

Nortel

Optical Metro 5100/5200

Hardware Description, Part 1 of 2

Standard Release 8.0 Issue 1 April 2005

What's inside...

[Optical Metro 5200 shelves](#), [Optical Metro 5100 shelves](#), [Optical Metro 5100/5200 shelf installation kit](#), [General circuit pack information](#), [OCI circuit packs](#), [OCLD circuit packs](#), [OTR circuit packs](#), [Muxponder circuit packs](#), [OCM circuit packs](#), [OSC circuit packs](#), [SP circuit packs](#), [OFA circuit packs](#), [APBE circuit packs](#), [Filler cards](#)

See Part 2 for the following:

[OMX modules](#), [OSC trays](#), [C&L splitter/coupler](#), [ECT](#), [Per Band Equalizer](#), [Ethernet hub](#), [Cables and optical patch cords](#), [Rectifiers](#), [Patch panel](#), [Transponder Protection Tray](#), [Optical Trunk Switch](#), [Enhanced Trunk Switch](#), [Fiber Manager](#), [1310 nm splitter/coupler](#), [Equipment Inventory Unit](#), [Discrete VOA](#), [DSCMs](#)

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About this document

This document describes the components of the Nortel Optical Metro 5100/5200 product and the functionality of each.

ATTENTION

This document is presented in two parts: Part 1 and Part 2. Each part has its own table of contents. The table of contents in Part 1 contains topics found in Part 1 only. The table of contents in Part 2 contains topics found in Part 2 only. Part 2 continues sequential chapter numbering from Part 1.

Hardware Description, Part 1, 323-1701-102, contains the following:

- Chapter 1, “Optical Metro 5200 shelves”
- Chapter 2, “Optical Metro 5100 shelves”
- Chapter 3, “Optical Metro 5100/5200 shelf installation kit”
- Chapter 4, “General circuit pack information”
- Chapter 5, “OCI circuit packs”
- Chapter 6, “OCLD circuit packs”
- Chapter 7, “OTR circuit packs”
- Chapter 8, “Muxponder circuit packs”
- Chapter 9, “OCM circuit packs”
- Chapter 10, “OSC circuit packs”
- Chapter 11, “SP circuit packs”
- Chapter 12, “OFA circuit packs”
- Chapter 13, “APBE circuit packs”
- Chapter 14, “Filler cards”

Hardware Description, Part 2, 323-1701-102, contains the following:

- Chapter 15, “OMX modules”
- Chapter 16, “OSC trays”
- Chapter 17, “C&L splitter/coupler”

- Chapter 18, “ECT”
- Chapter 19, “Per Band Equalizer”
- Chapter 20, “Ethernet hub”
- Chapter 21, “Cables and optical patch cords”
- Chapter 22, “Rectifiers”
- Chapter 23, “Patch panel”
- Chapter 24, “Transponder Protection Tray”
- Chapter 25, “Optical Trunk Switch”
- Chapter 26, “Enhanced Trunk Switch”
- Chapter 27, “Fiber Manager”
- Chapter 28, “1310 nm splitter/coupler”
- Chapter 29, “Equipment Inventory Unit”
- Chapter 30, “Discrete VOA”
- Chapter 31, “DSCMs”

This document contains an overview of hardware components, including

- shelves
- circuit packs
- modules
- the Ethernet hub
- connectors
- cables
- rectifiers
- patch panels

Audience for this document

This document is intended for the following audience:

- strategic and current planners
- provisioners
- installers
- transmission standards engineers
- field maintenance engineers
- system line-up and testing (SLAT) personnel
- maintenance technicians
- network administrators

Optical Metro 5100/5200 library

The Optical Metro 5100/5200 library consists of the *Nortel Optical Metro 5100/5200 Technical Publications*, NT0H65AM.

Technical Publications

The *Optical Metro 5100/5200 Nortel Technical Publications* (NTP) consist of descriptive information and procedures.

