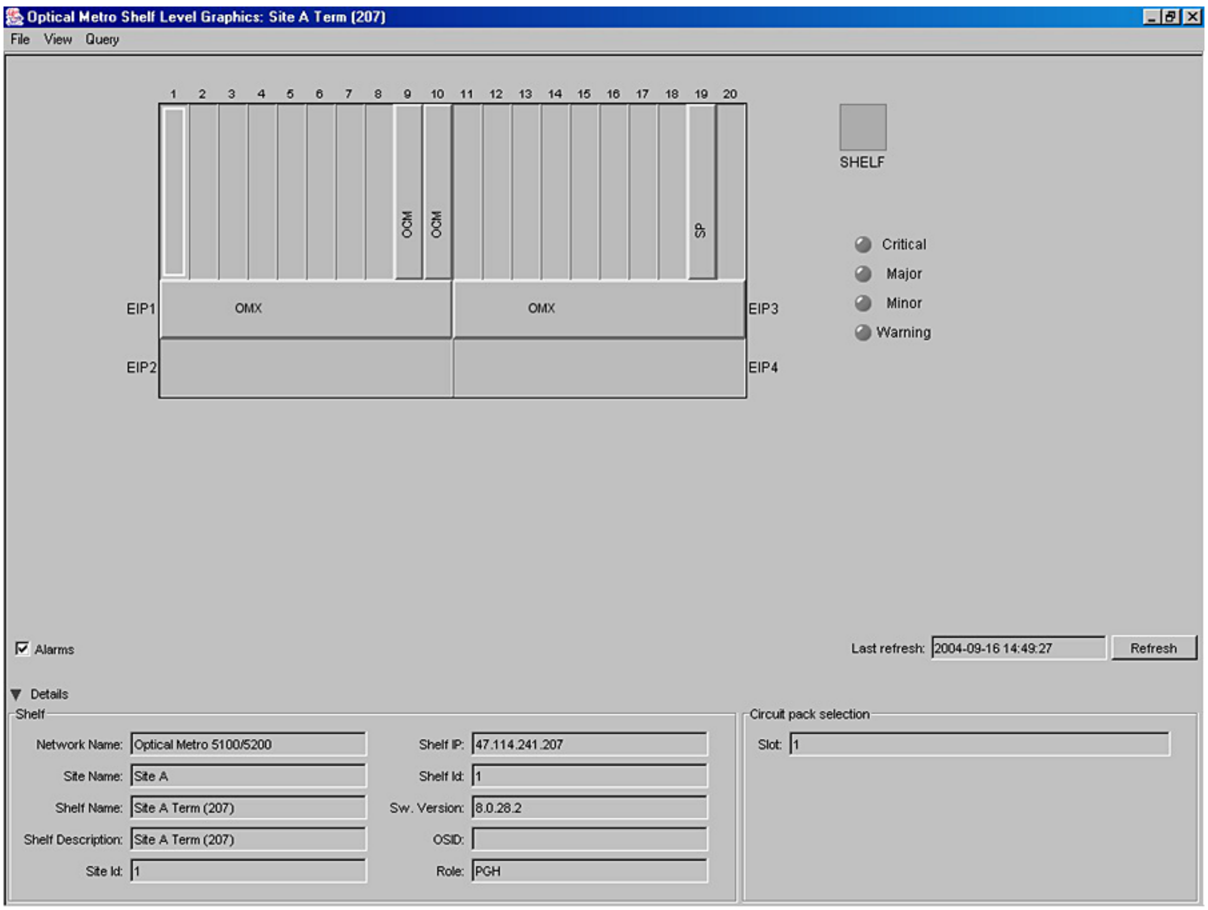
Passive devices slot numbering in Shelf Level Graphics

This feature adds the slot number next to the passive devices connected to the shelf's Equipment Inventory Ports (EIP) in the System Manager Shelf Level Graphics screen. By default, the 4 Equipment Inventory Ports are displayed as EIP1, EIP2, EIP3 and EIP4.

If the UPSN (User Provisionable Slot Number) feature is enabled, the slot numbers displayed will be whatever the user provisions, rather than the hard coded values of EIP1, EIP2, EIP3, and EIP4.

Figure 4-10
Shelf Level Graphics screen change

OM2766p



Band 9 support for 100 GHz circuit packs

Release 8.0 software supports Band 9 for 100 GHz circuit packs. Although Release 7.0 introduced 100 GHz circuit packs that are compliant with the Common Photonic Layer wavelength plan, you cannot use Release 7.0 software to provision Band 9 circuit packs in an Optical Metro 5100/5200 shelf. Release 7 software only supported 32 wavelengths (Bands 1-8 and channels 1-4). Release 8.0 software supports all 36 wavelengths (Bands 1-9 and channels 1-4) in the wavelength plan. All variants of the 100 GHz circuit packs are supported (OCLD 2.5 Gbit/s Flex, OTR 2.5 Gbit/s Flex 1310 nm, OTR 2.5 Gbit/s Flex 850 nm, OTR 10 Gbit/s Enhanced, Muxponder 10 Gbit/s GbE/FC, Muxponder 10 Gbit/s GbE/FC VCAT).

All band displays (inventory, channel assignments) in System Manager are modified to allow for Band 9. Also, the provisioning wizards for the OCLD, OTR and Muxponder are modified to allow Band 9 as a choice if a 100 GHz circuit pack has been selected.

Figure 4-11
OTR Optical Metro Inventory - Add wizard screen

OM2767t

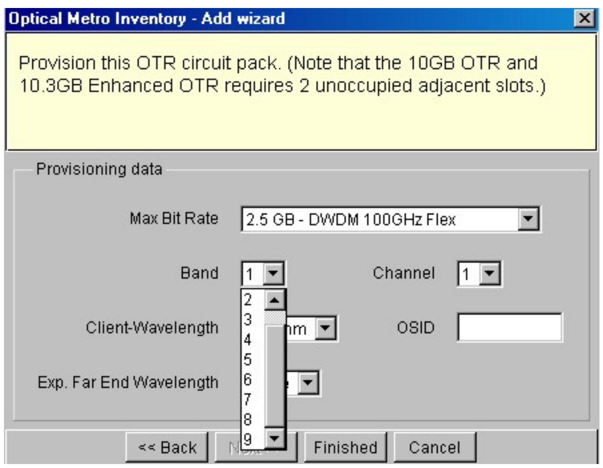


Figure 4-12
OCLD Inventory Details screen

OM2771t

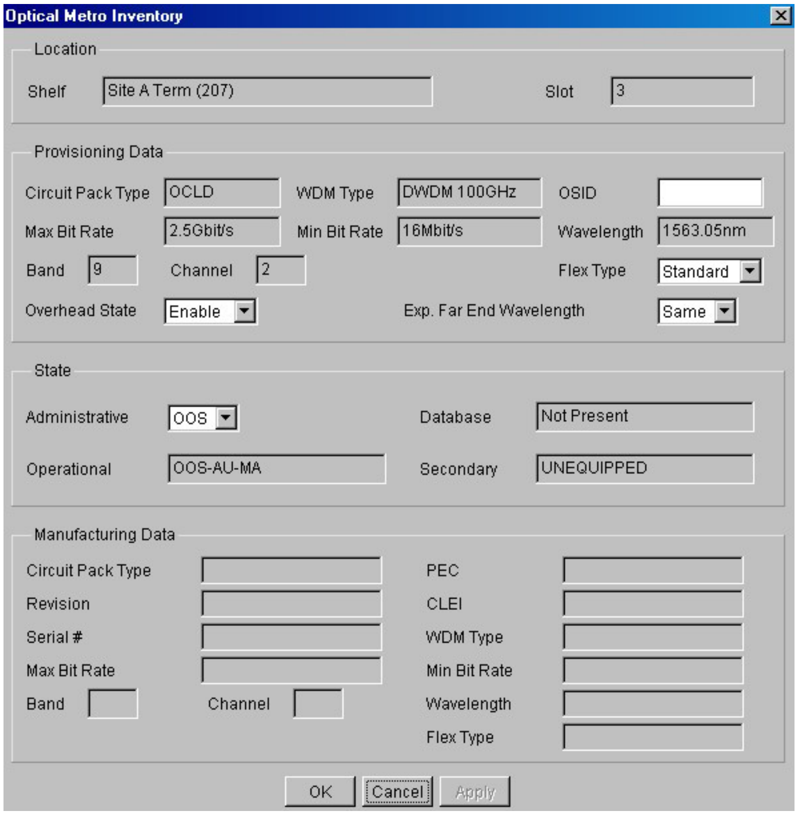
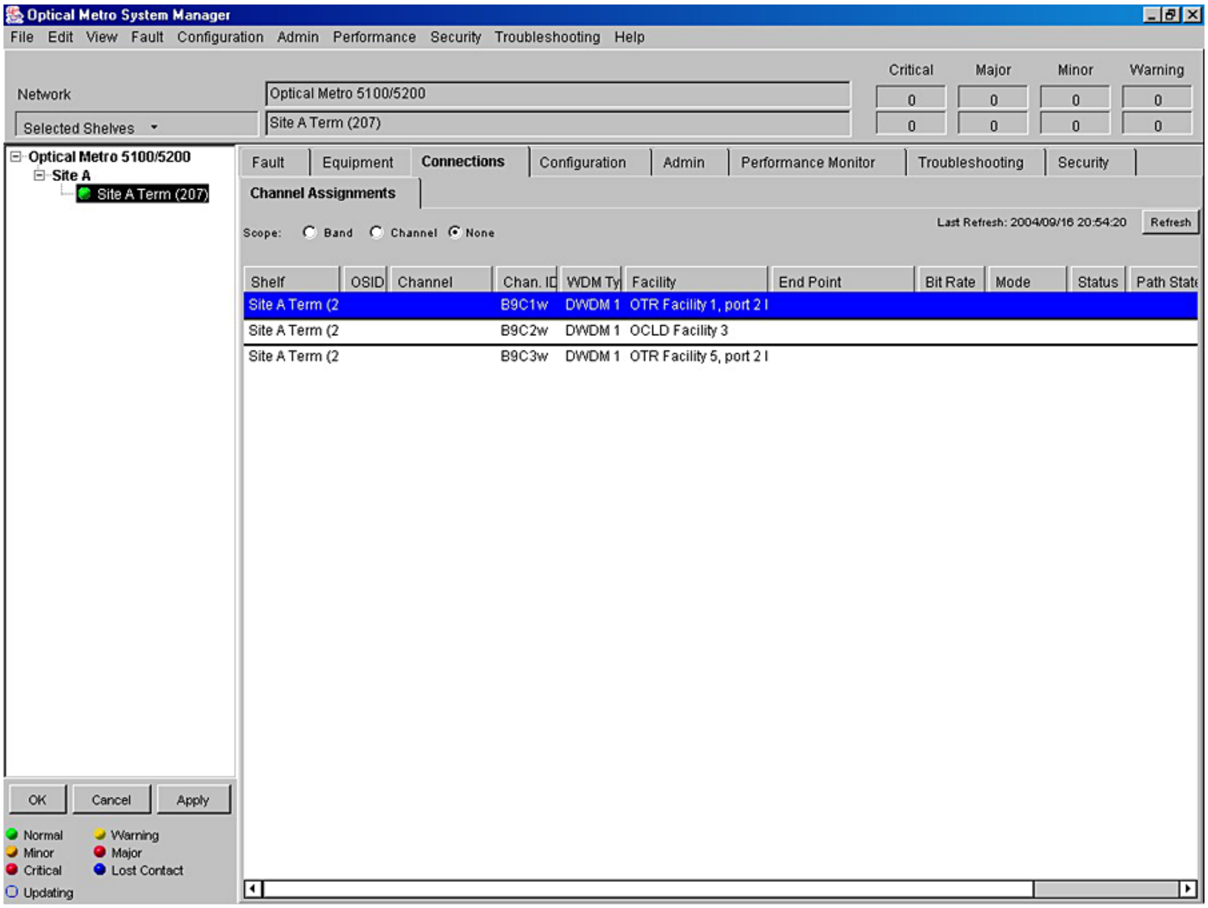


Figure 4-13
Channel assignment screen

OM2772p



Additional troubleshooting information

This feature provides you with additional information to better troubleshoot Optical Metro 5100/5200 network problems. You can view data from Optical Metro 5100/5200 routing and interface statistic tables using System Manager. The additional routing and interface statistic information is provided in accordance with standard MIB-2.

System Manager changes

A new tab and a top level menu named **Troubleshooting** is added to the System Manager enabling users to view all additional troubleshooting data. This tab/menu is enabled for users with the following user privilege classes: Admin, Operator and Observer.

Under this tab/menu, System Manager has two new screens named: **IP Routing Table** and **Interface Statistics**. All menu items on the popup menu/Edit menu for a selected row are disabled as the tables presented in the screens are read only. Users are able to choose **Save As,** to save data from the screen as a comma separated file, and **Print**.

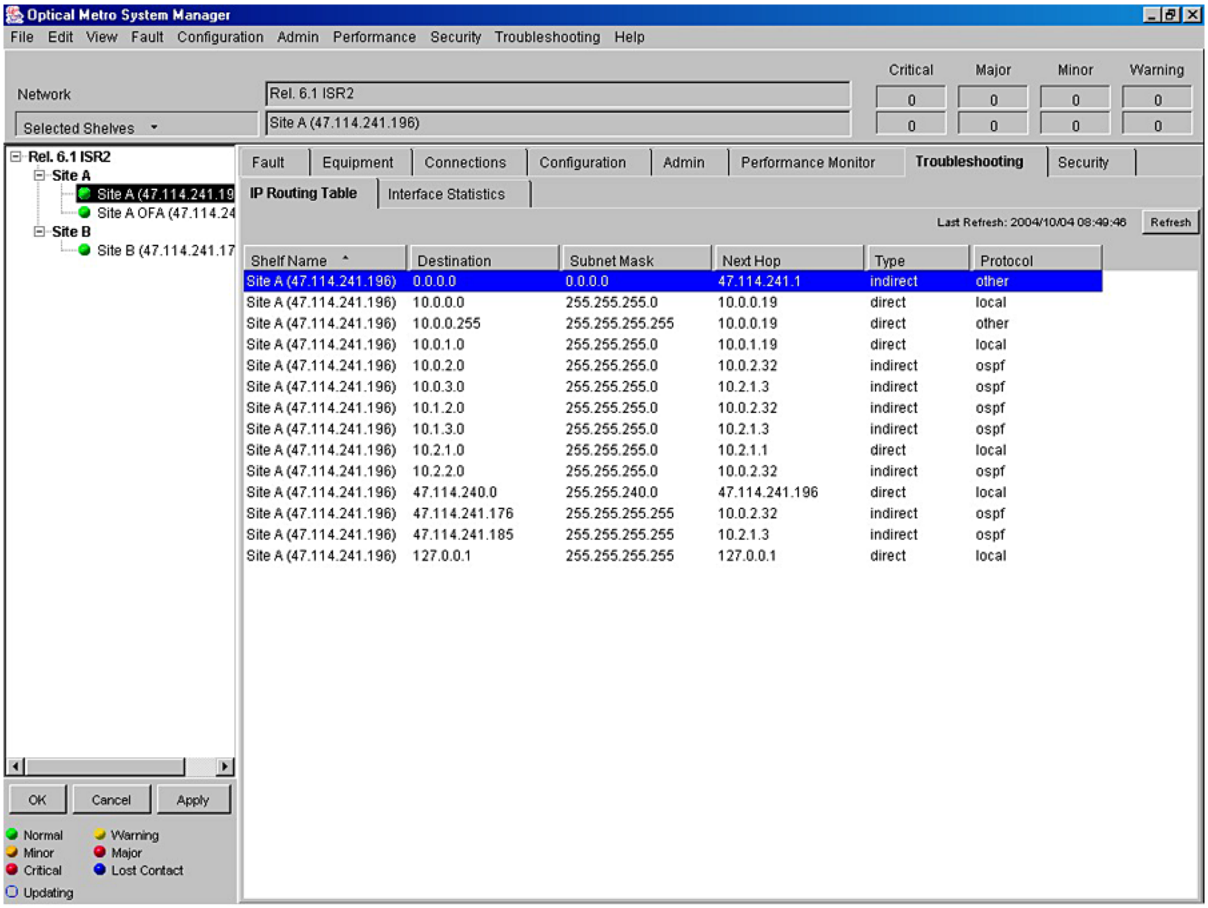
The IP Routing Table screen provides users with information related to network configuration. The following data is displayed in the IP Routing Table screen (see Figure 4-14 on page 4-38):

- **Shelf Name**
- **Destination** IP address of the route
- **Subnet Mask**
- **Next Hop** address
- Route **Type** (other, direct, indirect, invalid)
- Route **Protocol** (other, local, ospf, bgp)

For a definition of these parameters, refer to RFC 1213.

Figure 4-14
New IP Routing Table screen

OM2768p



The Interface Statistics screen provides users with information related to interface statistics. The following data is displayed in the Interface Statistics screen (see Figure 4-15 on page 4-40 and Figure 4-16 on page 4-41):

- **Shelf Name**
- Interface **Description**
  - — tsb0: interface to the SBUS (serial bus) which is used for intra-shelf communications. This bus is modelled as an Ethernet.

  Note: For the tsb0 interface, the interface type field indicates Ethernet since the SBUS is modelled as an Ethernet.

  - — lo: local interface. lo0 is a standard loopback interface and is always present. In cases where the shelf address mask is set to 32 bits (255.255.255.255), there is an additional loopback interface (lo1) which holds the shelf address.

— cpm: cpm1 and cpm2 are the 1X-Ethernet port and 2X-Ethernet port, respectively.

— ppp: ppp0 and ppp1 are Point-to-Point Protocol interfaces corresponding to the Serial-1 and Serial-2 ports, respectively.

— vif: a virtual interface (VIF) is a group of one or more PPP-based overhead channels from a given shelf to the same destination shelf. A vif only includes channels of like OSPF cost. For example, if there are four OCLD overhead channels between two shelves of the same band, those four channels are grouped as a single VIF, such as "vif0". If there is also an OSC channel between the same two shelves, this would be a separate VIF, such as "vif1". As they are created, the VIFs are numbered sequentially, starting from zero. VIFs use the SBUS (serial bus) to pass packets to the OCLD/OSC/OTR/Muxponder circuit packs in the shelf which, in turn, forward the packets to the respective remote shelf. The channels in a given VIF are used in a round-robin fashion.

Note: Since a VIF uses the SBUS, which is modelled as an Ethernet, the interface type for a VIF is Ethernet.

- Interface **Internet Address** (in condensed form)
- **Ethernet Address (**in hex form)

Note: The Ethernet Address is not displayed for tsb0 or vif interfaces. The SBUS is modelled as Ethernet but uses an internal Ethernet address scheme which is not consistent with Ethernet standards.

- Interface **Type** (ethernet, loopback, ppp)

Note: For tsb0 and vif interfaces, the interface type field indicates Ethernet since the SBUS is modelled as an Ethernet.

- **MTU** Size
- **Admin State** (up, down)
- **Operational State** (up, down)
- **InPkts** (all received packets)
- **OutPkts** (all send packets)
- **InUcastPkts** (only unicast packets received)
- **OutUcastPkts** (only unicast packets sent)
- **InNUcastPkts** (only non-unicast packets received)
- **OutNUcastPkts** (only non-unicast packet sent)
- **InDiscards**
- **OutDiscards**
- **InErrors**

- **OutErrors**
- **UnknownProtocols**

For a definition of these parameters, refer to RFC 1213.

As the number of columns is high, a horizontal scroll bar is provided to enable users to view all data.

Figure 4-15
New Interface Statistics screen

OM2769p

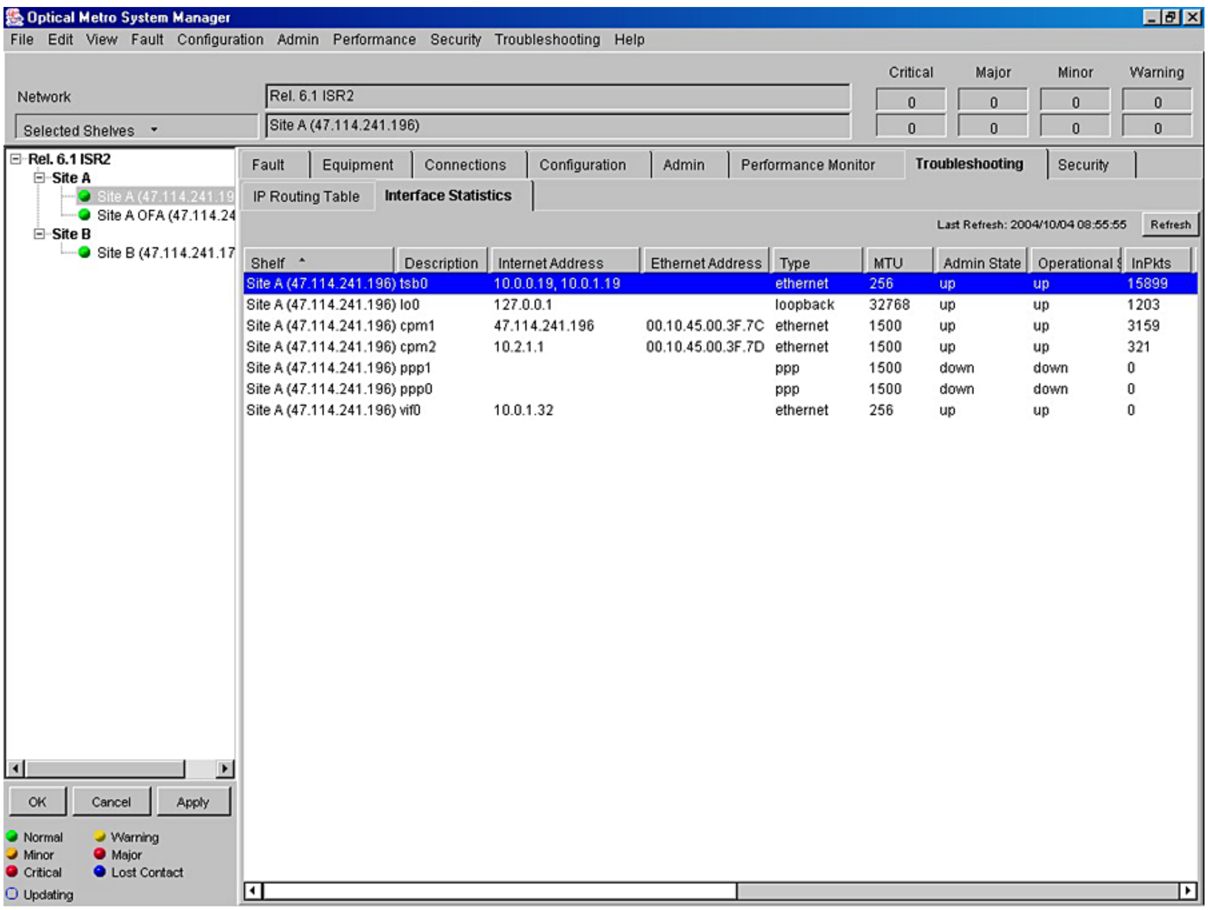
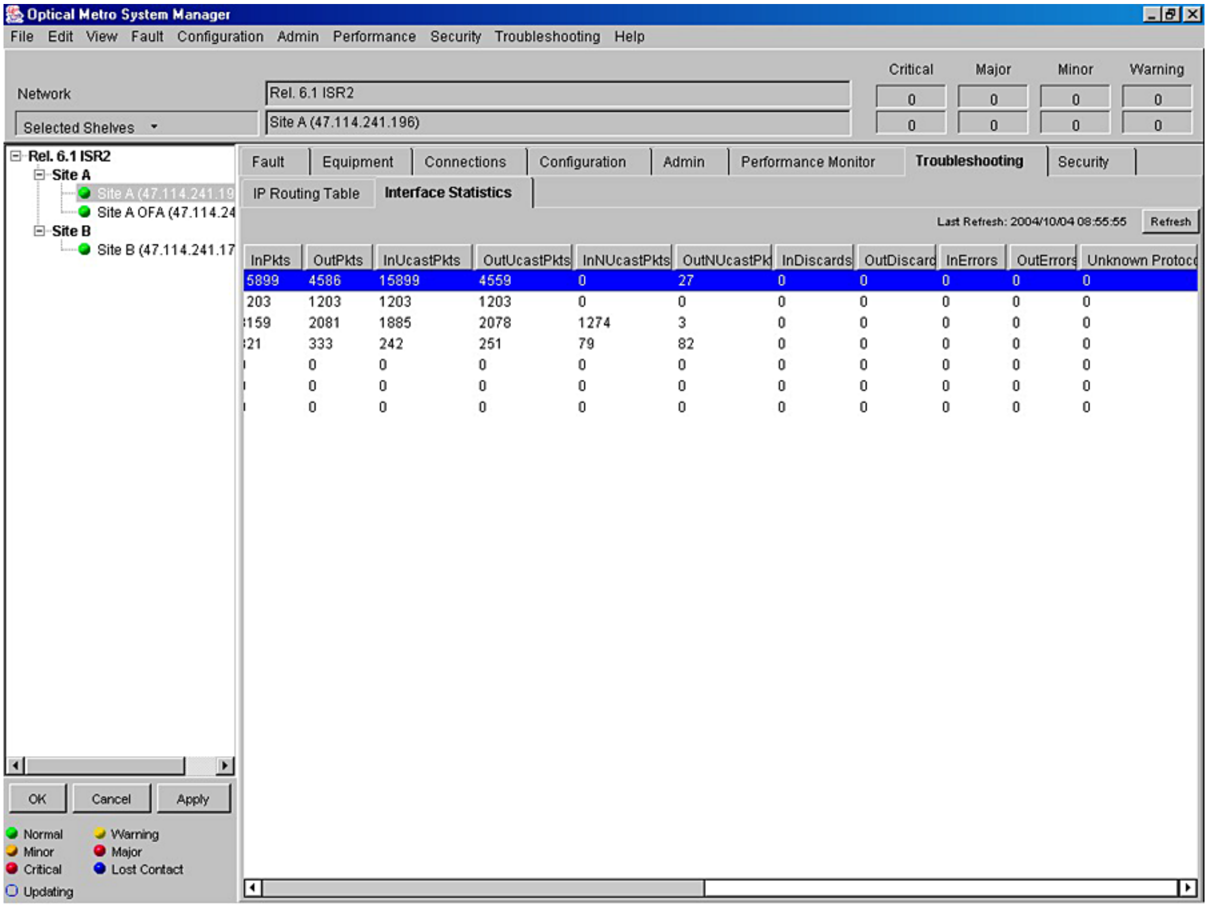


Figure 4-16
New Interface Statistics screen

OM2770p



Alarm Severity Provisioning

This feature allows nodal-based alarm severity provisioning for each individual alarm using System Manager. Once the alarm severity is provisioned, alarms are raised with the provisioned alarm severity. Also, the behavior of the shelf lamps (Critical, Major, Minor) and ACO (Alarm Cut Off) are consistent with the provisioned alarm severity.

If there is an active alarm during a provisioning change, the active alarm with the old alarm severity is cleared and the alarm is raised again with the new alarm severity.

Severity is the only attribute of an alarm that can be edited. All other alarm information, such as: alarm text, service effecting, etc., is not editable. This feature does not allow alarms to be disabled. Moreover, the alarm hierarchy is not altered by this feature. As a result, it is possible that a minor alarm mask a major alarm. For example, suppose the severity of the “Circuit pack mismatch” alarm is changed from major to minor, and the “Loss of Signal” severity is kept as default (i.e., major). Based on the alarm hierarchy, the “Circuit pack mismatch” alarm masks the “Loss of Signal” alarm. The shelf will raise a minor “Circuit pack mismatch” alarm instead of a major “Circuit pack mismatch” alarm.

The TL1 interface does not support the provisioning of alarm severity. However, it is consistent to the System Manager when reporting alarms. For example, if the LOS alarm is provisioned as Minor/NSA. Both System Manager and TL1 reports the LOS alarm as Minor/NSA whenever the LOS is raised.

System Manager changes

The System Manager provides the interface to provision the severity of individual alarms as Critical, Major, Minor, or Warning. Some alarms have dual severities; a severity for a service affecting condition and a severity for a non-service affecting condition. This feature allows each of these dual severities to be provisioned.

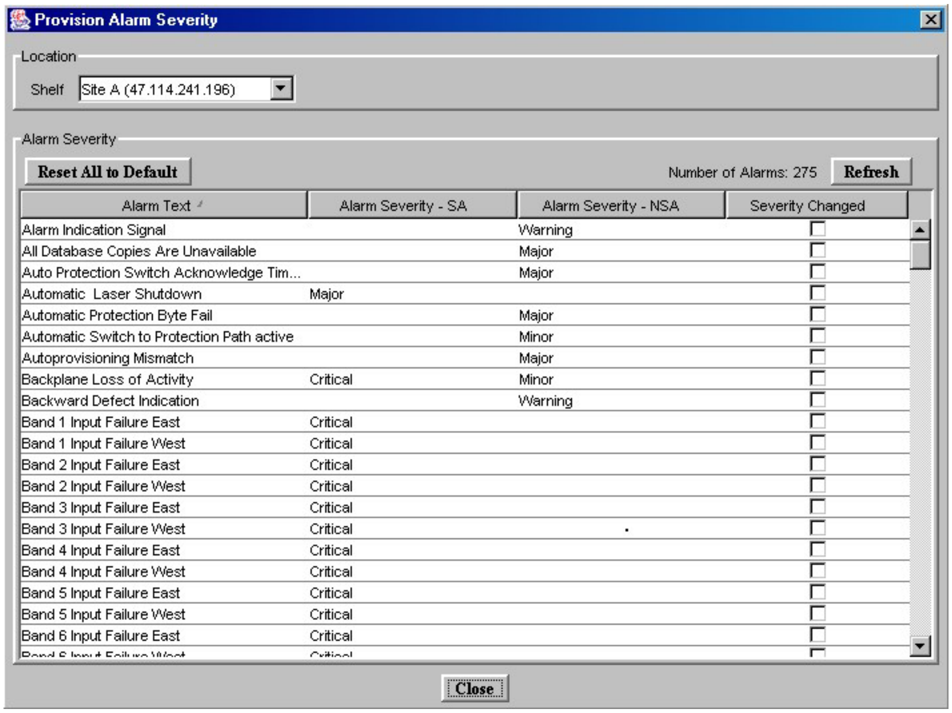
For each alarm, the System Manager provides an indication as to whether the alarm severity is default or not. It provides the ability to reset the alarm severity to the default value for an individual alarm or for all alarms.

A new menu item named **Provision Alarm Severity** is added to the **Edit** top level menu. This menu item is enabled only for users with the Admin user privilege class.

The Configure Alarm Severity screen (see Figure 4-17 on page 4-43) is displayed once the **Provision Alarm Severity** menu is selected.

Figure 4-17
Configure Alarm Severity screen

OM2773t



The **Shelf** field contains a list of shelf names provisioned in the network. The **Reset All to Default** button returns the alarm severity for all alarms back to their default state. Double-clicking a table row brings up the **Change Alarm Severity** window in order to change the selected alarm's severity (see Figure 4-18 and Figure 4-19 on page 4-44). The Reset Severity To Default check box is only enabled when the Alarm Severity Changed check box is checked.

Figure 4-18
Change Alarm Severity window for an alarm with dual severity

OM2774t

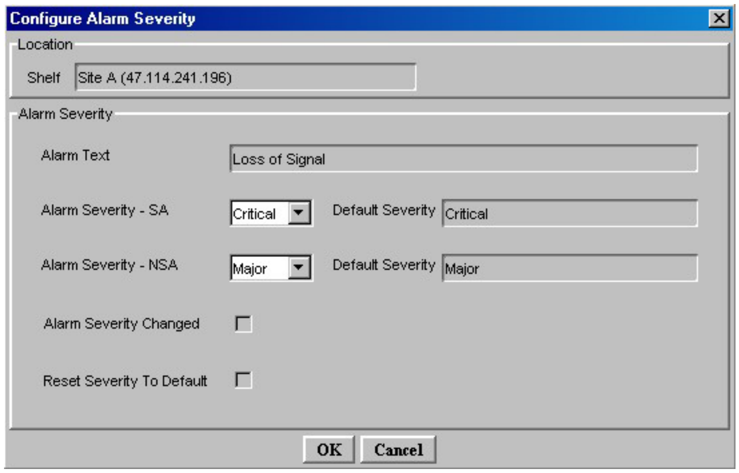
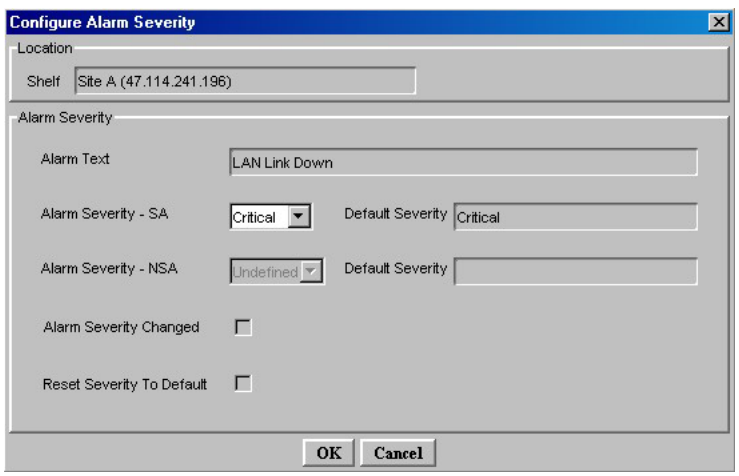


Figure 4-19
Change Alarm Severity window for an alarm with single severity

OM2775t



Alarm Indication Detail

This feature provides the following additional detailed information in alarm, event and log messages:

- sub card type
- signal layer information

The sub card type information is valid for most equipment and facility alarms but not for some shelf alarms, such as environment and telemetry alarms. The signal layer information is valid for most facility alarms but not for other alarms such as equipment or environment alarms.

System Manager changes

Alarm Details window from the Active Alarms screen

By double-clicking on an active alarm in the System Manager Active Alarms screen, the Alarm Details window is displayed. In the Alarm Details window (see Figure 4-20 on page 4-47), the following new parameters are added:

- Type: This field displays the provisioned card sub-type. For example, for the OCI card, the following OCI types can be displayed:
  - — 622MB Transparent
  - — 1.25GB Transparent 1310nm
  - — 1.25GB ISC
  - — 1.25GB Transparent 850nm
  - — 1.25GB GE 1310nm
  - — 1.25GB GE 850nm
  - — 2.5GB SONET/SDH
  - — 2.5GB Transparent

  Note: This field is displayed but left empty for alarms that are not raised against a specific circuit pack (e.g., shelf, environmental or telemetry alarms).

- Layer: This field displays the alarmed layer. For example, for the Muxponder 10 Gbit/s GbE/FC circuit pack, some of the alarm layers that can be displayed include:
  - — Line-Multiplex Section
  - — Path Group
  - — Optical channel Transport Unit

  Note: This field is not displayed if both Layer and Signal is unavailable.

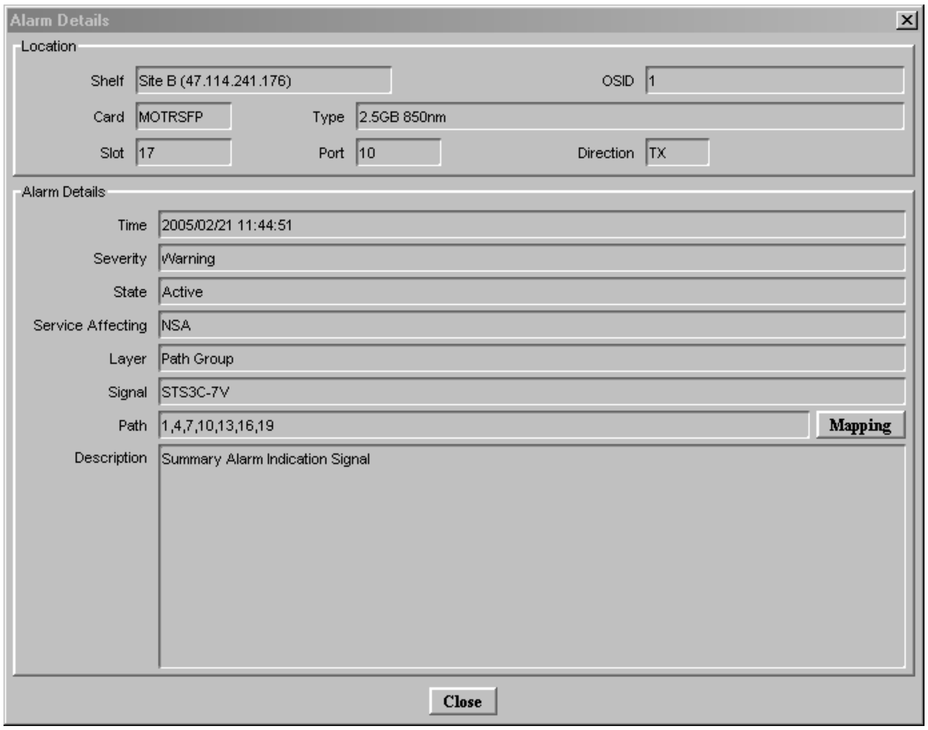
- Signal: This field displays the alarmed signal. For example, for the Muxponder 10 Gbit/s GbE/FC circuit pack, some of the alarm signals that can be displayed include:
  - — STS192
  - — STS3C-7V
  - — OTN2

  Note: This field is not displayed if both Layer and Signal is unavailable.

- Path: displays the affected client-side paths and is only applicable to summary path alarms raised by the Muxponder 10 Gbit/s circuit packs. When a path fault is detected on a path associated with a client-side facility, a summary path alarm is generated against the client-side facility. If a fault is detected on a different path associated with the same client-side facility, a new summary alarm is not raised. However, when a user double-clicks on the summary alarm in the Active Alarms list, the software polls the circuit pack to determine the existing faulty paths and this information is displayed in the Path field of the Alarm Details window.
  - — next to the path field is the Mappings button. When pressed, this button brings up the Client to Line Side Path Mappings screen (see Figure 2-20 on page 2-74) so that client-side paths can be correlated to line-side paths.

  Note: This Path field is not displayed if the path information is not unavailable.

Figure 4-20
Alarm Details window

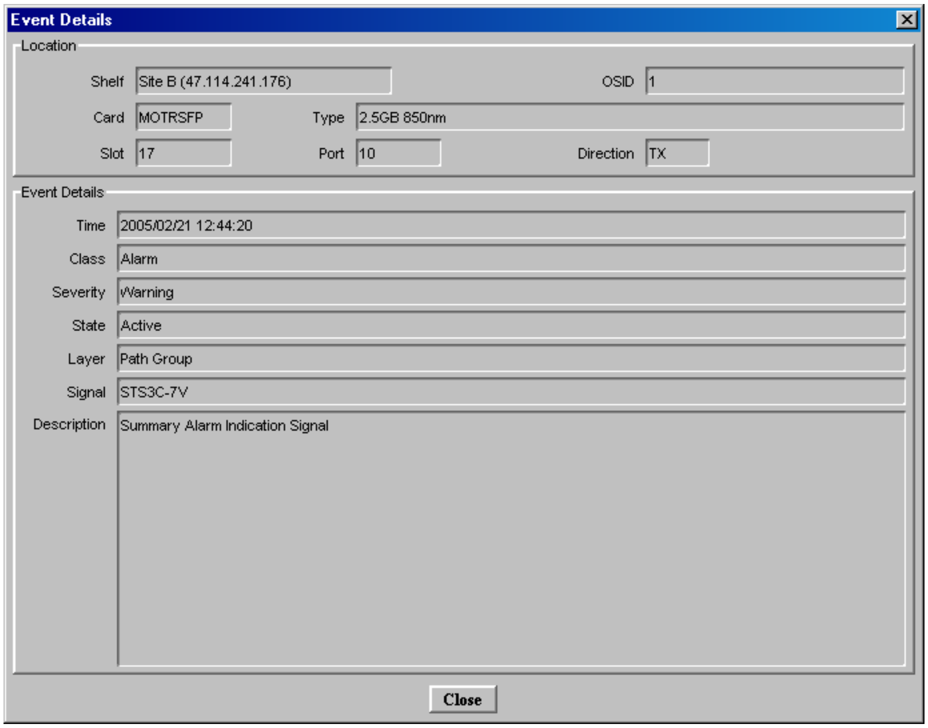


Event Details window from the Event Console screen

By double-clicking on an alarm in the System Manager Event Console screen, the Event Details window is displayed. In the Event Details window (see Figure 4-21 on page 4-48), the Type, Layer and Signal fields are added. The field definitions are the same as those presented above for the Alarm Details window.

Figure 4-21
Event Details window from the Event Console screen

OM2776t



Event Details window from the Event History screen

By double-clicking on an alarm in the System Manager Event History screen, the Event Details window is displayed. In the Event Details window (see Figure 4-22), the Type, Layer and Signal fields are added. The field definitions are the same as those presented above for the Alarm Details window.

This window also includes a new **Show Circuit Pack Event** button that provides the ability to tunnel deeper into the circuit pack to trace outstanding events against the circuit pack that may have contributed to the historical event. The events are actually stored and retrieved from the circuit pack. This functionality is only available on the Muxponder 10 Gbit/s circuit packs.

Figure 4-22
Event Details window from the Event History screen

OM2748t

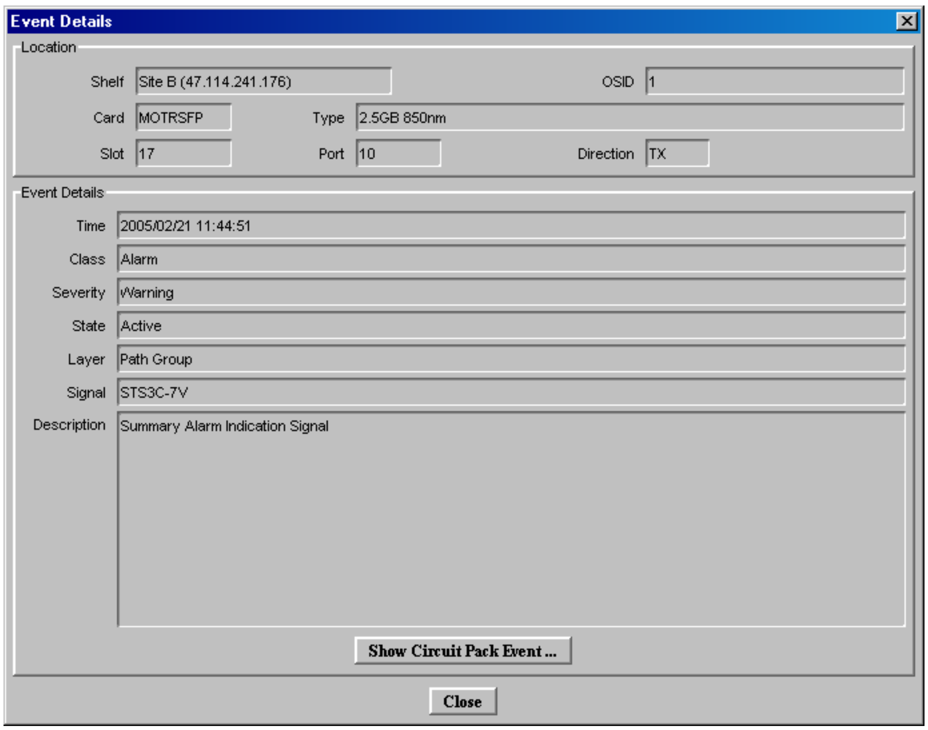
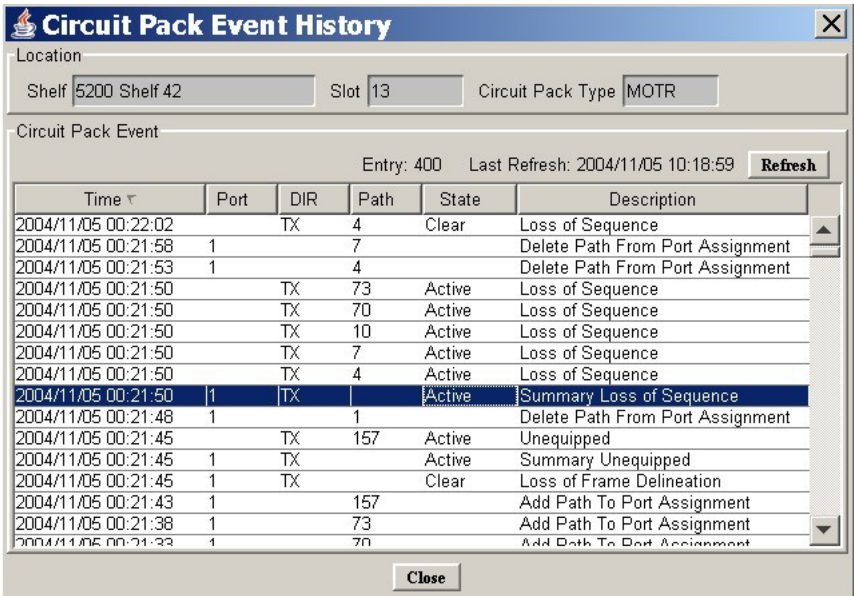


Figure 4-23
Circuit Pack Event History window

OM2749t



TL1 changes

TL1 changes introduced in Release 8.0 for this feature are described in "TL1 changes" on page 4-90.

SNMP changes

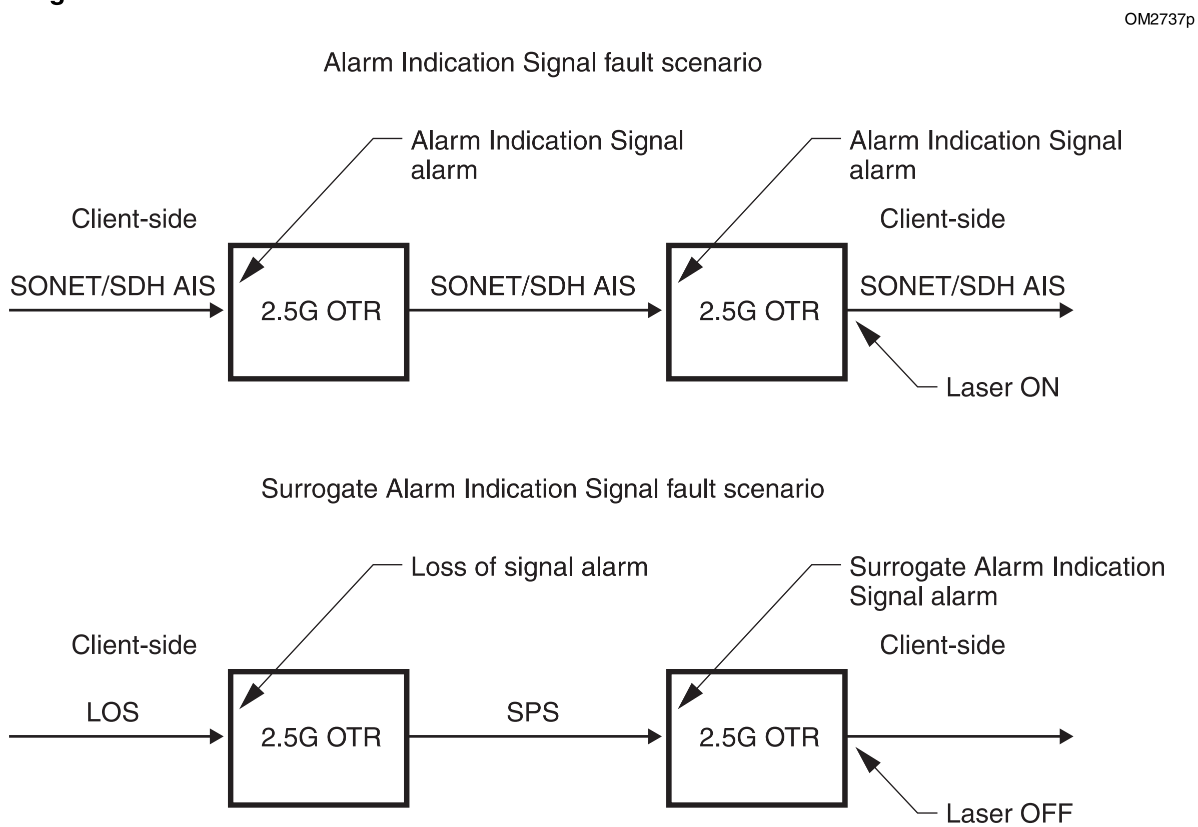
Additional information such as sub card type and signal layer is added to the active alarm table, log table and alarm traps (Critical, Major, Minor, Alert).

In addition, the subCardType is added to the physical equipment group as a new column(string) in the manufacturing data and provisioning data. The string is 32 bytes long and read-only.

New Surrogate Alarm Indication Signal alarm

This feature also distinguishes the Surrogate Payload Signal (SPS) fault from the SONET/SDH Alarm Indication Signal (AIS) fault. In previous releases, these two faults would raise the "Alarm Indication Signal" alarm. In Release 8.0, a new alarm "Surrogate Alarm Indication Signal" is raised for an SPS fault. The existing "Alarm Indication Signal" alarm is raised for the SONET/SDH AIS fault. See Figure 4-24 on page 4-51 for the different fault scenarios.

Figure 4-24
Surrogate AIS and AIS fault scenarios



All OTR 2.5 Gbit/s circuit packs and all OCLD circuit packs have the ability to inject and detect SPS. All OTR 2.5 Gbit/s circuit packs and all OCLD circuit packs (except OCLD 1.25 Gbit/s and OCLD 2.5 Gbit/s) have the ability to detect SONET/SDH AIS. When both fault conditions exist (SONET/SDH AIS and SPS), the Surrogate Alarm Indication Signal alarm masks the Alarm Indication Signal (SONET/SDH AIS) alarm.

OM Binning

In previous releases, OMs (Operational Measurements) only supported untimed counters. With this feature, the OM counters are put into bins as is done with the other performance parameters. The OM bins are stored on the circuit packs which collect them (not the Shelf Processor). The following bins for each OM exists:

- one current 15 minute bin
- 32 15 minute bins
- one current 1 day bin
- one previous day bin
- one untimed bin

Users can query these OM counters from System Manager, TL1 or SNMP. Users can reset OM bins on a specific circuit pack or all circuit packs in the shelf from System Manager or TL1. TL1 also supports the ability to reset all OM bins for a specific location (location is NE, slot, port, direction). The ability to reset a specific OM bin is not supported. Also, OM Threshold Crossing Alerts (TCAs) are not supported.

OM Handling

The Invalid data flag (IDF) is used to indicate that the data is not accurate because one or more event occurred. The following events could trigger IDF to be set:

- circuit pack reboot
- NE time change
- facility OOS
- SFP missing or mismatch
- channel assignment rate change
- user manually resets the current bins
- bin started too late
- counter overflow

Circuit pack reboot handling

If the Shelf Processor (SP) reboots, there is no impact on the OM counts since all OM data is stored on the circuit packs which collect them (not the SP). However, when the circuit pack that collects the OM data reboots, all the OM current bins and historical bins are reset to 0. IDF is set for the current 15 minute bin and current 1 day bin.

NE time change handling

The Network Element PM system collects and reports OM data according to GMT/UMT time. Under normal conditions, OM 'rolls over' current bins into previous bins and updates history at normal interval boundaries (at the quarter hour for 15 minute bins and midnight for day bins).

If the time change is within a current bin, the current bin continues to count. If the time change is outside a current bin, the current bin is closed and rolled into history. Counting continues in the new current bin.

If time change at one time is over 10 seconds, IDF is set.

Facility admin status change handling

OMs are counted only if there is channel assignment and the facility is in-service. When a facility admin status change occurs from IS to OOS, OMs stop counting and IDF is set for the current bins. When the facility admin status is changed back to IS, the OMs start counting from the value when it was set to OOS.

Channel assignment handling

When the channel assignment rate is changed, all OM bins are reset to 0 and the IDF flag is set for all the current bins.

OM counter reset handling

When the 15 minute bins are reset, IDF is set for the current 15 minute bin. When the 24 hour bins are reset, IDF is set for the current 24 hour bin.

Bin started too late handling

Non-SP circuit packs receive a rollover message every 15 minutes from the SP circuit pack. If for some reason, the message comes more than 10 seconds later, IDF is set for the current 15 minute bin and the current 1 day bin.