Descriptive information

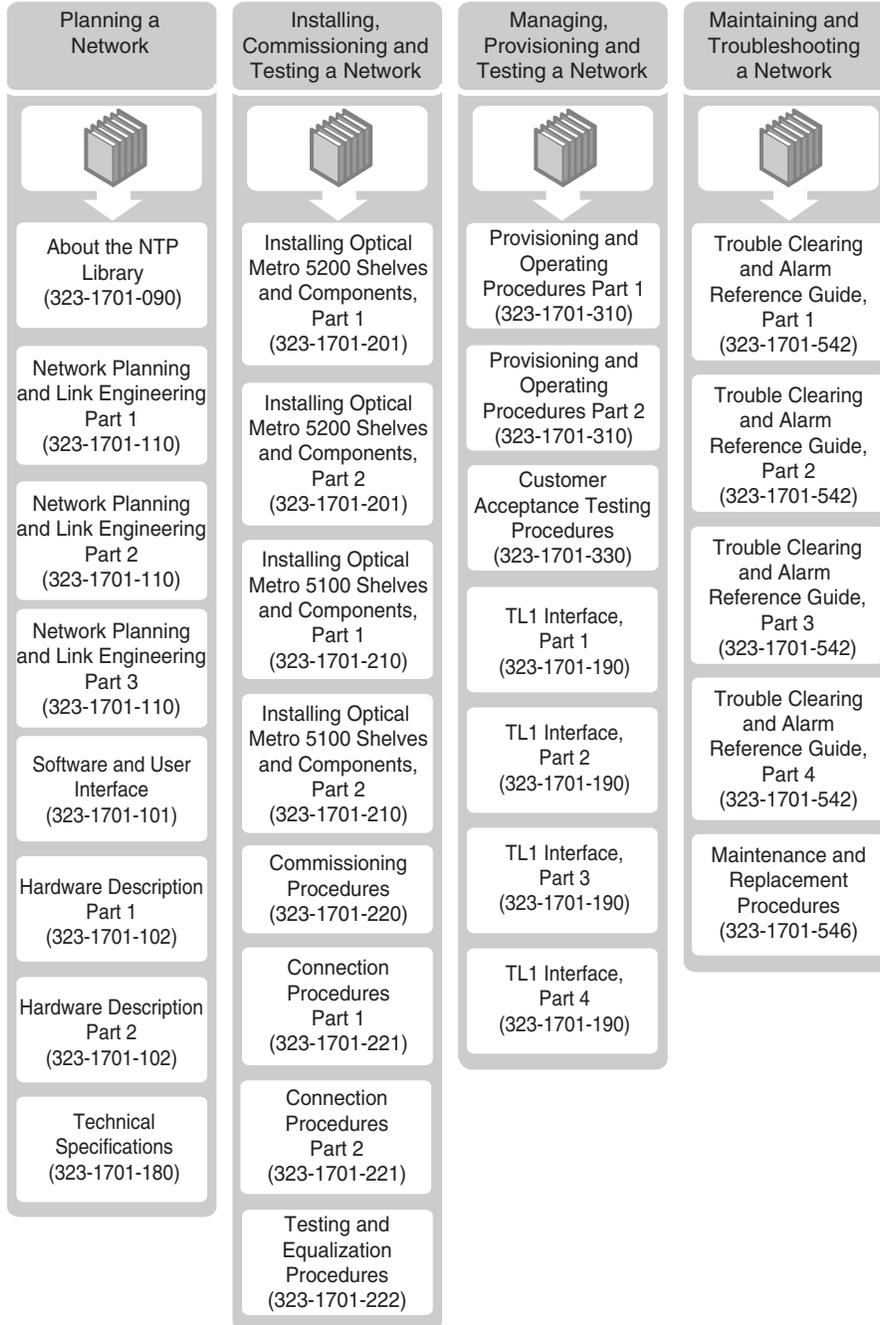
These NTPs provide detailed descriptive information about the Optical Metro 5100/5200 system, including system software and hardware descriptions, technical specifications, ordering information, and TL1 user information.

Procedures

These NTPs contain all procedures required to install, provision, and maintain the Optical Metro 5100/5200 system.

The following roadmap lists the documents in the Optical Metro 5100/5200 library.

OM2805p



Technical assistance service telephone numbers

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

Technical Assistance Service	
<p>For service-affecting problems: For 24-hour emergency recovery or software upgrade support, that is, for:</p> <ul style="list-style-type: none"> • 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 	<p>North America: 1-800-4NORTEL (1-800-466-7835)</p> <p>International: 001-919-992-8300</p>
<p>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.</p>	<p>North America: 1-800-4NORTEL (1-800-466-7835)</p> <p>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.</p> <p>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.</p>
<p>Global software upgrade support:</p>	<p>North America: 1-800-4NORTEL (1-800-466-7835)</p> <p>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.</p>

Optical Metro 5200 shelves

In this chapter

This chapter includes the following sections:

- [Shelf formats on page 1-1](#)
- [Shelf layouts on page 1-3](#)
- [Cooling unit on page 1-5](#)
- [Maintenance panel on page 1-6](#)
- [Fiber management trough on page 1-13](#)
- [Shelf cover on page 1-13](#)
- [NEBS shelf extension on page 1-14](#)
- [Air baffle on page 1-14](#)

Shelf formats

The Optical Metro 5200 shelf is available in two formats:

- Standard 12 U
- Variant 11 U

Two versions of the Variant 11 U shelf are available:

- Optical Metro 5200 shelf assembly modified for OMX variants (11 U high)
- Optical Metro 5200 shelf assembly modified for OMX variants (11 U high) Enhanced

In the Optical Metro 5200 shelf assembly (standard 12 U high), a built-in drawer holds two standard OMXs or an ECT.