Counter overflow handling

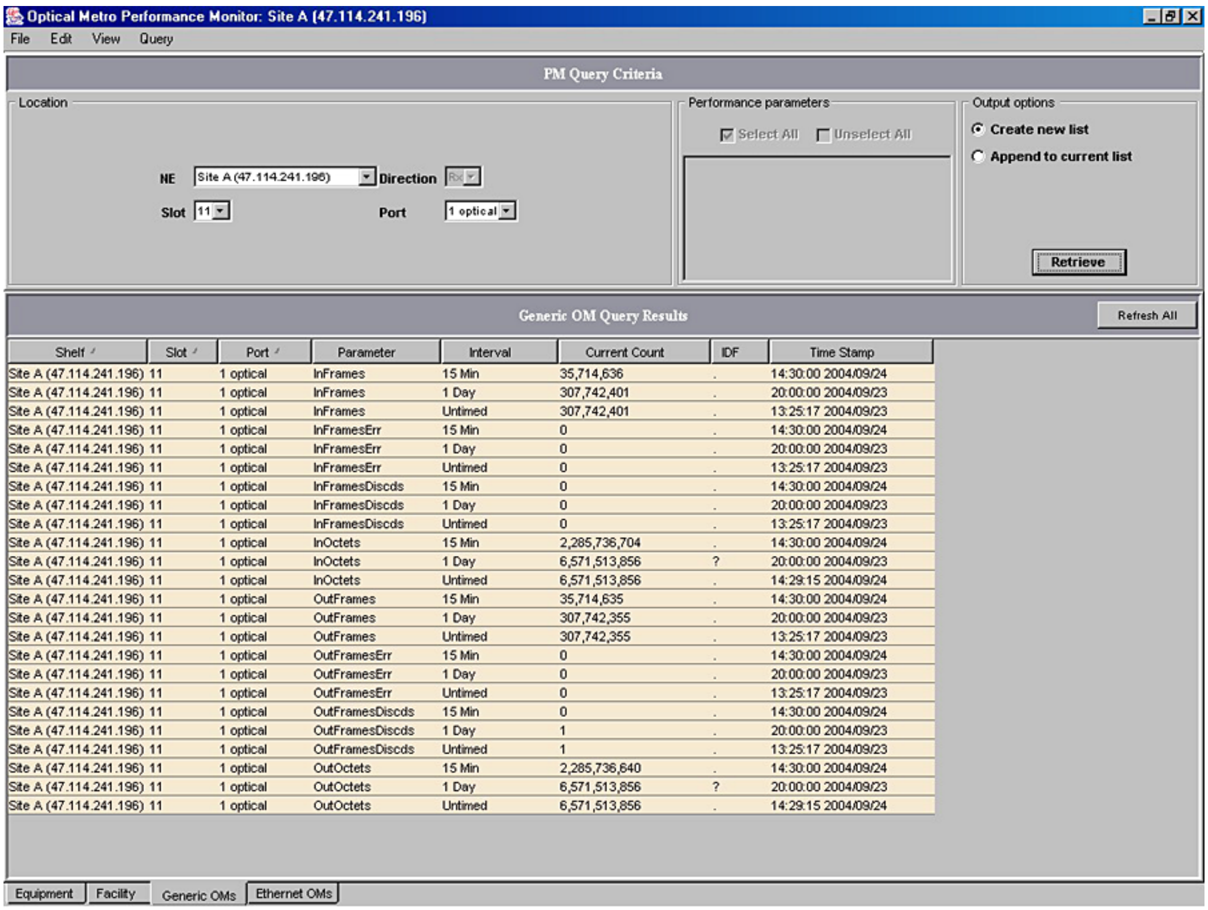
In the event of counter overflows, the counter remains at (the maximum count-1). IDF is set when overflow occurs.

System Manager changes

In previous releases, the Generic OM and Ethernet OM screen displayed all OMs for each location in one row. In Release 8.0, it is changed such that each OM has three rows: a 15 minute bin row, a 1 day bin row and an untimed bin row. Each row has the following fields: shelf, slot, port, parameter, interval, current count, IDF and time stamp see Figure 4-25).

Figure 4-25
Generic OM screen

OM2778p



Detailed information for a row is available by double-clicking on that row. This is similar to what is available for performance parameters (PPs). However, in the detailed window, support for TCA settings and per OM bin resetting is not available.

The Shelf Level Parameters screen, available by selecting the **Shelf level parameters** menu item in the **Edit** top level menu, is changed to include the Reset all OM counts option.

The Card Level Parameters screen, available by selecting the **Shelf level parameters** menu item in the **Edit** top level menu, is changed to include the Reset all 15 Min OM counts option, Reset all 1 Day OM counts and Reset all Untimed OM counts options.

TL1 changes

TL1 changes introduced in Release 8.0 for this feature are described in "TL1 changes" on page 4-90.

SNMP changes

SNMP is modified to add a new table for the OM bins. The OM query interface is also modified to allow query on a per OM basis.

Provisionable PM Bin Zero Suppression

The Optical Metro 5100/5200 Performance Monitoring (PM) system maintains history bins. There are 32 history bins for 15 minute bin readings. Normally the current 15 minute bin rolls over into the history bin and is cleared to begin counting for the next 15 minute period.

With zero suppression, the current bin is not rolled over into history if it has no count (equal to 0) and the bin does not have an Invalid Data Flag (IDF). In this way the history bins contain only the last 32 time periods with non-zero counts and not simply the last eight hours of data (32 x 15 minutes).

This feature introduces a new user settable parameter which provides more control over zero suppression. The user can choose between one of three settings for the shelf:

- All Zero Suppression: all PM modes perform zero suppression
- No Zero Suppression: no zero suppression for all PM modes
- SDH Zero Suppression: perform zero suppression only for SDH PM mode

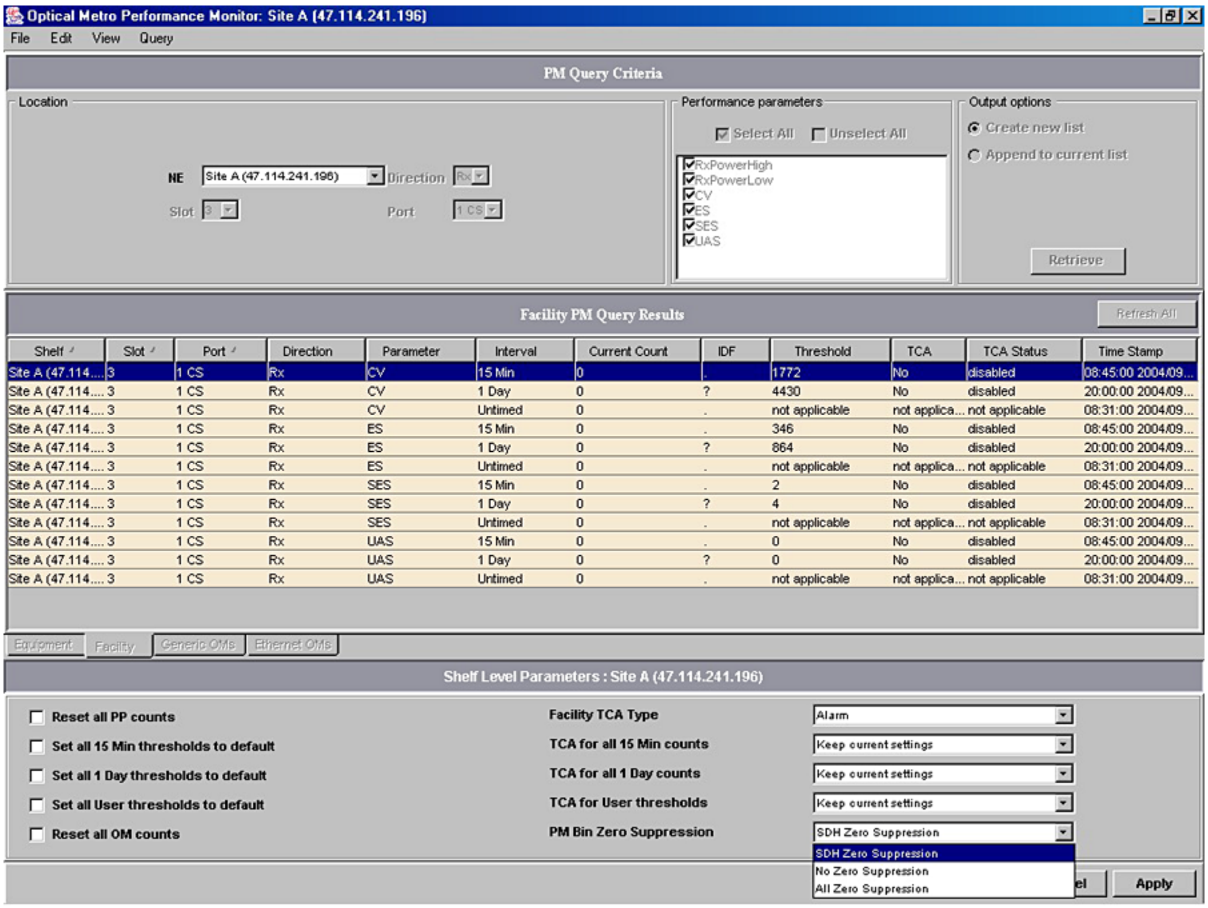
SDH Zero Suppression is the default setting to maintain consistency with previous releases.

System Manager changes

The Shelf Level Parameters screen, available by selecting the **Shelf level parameters** menu item in the **Edit** top level menu, is changed to include the PM Bin Zero Suppression option (see Figure 4-26).

Figure 4-26
Shelf Level Parameters screen

OM2782p



TL1 changes

TL1 changes introduced in Release 8.0 for this feature are described in "TL1 changes" on page 4-90.

Security Enhancements

The security enhancements introduced in Release 8.0 provide the following additions to the existing security functionality:

- Ability to change the centralized user password through RADIUS protocol using System Manager or TL1
- Idle timeout configurable on a user account basis
- Idle timeout on System Manager sessions

Ability to change the centralized user password through RADIUS protocol using System Manager or TL1

Two password changing scenarios are supported:

- System forced password change
- User requested password change

The centralized users password change request and response is sent to and received from the shelf through an encrypted proprietary communication protocol.

Changing the centralized user's password through RADIUS protocol using System Manager or TL1 is only supported with OMEA that has an embedded RADIUS server. Third-party RADIUS servers require a customized solution to support password changes through the RADIUS protocol. This is due to the lack of a standard RADIUS solution for this operation.

System forced password change

In this scenario, the user is forced to change their password. Here are the steps for this scenario:

- User attempts to log into an Optical Metro 5100/5200 shelf after his/her password has expired or has been reset by the administrator.
- The System Manager or TL1 interface prompts the user to change their password.
- After the user enters the new password along with the old password, this password change request is sent to the local host shelf. This shelf forwards the request to the RADIUS client residing on the security gateway Optical Metro 5100/5200 shelf.
- The RADIUS client formats an Access-Request message with the new password as a vendor specific attribute and the old password as the standard attribute in the password field and sends this message to the RADIUS server.
- The RADIUS server processes the Access-Request with password change. If the new password is accepted, an Access-Accept message is sent to the RADIUS client and the user is granted access. If the password change is

rejected, an Access-Reject is sent to the RADIUS client with a reason for the password change failure and the System Manager or TL1 interface prompts the user to change their password again.

User requested password change

In this scenario, the password change is requested by individual users. Anytime the user issues the **ED-PID** TL1 command or selects System Manager's **Change Password** menu option in the **Security** top level menu, the password change request is sent to the local host shelf. The local host shelf forwards the request to the RADIUS client and triggers the password change through the RADIUS protocol.

Alarm/event strategy

A security event is generated by the shelf when the centralized user password is changed using the System Manager or TL1 interface. No event is generated if the password is changed from OMEA.

Idle timeout configurable on a user account basis

The idle timeout configurable on a user account basis feature operates in both local and centralized authentication mode. The local user idle timeout interval is configurable on the shelf using TL1 or System Manager. The centralized user idle timeout is also configurable from OMEA and is returned to the shelf upon a successful login. Only admin level users can provision the idle timeout. The supported value range is 0 to 999 minutes. Default is 30 minutes, 0 means disable. If a shelf is upgraded from a previous release to Release 8.0, all local user idle timeout values are set to 0.

Idle timeout on System Manager sessions

System Manager session idle timeout operates in both local and centralized authentication modes. Upon a successful login, the System Manager session receives the configured idle timeout value from the shelf. From the value that is received from the shelf, the System Manager then sets its idle timer. If there is no key stroke or mouse click for the configured time interval, the System Manager prompts the user to either continue or terminate the session.

TL1 session idle timeout was introduced in Release 6.1 and continues to be supported in Release 8.0.

System Manager changes

Centralized user password change

When a system forced password change occurs, System Manager pops up the password change prompt. The user can also change their password using the **Change Password** menu option in the **Security** top level menu. This is enabled in Release 8.0 for the centralized users, allowing password changing at any time.

Idle timeout configurable on a user account basis

A new column named **Idle Timeout** is added to the System Manager User Profile List screen available from the User Profile List menu option in the Security top level menu (see Figure 4-27). The idle timeout field is also added to the Add User (see Figure 4-28 on page 4-61) and the Modify User (see Figure 4-29 on page 4-61) dialog boxes.

Figure 4-27
User Profile List screen

OM2783p

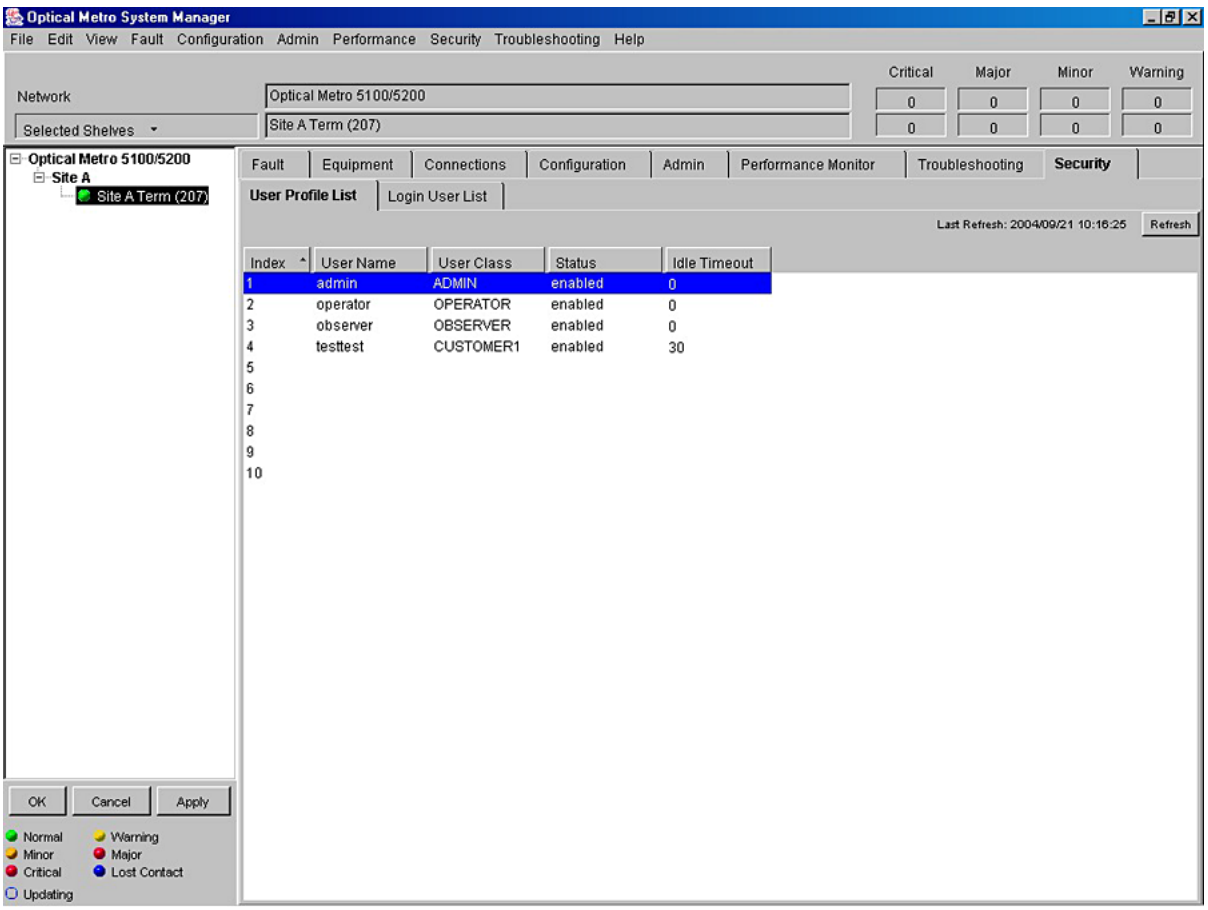


Figure 4-28
Add User window

OM2784t

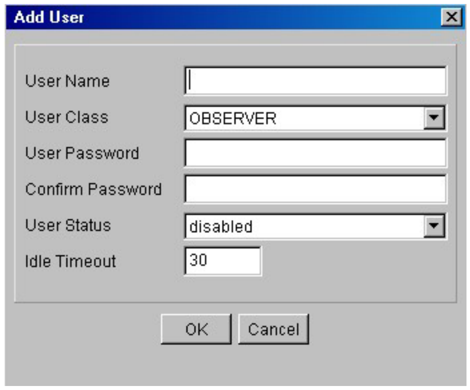
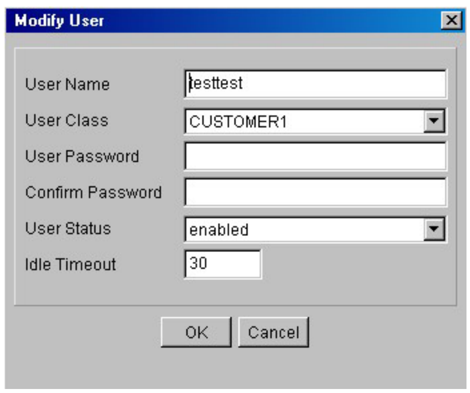


Figure 4-29
Modify User window

OM2785t



TL1 changes

TL1 changes introduced in Release 8.0 for this feature are described in "TL1 changes" on page 4-90.

SNMP changes

A new field that represents the user account idle timeout value is added to adminUserAccountTable.

OC-3/STM-1 support on OTR 2.5 Gbit/s Flex 1310 nm 100 GHz circuit pack

In Release 8.0, the OTR 2.5 Gbit/s Flex 1310 nm 100 GHz circuit pack supports the OC-3 and STM-1 protocols.

DMIF protocol support

In Release 8.0, DMIF protocol support is added to the following circuit packs:

- OTR 2.5 Gbit/s Flex/Universal 1310 nm
- OTR 2.5 Gbit/s Flex/Universal ITU CWDM 1310 nm
- OTR 2.5 Gbit/s Flex/Universal CWDM 1310 nm
- OTR 2.5 Gbit/s Flex 1310 nm 100 GHz
- OCLD 2.5 Gbit/s Flex/Universal (for pass-through purposes only, not for connections to OCIs)

DMIF (Director Multiple Interface Facility) is a high speed protocol (960 Mbit/s) that consists of four ESCON signals.

Supported performance monitoring modes

The supported PM modes for the DMIF protocol are SFC and None.

Supported optical protocols

For the list of supported DMIF protocols, see Table 4-9 on page 4-63.

Notes about the Protocol table

- The attenuator and reach values refer to the client-side of the network.
- Since various fiber losses exist, the tables list both a maximum allowed loss and a maximum distance. The maximum distance is calculated from the maximum loss based on the allowed fiber loss for a given protocol.
- The attenuator values apply to the Optical Metro 5100/5200 Tx and Rx only, and are required for minimum overload protection when the subtending equipment is co-located with the Optical Metro 5100/5200 equipment. The attenuator value can be traded off for fiber loss as long as the input power to the receiver meets the minimum overload specification.
- The attenuator values provided are minimum values. For example, if the table indicates that a 1 dB pad is needed, an 2 dB pad can be used.
- In most cases, the attenuator does not limit the reach. However, there are certain cases where the attenuator will limit the reach. In this case, the reach specified is with the attenuator removed.

Table 4-9
DMIF protocols

Protocol	Bit rate	System Manager menu name	Protection scheme	Attenuator value for colocation		Fiber type	Reach
				Tx	Rx		
DMIF (10 km)	960 Mbit/s	DMIF	Protected	1	0	SM	1.5 dB, BER=10^{-15} 3 km (see Note:)
			Unprotected	3	0		5.5 dB, BER=10^{-15} 11 km (see Note:)
DMIF (20 km)	960 Mbit/s	DMIF	Protected	1	0	SM	3.5 dB, BER=10^{-15} 7 km (see Note:)
			Unprotected	3	0		7.5 dB, BER=10^{-15} 15 km (see Note:)
Note: The distance is estimated using the assumption of 0.5 dB/km installed fiber loss including splices and cable margins for 1310 nm systems.							

System Manager changes

The Channel Assignment screen is modified to include the new DMIF Bit Rate for the above mentioned circuit packs.

TL1 changes

TL1 changes introduced in Release 8.0 for this feature are described in “TL1 changes” on page 4-90.

Orion protocol support

In Release 8.0, Orion protocol support is added to the following circuit packs:

- OTR 2.5 Gbit/s Flex/Universal 1310 nm
- OTR 2.5 Gbit/s Flex 1310 nm 100 GHz
- OCLD 2.5 Gbit/s Flex/Universal (for pass-through purposes only, not for connections to OCIs)

The Orion protocol is a high speed protocol (1.08 Gbit/s) proprietary to International Fiber Systems Incorporated and their Orion Optical Fiber Communication System.

Supported performance monitoring modes

The supported PM modes for the Orion protocol are SFC and None.

Supported optical protocols

For the list of supported Orion protocols, see Table 4-10 on page 4-64.

Notes about the Protocol table

- The attenuator and reach values refer to the client-side of the network.
- Since various fiber losses exist, the tables list both a maximum allowed loss and a maximum distance. The maximum distance is calculated from the maximum loss based on the allowed fiber loss for a given protocol.
- The attenuator values apply to the Optical Metro 5100/5200 Tx and Rx only, and are required for minimum overload protection when the subtending equipment is co-located with the Optical Metro 5100/5200 equipment. The attenuator value can be traded off for fiber loss as long as the input power to the receiver meets the minimum overload specification.
- The attenuator values provided are minimum values. For example, if the table indicates that a 1 dB pad is needed, an 2 dB pad can be used.
- In most cases, the attenuator does not limit the reach. However, there are certain cases where the attenuator will limit the reach. In this case, the reach specified is with the attenuator removed.

Table 4-10
Orion protocol

Protocol	Bit rate	System Manager menu name	Protection scheme	Attenuator value for colocation		Fiber type	Reach
				Tx	Rx		
Orion	1080 Mbit/s	Orion	Protected	0	0	SM	6 dB, BER=10^{-12} 12 km (see Note:)
			Unprotected	1	0		10 dB, BER=10^{-12} 20 km (see Note:)

Note: The distance is estimated using the assumption of 0.5 dB/km installed fiber loss including splices and cable margins for 1310 nm systems.

System Manager changes

The Channel Assignment screen is modified to include the new Orion Bit Rate for the above mentioned circuit packs.

TL1 changes

TL1 changes introduced in Release 8.0 for this feature are described in “TL1 changes” on page 4-90.

SRM and ESCON SRM interoperable topologies using OTR

This feature expands upon the interoperable topologies supported by the OCI SRM 1310 nm, OCI SRM 1310 nm LC and OCI ESCON SRM circuit packs.

Implementing interoperable topologies with OCI SRM ESCON circuit packs

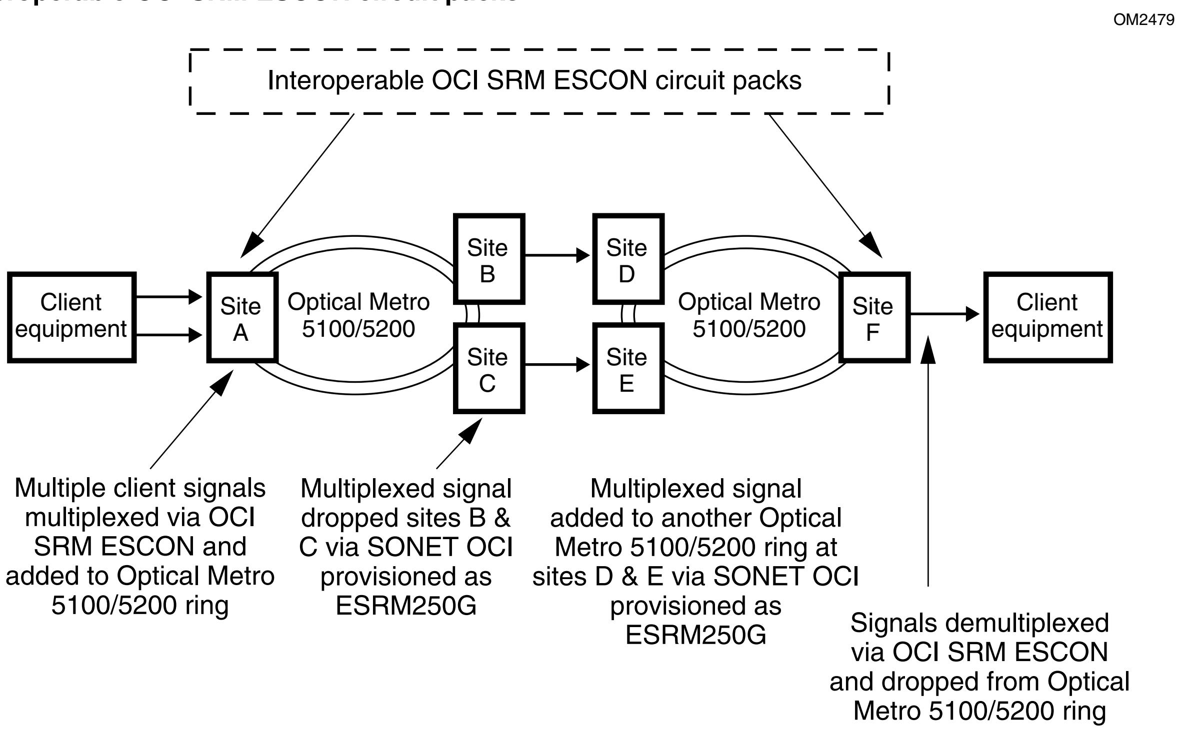
You can implement interoperable topologies with OCI SRM ESCON circuit packs. Figure 4-30 shows OCI SRM ESCON circuit packs configured in an interoperable topology. In this example, the interoperable topology is used for dual homing protection. The OCI SRM ESCON circuit packs are paired at Sites A and F.

In previous releases, the only valid OCI circuit pack for sites B, C, D, and E is the SONET/SDH OCI (which must be provisioned with the ESRM-250 protocol).

In Release 8.0, you can also use the following circuit packs for sites B, C, D, and E (which must be provisioned with the ESRM-250 protocol):

- OTR 2.5 Gbit/s Flex/Universal 1310 nm
- OTR 2.5 Gbit/s Flex 100 GHz 1310 nm

Figure 4-30
Interoperable OCI SRM ESCON circuit packs



Implementing interoperable topologies with OCI SRM 1310 nm and OCI SRM 1310 nm LC circuit packs

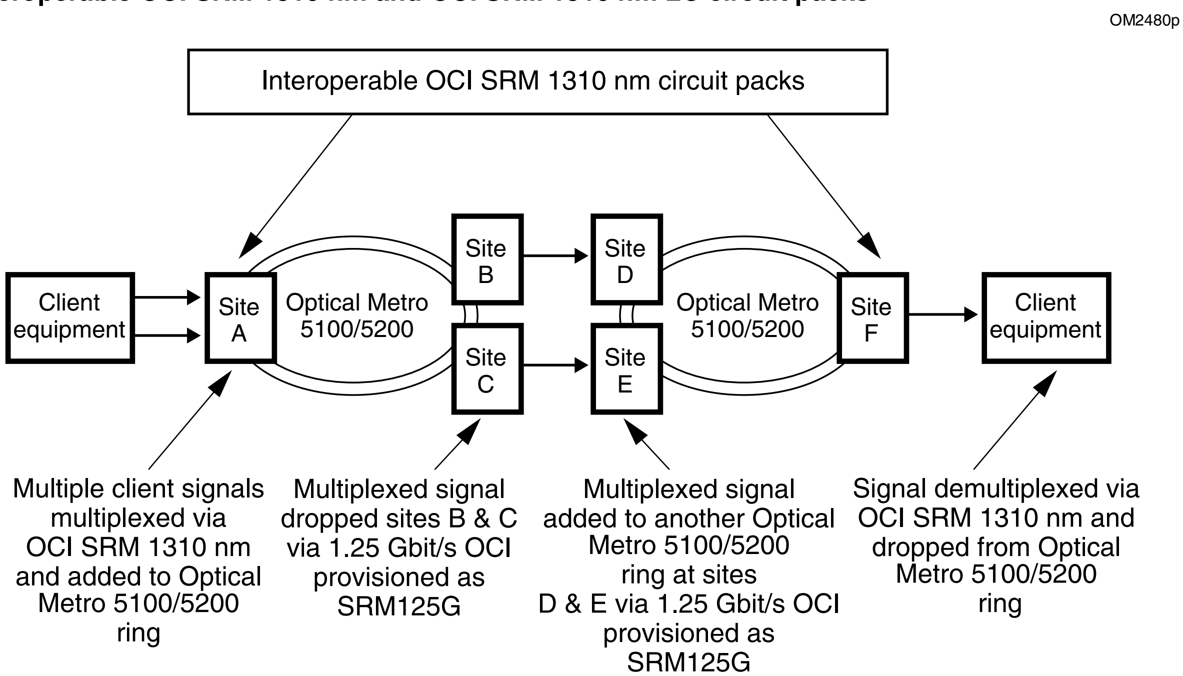
You can implement interoperable topologies with OCI SRM 1310 nm and OCI SRM 1310 nm LC circuit packs. Figure 4-31 shows OCI SRM 1310 nm circuit packs configured in an interoperable topology. In this example, the interoperable topology is used for dual homing protection. The OCI SRM 1310 nm circuit packs are paired at Sites A and F.

In previous releases, the only valid OCI circuit pack for sites B, C, D, and E is the OCI 1.25 Gbit/s (which must be provisioned with the SRM-125 protocol).

In Release 8.0, you can also use the following circuit packs for sites B, C, D, and E (which must be provisioned with the SRM-125 protocol):

- OTR 2.5 Gbit/s Flex/Universal 1310 nm
- OTR 2.5 Gbit/s Flex 100 GHz 1310 nm

Figure 4-31
Interoperable OCI SRM 1310 nm and OCI SRM 1310 nm LC circuit packs



Supported performance monitoring modes

The supported PM modes for the SRM-125 protocol are SFC and None.

The supported PM modes for the ESRM-250 protocol are SONET, SDH and None.

Supported optical protocols

For the list of supported SRM-125 and ESRM-250 protocols, see Table 4-11 on page 4-67.

Notes about the Protocol table

- The attenuator and reach values refer to the client-side of the network.
- Since various fiber losses exist, the tables list both a maximum allowed loss and a maximum distance. The maximum distance is calculated from the maximum loss based on the allowed fiber loss for a given protocol.
- The attenuator values apply to the Optical Metro 5100/5200 Tx and Rx only, and are required for minimum overload protection when the subtending equipment is co-located with the Optical Metro 5100/5200 equipment. The attenuator value can be traded off for fiber loss as long as the input power to the receiver meets the minimum overload specification.
- The attenuator values provided are minimum values. For example, if the table indicates that a 1 dB pad is needed, an 2 dB pad can be used.
- In most cases, the attenuator does not limit the reach. However, there are certain cases where the attenuator will limit the reach. In this case, the reach specified is with the attenuator removed.

Table 4-11
SRM125G and ESRM250G protocol

Protocol	Bit rate	System Manager menu name	Protection scheme	Attenuator value for colocation		Fiber type	Reach
				Tx	Rx		
SRM-125	1250 Mbit/s	SRM-125	Protected	0	0	SM	8 dB, BER=10^{-10} 14 km (see Note:)
			Unprotected	0	0		12 dB, BER=10^{-10} 21 km (see Note:)
ESRM-250	2488.32 Mbit/s	ESRM-250	Protected	0	0	SM	8 dB, BER=10^{-10} 14 km (see Note:)
			Unprotected	0	0		12 dB, BER=10^{-10} 21 km (see Note:)

Note: The distance is estimated using the assumption of 0.55 dB/km installed fiber loss including splices and cable margins for 1310 nm systems.

System Manager changes

The Channel Assignment screen is modified to include the SRM-125 and ESRM-250 Bit Rates for the above mentioned circuit packs.

TL1 changes

TL1 changes introduced in Release 8.0 for this feature are described in "TL1 changes" on page 4-90.

OCI SRM GbE, OCI SRM GbE/FC and OCI SRM GbE/FC Enhanced circuit pack enhancements

GFP FCS inclusion/exclusion for all supported protocols

GFP Frame Check Sequence (FCS) occupies 4 bytes in the GFP frame. You can provision the GFP FCS to be included in the GFP frame (provisioned as Enable) or excluded from the GFP frame (provisioned as Disable). This allows interoperability with GFP equipment that does not support the FCS field. This parameter can be provisioned on the OCI SRM GbE, OCI SRM GbE/FC and OCI SRM GbE/FC Enhanced circuit packs.

Note 1: Note that the GFP Conditioning parameter must be in the Enable state in order to change the GFP FCS parameter.

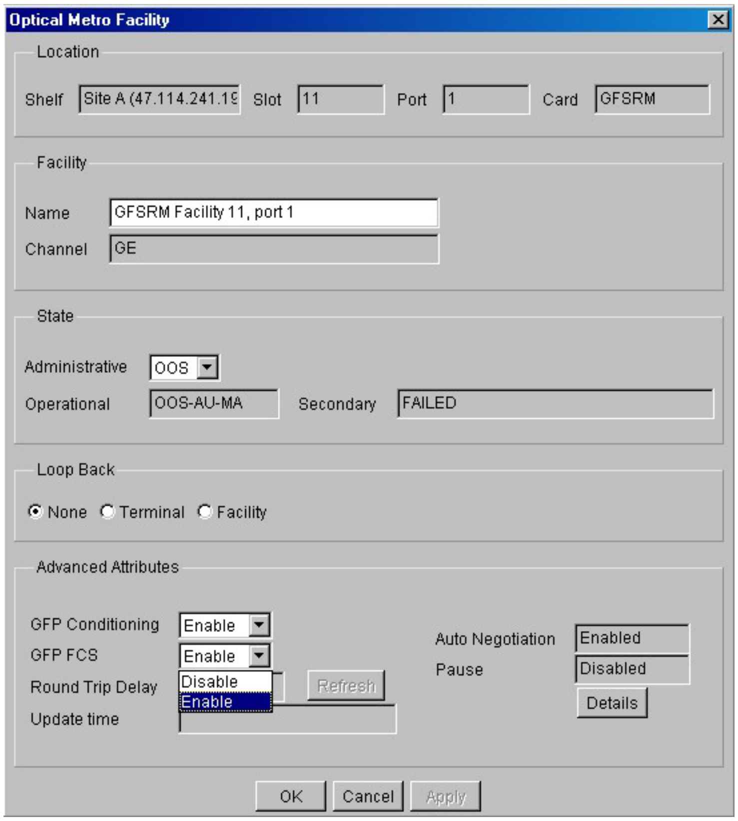
Note 2: This parameter can also be provisioned on the Muxponder 10 Gbit/s GbE/FC circuit pack and the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

System Manager changes

The System Manager Detailed Facility screen for the OCI SRM GbE, OCI SRM GbE/FC and OCI SRM GbE/FC Enhanced circuit packs is modified to include the new GFP FCS field (see Figure 4-32).

Figure 4-32
OCI SRM GbE, OCI SRM GbE/FC and OCI SRM GbE/FC Enhanced circuit pack Detailed Facility screen

OM2787t



TL1 changes

TL1 changes introduced in Release 8.0 for this feature are described in "TL1 changes" on page 4-90.

AOC (Automatic Output Control) provisionable conditioning holdoff

Table 4-12 summarizes the client-side signal conditioning applied on the client ports of OCI SRM GbE, OCI SRM GbE/FC and OCI SRM GbE/FC Enhanced circuit packs upon different fault and provisioning conditions.

Table 4-12
Client-side conditioning

Circuit pack	Condition	Protocol	Action
OCI SRM GbE/FC	• Line-side fault • Line-side facility OOS • Far-end client-side fault • Far-end client-side facility OOS • No channel assignment at far-end OCI	Gigabit Ethernet	Laser shutdown
		FC-100/FICON	8B/10B error code
	• Client-side facility OOS • Circuit pack failure • No channel assignment	Any	Laser shutdown
OCI SRM GbE/FC Enhanced	• Line-side fault • Line-side facility OOS • Far-end client-side fault • Far-end client-side facility OOS • No channel assignment at far-end OCI	Gigabit Ethernet	Laser shutdown
		FC-100/FICON and subrate enabled	FC idles
		FC-100/FICON and subrate disabled	8B/10B error code
	• Client-side facility OOS • Circuit pack failure • No channel assignment	Any	Laser shutdown
OCI SRM GbE	• Line-side fault • Line-side facility OOS • Far-end client-side fault • Far-end client-side facility OOS • No channel assignment at far-end OCI • Client-side facility OOS • Circuit pack failure • No channel assignment	Gigabit Ethernet	Laser shutdown

The AOC (Automatic Output Control) Provisionable hold off timer (0 ms to 1000 ms, 100 ms steps) can be used to hold off the conditioning indicated in the Action column of Table 4-12 on page 4-70. Defaults are 0 ms for unprotected channel assignments and 500 ms for protected channel assignments.

> ***Note 1:*** The holdoff does not apply when the client-side facility is put in the OOS state. In this case, the laser is shutdown as soon as the facility is put OOS.
>
> ***Note 2:*** This parameter can also be provisioned on the Muxponder 10 Gbit/s GbE/FC circuit pack and the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

The holdoff time is implemented to prevent Optical Metro 5100/5200, OTS or ETS protection switches from impacting the subtending equipment. During an Optical Metro 5100/5200, OTS or ETS protection switch, the subtending equipment will not know that a switch actually occurred in terms of the physical level protocol. This prevents the subtending equipment from bringing down the link and causing extended outage times during protection switching.

See Table 4-13 for action during the holdoff period.

Table 4-13
Actions during the holdoff period

Circuit pack	Protocol	Action
OCI SRM GbE/FC	Gigabit Ethernet	Gigabit Ethernet idles
	FC-100/FICON	8B/10B error code
OCI SRM GbE/FC Enhanced	Gigabit Ethernet	Gigabit Ethernet idles
	FC-100/FICON and subrate enabled	FC idles
	FC-100/FICON and subrate disabled	8B/10B error code
OCI SRM GbE	Gigabit Ethernet	Gigabit Ethernet idles

System Manager changes

The System Manager Detailed Channel Assignment screen (see Figure 4-33 on page 4-72) is modified for the OCI SRM GbE, OCI SRM GbE/FC and OCI SRM GbE/FC Enhanced circuit packs to include a new Advanced button to access the Channel Assignment Advance Details screen and the new AOC Holdoff attribute (see Figure 4-34 on page 4-72).

Figure 4-33
OCI SRM GbE, OCI SRM GbE/FC and OCI SRM GbE/FC Enhanced circuit pack Detailed Channel Assignment screen

OM2790t

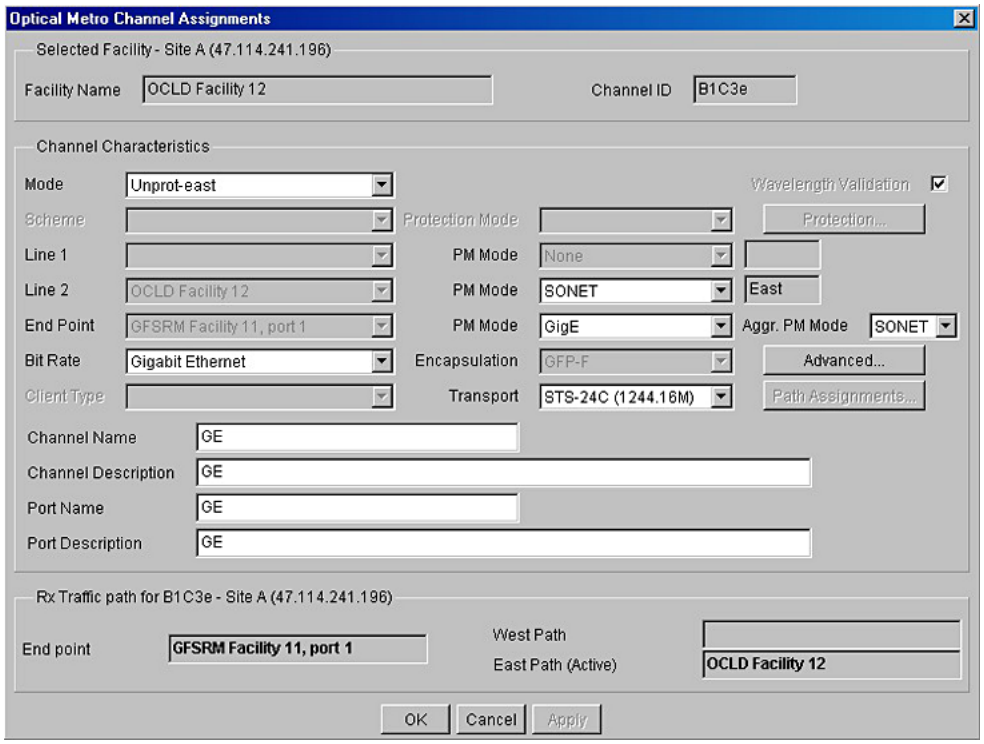
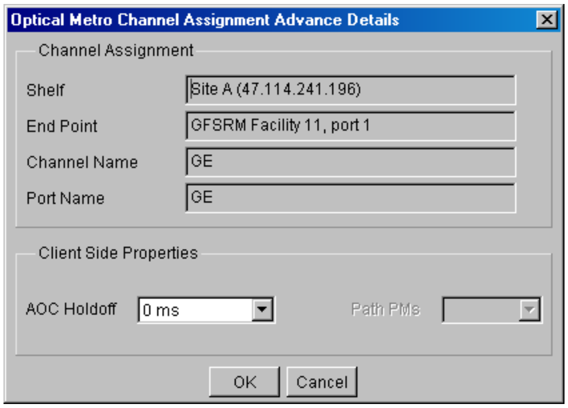


Figure 4-34
OCI SRM GbE, OCI SRM GbE/FC and OCI SRM GbE/FC Enhanced circuit pack Channel Assignment Advance Detail screen

OM2791t



TL1 changes

TL1 changes introduced in Release 8.0 for this feature are described in "TL1 changes" on page 4-90.

GFP Encapsulation

On the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack, the Gigabit Ethernet protocol can be supported in both the GFP-T and GFP-F modes. For the OCI SRM GbE, OCI SRM GbE/FC and OCI SRM GbE/FC Enhanced circuit packs and the FC-100, FC-200, FICON and FICON Express protocols, a new read only parameter is introduced to reflect the mode that is actually being used. See the Encapsulation field in Figure 4-33 on page 4-72.

Inventory support for OADM ITU CWDM OMXs

Release 7.0 introduced the following OADM ITU CWDM OMXs:

- 2 variants (1471, 1491, 1511, 1531 nm and 1551, 1571, 1591, 1611 nm) of the OMX 4CH OADM ITU CWDM
- 8 variants (1471, 1491, 1511, 1531, 1551, 1571, 1591, and 1611 nm) of the OMX 1CH OADM ITU CWDM

This Release 8.0 feature provides the following System Manager and TL1 functionality for the OADM ITU CWDM OMXs:

- inventory support
- provisioning and deprovisioning operations
- alarming

Alarm Strategy

The alarm strategy for the OADM ITU CWDM OMXs is consistent with other passive trays.

- The Optical Tray Missing alarm is raised if the monitor cable is disconnected after the OMX has been provisioned.
- The Optical Tray Mismatch alarm is raised if the data retrieved from the OMX is different from what has been provisioned.

System Manager changes

OMX provisioning wizard

The System Manager OMX provisioning wizard screen is modified as follows:

- for the OMX 4CH OADM ITU CWDM, as was the case with the OMX 4CH ITU CWDM, the “Multi-Band ITU” option from the OMX Type chooser field is used to provision this OMX type. Selection of this OMX type populates the:
  - Band selection box with “ITU4” and the # of Channels box with 4 or
  - Band selection box with “ITU8” and the # of Channels box with 8
  - a new wavelength field is added and is editable when the OMX type is ITU4 (see Figure 4-35 on page 4-74)

Note: This new wavelength field also appears for other OMX types but is not editable. The wavelength field displays the wavelength or wavelengths (the minimum and maximum wavelength values are displayed) supported by the OMX.

- for the OMX 1CH OADM ITU CWDM, the "Single Band ITU" option is added to the OMX Type chooser field. When selected it lists bands 1-8 in the Band list and the corresponding wavelength is shown in the wavelength list. See Figure 4-36 on page 4-74.

Figure 4-35
OMX 4CH ITU Optical Metro Inventory - Add wizard screen

OM2788t

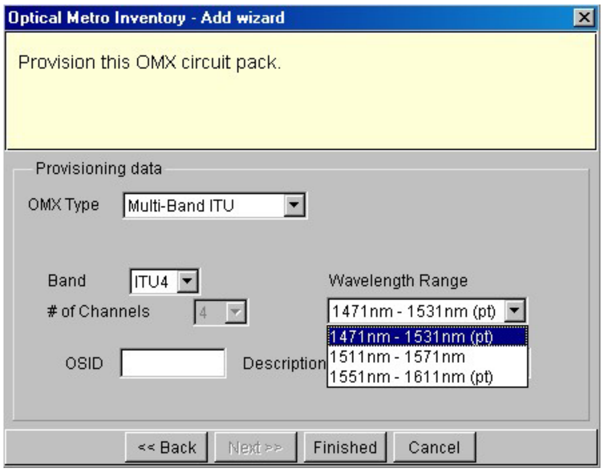
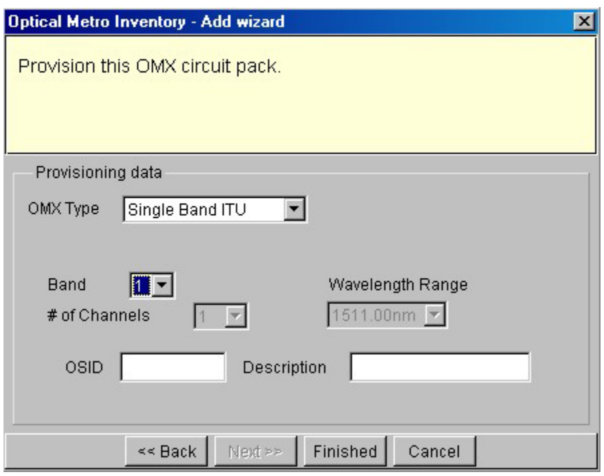


Figure 4-36
OMX 1CH ITU Optical Metro Inventory - Add wizard screen

OM2792t

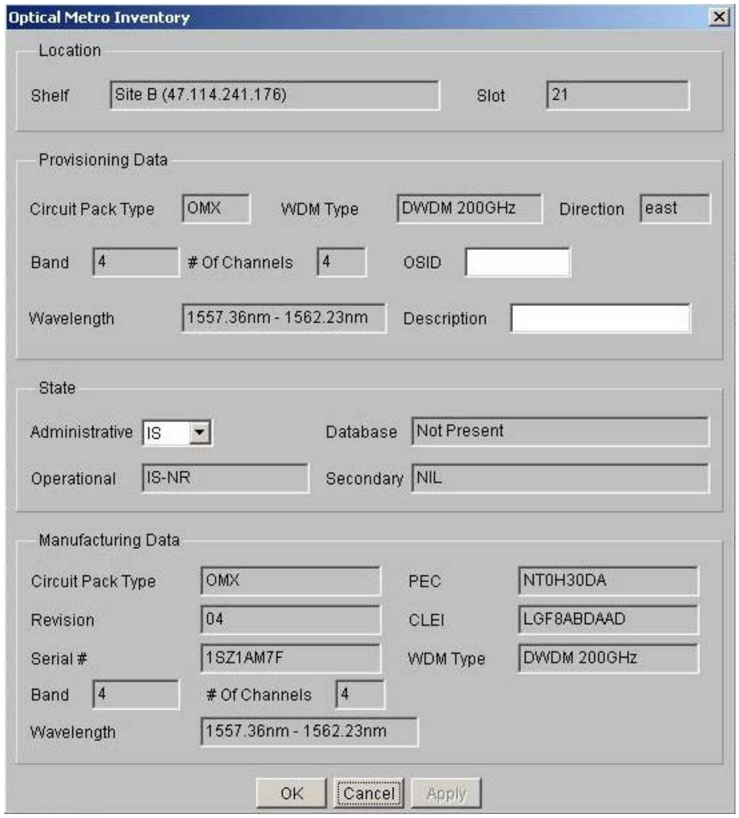


OMX Equipment Details screen

The System Manager OMX Equipment Details screen (see Figure 4-37 on page 4-75) is modified to include the new wavelength field.

Figure 4-37
OMX Equipment Details screen

OM2798t



TL1 changes

TL1 changes introduced in Release 8.0 for this feature are described in “TL1 changes” on page 4-90.

Inventory support for DSCMs

Release 8.0 introduces the following System Manager and TL1 functionality:

- DSCM inventory support
- DSCM provisioning and deprovisioning operations
- DSCM alarming

Alarm Strategy

The alarm strategy for the DSCMs is consistent with other passive trays.

- The Optical Tray Missing alarm is raised if the monitor cable is disconnected after the DSCM has been provisioned.
- The Optical Tray Mismatch alarm is raised if the data retrieved from the DSCM is different from what has been provisioned.

System Manager changes

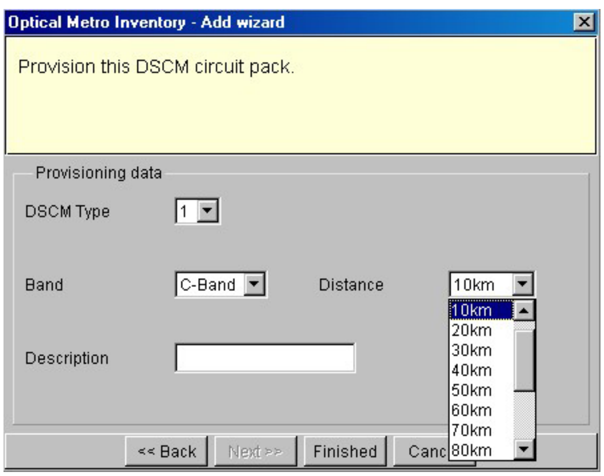
DSCM provisioning wizard

The System Manager DSCM provisioning wizard screen is added and includes the following fields:

- DSCM Type: This field can only be set to “1” in Release 8.0.
- Band: Possible values are C-Band or L-Band
- Distance: Possible values are 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, or 140 km
- Description: User provisionable DSCM description

Figure 4-38
DSCM Optical Metro Inventory - Add wizard screen

OM2789t



TL1 changes

TL1 changes introduced in Release 8.0 for this feature are described in “TL1 changes” on page 4-90.

New OFA and APBE Locations

In previous releases, OFA and APBE/APBE Enhanced circuit pack provisioning required users to provision the OFA and APBE/APBE Enhanced location as either Pre, Post, or Thru. Release 8.0 introduces two new OFA and APBE/APBE Enhanced locations: Pre2 and Thru2. This is to support the dual OFA topologies when two OFAs are placed back-to-back in a pre-amplifier or a thru-amplifier topology (see “Dual OFA optical layer topologies” on page 3-25 for more information).

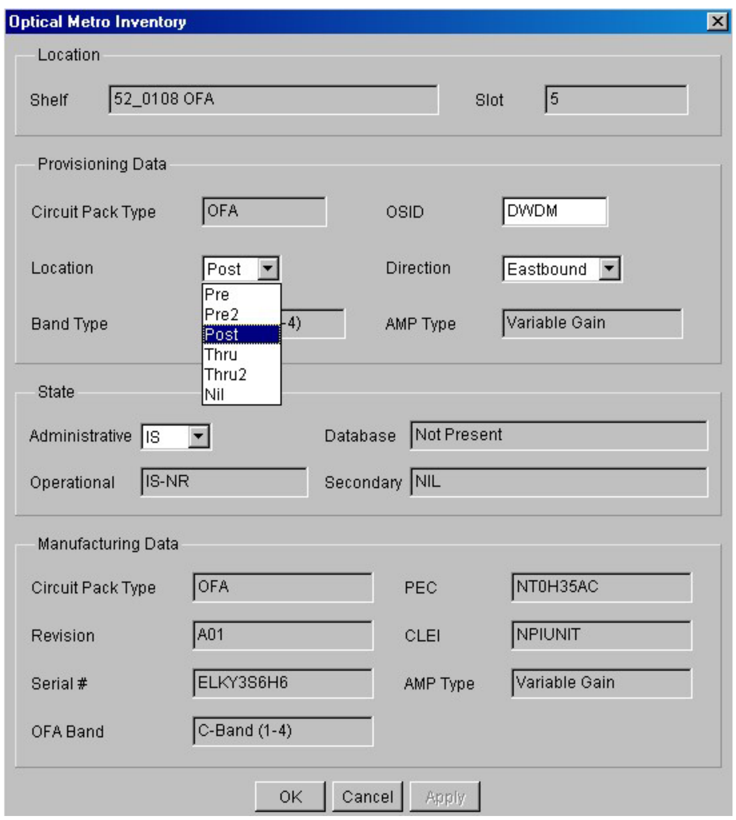
System Manager changes

OFA equipment screen

The System Manager OFA equipment screen (see Figure 4-39) is modified by the addition of the Pre2 and Thru2 options for the location field. A similar change is done for the APBE/APBE Enhanced equipment screen.

Figure 4-39
OFA equipment screen

OM2793t



TL1 changes

TL1 changes introduced in Release 8.0 for this feature are described in “TL1 changes” on page 4-90.

APBE associated equipment attributes

In previous releases, users could provision the type of device the APBE physically connects to. The possible values a user could provision was OFA Standard or OFA HIP. Once provisioned, it sets a maximum output power target that software uses when the individual band facilities are put in-service to ensure that Rx overload values on the OFA are not exceeded. In Release 8.0, users can now also provision OFA VGA or DSCM as valid equipment that connect to an APBE/APBE Enhanced.

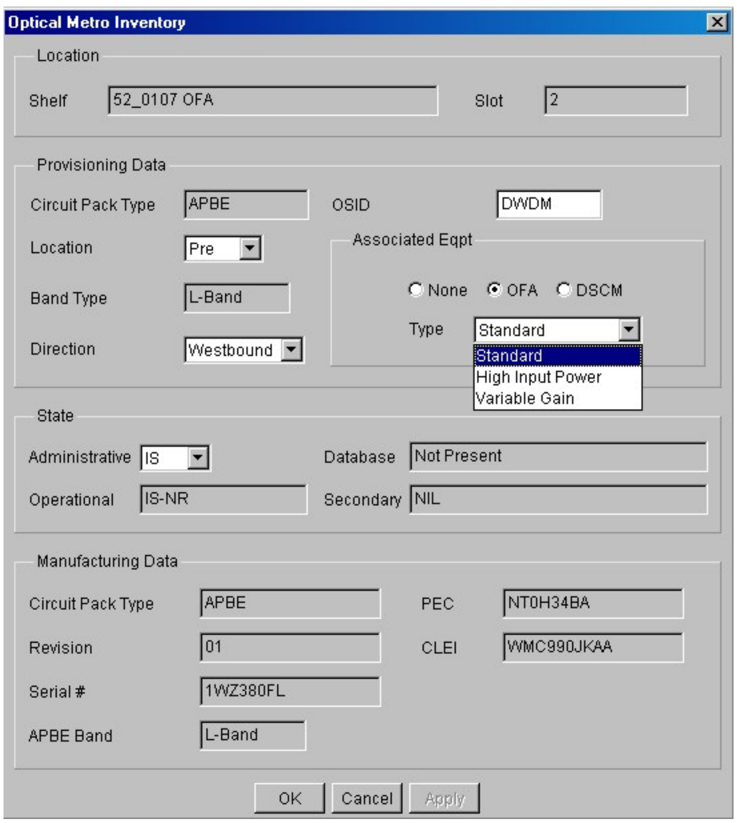
System Manager changes

APBE/APBE Enhanced equipment screen

The System Manager APBE/APBE Enhanced equipment screen (see Figure 4-40) is modified to include new Associated Eqpt attributes. This identifies the equipment the APBE/APBE Enhanced connects to.