In the Optical Metro 5200 shelf assembly modified for OMX variants (11 U high) and Optical Metro 5200 shelf assembly modified for OMX variants (11 U high) Enhanced, the built-in drawer is eliminated. When an Optical Metro 5200 shelf assembly modified for OMX variants (11 U high) or the Optical Metro 5200 shelf assembly modified for OMX variants (11 U high) Enhanced is used, an OMX Mounting Kit must be installed directly below the shelf to hold the standard OMX or an ECT.

The Optical Metro 5200 shelf assembly modified for OMX variants (11 U high) Enhanced is the same as the Optical Metro 5200 shelf assembly modified for OMX variants (11 U high) with the following changes:

- New offset hole plate in air plenum at the top of the shelf. With this change, the Optical Metro 5200 shelf assembly modified for OMX variants (11 U high) Enhanced meets NEBS flame spread requirements without the use of the NEBS Extension Shelf.

Note: The NEBS Extension Shelf uses 1 U of rack space and is required when using the other Optical Metro 5200 shelf types in applications requiring that the shelf meet NEBS flame spread requirements. See [“NEBS shelf extension” on page 1-14](#) for more information on the NEBS Shelf Extension kit.

- Formed metal card guides instead of plastic card guides
- Full trough for circuit pack latching instead of notched circuit pack latching
- Addition of a slot under the power card to allow for easier card removal
- Enlargement of opening on left hand side of maintenance panel for cable exit
- Changes to the physical design of the Cooling Unit
 - Fan finger guard added for improved safety
 - Sheet metal design modified for improved manufacturability
- Introduction of the Universal Fiber Tool and the introduction of features on the shelf door to retain the tool
 - The Universal Fiber Tool allows for easier removal of LC type patch cords from circuit pack faceplate connectors, specifically for the Muxponder circuit pack
 - This change is implemented on both the Optical Metro 5200 shelf assembly modified for OMX variants (11 U high) Enhanced and the Optical Metro 5200 shelf assembly modified for OMX variants (11 U high) since they share the same door assembly

For more information about shelf specifications, refer to the [“Optical Metro 5200 shelf general specifications”](#) section in *Technical Specifications*, 323-1701-180.

Product engineering codes

For a list of the product engineering codes (PEC) related to the items in following list, refer to “[Optical Metro 5100/5200 ordering information](#)” of *Network Planning and Link Engineering*, 323-1701-110.

- Optical Metro 5200 shelf assemblies and circuit packs
- components of Optical Metro 5200 shelf assembly (installation kit, maintenance panel cards, cooling unit, and air filter)

Shelf layouts

[Figure 1-1](#) shows a Standard 12U shelf, equipped with OMXs.

The standard 12U shelf is divided into the following areas:

- maintenance panel
- card cage
- fiber management trough
- cooling unit
- a pair of standard OMXs, or an ECT (for OFA applications)

The Standard 12U shelf has 20 slots. For equipping rules and slot assignments, see the “[Site requirements and equipping rules](#)” chapter in *Network Planning and Link Engineering*, 323-1701-110.