Figure 4-40
APBE/APBE Enhanced equipment screen

OM2794t



TL1 changes

TL1 changes introduced in Release 8.0 for this feature are described in "TL1 changes" on page 4-90.

New Component Level Power Equalization System Manager screens

In previous releases, System Manager supported component level power equalization on APBE/APBE Enhanced circuit packs using a menu item selection (see Figure 4-41). It did not provide a means to monitor the equalization progress status except for the generation of events. In Release 8.0, the new System Manager screen as shown in Figure 4-42 on page 4-80 is displayed when the Equalize menu item is selected. Equalization is started when the user clicks on the Adjust Power button and equalization status can be monitored using the Power Control Status field and the Refresh button. Equalization status events are also generated. A similar screen is also available for the OFA VGA circuit pack (see Figure 4-43 on page 4-80).

Figure 4-41
Equalization menu item selection

OM2795p

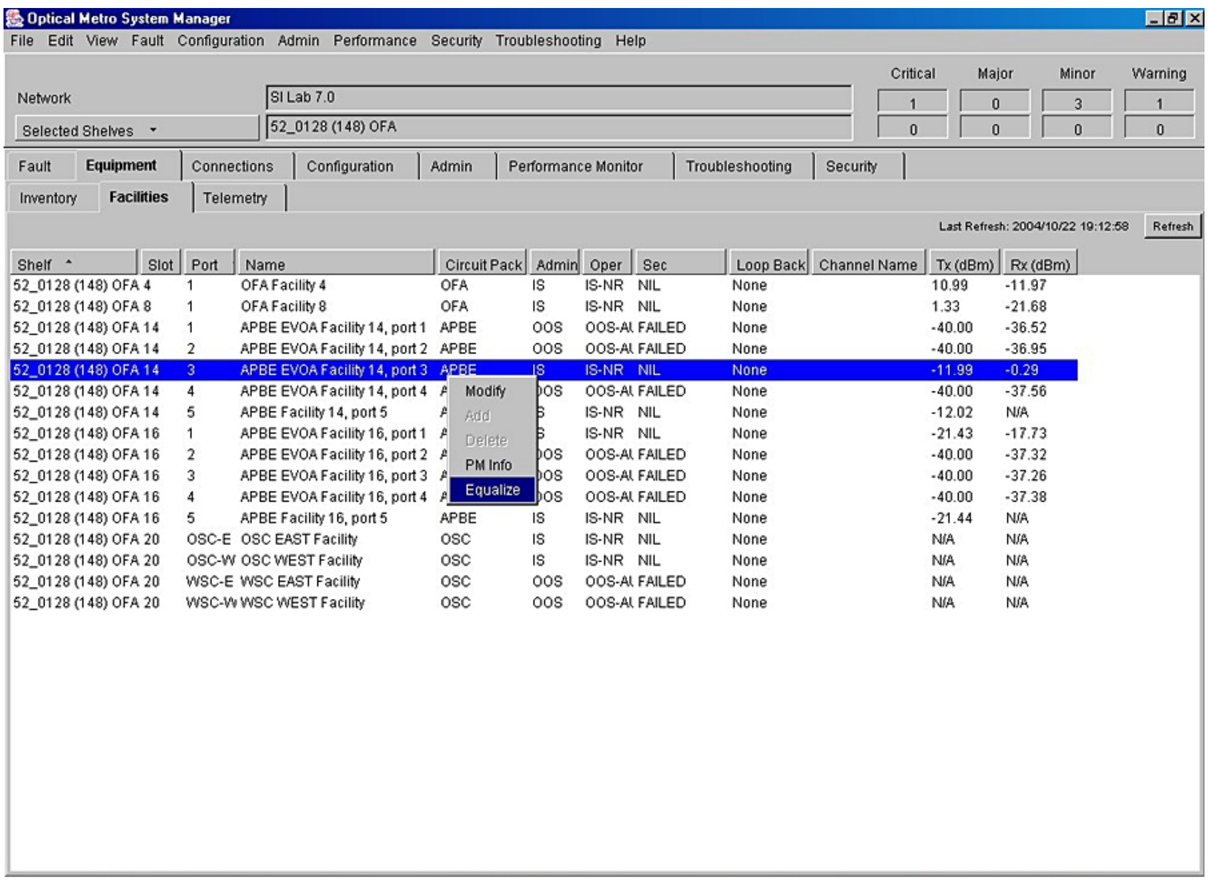


Figure 4-42
APBE/APBE Enhanced Component Level Power Equalization screen

OM2796t

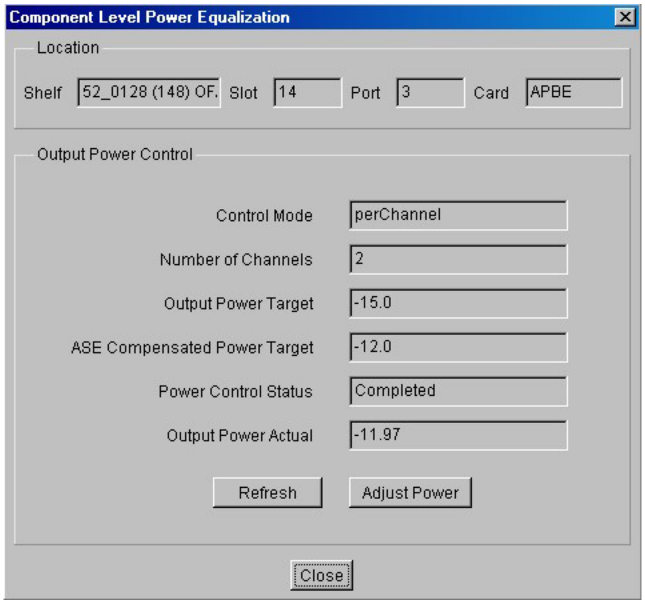
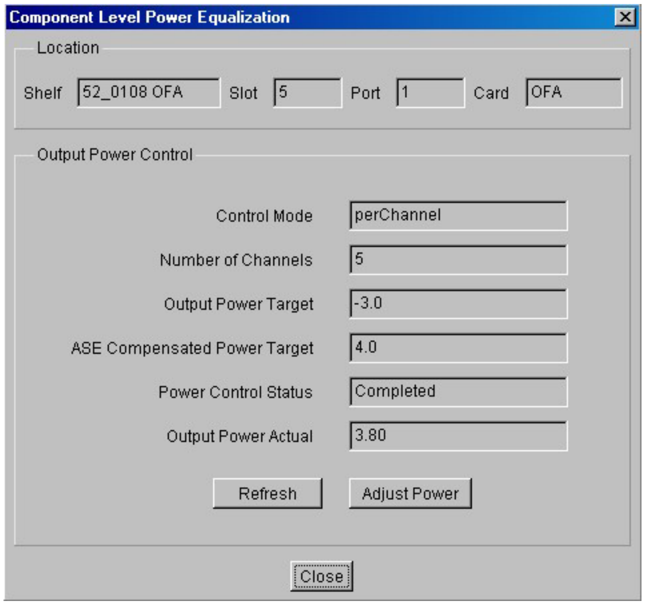


Figure 4-43
OFA VGA Component Level Power Equalization screen

OM2797t



System Software upgrade support

The following system software upgrade paths are supported in Release 8.0:

- Release 6.0 to Release 8.0
- Release 6.1 to Release 8.0
- Release 7.0 to Release 8.0
- Release 7.01 to Release 8.0

System Manager requirements

The Optical Metro 5100/5200 System Manager specifications required in Release 8.0 are shown in Table 4-14.

Table 4-14
Minimum platform requirements for the System Manager computer

Component	**Solaris 8**	**Windows 2000/ Windows NT** (See Note 1 and Note 4)	**Windows XP**
Machine type	Ultra 5	Pentium II - 266 MHz (See Note 2)	Pentium III - 500 MHz
RAM	128 Mbyte	Minimum: 64 Mbyte Recommended: 128 Mbyte (See Note 2)	256 Mbyte
Display settings	VGA 800 x 600 pixels true color (32-bit) (See Note 3)	VGA 800 x 600 pixels true color (32-bit) (See Note 3)	VGA 800 x 600 pixels true color (32-bit) (See Note 3)
Software environment	• Common Desktop Environment (CDE) and Netscape Communicator 4.76 • Exceed Version 9.0 (See Note 5)	Internet Explorer 5.5 or Netscape Communicator 4.75/4.76 (See Note 6)	Internet Explorer 6.0
Space available on drive C	310 Mbytes (See Note 7)	300 Mbytes (See Note 7)	300 Mbytes
Virtual memory	256 Mbytes	Double the size of the allocated RAM (128 or 256 Mbytes)	Double the size of the allocated RAM (512 Mbytes)
Environment source	CD-ROM	CD-ROM	CD-ROM
Plug-in	Java plug-in 1.4.1_05	Java plug-in 1.4.1_05	Java plug-in 1.4.1_05
Plug-in source	CD	CD	CD

Table 4-14 (continued)
Minimum platform requirements for the System Manager computer

Component	Solaris 8	Windows 2000/ Windows NT (See Note 1 and Note 4)	Windows XP
Plug-in patches	(none)	(none)	(none)
Ethernet adapter	10BASE-T	10BASE-T	10BASE-T
Networking	TCP/IP	TCP/IP	TCP/IP

Note 1: Service Pack 2 or later required for Windows 2000 (Service Pack 3 is recommended if you will be using the “file save” function on the System Manager to save files on a network drive instead of on the System Manager computer local disk). Service Pack 5 or later required for Windows NT.

Note 2: The minimum Windows 2000/NT requirement for managing a ring network with more than 12 shelves is 128 Mbyte of RAM with a Pentium 266 processor. If you want to manage a ring network of more than 12 shelves and run several System Manager sessions at one time, with other applications running in the background, you will need more memory and a faster processor. For example, for a large ring network of 40 shelves, Nortel Networks recommends 256 Mbyte of RAM and a Pentium III 500 MHz (or more) processor.

Note 3: Nortel Networks recommends that you use a setting of 1024 x 768 pixels.

Note 4: When viewing the Nortel Networks Technical Publications (NTPs) on a computer running Windows 2000, it is recommended to close the Bookmarks pane in Adobe Acrobat for clearer viewing.

Note 5: Exceed permits applications that normally are only available on UNIX workstations, to be accessed from Windows-based PCs. This feature supports the ability to launch System Manager using Exceed version 9.0. Although this method of displaying System Manager is functionally operational, it is expected that the display is not as aesthetically pleasing as a standalone System Manager session due to inter-platform font transformations. Some display issues can be reduced if the PC’s video card supports the display of 3D graphics.

Note 6: You can run a maximum of eight System Manager sessions from a single computer, as long as the computer has 64 Mbyte available for each session. However, Nortel Networks recommends that you run no more than five System Manager sessions at a time for best performance. You cannot run the System Manager simultaneously from both types of browsers on a single computer.

Note 7: If proper space is allocated for virtual memory disk caching of RAM, this space can be reduced to 110 Mbyte. Refer to the manual for your operating system to allocate space.

Alarm changes

Table 4-15 lists the alarm changes in Release 8.0.

Table 4-15
Alarm changes in Release 8.0

Alarm name	Meaning	Change in Rel. 8.0	Raised on	Service Code	Severity
Power Out of Range Low	For the OFA VGA circuit pack, raised if the gain control has succeeded and the actual output power is less than 2.1 dB below the target power cleared when the actual output power is more than 1.1 dB below the target power (this is called the 1.1 dB clear threshold) raised if the gain control has failed and the power target is below the 1.1 dB clear threshold	Also raised on the OFA VGA	OFA VGA, APBE	Minor	NSA
Power Out of Range High	For the OFA VGA circuit pack, raised if the gain control has succeeded and the actual output power is more than 2.1 dB above the target power cleared when the actual output power is less than 1.1 dB above the target power (this is called the 1.1 dB clear threshold) raised if the gain control has failed and the power target is above the 1.1 dB clear threshold	Also raised on the OFA VGA	OFA VGA, APBE	Minor	NSA
Optical System Identifier Mismatch	For the OCLD, OTR and Muxponder circuit packs, this alarm is raised when the near-end and far-end optically connected circuit packs do not have the same OSID value.	Also raised on OCLD, OTR, and Muxponder circuit packs.	OSC, OCLD, OTR, Muxponder	Minor	NSA

Table 4-15 (continued)
Alarm changes in Release 8.0

Alarm name	Meaning	Change in Rel. 8.0	Raised on	Service Code	Severity
Invalid provisioning	Raised when duplicate line equipment is detected on different shelves within the same site. Note that the circuit pack must be physically seated for the alarm to be correlated and the shelves must be hubbed together via the Ethernet 2 port and there must be an OSC present at the site provisioned with the same OSID as the duplicate circuit packs. OCLD/OTR/Muxponder has invalid provisioning if 2 or more circuit packs in different shelves at the same site are in the same plane and have identical band, channel, and OSID. Within the same shelf you cannot provision 2 identical circuit packs. Note that they do not have to be the same circuit pack type, only band and channel. OSC has invalid provisioning if 2 or more OSCs at the same site have the same OSID. OFA/APBE has invalid provisioning if 2 or more circuit packs in different shelves at the same site have identical band, OSID, location and direction parameters. Within the same shelf you cannot provision a duplicate OFA/APBE.	Also raised on OCLD, OTR, Muxponder, APBE, APBE Enhanced and OFA and the meaning has been changed.	OSC, OCLD, OTR, Muxponder, APBE, OFA	Major	NSA

Table 4-15 (continued)
Alarm changes in Release 8.0

Alarm name	Meaning	Change in Rel. 8.0	Raised on	Service Code	Severity
LAN Link Down	For the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack in GE mode, the LAN link down defect is asserted when auto-negotiation is in progress for more than 100 +100/-0 ms or when auto-negotiation completes but is unable to resolve the exchanged attributes. The LAN link down alarm is not raised in FC mode.	Also raised on the Muxponder 10 Gbit/s GbE/FC VCAT	OCI SRM GbE/FC, Muxponder 10 Gbit/s GbE/FC VCAT	Critical	SA
Loss of Alignment	Raised when there is insufficient differential delay memory to reconstitute a virtually concatenated group.	New alarm	Muxponder 10 Gbit/s GbE/FC VCAT	Critical	SA
Insufficient Link Capacity	For the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack, raised when the configured bandwidth is insufficient for the bit-rate selected. Since GE sub-rate is permitted this alarm is not raised for GE. Raised for FC-100/FICON when fewer than 6 STS-3c/VC-4 circuits are provisioned. Raised for FC-200/FICON Express when fewer than 12 STS-3c/VC-4 are provisioned.	Also raised on the Muxponder 10 Gbit/s GbE/FC VCAT	OCI SRM GbE/FC, Muxponder 10 Gbit/s GbE/FC VCAT	Critical	SA
Signal Failure	For the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack, this alarm is raised when the Line BER exceeds 10^{-3}.	Also raised on the Muxponder 10 Gbit/s GbE/FC VCAT	OCI SRM, Muxponder 10 Gbit/s GbE/FC VCAT	Critical	• Critical, SA for unpro-tected • Minor, NSA for protect-ed

Table 4-15 (continued)
Alarm changes in Release 8.0

Alarm name	Meaning	Change in Rel. 8.0	Raised on	Service Code	Severity
Summary Loss of MultiFrame	Raised against the affected client service port when one or more of its corresponding paths are affected by a path Loss Of Multiframe. The Loss of Multiframe indicator defect applies to virtually concatenated payloads only. It becomes asserted when there is a Loss of Multiframe 1 sync (OOM1) or a Loss of Multiframe 2 sync (OOM2) for more than 5-10 ms. The multiframe indication is a sequential pattern in the H4 path overhead byte. See G.783 for details.	New alarm	Muxponder 10 Gbit/s GbE/FC VCAT	Critical	SA
Summary Loss of Sequence	Raised against the affected client service port when one or more of its corresponding paths are affected by a path Loss of Sequence. The Loss of Sequence defect applies to virtually concatenated circuits only. It is asserted when the sequence number of the virtually concatenated member does not match the expected sequence number.	New alarm	Muxponder 10 Gbit/s GbE/FC VCAT	Critical	SA
Surrogate Alarm Indication Signal	Raised when the Surrogate Payload Signal (SPS) is detected.	New alarm	OTR, OCLD	Warning	NSA

Table 4-15 (continued)
Alarm changes in Release 8.0

Alarm name	Meaning	Change in Rel. 8.0	Raised on	Service Code	Severity
Circuit Pack Minor Mismatch	Raised when a Universal circuit pack is inserted in a slot that has been provisioned as a Flex circuit pack. The same applies when a Flex circuit pack is inserted in a slot that has been provisioned as a Universal circuit pack	New alarm	OTR, OCLD	Minor	NSA
Far End Circuit Pack Mismatch	Raised when a Universal circuit pack is connected to a Flex circuit pack on the line-side since fault detection and Link Engineering cannot be guaranteed on this link.	New alarm	OTR, OCLD	Minor	NSA
Band 9 Input Failure West and Band 9 Input Failure East	This alarm becomes active when all provisioned OCLD, OTR or Muxponder circuit packs in the band have an optical input failure (Rx Loss of Signal) or are receiving an Rx Invalid Signal alarm. A Band Input Failure alarm is only raised when there is more than one channel in the band. If there is a single-channel band, only an Rx Loss of Signal alarm is raised.	Also raised for Band 9 as a result of Band 9 software support in Rel. 8.0	OMX	Critical	SA
Optical Tray Missing	Raised if the monitor cable is disconnected after the passive optical component has been provisioned.	Also raised on the DSCM and OADM ITU CWDM OMX passive optical components.	OMX, ECT, DSCM, TPT, VOA, EIU, W-SPLTR, OSC-SPLTR	Minor	NSA

Table 4-15 (continued)
Alarm changes in Release 8.0

Alarm name	Meaning	Change in Rel. 8.0	Raised on	Service Code	Severity
Optical Tray Mismatch	Raised if the data retrieved from the passive optical component is different from what has been provisioned.	Also raised on the DSCM and OADM ITU CWDM OMX passive optical components.	OMX, ECT, DSCM, TPT, VOA, EIU, W-SPLTR, OSC-SPLTR	Minor	NSA
High Optical Power Warning	Optical power has exceeded Rx High Degrade threshold.	Alarm text changed from “High Optical Power warning” to “High Optical Power Warning”	OCI, OCI SRM, OCI SRM GbE/FC OCLD, OTR, OFA, APBE, Muxponder	Major	NSA
Low Optical Power Warning	Optical power has exceeded Rx Low Degrade threshold.	Alarm text changed from “Low Optical Power warning” to “Low Optical Power Warning”	OCI, OCI SRM, OCI SRM GbE/FC OCLD, OTR, OFA, APBE, Muxponder	Major	NSA
Path Alarm Indication Signal(s)	Raised against the SONET/SDH path (TX) of a connection when local equipment is receiving an alarm indication signal from upstream equipment.	In previous releases, when this condition was active, the OCI SRM GbE/FC or OCI SRM GbE circuit pack raised the Alarm Indication Signal alarm.	OCI SRM LTE, OCI SRM GbE/FC, OCI SRM GbE	Warning	NSA

Event changes

Table 4-16 lists the event changes in Release 8.0.

Table 4-16
Event changes in Release 8.0

Event	Change in Rel. 8.0
Database Restore - Commit In Progress Database Restore - Load Completed Database Restore - Commit Failed Database Restore - Commit Completed Database Restore - Cancel Failed Database Restore - Cancel Completed	Text change
System Equalization Started System Equalization Completed System Equalization Failed System Equalization Aborted Equalization Failed Continuous Equalization Started Equalization Completed Gail Control Started Gain Control Failed Gain Control Succeeded Gain Control Failed: Unexpected Power Change Gain Control Failed: Power Unattainable Low Gain Control Failed: Power Unattainable High Gain Control Failed: Can not converge Alarm Severity Changed Alarm Severity Reset All Alarm Severity Reset to Default User Password Changed User Password Change Failed Add Equipment - Pluggable Delete Equipment - Pluggable Applying Terminal Loopback Removing Terminal Loopback Add Facility Add Equipment Delete Facility Delete Equipment Create Channel Assignment Delete Channel Assignment Create Port Assignment Delete Port Assignment Add Path To Port Assignment Delete Path From Port Assignment	New event

TL1 changes

Table 4-17 lists the new TL1 commands introduced in Release 8.0.

Table 4-17
New TL1 commands introduced Release 8.0

TL1 Command	Description
INIT-OMREG-MOTRSFP	Initialize (zero) the OM data registers for MOTRSFP facility.
INIT-OMREG-EQPT	Initialize Operational Measurement (OM) registers for all cards {GFSRM, MOTRSFP, OTR} at the shelf or card level.
EQ-OFA	Power adjust OFA VGA according to provisioned output power target value.
RTRV-DFCT-MOTRSFP	Retrieve MOTR VCAT Facility Path Defects.
RTRV-CP-LOG	Retrieve MOTR VCAT circuit pack event history logs.
RTRV-PROTNSW-MOTR	Retrieve protection info for MOTR facility.
RTRV-OM-MOTRSFP	Retrieve MOTRSFP facility OM data.
RTRV-OM-ALL	Retrieve OM data.
RTRV-OMTYPE-MOTRSFP	Retrieve supported OM types for MOTRSFP facility.

Table 4-18 lists the Equipment Access Identifier (AID) changes in Release 8.0. The general format for an equipment AID is <Equipment Type>-<Equipment slot number>.

Table 4-18
Equipment AID changes in Release 8.0

Entity	Description	5200 AID Syntax range	5100 AID Syntax range	Protection	Change in Rel 8.0
OFA	Optical Fiber Amplifier circuit pack	OFA-{3-8,13-18}	Not applicable	None	Slots 3 and 13 are for OFA VGA circuit packs only
OFA	OFA Equipment optical port	OFA-{3-8,13-18}-1	Not applicable	None	Slots 3 and 13 are for OFA VGA circuit packs only
DSCM	Dispersion and Slope Compensating Module Tray	DSCM-{EIP1-EIP4}-{0-16}	DSCM-{EIP1-EIP4}-{0-16}	None	New

Table 4-19 lists the Facility Access Identifier (AID) changes in Release 8.0. The general format for a facility AID is <Equipment slot number>-<channel number>.

Table 4-19
Facility AID changes in Release 8.0

Entity	Description	5200 AID Syntax range	5100 AID Syntax range	Change in Rel 8.0
MOTR	MOTR line-side Path facility	{1-7,11-17}-11-{1-192}	{1,3}-11-{1-192}	New
MOTRSFP	MOTRSFP client side Path facility	{1-7,11-17}-{1-10}-{1-192}	{1,3}-{1-10}-{1-192}	New
OFA	OFA Facility	{3-8,13-18}-1	Not applicable	Slots 3 and 13 are for OFA VGA circuit packs only

TL1 changes as a result of the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

All existing equipment provisioning commands are applicable for the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack and SFP modules.

The following new AIDs are introduced:

MOTRSFP Client Side Path facility <slot>-{1-10}-{1-48}
MOTR Line Side Path facility <slot>-11-{1-192}

MOTR/MOTRSFP Equipment provisioning
In Release 8.0, a new Inter-Shelf protocol is introduced: “GEFC”. GEFC applies to the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack and Transparent applies to the Muxponder 10 Gbit/s GbE/FC circuit pack.

Impacted commands are:

ENT-EQPT:[TID]:<AID>:[CTAG]:::[BAND=<band>],[CHAN=<chan>],
[MAX_BR=<maxBr>],**[INTERSHELFPROTOCOL=<intershelfprotocol>]**,
[WAVELENGTH=<wavelength>],[WDMTYPE=<wdmtype>],[OSID=<osid>],
[FEWAVELENGTH= <fewavelength>]:[<pst>];

RTRV-EQPT:[TID]:[AID]:[CTAG];
Output Format
SID DATE TIME
M CTAG COMPLD
"<AID>:[BAND=<band>],[CHAN=<chan>],[MAX_BR=<maxBitrate>],
[INTERSHELFPROTOCOL=<intershelfprotocol>],
[WAVELENGTH=<wavelength>],[WDMTYPE=<wdmtype>],[FBRDIRN=<fbrDirn>],
[OSID=<osid>],[FEWAVELENGTH=<fewavelength>],:<pst>,<sst>,<ost>"

RTRV-INVENTORY:[TID]:[AID]:[CTAG]
Output Format
SID DATE TIME
M CTAG COMPLD
"<aid>:[PEC=<pec>],[CLEI=<clei>],[SER=<ser>],[REV=<rev>],
[BAND= <band>],[CHAN=<chan>],[MAX_BR=<maxBitrate>],[CDR=<cdr>],
[INTERSHELFPROTOCOL=<intershelfprotocol>],
[WAVELENGTH=<wavelength>],[WDMTYPE=<wdmtype>],[MAC1=<mac1>],
[MAC2=<mac2>],[MAC3=<mac3>],[MAC4=<mac4>],[MAC5=<mac5>],
[MAC6=<mac6>],[MAC7=<mac7>],[MAC8=<mac8>],
[MAC9=<mac9>],[MAC10=<mac10>]"

where:
INTERSHELFPROTOCOL: is the inter-shelf protocol {TRANSPARENT, **GEFC**}

MOTR Protection commands
The following new command is introduced in Release 8.0:

RTRV-PROTNSW-MOTR:[TID]:<AID>:[CTAG];
Output Format
SID DATE TIME
M CTAG COMPLD
"<aidfrom>,<aidto>:SWSTATUS=<swstatus>,SWEND=<swend>,
[SWREASON=<swreason>],[SWMATE=<swmate>]"

Where:
<swstatus> is the switch status [IDLE, AUTO, MAN, FRCD, WTR, LOCKOUT]
<swend> is the switch end [REMOTE, LOCAL]
<swreason> is the reason for switching (unused)

Cross-connect Provisioning Commands
New attributes are introduced for use in the ENT-CRS-ALL command:

An encapsulation attribute which can be either GFP-T or GFP-F depending upon which MOTR circuit pack is provisioned in the slot as well as which protocol is being provisioned on the port.

A Conditioning Holdoff attribute which has a range of 0 ms to 1000 ms. This is an optional attribute.

V-cat Channel Assignment and Port Assignment TL1 Commands
When provisioning V-cat connections the TRANSPORT field is optional. It’s presence during the creation of a Port Assignment determines if underlying paths are created or not.

Option 1: Not specifying the TRANSPORT field. This causes a CA and PA to be provisioned but no path assignments, the TRANSPORT value is assigned Nil, Encapsulation defaults to GFP-F for GigE and GFP-T for FICON and Fibre Channel.

Provisioning

ENT-CRS-ALL::2-11,2-1:::2WAY:
PROTOCOL=GIGABITETHERNET, **ENCAPSULATION=TGFP**,
NAME="GigE connection 1",
CHANDESC="GigE connection 1 description",
CONNECTIONDESC="GigE end to end connection description",
CONNECTIONNAME="GigE end to end connection name",
[REVERTIVE=<revertive>], [WAITTORESTORE=<waittorestore>],
[WCV=<wcv>], [PROTNSCHM=<protnschm>], [PROTNMODE=<protnmode>];

ENT-CRS-ALL::2-11,2-10:::2WAY:
PROTOCOL=GIGABITETHERNET,
NAME="GigE connection 2",
CHANDESC="GigE connection 2 description",
CONNECTIONDESC="GigE end to end connection description",
CONNECTIONNAME="GigE end to end connection name",
[REVERTIVE=<revertive>], [WAITTORESTORE=<waittorestore>],
[WCV=<wcv>], [PROTNSCHM=<protnschm>], [PROTNMODE=<protnmode>];

Queries

OPTERA-TL1> RTRV-CRS-ALL;
OPTERA-TL1> IP 0
< OM5000-1-44 02-08-02 23:55:50
M 0 COMPLD

"2-11,2-1:2WAY,BIDIR:
NAME=\"GigE connection 1\",
CHANDESC=\"GigE connection 1 description\",
CONNECTIONDESC=\"GigE end to end connection description\",
CONNECTIONNAME=\"GigE end to end connection name\",
CONNECTIONID=000000000000000000,
PROTOCOL=GIGABITETHERNET, **TRANSPORT=NIL,**
ENCAPSULATION=FGFP, HOLDOFF=300ms,
OCMPATHA=WEST, OCMPATHB=WEST, LOCKOUT=N, FORCE=N,
MANUAL=N, OCIPLANE=NIL, OCLD1PLANE=NIL, OCLD2PLANE=NIL,
REVERTIVE=Y, WAITTORESTORE=6, WCV=Y, PROTNSCHM=1PLUS1,
PROTNMODE=BIDIRN: OOS"

"2-11,2-10:2WAY,BIDIR:
NAME=\"GigE connection 2\",
CHANDESC=\"GigE connection 2 description\",
CONNECTIONDESC=\"GigE end to end connection description\",
CONNECTIONNAME=\"GigE end to end connection name\",
CONNECTIONID=000000000000000000,
PROTOCOL=GIGABITETHERNET, **TRANSPORT=NIL,**
ENCAPSULATION=TGFP, HOLDOFF=300ms,
OCMPATHA=WEST, OCMPATHB=WEST, LOCKOUT=N, FORCE=N,
MANUAL=N, OCIPLANE=NIL, OCLD1PLANE=NIL,
OCLD2PLANE=NIL,REVERTIVE=Y, WAITTORESTORE=6, WCV=Y,
PROTNSCHM=1PLUS1, PROTNMODE=BIDIRN:OOS"

Option 2: Specify the TRANSPORT field. This causes a CA and PA to be provisioned as well as the specified amount of paths. The paths have to be supplied if a TRANSPORT field is specified otherwise the command is rejected at the TL1 level.

Provisioning

ENT-CRS-ALL:: 2-11,2-1:::2WAY:
PROTOCOL=GIGABITETHERNET, **TRANSPORT=STS3Cx4v,**
ENCAPSULATION=TGFP, HOLDOFF=300ms,
NAME="GigE connection 1",
CHANDESC="GigE connection 1 description",
CONNECTIONDESC="GigE end to end connection description",
CONNECTIONNAME="GigE end to end connection name"
PATHS=4&7&10&16,
[REVERTIVE=<revertive>],[WAITTORESTORE=<waittorestore>],
[WCV=<wcv>], [PROTNSCHM=<protnschm>],[PROTNMODE=<protnmode>];

ENT-CRS-ALL::2-11,2-10:::2WAY:
PROTOCOL=GIGABITETHERNET, **TRANSPORT=STS3Cx3v,**
ENCAPSULATION=TGFP, HOLDOFF=300ms,
NAME="GigE connection 2",
CHANDESC="GigE connection 2 description",
CONNECTIONDESC="GigE end to end connection description",
CONNECTIONNAME="GigE end to end connection name"
PATHS=31&34&37,
[REVERTIVE=<revertive>],[WAITTORESTORE=<waittorestore>],
[WCV=<wcv>], [PROTNSCHM=<protnschm>],[PROTNMODE=<protnmode>];

CA Queries:

OPTERA-TL1> RTRV-CRS-ALL;
OPTERA-TL1> IP 0
< OM5000-1-44 02-08-02 23:55:50
M 0 COMPLD

"2-11,2-1:2WAY,BIDIR:
NAME=\"GigE connection 1\",
CHANDESC=\"GigE connection 1 description\",
CONNECTIONDESC=\"GigE end to end connection description\",
CONNECTIONNAME=\"GigE end to end connection name\",
CONNECTIONID=000000000000000000,
PROTOCOL=GIGABITETHERNET, **TRANSPORT=STS3Cx4v,**
ENCAPSULATION=TGFP, HOLDOFF=300ms, PATHS=4&7&10&16,
OCMPATHA=WEST, OCMPATHB=WEST, LOCKOUT=N, FORCE=N,
MANUAL=N, OCIPLANE=NIL, OCLD1PLANE=NIL, OCLD2PLANE=NIL,
REVERTIVE=Y, WAITTORESTORE=6, WCV=Y, PROTNSCHM=1PLUS1,
PROTNMODE=BIDIRN: OOS"

"2-11,2-10:2WAY,BIDIR:
NAME=\"GigE connection 2\",
CHANDESC=\"GigE connection 2 description\",
CONNECTIONDESC=\"GigE end to end connection description\",
CONNECTIONNAME=\"GigE end to end connection name\",
CONNECTIONID=000000000000000000,
PROTOCOL=GIGABITETHERNET, **TRANSPORT=STS3Cx3v,**
ENCAPSULATION=TGFP, HOLDOFF=300ms, PATHS=31&34&37,

```
OCMPATHA=WEST, OCMPATHB=WEST, LOCKOUT=N, FORCE=N,
MANUAL=N, OCIPLANE=NIL, OCLD1PLANE=NIL, OCLD2PLANE=NIL,
REVERTIVE=Y, WAITTORESTORE=6, WCV=Y, PROTNSCHM=1PLUS1,
PROTNMODE=BIDIRN: OOS"
```

Path Queries:
Option A) Retrieve the path allocation for a specific port

```
OPTERA-TL1> RTRV-CRS-PATH::2-1;
OPTERA-TL1>

  OM5000-1-43 03-11-12 18:56:00
M  0 COMPLD
  "2-1-1,2-11-4:2WAY,BIDIR:TRANSPORT=STS3C:OOS"
  "2-1-4,2-11-7:2WAY,BIDIR:TRANSPORT=STS3C:OOS"
  "2-1-7,2-11-10:2WAY,BIDIR:TRANSPORT=STS3C:OOS"
  "2-1-10,2-11-16:2WAY,BIDIR:TRANSPORT=STS3C:OOS" ;
```

Option B) Retrieve the available paths available for the given slot, port and TRANSPORT.

```
OPTERA-TL1> RTRV-CRS-PATH::2-1::::TRANSPORT=STS12c;
OPTERA-TL1>
  "2-1,2-11-4:,:TRANSPORT=STS12C:"    (available for connection)
```

V-cat Path Assignment TL1 Commands

The following examples show the provisioning of path assignments after a CA/PA has been provisioned. You could provision the CA/PA as part of option 1 above and then provision the following path commands, or provision the CA&PA and several paths as part of option 2 above and then add a few more paths to increase the bandwidth of a port.

Provisioning

```
OPTERA-TL1>ENT-CRS-PATH::2-1-1,2-11-4:::2WAY:TRANSPORT=STS3c;
OPTERA-TL1>ENT-CRS-PATH::2-1-4,2-11-7:::2WAY:TRANSPORT=STS3c;
OPTERA-TL1>ENT-CRS-PATH::2-1-7,2-11-10:::2WAY:TRANSPORT=STS3c;
OPTERA-TL1>ENT-CRS-PATH::2-1-10,2-11-16:::2WAY:TRANSPORT=STS3c;

OPTERA-TL1>ENT-CRS-PATH::2-2-1,2-11-31:::2WAY:TRANSPORT=STS3c;
OPTERA-TL1>ENT-CRS-PATH::2-2-4,2-11-34:::2WAY:TRANSPORT=STS3c;
OPTERA-TL1>ENT-CRS-PATH::2-2-7,2-11-37:::2WAY:TRANSPORT=STS3c;
```

Queries

```
OPTERA-TL1> RTRV-CRS-ALL;
OPTERA-TL1> IP 0
< OM5000-1-44 02-08-02 23:55:50
M 0 COMPLD

"2-11,2-1:2WAY,BIDIR:
NAME=\"GigE connection 1\",
CHANDESC=\"GigE connection 1 description\",
CONNECTIONDESC=\"GigE end to end connection description\",
CONNECTIONNAME=\"GigE end to end connection name\",
CONNECTIONID=000000000000000000,
PROTOCOL=GIGABITETHERNET, TRANSPORT=STS3Cx4v,
PATHS=4&7&10&16,OCMPATHA=WEST,OCMPATHB=WEST, LOCKOUT=N,
FORCE=N,MANUAL=N,OCIPLANE=NIL,OCLD1PLANE=NIL,
OCLD2PLANE=NIL,REVERTIVE=Y, WAITTORESTORE=6, WCV=Y,
PROTNSCHM=1PLUS1, PROTNMODE=BIDIRN:OOS"


"2-11,2-10:2WAY,BIDIR:
NAME=\"GigE connection 2\",
CHANDESC=\"GigE connection 2 description\",
CONNECTIONDESC=\"GigE end to end connection description\",
CONNECTIONNAME=\"GigE end to end connection name\",
CONNECTIONID=000000000000000000,
PROTOCOL=GIGABITETHERNET, TRANSPORT=STS3Cx3v,
PATHS=31&34&37,OCMPATHA=WEST,OCMPATHB=WEST, LOCKOUT=N,
FORCE=N,MANUAL=N,OCIPLANE=NIL,OCLD1PLANE=NIL,
OCLD2PLANE=NIL,REVERTIVE=Y, WAITTORESTORE=6, WCV=Y,
PROTNSCHM=1PLUS1, PROTNMODE=BIDIRN:OOS"
```

Client Facility Attributes: AN/PAUSE and GFPFCS
New attributes “PREAMBLECRTL”, “GFPFCS” are introduced for the OCI SRM GbE/FC, OCI SRM GbE/FC Enhanced, OCI SRM GbE and Muxponder circuit packs. Impacted commands are RTRV-GFSRM and RTRV-MOTRSFP:

RTRV-MOTRSFP:
Output:
"<aid>:[NAME=<name>],[CONNECTED=<connected>],[LOOPBACK=<loopback>],
[ANENABLE=<anenable>],[ANSTATE=<anstate>],[ETHDPX=<ethdpx>],
[SPEED=<speed>],[FLOWCTRL=<flowctrl>],[PAUSETX=<pausetx>],
[PAUSERX=<pauserx>],[PAUSERXOVRRIDE=<pauserxovrride>],
[ANETHDPX=<anethdpx>],[ANSPEED=<anspeed>],[ANPAUSETX=<anpausetx>],
[ANPAUSERX=<anpauserx>],[ADVETHDPX=<advethdpx>],
[ADVSPEED=<advspeed>],[ADVFLOWCTRL=<advflowctrl>],[MTU=<mtu>],
[PASSCTRL=<passctrl>],[RTDELAY=<rtdelay>],[PHYSADDR=<physaddr>],
[PREAMBLECTRL=<preamblectrl>],[GFPFCS =<GFPFCS>]:<pst>,<sst>,<ost>";

RTRV-GFSRM:
Output:
"<aid>:[NAME=<name>],[CONNECTED=<connected>],[LOOPBACK=<loopback>],
[CONCAT=<concat>],[TIMING=<timing>],[TRANSPORTMODE=<transportmode>],
[ANENABLE=<anenable>],[ANSTATE=<anstate>],[ETHDPX=<ethdpx>],
[SPEED=<speed>],[FLOWCTRL=<flowctrl>],[PAUSETX=<pausetx>],
[PAUSERX=<pauserx>],[PAUSERXOVRRIDE=<pauserxovrride>],
[ANETHDPX=<anethdpx>],[ANSPEED=<anspeed>],[ANPAUSETX=<anpausetx>],
[ANPAUSERX=<anpauserx>],[ADVETHDPX=<advethdpx>],
[ADVSPEED=<advspeed>],[ADVFLOWCTRL=<advflowctrl>],[MTU=<mtu>],
[PASSCTRL=<passctrl>],**[PREAMBLECTRL=<preamblectrl>],**
[GFPFCS=<GFPFCS],[SUBRATE=<subrate>],[EXTREACH=<extreach>],
[BBC=<bbc>],[BBCOVERRIDE=<bbcoverride>],[FCLINKSTATE=<fclinkstate>],
[RTDELAY=<rtdelay>],[GFPCOND=<gfpcond>],[PHYSADDR=<physaddr>]:<pst>,
<sst>,<ost>";

where:
PREAMBLECTRL = {enable, disable}
GFPFCS = {enable, disable}

MOTR Alarm Surveillance Commands
Retrieve Facility Path Defects
RTRV-DFCT-MOTRSFP:[TID]:<aid>:[CTAG]::<condtype>;
Output Format
SID DATE TIME
M CTAG COMPLD
"<aid>,<aidtype>:[<ntfncde>],<condtype>,[<srveff>],[<ocrdat>],[<ocrtm>],[<locn>],
[<dirn>],[<tmper>],[<description>]"

Note: <aid> in input command is MOTRSFP client port facility AID and <aid> in the response is MOTRSFP client path facility AID. GFSRM AIDs are also accepted by this command.
Note: <condtype> in input command is the condition type of summary alarm/event and <condtype> in the response is the condition type of actual defect. The condtype attribute is mandatory.

Example:
RTRV-DFCT-MOTRSFP::5-1:::SUMAIS;
"5-1-1,MOTRSFP:,AIS-P,,,,,,""
"5-1-4,MOTRSFP:,AIS-P,,,,,,""
"5-1-7,MOTRSFP:,AIS-P,,,,,,""

RTRV-CP-LOG:[TID]:<AID>:[CTAG];
Output Format
SID DATE TIME
M CTAG COMPLD
"[<aid>],[<aidtype>]:[<ntfncde>],[<condtype>],[<srveff>],<ocrdat>,<ocrtm>,[<locn>],[<dirn>],[<tmper>],[<uid>],[<uap>],[<linkid>],[<command>],[<status>],<logclass>,<logindex>:<logdesc>"

Where <AID> in RTRV-CP-LOG is the circuit pack AID whose logs to be retrieved. This is a mandatory attribute.

Example:
RTRV-CP-LOG::MOTR-5;
"5-1-1,MOTRSFP:NA,AIS-P,,08-21,17-29-53,,,,,,,,,ALM,43:\"Path AIS\"“
"5-1-4,MOTRSFP:CL,AIS-P,,08-21,17-30-18,,,,,,,,,ALM,46:\"Path AIS\"",

TL1 changes as a result of the OFA VGA circuit pack

All existing OFA equipment and facility commands are supported for the OFA VGA circuit pack with following enhancements.

OFA Equipment Provisioning Commands
OFA Equipment AID = OFA-<slot>

ENT-EQPT:[TID]:<AID>:[CTAG]:::[BANDTYPE=<ofaBandType>],
[FBRDIRN=<fbrDirn>],[AMPLOCN=<ampLocn>],[OSID=<osid>],
[OFATYPE=<ofatype>],:[<pst>];

ED-EQPT:[TID]:<AID>:[CTAG]:::[FBRDIRN=<fbrDirn>],[AMPLOCN=<ampLocn>],
[OSID=<osid>];

DLT-EQPT:[TID]:<AID>:[CTAG];
RMV-EQPT:[TID]:<AID>:[CTAG]::[<mode>],[<state>];
RST-EQPT:[TID]:<AID>:[CTAG]::[<mode>];

RTRV-EQPT:[TID]:[AID]:[CTAG];
Output Format
SID DATE TIME
M CTAG COMPLD
"<AID>:[BANDTYPE=<ofabandtype>],[FBRDIRN=<fbrDirn>],
[AMPLOCN=<ampLocn>],[OFATYPE=<ofatype>],[OSID=<osid>]:
<pst>,<sst>,<ost>"

RTRV-INVENTORY:[TID]:[AID]:[CTAG]
Output Format
SID DATE TIME
M CTAG COMPLD
"<aid>:[PEC=<pec>],[CLEI=<clei>],[SER=<ser>],[REV=<rev>],
[BANDTYPE=<ofabandtype>],[OFATYPE=<ofatype>]"

Where:
<ofatype> has the new value [**VG**] for Variable Gain Amplifier in addition to HIP and STANDARD

OFA Facility Provisioning Commands
OFA Facility AID = <slot>-1

ENT-OFA:[TID]:<aid>:[CTAG]:[:[NAME=<name>], **[NUMCHAN=<numchan>], [PWRPCHAN=<pwrpchan>]**:<pst>;

ED-OFA:[TID]:<aid>:[CTAG]:::[NAME=<name>], **[NUMCHAN=<numchan>], [PWRPCHAN=<pwrpchan>]**;

RMV-OFA:[TID]:<AID>:[CTAG]::[<mode>],[<state>];

RST-OFA:[TID]:<AID>:[CTAG]::[<mode>];

DLT-OFA:[TID]:<AID>:[CTAG];

EQ-OFA:[TID]:<aid>:[CTAG];

RTRV-OFA:[TID]:[<AID>]:[CTAG];
Output Format
SID DATE TIME
M CTAG COMPLD
"<AID>:[NAME=<name>],[CONNECTED=<connected>],[LOOPBACK=<loopback>],**[NUMCHAN=<numchan>],[PWRPCHAN=<pwrpchan>], [TXPWR=<txpwr>],[RXPWR=<rxpwr>],[AGGPWR=<aggpwr>] [EQSTATUS<eqstatus>]**:<pst>,<sst>,<ost>"

RTRV-APBE:[TID]:[<aid>]:[CTAG];
Output Format
SID DATE TIME
M CTAG COMPLD
"<aid>:NAME=<name>,[NUMCHAN=<numchan>],[PWRPBAND=<pwrpband>],[PWRPCHAN=<pwrpchan>],[TXPWR=<txpwr>],[RXPWR=<rxpwr>],**[AGGPWR=<aggpwr>]**,[PROVMODE=<provmode>],**[EQSTATE=<eqstate>]**:<pst>,<sst>,<ost>"

Where:
<pwrpchan> Power Per Channel. PWRPCHAN is of type float.
<numchan> Number of channels. NUMCHAN is of type Integer.
<aggpwr> Calculated Aggregate Optical Power used for equalization.
<eqstatus> Equalization State [COMPLD, FAIL, IP, NIL, NREQD, REQD]

TL1 changes as a result of the OCLD/OTR 2.5 Gbit/s Universal circuit pack

A new data tag FLEXTYPE is added to the ENT-EQPT, ED-EQPT, RTRV-EQPT and RTRV-INVENTORY TL1 commands. This new tag has possible values of “STANDARD” or “UNIVERSAL”. When not specified for the ENT-EQPT command, the NE uses the default value of “STANDARD”.

New Command Syntax:
ENT-EQPT:[TID]:<all>:[CTAG]::[]:[BAND=<band>],[CHAN=<chan>],
[MIN_BR=<minBr>],[MAX_BR=<maxBr>],
[INTERSHELFPROTOCOL=<intershelfprotocol>],[WAVELENGTH=<wavelength>],
[BANDTYPE=<ofaBandType>],[OMX_WAVELEN=<omxWavelen>],
[ECTTYPE=<ecttype>],[WDMTYPE=<wdmtype>],[FBRDIRN=<fbrDirn>],
[AMPLOCN=<ampLocn>],[OSID=<osid>],[OFATYPE=<ofatype>],
[TPTTYPE=<tpttype>],[OSCSPLTTYPE=<oscsplttype>],[VOATYPE=<voatype>],
[EIUTYPE=<eiutype>],[WSPLTTYPE=<wsplttype>],[NUMPORTS=<numports>],
[DESCRIPTION=<description>],[FEWAVELENGTH=<fewavelength>],
[FLEXTYPE=<flextype>]:[<pst>];

ED-EQPT:[TID]:<all>:[CTAG]::[]:[MAX_BR=<maxBitrate>],[FBRDIRN=<fbrDirn>],
[AMPLOCN=<ampLocn>],[OSID=<osid>],[OFATYPE=<ofatype>],
[DESCRIPTION=<description>],[FEWAVELENGTH=<fewavelength>],
[FLEXTYPE=<flextype>];

New Command Output
RTRV-EQPT
SID DATE TIME
M CTAG COMPLD
"<aid>:[BAND=<band>],[CHAN=<chan>],[MIN_BR=<minBitrate>],
[MAX_BR=<maxBitrate>],[INTERSHELFPROTOCOL=<intershelfprotocol>],
[REACH=<reach>],[BANDTYPE=<ofabandtype>],[BIP8=<bip>],
[WAVELENGTH=<wavelength>],[OMX_WAVELEN=<omxWavelen>],
[ECTTYPE=<ecttype>],[WDMTYPE=<wdmtype>],[FBRDIRN=<fbrDirn>],
[AMPLOCN=<ampLocn>],[ERN=<ern>],[OFATYPE=<ofatype>],[OSID=<osid>],
[SYNCACTIVE=<syncactive>],[TPTTYPE=<tpttype>],
[OSCSPLTTYPE=<oscsplttype>],[VOATYPE=<voatype>],[EIUTYPE=<eiutype>],
[WSPLTTYPE=<wsplttype>],[NUMPORTS=<numports>],
[DESCRIPTION=<description>],[FEWAVELENGTH=<fewavelength>],
[DIVERSEROUTE=<diverseroute>],[TXWAVELENGTH=<txwavelength>],
[FLEXTYPE=<flextype>]:<pst>,<sst>,<ost>"
;

```
RTRV-INVENTORY
  SID DATE TIME
M  CTAG COMPLD
"<aid>:[PEC=<pec>],[CLEI=<clei>],[SER=<ser>],[REV=<rev>],[BAND=<band>],
[CHAN=<chan>],[MIN_BR=<minBitrate>],[MAX_BR=<maxBitrate>],[CDR=<cdr>],
[INTERSHELFPROTOCOL=<intershelfprotocol>],[BANDTYPE=<ofabandtype>],
[WAVELENGTH=<wavelength>],[OMX_WAVELEN=<omxWavelen>],
[ECTTYPE=<ecttype>],[WDMTYPE=<wdmtype>],[OFATYPE=<ofatype>],
[TPTTYPE=<tpttype>],[OSCSPLTTYPE=<oscsplttype>],[VOATYPE=<voatype>],
[EIUTYPE=<eiutype>],[WSPLTTYPE=<wsplttype>],[NUMPORTS=<numports>],
[TXWAVELENGTH=<txwavelength>],[FLEXTYPE=<flextype>],
[MAC1=<mac1>],[MAC2=<mac2>],[MAC3=<mac3>],[MAC4=<mac4>],
[MAC5=<mac5>],[MAC6=<mac6>],[MAC7=<mac7>],[MAC8=<mac8>],
[MAC9=<mac9>],[MAC10=<mac10>]"
;
```

TL1 changes as a result of the OMX 4CH CWDM with dual taps

Software does not distinguish between the OMX 4CH CWDM and the OMX 4CH CWDM with dual taps OMX types. That is, the OMX type field displays Quad Band Coarse for both. The 2 OMX types can be distinguished by their PEC. As a result, there are no TL1 changes for this new hardware component.

TL1 changes as a result of the Mixed Shelf Type feature

A new value “MIXED” is added to the NETYPE attribute of the SET-NETYPE, RTRV-NETYPE and ENT-NE-CFG commands.

Possible values for this attribute are: NETYPE = {OADM, OFA, MIXED, TERMINAL}.

TL1 changes as a result of the Alarm Indication Details feature

New attributes are introduced for alarm surveillance commands in Release 8.0. This only impacts the output response of those commands:

- AIDDET: text string included in all alarm messages. It includes the signal and rate information, and has the following format: **“\signal: layer”**.
- SUBCARDTYPE: included in all alarm messages as well as in equipment inventory.