Figure 1-1
Standard 12 U shelf

OM0154p

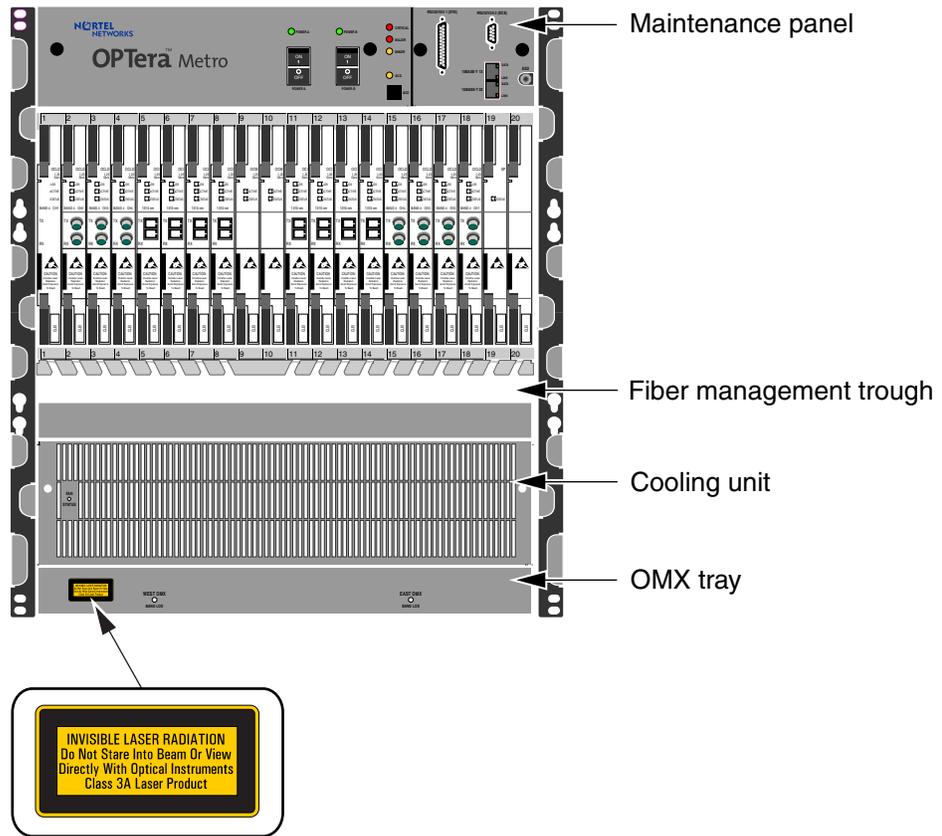


Figure 1-2 on page 1-5 shows a Variant 11 U, equipped with external 1U drawers.

The Variant 11 U shelf is divided into the following areas:

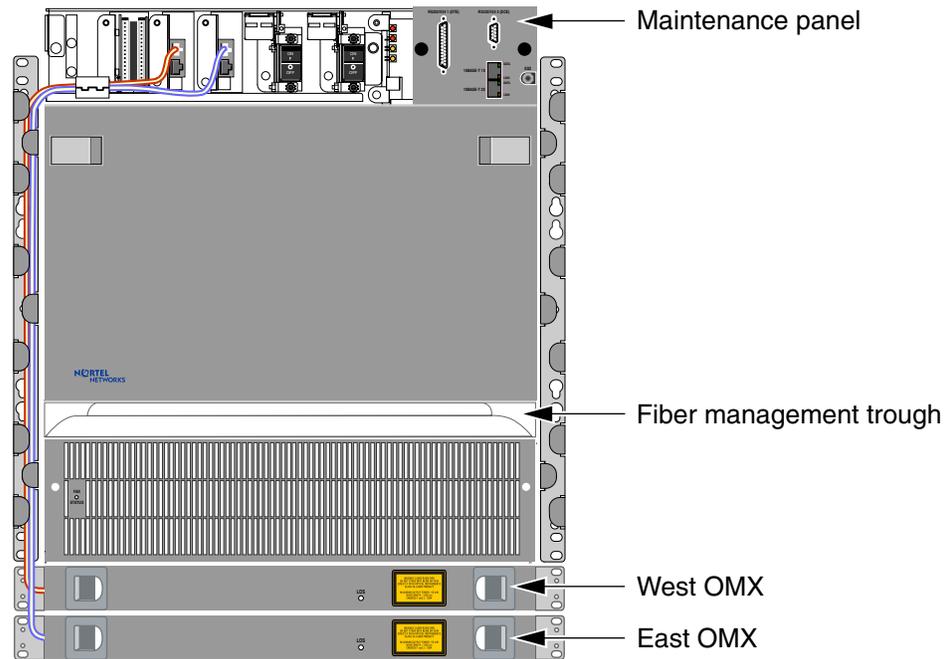
- maintenance panel
- card cage
- fiber management trough
- cooling unit

One or more drawers can be added at the bottom of the shelf.

The Variant 11 U shelf has 20 slots. For equipping rules and slot assignments, see the “[Site requirements and equipping rules](#)” chapter in *Network Planning and Link Engineering*, 323-1701-110.

Figure 1-2
Variant 11 U shelf

OM0509p



Cooling unit

Two fans in the cooling unit draw air through the front of the shelf to cool the Optical Metro 5200 circuit packs. The air exits through the top back of the shelf.

The cover of the cooling unit attaches to the front of the shelf with two captive thumbscrews. Behind the cooling unit cover are two fans and an air filter. When it is completely inserted, the cooling unit is powered by a connection on the backplane of the shelf.