Impacted Commands are:

- RTRV-ALM-APBE/COM/EQPT/GFSRM/MOTR/MOTRSFP/OCI/OCLD/OFA/ OHCHN/OMX/OSC/OTR/SPLT/SRM/WSC/XC/ALL
- REPT ALM APBE/COM/EQPT/GFSRM/MOTR/MOTRSFP/OCI/OCLD/OFA/ OHCHN/OMX/OSC/OTR/SPLT/SRM/WSC/XC
- RTRV-COND-APBE/COM/EQPT/GFSRM/MOTR/MOTRSFP/OCI/OCLD /OFA/OHCHN/OMX/OSC/OTR/SPLT/SRM/WSC/XC/ALL

- REPT COND APBE/COM/EQPT/GFSRM/MOTR/MOTRSFP/OCI/OCLD/OFA/OHCHN/OMX/OSC/OTR/SPLT/SRM/WSC/XC
- RTRV-NE-LOG
- RTRV-INVENTORY
- RTRV-EQPT

Alarm Notification:
SID DATE TIME
** ATAG REPT ALM {AIDTYPE}
"[<aid>]:<ntfncde>,<condtype>,<srveff>,<ocrdat>,<ocrtm>,[<locn>],[<dirn>]:
[<conddescr>],**[<aiddet>]**,[<obsdbhvr>]:[<dgntype>],[<tblislt>]:
[SUBCARDTYPE=<subcardtype>],[SIGLAYER=<siglayer>],[YEAR=<year>]";

Retrieve Alarm:
Input Format:
RTRV-ALM-{AIDTYPE}:[TID]:[<aid>]:[CTAG]::[<ntfncde>],[<condtype>],[<srveff>],
[<locn>],[<dirn>],[<tmper>];

Output Format:
SID DATE TIME
M CTAG COMPLD
"[<aid>],<aidtype>:<ntfncde>,<condtype>,<srveff>,<ocrdat>,<ocrtm>,[<locn>],
[<dirn>]:<description>,**[<aiddet>]**,[<obsdbhvr>]:[<dgntype>],[<tblislt>]:
[SUBCARDTYPE=<subcardtype>],[SIGLAYER=<siglayer>],[YEAR=<year>]";

Condition Notification:
SID DATE TIME
A ATAG REPT COND {AIDTYPE}
"[<aid>]:<ntfncde>,<condtype>,<srveff>,[<ocrdat>],[<ocrtm>],[<locn>],
[<dirn>],[<tmper>]:**[SUBCARDTYPE=<subcardtype>],[SIGLAYER=<siglayer>]**";

Retrieve Condition:
Input Format:
RTRV-COND-{AIDTYPE}:[TID]:[<aid>]:[CTAG]::[<condtype>],[<locn>],[<dirn>],
[<tmper>];

Output Format:
SID DATE TIME
M CTAG COMPLD
"[<aid>],<aidtype>:<ntfncde>,<condtype>,<srveff>,<ocrdat>,[<ocrtm>],
[<locn>],[<dirn>],[<tmper>],<conddesc>:**[SUBCARDTYPE=<subcardtype>],**
[SIGLAYER=<siglayer>],[DGNTYPE=<dgntype>],[YEAR=<year>],
[OBSDBHVR=<obsdbhvr>]";

Retrieve Logs:
Input Format:
RTRV-NE-LOG:[TID]::[CTAG];

Output Format:
SID DATE TIME
M CTAG COMPLD
"[<aid>],[<aidtype>]:[<ntfncde>],[<condtype>],[<srveff>],<ocrdat>,<ocrtm>,
[<locn>],[<dirn>],[<tmper>],[<uid>],[<uap>],[<linkid>],[<command>],
[<status>],<logclass>,<logindex>:<logdesc>:**[SUBCARDTYPE=<subcardtype>],**
[SIGLAYER=<siglayer>]";

Retrieve Inventory:
Input Format:
RTRV-INVENTORY:[TID]:[<all>]:[CTAG];

Output Format:
SID DATE TIME
M CTAG COMPLD
"<aid>:**[SubCardType=<subcardtype>]**,[PEC=<pec>],[CLEI=<clei>],[SER=<ser>],
[REV=<rev>],[BAND=<band>],[CHAN=<chan>],[MIN_BR=<minBitrate>],
[MAX_BR=<maxBitrate>],[CDR=<cdr>],
[INTERSHELFPROTOCOL=<intershelfprotocol>],[BANDTYPE=<ofabandtype>],
[WAVELENGTH=<wavelength>],[OMX_WAVELEN=<omxWavelen>],
[ECTTYPE=<ecttype>],[WDMTYPE=<wdmtype>],[OFATYPE=<ofatype>],
[TPTTYPE=<tpttype>],[OSCSPLTTYPE=<oscsplttype>],[VOATYPE=<voatype>],
[EIUTYPE=<eiutype>],[WSPLTTYPE=<wsplttype>],[NUMPORTS=<numports>],
[TXWAVELENGTH=<txwavelength>],[MAC1=<mac1>],[MAC2=<mac2>],
[MAC3=<mac3>],[MAC4=<mac4>],[MAC5=<mac5>],[MAC6=<mac6>],
[MAC7=<mac7>],[MAC8=<mac8>], [MAC9=<mac9>],[MAC10=<mac10>]" ;

Retrieve equipment:
Input Format:
RTRV-EQPT:[TID]:[<all>]:[CTAG];

Output Format:
SID DATE TIME
M CTAG COMPLD
"<aid>:**[SubCardType=<subcardtype>]**,[BAND=<band>],[CHAN=<chan>],
[MIN_BR=<minBitrate>],[MAX_BR=<maxBitrate>],
[INTERSHELFPROTOCOL=<intershelfprotocol>],[REACH=<reach>],
[BANDTYPE=<ofabandtype>],[BIP8=<bip>],[WAVELENGTH=<wavelength>],
[OMX_WAVELEN=<omxWavelen>],[ECTTYPE=<ecttype>],
[WDMTYPE=<wdmtype>],[FBRDIRN=<fbrDirn>],[AMPLOCN=<ampLocn>],
[ERN=<ern>],[OFATYPE=<ofatype>],[OSID=<osid>],[SYNCACTIVE=<syncactive>],
[TPTTYPE=<tpttype>],[OSCSPLTTYPE=<oscsplttype>],[VOATYPE=<voatype>],
[EIUTYPE=<eiutype>],[WSPLTTYPE=<wsplttype>],[NUMPORTS=<numports>],
[DESCRIPTION=<description>],[FEWAVELENGTH=<fewavelength>],
[DIVERSEROUTE=<diverseroute>],[TXWAVELENGTH=<txwavelength>]:<pst>,
<sst>, <ost>" ;

TL1 changes as a result of the Customer User Classes feature

Users with a user privilege class of Customer1 or Customer2 can be provisioned using TL1 but cannot be used to log into an Optical Metro 5100/5200 shelf using TL1 interfaces.

The following TL1 commands are impacted by this feature:
ENT-USER-SECU:[TID]:<uid>:[CTAG]::<pid>,[<cid>],<uap>:[ATAGBEH];
ED-USER-SECU:[TID]:UID:CTAG::NEWUID,NEWPID,CID,UAP:
ATAGBEH=ATAGBEH;

Input parameter change:
UAP:User Access Privileges (ADMIN, OPERATOR, OBSERVER, CUSTOMER1 and CUSTOMER2)

ED-USER-CMNTY:[TID]:<uap>:[CTAG]::<cstr>;

Input parameter change:
UAP: User Access Privileges for which community string to be set. One of the following values: "ADMIN", "OPERATOR", "OBSERVER","SURVEILLANCE", “CUSTOMER1” and “CUSTOMER2”.

RTRV-USER:[TID]:[<uid>]:[CTAG];
RTRV-USER-SECU:[TID]:[<uid>]:[CTAG];

Output parameter change:
UAP:User Access Privileges (ADMIN, OPERATOR, OBSERVER, CUSTOMER1 and CUSTOMER2)

Note: The RTRV-USER command does not return the new user access privilege in Release 8.0 as the users with the new privilege are not able to login via TL1 interface.

TL1 changes as a result of the OM Binning feature

The following new TL1 commands are introduced.

INIT-OMREG-MOTRSFP:[TID]:<aid>:[CTAG]::[<omclass>],
[<tmper>],[<mondat>],[<montm>];
Initialize MOTRSFP facility Operational Measurement (OM) register. MOTRSFP facility AID must be specified.

INIT-OMREG-EQPT:[TID]:[<aid>]:[CTAG]::[<omclass>],[<tmper>],[<mondat>],
[<montm>];
Initialize Operational Measurement (OM) registers for all cards {GFSRM, MOTRSFP, OTR} at the shelf or card level. Slot AID must be specified for the card level, empty AID for the shelf level reset.

RTRV-OM-MOTRSFP:[TID]:[<aid>]:[CTAG]::[<omclass>], [<omtype>],[<tmper>],
[<mondat>],[<montm>];

SID DATE TIME
M CTAG COMPLD
"<aid>,<aidtype>:<omtype>,<monval>,<vldty>,<tmper>,<mondat>, <montm>"
;

RTRV-OMTYPE-MOTRSFP:[TID]:[<aid>]:[CTAG]::[<omclass>];
Output Format
SID DATE TIME
M CTAG COMPLD
"<aid>,<aidtype>:<omtype>"
;

RTRV-OM-ALL:[TID]:[<aid>]:[CTAG]::[<omclass>],[<omtype>],[<tmper>],
[<mondat>], [<montm>];

SID DATE TIME
M CTAG COMPLD
"<aid>,<aidtype>:<omtype>,<monval>,<vldty>,<tmper>,<mondat>, <montm>"
;

TL1 changes as a result of the Provisionable PM Bin Zero Suppression feature

A new attribute “FAPZS” is added to the ED-NE-FEAT and RTRV-NE-FEAT TL1 commands. Possible values for this attribute are: SDH, ALL, NONE.

TL1 changes as a result of the DMIF protocol support feature

The new DMIF Bit Rate is added to the following TL1 commands: ED-CRS-ALL, ENT-CRS-ALL, RTRV-CRS-ALL, RTRV-PROT, RTRV-PROT-CRS.

TL1 changes as a result of the Orion protocol support feature

The new Orion Bit Rate is added to the following TL1 commands: ED-CRS-ALL, ENT-CRS-ALL, RTRV-CRS-ALL, RTRV-PROT, RTRV-PROT-CRS.

TL1 changes as a result of the SRM and ESCON SRM interoperable topologies using OTR feature

The SRM-125 and ESRM-250 Bit Rates are added as valid bit rates for the OTR 2.5 Gbit/s Flex/Universal 1310 nm and OTR 2.5 Gbit/s Flex 100 GHz 1310 nm circuit packs when using the following TL1 commands: ED-CRS-ALL, ENT-CRS-ALL, RTRV-CRS-ALL, RTRV-PROT, RTRV-PROT-CRS.

TL1 changes as a result of the Inventory support for DSCMs feature

TL1 supports the following new equipment AID for DSCM equipment:

DSCM-[EIP1-EIP4]-[0-16]

Where:

[EIP1-EIP4] designates one of the 4 equipment inventory ports on the maintenance panel.

[0-16] where 0 means device is directly connected to the maintenance panel and 1-16 means the device is connected through one of the EIU’s port 1 to 16.

The provisioning command syntax for the DSCM is as follows:

ENT-EQPT:[TID]:<AID>:[CTAG]:::**[DSCMTYPE=<dscmtype>]**:[<pst>];
ED-EQPT:[TID]:<AID>:[CTAG]:::**[DSCMTYPE=<dscmtype>]**;
RMV-EQPT:[TID]:<AID>:[CTAG];
RST-EQPT:[TID]:<AID>:[CTAG];
DLT-EQPT:[TID]:[AID]:[CTAG];
RTRV-EQPT:[TID]:[AID]:[CTAG];
Output Format:
SID DATE TIME
M CTAG COMPLD
"<aid>:**[DSCMTYPE=<dscmtype>]**:<pst>,<sst>,<ost>"
;

RTRV-INVENTORY:[TID]:[AID]:[CTAG];
Output Format:
SID DATE TIME
M CTAG COMPLD
"<aid>:[PEC=<pec>],[CLEI=<clei>],[SER=<ser>],[REV=<rev>],
[DSCMTYPE=<dscmtype>]"

TL1 changes as a result of the Inventory support for OADM ITU CWDM OMXs feature

TL1 adds support for 2 new OMX bands in order to support the OMX 4CH OADM ITU CWDM:

- **ITU4_1471nm-1531nm**
- **ITU4_1551nm-1611nm**

The OMX 4CH ITU CWDM band is renamed **ITU4_1511nm-1571nm**.

For the OMX 1CH OADM ITU CWDM, the band field displays the same information as the existing DWDM and CWDM OMXs. That is, BAND=1-8.

TL1 changes as a result of the New OFA and APBE Locations feature

New location values are added for the OFA and APBE/APBE Enhanced. The valid values are now NIL, POSTA, PREA, THRUA, PRE2A (new) and THRU2A (new).

Provisioning commands for OFA:
ENT-EQPT:[TID]:<AID>:[CTAG]:::[BANDTYPE=<ofaBandType>],
[FBRDIRN=<fbrDirn>],**[AMPLOCN=<amplocn>]**,[OFATYPE=<ofatype>]:[<pst>];

ED-EQPT:[TID]:<AID>:[CTAG]:::[BANDTYPE=<ofaBandType>],
[FBRDIRN=<fbrDirn>],**[AMPLOCN=<amplocn>]**,[OFATYPE=<ofatype>]:[<pst>];

TL1 changes as a result of the APBE associated equipment attributes feature

APBE/APBE Enhanced can have the DSCMTYPE to specify that a DSCM follows it. When the DSCM is used, the OFATYPE for the APBE/APBE Enhanced is NIL. DSCMTYPE is set to NIL when an OFA follows an APBE/APBE Enhanced.

Provisioning commands for APBE/APBE Enhanced:
ENT-EQPT:[TID]:<AID>:[CTAG]:::[BANDTYPE=<ofaBandType>],
[FBRDIRN=<fbrDirn>],**[AMPLOCN=<amplocn>]**,[OFATYPE=<ofatype>],
[DSCMTYPE=<dscmtype>]:[<pst>];

ED-EQPT:[TID]:<AID>:[CTAG]:::[BANDTYPE=<ofaBandType>],
[FBRDIRN=<fbrDirn>],**[AMPLOCN=<amplocn>]**,[OFATYPE=<ofatype>],
[DSCMTYPE=<dscmtype>]:[<pst>];

Retrieve command for APBE/APBE Enhanced includes the DSCMTYPE.

TL1 changes as a result of the SLEC feature

Two new OSC equipment attributes are added to the OSC equipment commands:

- West Neighbor: WNBRPROVSITE
- East Neighbor: ENBRPROVSITE

Possible values for each are: “Connected” or “Not Connected”.

Impacted commands are:

```
ED-EQPT:[TID]:<all>:[CTAG]::[]:[MAX_BR=<maxBitrate>],[FBRDIRN=<fbrDirn>],
[AMPLOCN=<ampLocn>],[OSID=<osid>],[OFATYPE=<ofatype>],
[DSCMTYPE=<dscmtype>],[DESCRIPTION=<description>],
[FEWAVELENGTH=<fewavelength>],[FLEXTYPE=<flextype>],
[WNBRPROVSITE=<wnbrprovsite>],[ENBRPROVSITE=<enbrprovsite>];
```

```
ENT-EQPT:[TID]:<all>:[CTAG]::[]:[BAND=<band>],[CHAN=<chan>],
[MIN_BR=<minBr>],[MAX_BR=<maxBr>],
[INTERSHELFPROTOCOL=<intershelfprotocol>],
[WAVELENGTH=<wavelength>],[BANDTYPE=<ofaBandType>],
[OMX_WAVELEN=<omxWavelen>],[ECTTYPE=<ecttype>],
[WDMTYPE=<wdmtype>],[FBRDIRN=<fbrDirn>],[AMPLOCN=<ampLocn>],
[OSID=<osid>],[OFATYPE=<ofatype>],[TPTTYPE=<tpttype>],
[DSCMTYPE=<dscmtype>],[DSCMDIST=<dscmdist>],
[OSCSPLTTYPE=<oscsplttype>],[VOATYPE=<voatype>],[EIUTYPE=<eiutype>],
[WSPLTTYPE=<wsplttype>],[NUMPORTS=<numports>],
[DESCRIPTION=<description>],[FEWAVELENGTH=<fewavelength>],
[FLEXTYPE=<flextype>],[WNBRPROVSITE=<wnbrprovsite>],
[ENBRPROVSITE=<enbrprovsite>]:[<pst>];
```

```
RTRV-EQPT:TID:AID:1234;
   SID DATE TIME
M  CTAG COMPLD
   "<aid>:[SUBCARDTYPE=<subcardtype>],[BAND=<band>],[CHAN=<chan>],
[MIN_BR=<minBitrate>],[MAX_BR=<maxBitrate>],
[INTERSHELFPROTOCOL=<intershelfprotocol>],[REACH=<reach>],
[BANDTYPE=<ofabandtype>],[BIP8=<bip>],[WAVELENGTH=<wavelength>],
[OMX_WAVELEN=<omxWavelen>],[ECTTYPE=<ecttype>],
[WDMTYPE=<wdmtype>],[FBRDIRN=<fbrDirn>],[AMPLOCN=<ampLocn>],
[ERN=<ern>],[OFATYPE=<ofatype>],[OSID=<osid>],[SYNCACTIVE=<syncactive>],
[TPTTYPE=<tpttype>],[DSCMTYPE=<dscmtype>],[DSCMDIST=<dscmdist>],
[OSCSPLTTYPE=<oscsplttype>],[VOATYPE=<voatype>],[EIUTYPE=<eiutype>],
[WSPLTTYPE=<wsplttype>],[NUMPORTS=<numports>],
[DESCRIPTION=<description>],[FEWAVELENGTH=<fewavelength>],
[DIVERSEROUTE=<diverseroute>],[TXWAVELENGTH=<txwavelength>],
[FLEXTYPE=<flextype>],[WNBRPROVSITE=<wnbrprovsite>],
[ENBRPROVSITE=<enbrprovsite>]:<pst>,<sst>,<ost>"
;
```

TL1 changes as a result of the Security Enhancements feature

Per User Account Idle Timeout

ENT-USER-SECU:[TID]:<uid>:[CTAG]::<pid>,[<cid>],<uap>:[ATAGBEH=<atagbeh>],
[TMOUT=<tmout>];

ED-USER-SECU:[TID]:<uid>:[CTAG]::[<newuid>],[<newpid>],[<cid>],[<uap>]:
[ATAGBEH=<atagbeh>],**[TMOUT=<tmout>]**;

RTRV-USER:TID:UID:CTAG;
Output format:
SID DATE TIME
M CTAG COMPLD

"<uid>:[<cid>],<uap>:[ATAGBEH=<atagbeh>],STATUS=<status>,**TMOUT=<tmout>**"
;

RTRV-USER-SECU:[TID]:[<uid>]:[CTAG];
Output format:
SID DATE TIME
M CTAG COMPLD

"<uid>:[<cid>],<uap>:[ATAGBEH=<atagbeh>],STATUS=<status>,**TMOUT=<tmout>**"
;

Change Password through RADIUS

The existing TL-1 command is used to change the centralized user password through RADIUS.

ED-PID: [TID] :< uid>: [CTAG] ::< oldpid>, <newpid>;

Miscellaneous TL1 changes

DGNTYPE and YEAR parameters

The following new parameters are introduced:

- DGNTYPE: Type of diagnostic routine. Only 4 digits are used for the alarm id (probable cause).
- YEAR: Year information, 4 digits YYYY.

These changes affect the following TL1 commands:

- RTRV-COND
- RTRV-ALM
- RTRV-ALM-ENV
- RTRV-ALM-SECU
- REPT EVT
- REPT ALM
- REPT ALM ENV
- REPT ALM SECU
- REPT EVT SECU

Example output:

```
"OCM-10,EQPT:MJ,PROTNA,NSA,11-21,11-12-24,,NA,,\"Protection Not
Available\":SUBCARDTYPE=\"2.5GB Transparent\",DGNTYPE
  =000000-0000-0257,YEAR=2004,"
```

OBSDBHVR parameter

The following new parameter is introduced:

- OBSDBHVR: Connection information for alarms related to a connection.

This change affects the following TL1 commands:

- RTRV-COND
- REPT ALM
- REPT EVT

Example output:

```
"12-1,GFSRM:CR,LOS,SA,11-21,11-12-26,NEND,ZA,,\"Loss of
Signal\":SUBCARDTYPE=\"2.5GB GEFC 1310nm\",SIGLAYER=\"GIGABIT
ETHERNET:OS\",DGNTYPE=000000-0000-0007,YEAR=2004,OBSDBHVR=\"
ObservedBehavior \""
```

ENT-CRS-ALL command change

In Release 8.0, the ENT-CRS-ALL command is rejected if attempting to change existing channel assignment attributes (wcv, protnmode, protnschm, revertive, waittorestore) while provisioning a new port assignment. These parameters can only be passed successfully in the ENT-CRS-ALL input command when the channel assignment is first provisioned (first port assignment) or if they have the same values as those already provisioned in the existing channel assignment.

Optical Manager Element Adapter Release 3.1

Optical Manager Element Adapter (OMEA) Release 3.1 supports Optical Metro 5100/5200 Release 8.0 systems.

With Optical Metro 5100/5200 Release 8.0, OMEA Release 3.1 provides:

- support for new hardware
- support for all OAM&P features introduced in Release 8.0

For more information on OMEA Release 3.1 refer to the OMEA Release 3.1 documentation.

Release 8.0 Optical Metro 5100/5200 ordering information

In this chapter

This chapter lists the ordering information for all new Release 8.0 components. See *Network Planning and Link Engineering,* 323-1701-110 for ordering information for all Optical Metro 5100/5200 components. Ensure that you are familiar with the requirements of your network before you order equipment

Software delivery kits

Table 5-1 lists PECs for Optical Metro 5100/5200 software delivery kits. Software delivery kits are to be used for new installations. The kit includes two CDs:

- a software CD for installations from a Windows platform (the CD includes the software and the NTPs for the specific release)
- a software CD for installations from a Solaris platform (the CD includes the software and the NTPs for the specific release)

Table 5-1
Optical Metro 5100/5200 software delivery kits

Release	Product engineering code
8.0	NT0H60NA (see Note 1 and Note 2)
7.01	NT0H60MB (see Note 1 and Note 2)
7.0	NT0H60MA (see Note 1 and Note 2)
6.1	NT0H60LB (see Note 1 and Note 2)
6.0	NT0H60LA (see Note 1 and Note 2)
Note 1: It is mandatory to order an initial purchase right-to-use (RTU) (1 per network element) and a release-specific Software Certificate (1 per network element) when ordering this PEC. See the "Initial purchase RTUs" section and the "Software Certificates" section in Table 5-3 on page 5-4 for the list of PECs. ***Note 2:*** Other RTUs may need to be ordered. See the "Other RTUs" section in Table 5-3 on page 5-4.	

Software upgrade kits

Table 5-2 lists PECs for Optical Metro 5100/5200 software upgrade kits. Software upgrade kits are to be used to upgrade existing installations running a specific software load to a more recent software load. The kit includes three CDs:

- the same two CDs included in the software delivery kit (see Software delivery kits on page 5-2)
- a CD containing the Software Upgrade CAP (Change Application Procedure)

Table 5-2
Optical Metro 5100/5200 software upgrade kits

Release	Product engineering code	Software Upgrade CAP Product engineering code and title
8.0	NT0H61NA (see Note)	NTY434AJ: System software upgrade to Rel. 8.0 from Rel. 6.0, Rel. 6.1, Rel. 7.0 or Rel. 7.01
7.01	NT0H61MB (see Note)	NTY436AH: System software upgrade to Rel. 7.0.1 from Rel. 5.0, Rel. 6.0, Rel. 6.1 or Rel. 7.0
7.0	NT0H61MA (see Note)	NTY434AH: System software upgrade to Rel. 7.0 from Rel. 5.0, Rel. 6.0 or Rel. 6.1
6.1	NT0H61LB (see Note)	NTY434AG: System software upgrade to Rel. 6.1 from Rel. 4.1, Rel. 5.0 or Rel. 6.0
6.0	NT0H61LA (see Note)	NTY434AF: System software upgrade to Rel. 6.0 from Rel. 4.0, Rel. 4.1 or Rel. 5.0
Note: It is mandatory to order a software upgrade RTU (1 per network element) and a release-specific Software Certificate (1 per network element) when ordering this PEC. See the "Software upgrade RTUs" section and the "Software Certificates" section in Table 5-3 on page 5-4 for the list of PECs.		

Software licenses

Table 5-3 lists Optical Metro 5100/5200 license information.

Table 5-3
Optical Metro 5100/5200 licenses

Product engineering code	Item
Initial purchase RTUs	
NT0H68GA	New Optical Metro 5200 network element right-to-use (RTU) (1 per network element): This RTU provides the right to use the Optical Metro 5200 network element on initial purchase.
NTPM68GA	New Optical Metro 5100 network element RTU (1 per network element): This RTU provides the right to use the Optical Metro 5100 network element on initial purchase.
Software upgrade RTUs	
NT0H68HA	Optical Metro 5200 network element Supported Load Upgrade (SLU) RTU (1 per network element): This RTU provides the right to upgrade from any currently supported software load to a more recent software load on an Optical Metro 5200 network element (see Note 1).
NTPM68HA	Optical Metro 5100 network element Supported Load Upgrade (SLU) RTU (1 per network element): This RTU provides the right to upgrade from any currently supported software load to a more recent software load on an Optical Metro 5100 network element (see Note 1).
NT0H68HB	Optical Metro 5200 network element Non-Supported Load Upgrade (NSLU) RTU (1 per network element): This RTU provides the right to upgrade from any non-supported or obsolete software load to a more recent software load on an Optical Metro 5200 network element (see Note 1).
NTPM68HB	Optical Metro 5100 network element Non-Supported Load Upgrade (NSLU) RTU (1 per network element): This RTU provides the right to upgrade from any non-supported or obsolete software load to a more recent software load on an Optical Metro 5100 network element (see Note 1).

Table 5-3 (continued)
Optical Metro 5100/5200 licenses

Product engineering code	Item
Other RTUs	
NT0H68AJ	Optical Metro 5100/5200 System Manager Interface RTU (1 per network element): System Manager Interface is the craft terminal interface based on the network element. It is Web client based and accessible from any browser connected to the shelf using an IP network. This RTU provides the right to launch this software interface from a particular network element, and then to use this software to manage that network element.
NT0H68AK	Optical Metro 5100/5200 SNMP Northbound Interface RTU (1 per network element): SNMP is an interface provided northbound from the network element which provides some management and alarm reporting capabilities. When this interface is used directly by an application other than the System Manager Interface, an SNMP Northbound Interface RTU is required per network element.
NT0H68AM	Optical Metro 5100/5200 TL1 Northbound Interface RTU (1 per network element): TL1 is an interface provided northbound from the network element which allows full management and alarm reporting. When this interface is used by an application other than ONM (Optical Network Management or OMEA), a TL1 RTU is required per network element.
Software Certificates (see Note 2)	
NT0H68NA	Rel. 8.0 Optical Metro 5200 network element Software Certificate (1 per network element)
NTPM68NA	Rel. 8.0 Optical Metro 5100 network element Software Certificate (1 per network element)
NT0H68MB	Rel. 7.01 Optical Metro 5200 network element Software Certificate (1 per network element)
NTPM68MB	Rel. 7.01 Optical Metro 5100 network element Software Certificate (1 per network element)
NT0H68MA	Rel. 7.0 Optical Metro 5200 network element Software Certificate (1 per network element)
NTPM68MA	Rel. 7.0 Optical Metro 5100 network element Software Certificate (1 per network element)
NT0H68LB	Rel. 6.1 Optical Metro 5200 network element Software Certificate (1 per network element)
NTPM68LB	Rel. 6.1 Optical Metro 5100 network element Software Certificate (1 per network element)

Table 5-3 (continued)
Optical Metro 5100/5200 licenses

Product engineering code	Item
NT0H68LA	Rel. 6.0 Optical Metro 5200 network element Software Certificate (1 per network element)
NTPM68LA	Rel. 6.0 Optical Metro 5100 network element Software Certificate (1 per network element)

Note 1: A supported load is defined as a software load that has passed the General Availability milestone (GA), but has not passed the End Of Life milestone (EOL). GA and EOL milestones are published through PCNs. Contact Nortel Networks for details on supported loads and MD/EOL dates. Both the SLUs and NSLUs are independent of the number of steps required to upgrade the network element and are a one-time purchase fee per network element. The SLU and NSLU provide a right to upgrade, but do not include media (Software or Documentation CD-ROM). Software subscription services (SRS) are available separately which provide a reduced cost and annual subscription for software upgrades. Additional services are available from Nortel Networks to assist with implementation or consultation on implementation procedures, and for type-approval.

Note 2: Software Certificates are used to allow tracking of licensed software loads across each network element. These provide a proof of purchase for a particular software load, on a particular network element.

SNMP MIB CD-ROMs

Table 5-4 lists PECs for SNMP MIB CD-ROMs.

Table 5-4
SNMP MIB CD-ROMs

Product Engineering Code	Description
NT0H70NA	Release 8.0 surveillance MIB for Optical Metro 5100/5200
NT0H70NE	Release 8.0 MIB for Enhanced Trunk Switch (ETS)

Shelf processor (SP) circuit packs

Table 5-5 lists the ordering codes for Optical Metro 5200 SP circuit packs.

Table 5-5
Optical Metro 5200 SP circuit packs

Release	Ordering code
8.0	S0H60NAD1A
7.01	S0H60MBD1A
7.0	S0H60MAD1A
6.1	S0H60LBD1A
6.0	S0H60LAD1A

Optical channel manager (OCM) circuit packs

Table 5-6 lists the ordering codes for Optical Metro 5200 OCM circuit packs.

Table 5-6
Optical Metro 5200 OCM circuit packs

Release	Ordering code
8.0	NT0H40BC
7.01	NT0H40BC
7.0	NT0H40BC
6.1	NT0H40BC
6.0	NT0H40BC

OCLD circuit packs

OCLD 2.5 Gbit/s Universal

Table 5-7 lists the OCLD 2.5 Gbit/s Universal circuit packs.

Table 5-7
Product engineering codes for OCLD 2.5 Gbit/s Universal

Product engineering code	Band number	Channel number	Wavelength (nm)
NT0H05AA	1	1	1528.77
NT0H05AB	1	2	1533.47
NT0H05AC	1	3	1530.33
NT0H05AD	1	4	1531.90
NT0H05BA	2	1	1538.19
NT0H05BB	2	2	1542.94
NT0H05BC	2	3	1539.77
NT0H05BD	2	4	1541.35
NT0H05CA	3	1	1547.72
NT0H05CB	3	2	1552.52
NT0H05CC	3	3	1549.32
NT0H05CD	3	4	1550.92
NT0H05DA	4	1	1557.36
NT0H05DB	4	2	1562.23
NT0H05DC	4	3	1558.98
NT0H05DD	4	4	1560.61
NT0H05EA	5	1	1570.42
NT0H05EB	5	2	1575.37
NT0H05EC	5	3	1572.06
NT0H05ED	5	4	1573.71
NT0H05FA	6	1	1580.35
NT0H05FB	6	2	1585.36
NT0H05FC	6	3	1582.02
NT0H05FD	6	4	1583.69
NT0H05GA	7	1	1590.41

Table 5-7 (continued)
Product engineering codes for OCLD 2.5 Gbit/s Universal

Product engineering code	Band number	Channel number	Wavelength (nm)
NT0H05GB	7	2	1595.49
NT0H05GC	7	3	1592.10
NT0H05GD	7	4	1593.80
NT0H05HA	8	1	1600.60
NT0H05HB	8	2	1605.73
NT0H05HC	8	3	1602.31
NT0H05HD	8	4	1604.02

OTR circuit packs

OTR 2.5 Gbit/s Universal 1310 nm

Table 5-8 lists the OTR 2.5 Gbit/s Universal 1310 nm circuit packs.

Table 5-8
Product engineering codes for OTR 2.5 Gbit/s Universal 1310 nm

Product engineering code	Band number	Channel number	Wavelength (nm)
NT0H06AA	1	1	1528.77
NT0H06AB	1	2	1533.47
NT0H06AC	1	3	1530.33
NT0H06AD	1	4	1531.90
NT0H06BA	2	1	1538.19
NT0H06BB	2	2	1542.94
NT0H06BC	2	3	1539.77
NT0H06BD	2	4	1541.35
NT0H06CA	3	1	1547.72
NT0H06CB	3	2	1552.52
NT0H06CC	3	3	1549.32
NT0H06CD	3	4	1550.92
NT0H06DA	4	1	1557.36
NT0H06DB	4	2	1562.23
NT0H06DC	4	3	1558.98
NT0H06DD	4	4	1560.61
NT0H06EA	5	1	1570.42
NT0H06EB	5	2	1575.37
NT0H06EC	5	3	1572.06
NT0H06ED	5	4	1573.71
NT0H06FA	6	1	1580.35
NT0H06FB	6	2	1585.36
NT0H06FC	6	3	1582.02
NT0H06FD	6	4	1583.69
NT0H06GA	7	1	1590.41

Table 5-8 (continued)
Product engineering codes for OTR 2.5 Gbit/s Universal 1310 nm

Product engineering code	Band number	Channel number	Wavelength (nm)
NT0H06GB	7	2	1595.49
NT0H06GC	7	3	1592.10
NT0H06GD	7	4	1593.80
NT0H06HA	8	1	1600.60
NT0H06HB	8	2	1605.73
NT0H06HC	8	3	1602.31
NT0H06HD	8	4	1604.02

OTR 2.5 Gbit/s Universal 850 nm

Table 5-9 lists the OTR 2.5 Gbit/s Universal 850 nm circuit packs.

Table 5-9
Product engineering codes for OTR 2.5 Gbit/s Universal 850 nm

Product engineering code	Band number	Channel number	Wavelength (nm)
NT0H07AA	1	1	1528.77
NT0H07AB	1	2	1533.47
NT0H07AC	1	3	1530.33
NT0H07AD	1	4	1531.90
NT0H07BA	2	1	1538.19
NT0H07BB	2	2	1542.94
NT0H07BC	2	3	1539.77
NT0H07BD	2	4	1541.35
NT0H07CA	3	1	1547.72
NT0H07CB	3	2	1552.52
NT0H07CC	3	3	1549.32
NT0H07CD	3	4	1550.92
NT0H07DA	4	1	1557.36
NT0H07DB	4	2	1562.23
NT0H07DC	4	3	1558.98
NT0H07DD	4	4	1560.61
NT0H07EA	5	1	1570.42
NT0H07EB	5	2	1575.37
NT0H07EC	5	3	1572.06
NT0H07ED	5	4	1573.71
NT0H07FA	6	1	1580.35
NT0H07FB	6	2	1585.36
NT0H07FC	6	3	1582.02
NT0H07FD	6	4	1583.69
NT0H07GA	7	1	1590.41
NT0H07GB	7	2	1595.49

Table 5-9 (continued)
Product engineering codes for OTR 2.5 Gbit/s Universal 850 nm

Product engineering code	Band number	Channel number	Wavelength (nm)
NT0H07GC	7	3	1592.10
NT0H07GD	7	4	1593.80
NT0H07HA	8	1	1600.60
NT0H07HB	8	2	1605.73
NT0H07HC	8	3	1602.31
NT0H07HD	8	4	1604.02

Muxponder circuit packs

Table 5-10 lists the different Muxponder 10 Gbit/s GbE/FC VCAT circuit packs introduced in Release 8.0.

Table 5-10
Muxponder 10 Gbit/s GbE/FC VCAT circuit pack types introduced in Release 8.0

Circuit pack type	Bidirectional GbE, FC, FICON connections	Uni-add GbE connections	Uni-drop GbE connections	DWDM spacing
Muxponder 10 Gbit/s GbE/FC VCAT	√	√	√	200 GHz
Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz	√	√	√	100 GHz
Muxponder 10 Gbit/s GbE Uni-add	Not supported	√	Not supported	200 GHz
Muxponder 10 Gbit/s GbE Uni-add 100 GHz	Not supported	√	Not supported	100 GHz
Muxponder 10 Gbit/s GbE Uni-drop	Not supported	Not supported	√	200 GHz
Muxponder 10 Gbit/s GbE Uni-drop 100 GHz	Not supported	Not supported	√	100 GHz

Muxponder 10 Gbit/s GbE/FC VCAT

Tables 5-11, 5-12 and 5-13 list the Muxponder 10 Gbit/s GbE/FC VCAT circuit packs. Muxponder circuit packs require Small Form Factor Pluggable (SFP) modules to be ordered for each provisioned client-side port. See Table 5-15 on page 5-20 for SFP ordering information.

For DWDM

Use the following Muxponder 10 Gbit/s GbE/FC VCAT circuit packs in conjunction with Optical Metro 5100 or Optical Metro 5200 shelves for DWDM systems.

Table 5-11
Product engineering codes for Muxponder 10 Gbit/s GbE/FC VCAT circuit packs

Muxponder 10 Gbit/s GbE/FC VCAT PEC	Muxponder 10 Gbit/s GbE Uni-add PEC	Muxponder 10 Gbit/s GbE Uni-drop PEC	Band number	Channel number	Wavelength (nm)
NT0H15AE	NT0H15JA	NT0H15JE	1	1	1528.77
NT0H15AF	NT0H15JB	NT0H15JF	1	2	1533.47
NT0H15AG	NT0H15JC	NT0H15JG	1	3	1530.33
NT0H15AH	NT0H15JD	NT0H15JH	1	4	1531.90
NT0H15BE	NT0H15KA	NT0H15KE	2	1	1538.19
NT0H15BF	NT0H15KB	NT0H15KF	2	2	1542.94
NT0H15BG	NT0H15KC	NT0H15KG	2	3	1539.77
NT0H15BH	NT0H15KD	NT0H15KH	2	4	1541.35
NT0H15CE	NT0H15LA	NT0H15LE	3	1	1547.72
NT0H15CF	NT0H15LB	NT0H15LF	3	2	1552.52
NT0H15CG	NT0H15LC	NT0H15LG	3	3	1549.32
NT0H15CH	NT0H15LD	NT0H15LH	3	4	1550.92
NT0H15DE	NT0H15MA	NT0H15ME	4	1	1557.36
NT0H15DF	NT0H15MB	NT0H15MF	4	2	1562.23
NT0H15DG	NT0H15MC	NT0H15MG	4	3	1558.98
NT0H15DH	NT0H15MD	NT0H15MH	4	4	1560.61
NT0H15EE (see Note)	NT0H15NA (see Note)	NT0H15NE (see Note)	5	1	1570.42
NT0H15EF (see Note)	NT0H15NB (see Note)	NT0H15NF (see Note)	5	2	1575.37

Table 5-11 (continued)
Product engineering codes for Muxponder 10 Gbit/s GbE/FC VCAT circuit packs

Muxponder 10 Gbit/s GbE/FC VCAT PEC	Muxponder 10 Gbit/s GbE Uni-add PEC	Muxponder 10 Gbit/s GbE Uni-drop PEC	Band number	Channel number	Wavelength (nm)
NT0H15EG (see Note)	NT0H15NC (see Note)	NT0H15NG (see Note)	5	3	1572.06
NT0H15EH (see Note)	NT0H15ND (see Note)	NT0H15NH (see Note)	5	4	1573.71
NT0H15FE (see Note)	NT0H15PA (see Note)	NT0H15PE (see Note)	6	1	1580.35
NT0H15FF (see Note)	NT0H15PB (see Note)	NT0H15PF (see Note)	6	2	1585.36
NT0H15FG (see Note)	NT0H15PC (see Note)	NT0H15PG (see Note)	6	3	1582.02
NT0H15FH (see Note)	NT0H15PD (see Note)	NT0H15PH (see Note)	6	4	1583.69
NT0H15GE (see Note)	NT0H15QA (see Note)	NT0H15QE (see Note)	7	1	1590.41
NT0H15GF (see Note)	NT0H15QB (see Note)	NT0H15QF (see Note)	7	2	1595.49
NT0H15GG (see Note)	NT0H15QC (see Note)	NT0H15QG (see Note)	7	3	1592.10
NT0H15GH (see Note)	NT0H15QD (see Note)	NT0H15QH (see Note)	7	4	1593.80
NT0H15HE (see Note)	NT0H15RA (see Note)	NT0H15RE (see Note)	8	1	1600.60
NT0H15HF (see Note)	NT0H15RB (see Note)	NT0H15RF (see Note)	8	2	1605.73
NT0H15HG (see Note)	NT0H15RC (see Note)	NT0H15RG (see Note)	8	3	1602.31
NT0H15HH (see Note)	NT0H15RD (see Note)	NT0H15RH (see Note)	8	4	1604.02
Note: Contact Nortel Networks before ordering L-band Muxponder 10 Gbit/s GbE/FC VCAT circuit packs.					

For CWDM

Use the Muxponder 10 Gbit/s GbE/FC VCAT circuit packs listed in Table 5-12 with Optical Metro 5200 or Optical Metro 5100 shelves for CWDM systems. However, it is important to note that these circuit packs are made for a DWDM environment, so using them for a CWDM environment is more costly.

Table 5-12
Product engineering codes for Muxponder 10 Gbit/s GbE/FC VCAT circuit packs that can be used in CWDM systems

Muxponder 10 Gbit/s GbE/FC VCAT PEC	Muxponder 10 Gbit/s GbE Uni-add PEC	Muxponder 10 Gbit/s GbE Uni-drop PEC	Band number	Wavelength (nm)
NT0H15AF	NT0H15JB	NT0H15JF	1	1533.47
NT0H15BG	NT0H15KC	NT0H15KG	2	1539.77
NT0H15CH	NT0H15LD	NT0H15LH	3	1550.92
NT0H15DG	NT0H15MC	NT0H15MG	4	1558.98
NT0H15EF (see Note)	NT0H15NB (see Note)	NT0H15NF (see Note)	5	1575.37
NT0H15FE (see Note)	NT0H15PA (see Note)	NT0H15PE (see Note)	6	1580.35
NT0H15GE (see Note)	NT0H15QA (see Note)	NT0H15QE (see Note)	7	1590.41
NT0H15HH (see Note)	NT0H15RD (see Note)	NT0H15RH (see Note)	8	1604.02
Note: Contact Nortel Networks before ordering L-band Muxponder 10 Gbit/s GbE/FC VCAT circuit packs.				

For ITU CWDM

Use the Muxponder 10 Gbit/s GbE/FC VCAT circuit packs listed in Table 5-13 with Optical Metro 5200 or Optical Metro 5100 shelves for ITU CWDM systems. However, it is important to note that these circuit packs are made for a DWDM environment, so using them for an ITU CWDM environment is more costly.

Table 5-13
Product engineering codes for Muxponder 10 Gbit/s GbE/FC VCAT circuit packs that can be used in ITU CWDM systems

Muxponder 10 Gbit/s GbE/FC VCAT PEC	**Muxponder 10 Gbit/s GbE Uni-add PEC**	**Muxponder 10 Gbit/s GbE Uni-drop PEC**	**ITU CWDM channel center wavelength (nm)** (see Note 1)
not supported	not supported	not supported	1471
not supported	not supported	not supported	1491
not supported	not supported	not supported	1511
B1C3 (NT0H15AG)	B1C3 (NT0H15JC)	B1C3 (NT0H15JG)	1531
B3C3 (NT0H15CG)	B3C3 (NT0H15LC)	B3C3 (NT0H15KG)	1551
B5C1 (NT0H15EE) (see Note 2)	B5C1 (NT0H15NA) (see Note 2)	B5C1 (NT0H15NE) (see Note 2)	1571
B7C1 (NT0H15GE) (see Note 2)	B7C1 (NT0H15QA) (see Note 2)	B7C1 (NT0H15QE) (see Note 2)	1591
B8C2 (NT0H15HF) (see Note 2)	B8C2 (NT0H15RB) (see Note 2)	B8C2 (NT0H15RF) (see Note 2)	1611

Note 1: Some Optical Metro 5100/5200 ITU CWDM hardware introduced before the ITU CWDM standard (G.695) was finalized will have labels with a center wavelength that differs by 1 nm with respect to the finalized ITU CWDM standard (G.695). For example, for the 1471 nm wavelength, the label will show 1470 nm. However, there is no wavelength incompatibility since the passbands are the same. For example, the pre-finalized ITU CWDM standard 1470 nm channel specified a range of –5.5 to +7.5 nm, that is, a passband of 1464.5 to 1477.5 nm. The finalized ITU CWDM standard 1471 nm channel specifies a range of ±6.5 nm, that is, the passband is still 1464.5 to 1477.5 nm. The only difference is one of labeling.

Note 2: Contact Nortel Networks before ordering L-band Muxponder 10 Gbit/s GbE/FC VCAT circuit packs.

Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz

Use the Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz circuit packs listed in Table 5-14 with Optical Metro 5200 or Optical Metro 5100 shelves for Common Photonic Layer DWDM systems.

Table 5-14
Product engineering codes for Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz

Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz PEC	Muxponder 10 Gbit/s GbE Uni-add 100 GHz PEC	Muxponder 10 Gbit/s GbE Uni-drop 100 GHz PEC	Band/ Group number	Channel number	Wavelength (nm)
NT0H84AE	NT0H84KA	NT0H84KE	1	1	1530.334
NT0H84AF	NT0H84KB	NT0H84KF	1	2	1531.116
NT0H84AG	NT0H84KC	NT0H84KG	1	3	1531.898
NT0H84AH	NT0H84KD	NT0H84KH	1	4	1532.681
NT0H84BE	NT0H84LA	NT0H84LE	2	1	1534.250
NT0H84BF	NT0H84LB	NT0H84LF	2	2	1535.036
NT0H84BG	NT0H84LC	NT0H84KG	2	3	1535.822
NT0H84BH	NT0H84LD	NT0H84LH	2	4	1536.609
NT0H84CE	NT0H84MA	NT0H84ME	3	1	1538.186
NT0H84CF	NT0H84MB	NT0H84MF	3	2	1538.976
NT0H84CG	NT0H84MC	NT0H84MG	3	3	1539.766
NT0H84CH	NT0H84MD	NT0H84MH	3	4	1540.557
NT0H84DE	NT0H84NA	NT0H84NE	4	1	1542.142
NT0H84DF	NT0H84NB	NT0H84NF	4	2	1542.936
NT0H84DG	NT0H84NC	NT0H84NG	4	3	1543.730
NT0H84DH	NT0H84ND	NT0H84NH	4	4	1544.526
NT0H84EE	NT0H84PA	NT0H84PE	5	1	1546.119
NT0H84EF	NT0H84PB	NT0H84PF	5	2	1546.917
NT0H84EG	NT0H84PC	NT0H84PG	5	3	1547.715
NT0H84EH	NT0H84PD	NT0H84PH	5	4	1548.515

Table 5-14 (continued)
Product engineering codes for Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz

Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz PEC	Muxponder 10 Gbit/s GbE Uni-add 100 GHz PEC	Muxponder 10 Gbit/s GbE Uni-drop 100 GHz PEC	Band/ Group number	Channel number	Wavelength (nm)
NT0H84FE	NT0H84QA	NT0H84QE	6	1	1550.116
NT0H84FF	NT0H84QB	NT0H84QF	6	2	1550.918
NT0H84FG	NT0H84QC	NT0H84QG	6	3	1551.721
NT0H84FH	NT0H84QD	NT0H84QH	6	4	1552.524
NT0H84GE	NT0H84RA	NT0H84RE	7	1	1554.134
NT0H84GF	NT0H84RB	NT0H84RF	7	2	1554.940
NT0H84GG	NT0H84RC	NT0H84RG	7	3	1555.747
NT0H84GH	NT0H84RD	NT0H84RH	7	4	1556.555
NT0H84HE	NT0H84SA	NT0H84SE	8	1	1558.173
NT0H84HF	NT0H84SB	NT0H84SF	8	2	1558.983
NT0H84HG	NT0H84SC	NT0H84SG	8	3	1559.794
NT0H84HH	NT0H84SD	NT0H84SH	8	4	1560.606
NT0H84JE	NT0H84TA	NT0H84TE	9	1	1562.233
NT0H84JF	NT0H84TB	NT0H84TF	9	2	1563.047
NT0H84JG	NT0H84TC	NT0H84TG	9	3	1563.863
NT0H84JH	NT0H84TD	NT0H84TH	9	4	1564.679

Small Form Factor Pluggable (SFP) modules

Table 5-15 lists the product engineering codes for small form factor pluggable (SFP) modules that can be used on the Muxponder 10 Gbit/s GbE/FC circuit packs client side connections.

Table 5-15
Product engineering codes for SFP modules

Product engineering code	Description
NTTP06AF	850 nm SFP module
NTTP06CF	1310 nm SFP module

OFA VGA circuit packs

Use the following OFA VGA circuit packs with Optical Metro 5200 shelves for DWDM systems.

Table 5-16
Product engineering codes for OFA VGA circuit packs

Product engineering code	Description
NT0H35AC	OFA VGA C-band
NT0H35BC	OFA VGA L-band

APBE Enhanced circuit packs

Use the following APBE Enhanced circuit packs with Optical Metro 5200 shelves for DWDM systems.

Table 5-17
Product engineering codes for APBE Enhanced circuit packs

Product engineering code	Description
NT0H34AB	APBE Enhanced C-band
NT0H34BB	APBE Enhanced L-band

OMX 4CH CWDM with dual taps

Use an OMX 4CH CWDM with dual taps with an Optical Metro 5100 or Optical Metro 5200 shelf for CWDM systems. Table 5-18 on page 5-22 lists the ordering information for the OMX 4CH CWDM with dual taps.

Table 5-18
Product engineering codes for the OMX 4CH CWDM OMX with dual taps

Product engineering code	CWDM bands
NT0H33JB	C-band (1, 2, 3, 4)
NT0H33KB	L-band (5, 6, 7, 8)
Additional equipment	
NT0H4322 (see Note)	Simplex RJ45-RJ45 2.98 m (117 in.) ID cable used to connect to the maintenance panel or the Equipment Inventory Unit.
NT0H4345 (see Note)	Simplex RJ45-RJ45 1.5 m (60 in.) ID cable used to connect to the maintenance panel or the Equipment Inventory Unit.
Note: One NT0H4345 cable is shipped with each OMX 4CH CWDM with dual taps ordered. The longer ID cable (NT0H4322) is available from Nortel Networks and can be ordered separately, if required.	

Attenuators

Release 8.0 introduces new SC and LC fixed attenuator pads. Table 5-19 lists the PECs for SC attenuators. Table 5-20 lists the PECs for LC attenuators.

Table 5-19
Product engineering codes for SC attenuators

Product engineering code	Description
N0032819	1 dB SM (SC connector)
N0032817	2 dB SM (SC connector)
N0028270	3 dB SM (SC connector)
N0032816	4 dB SM (SC connector)
N0032815	5 dB SM (SC connector)
N0032814	6 dB SM (SC connector)
N0032813	7 dB SM (SC connector)
N0032812	8 dB SM (SC connector)
N0028267	9 dB SM (SC connector)
N0032810	10 dB SM (SC connector)
N0028268	11 dB SM (SC connector)
N0032809	12 dB SM (SC connector)
N0028269	13 dB SM (SC connector)
N0032808	14 dB SM (SC connector)
N0032807	15 dB SM (SC connector)
N0032805	16 dB SM (SC connector)

Table 5-20
Product engineering codes for LC attenuators

Product engineering code	Description
A0516698 (see Note)	1 dB SM (LC connector)
A0516699 (see Note)	2 dB SM (LC connector)
A0516700 (see Note)	3 dB SM (LC connector)
A0516701 (see Note)	4 dB SM (LC connector)
A0516703 (see Note)	5 dB SM (LC connector)

Table 5-20
Product engineering codes for LC attenuators

Product engineering code	Description
A0516704 (see Note)	6 dB SM (LC connector)
A0516705 (see Note)	7 dB SM (LC connector)
A0516706 (see Note)	8 dB SM (LC connector)
A0516707 (see Note)	9 dB SM (LC connector)
A0516708 (see Note)	10 dB SM (LC connector)
A0516711 (see Note)	11 dB SM (LC connector)
A0516712 (see Note)	12 dB SM (LC connector)
A0516713 (see Note)	13 dB SM (LC connector)
A0516714 (see Note)	14 dB SM (LC connector)
A0516715 (see Note)	15 dB SM (LC connector)
A0516717 (see Note)	16 dB SM (LC connector)
Note: Can only be used for OMX 16CH DWDM applications.	

Patch panel 20 port

The product engineering code for the patch panel is NT0H43CB.

Fiber-optic patch cords

Table 5-21 on page 5-25 lists the product engineering codes for the new fiber-optic patch cords introduced in Release 8.0.

Table 5-21
Product engineering codes for patch cords

PEC	Diameter	Type	Length	Used to connect
NT0H43JC	3 mm	SMF simplex SC/PC-SC/PC	0.39 m (15.5 in.)	OFA VGA circuit pack to OFA VGA circuit pack in the same shelf
NT0H39AB	1.6 mm (single jacket)	MMF 62.5 µm on RX side and SMF on TX side duplex SC/PC-LC/PC Straight boot for SC connector and 45° boot for LC connector	2.4 m (96 in.)	Muxponder 10 Gbit/s circuit pack to subtending equipment or to patch panel (see Note 1 and Note 2)
NT0H39AA	1.6 mm (single jacket)	MMF duplex SC/PC-LC/PC Straight boot for SC connector and 45° boot for LC connector	2.4 m (96 in.)	Muxponder 10 Gbit/s circuit pack to subtending equipment or to patch panel (see Note 1 and Note 2)

Note 1: This patch cord can be used to connect directly to the subtending equipment if the subtending equipment and the Optical Metro 5100/5200 shelf are co-located and the subtending equipment uses SC connectors. Contact Nortel Networks if longer length patch cords are required for your application.

Note 2: This patch cord has a 1.6 mm diameter to avoid over-filling the exit openings at the shelf base below the Muxponder 10 Gbit/s circuit pack when all client-side ports are used. This patch cord can also be used to connect the Muxponder 10 Gbit/s SFP modules to the Optical Metro 5100/5200 patch panel (NT0H43CA/CB). One NT0H43CA patch panel can accommodate up to 8 client-side ports on the Muxponder 10 Gbit/s GbE/FC circuit pack. One NT0H43CB patch panel can accommodate up to 10 client-side ports on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack.

Network Modeling Tool

Table 5-22 on page 5-26 lists the product engineering codes for the Release 8.0 Network Modeling Tool.

Table 5-22
Network Modeling Tool

Product engineering code	Description
NT0H71NZ	Release 8.0 NMT software (excluding Automated Link Engineering and Site Fibering Diagrams) and documentation
NT0H71NA	Release 8.0 NMT software including Automated Link Engineering and Site Fibering Diagrams) and documentation
NT0H7157	Release 8.0 NMT User Guide
NT0H7156	Release 8.0 Network Planning and Link Engineering NTP (323-1701-110)

Challenge/Response application

The product engineering code for the Release 8.0 Challenge/Response Tool software CD is NT0H72NA.

Documentation

Table 5-23
Optical Metro 5100/5200 documentation

Item	Product engineering code
Technical Publications Release 8.0 (paper), which includes • Network Planning and Link Engineering 323-1701-110 • Software and User Interface, 323-1701-101 • Hardware Description, 323-1701-102 • Technical Specifications, 323-1701-180 • TL1 Interface, 323-1701-190 • Installing Optical Metro 5200 Shelves and Components, 323-1701-201 • Installing Optical Metro 5100 Shelves and Components, 323-1701-210 • Commissioning Procedures, 323-1701-220 • Connection Procedures, 323-1701-221 • Testing and Equalization Procedures, 323-1701-222 • Provisioning and Operating Procedures, 323-1701-310 • Customer Acceptance Testing Procedures, 323-1701-330 • Trouble Clearing and Alarm Reference Guide, 323-1701-542 • Maintenance and Replacement Procedures, 323-1701-546 • About the Optical Metro 5100/5200 NTP Library, 323-1701-090	NT0H65AM
Release 8.0 Technical Publications (CD-ROM)	NT0H64AM
Release 8.0 Helmsman CD-ROM	NT0H64ZM
System software upgrade CAP to Rel. 8.0 from 6.0, 6.1, 7.0 or 7.0.1	NTY434AJ
Release 8.0 Planning Guide (paper)	NTY410AK
Release 8.0 5200C Cabinet Installation Guide	NTY406AC
Release 8.0 5200E Cabinet Installation Guide	NTY407AC

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Planning Guide

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