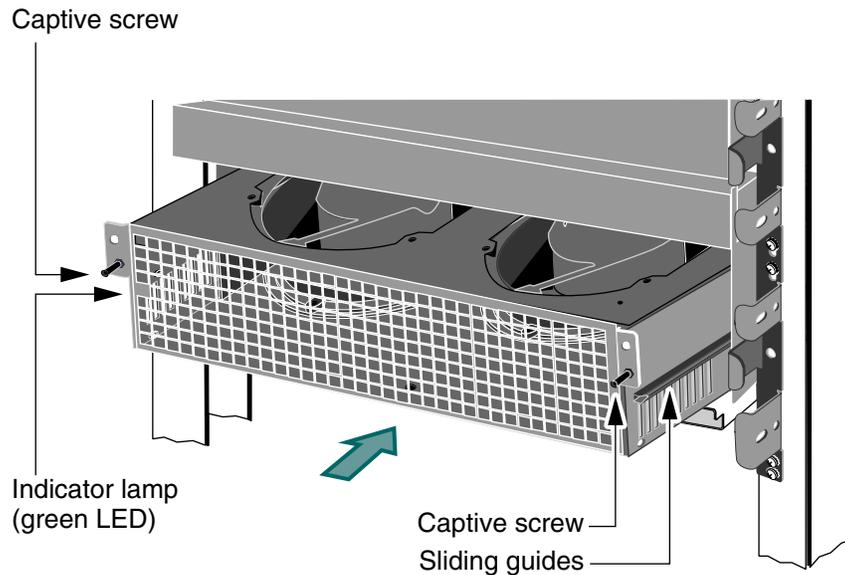
The cooling fans have two speeds—low and high. The low speed is the normal operating speed. The system automatically switches to the high speed if the operating temperature of the shelf exceeds the defined threshold or if one of the fans fails.

Both the air filter and the cooling unit are field-replaceable. If a fan fails the cooling unit must be replaced. You cannot replace individual fans.

[Figure 1-3](#) shows the cooling unit of the shelf without the louvered covers.

Figure 1-3
Cooling unit

OM0141t



Indicator lamps

The cooling unit has one indicator lamp, labeled STATUS.

Connectors

The cooling unit connects to the Optical Metro 5200 shelf through the backplane.

Location

The cooling unit is located below the card cage.

Product engineering codes

For a list of the product engineering codes (PEC) related to the cooling unit and the air filter, refer to [“Optical Metro 5100/5200 ordering information”](#) of *Network Planning and Link Engineering*, 323-1701-110.

Maintenance panel

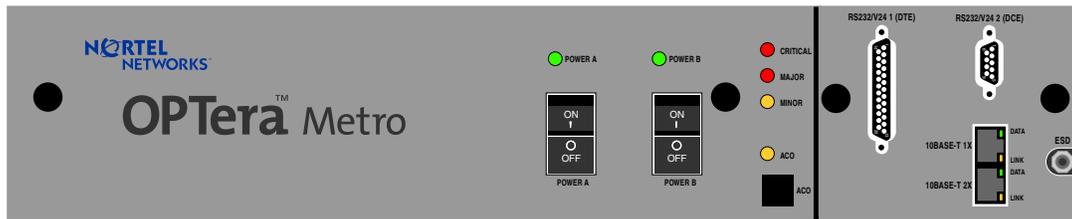
The maintenance panel faceplate has Telcordia-compliant

- fault indicators
- alarm indicator lamps
- alarm cut-off control
- connectors for Ethernet and RS-232 interfaces
- electrical breakers for redundant power feeds

[Figure 1-4](#) shows the maintenance panel for the Optical Metro 5200 shelf.

Figure 1-4
Optical Metro 5200 maintenance panel

OM0146p



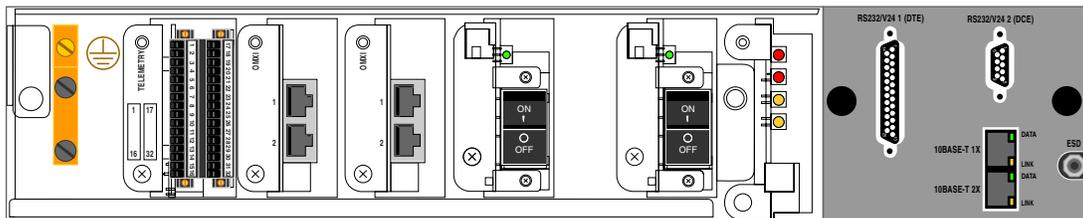
The left maintenance panel cover is held in position by two captive screws. You can remove the panel to access the power, communications, and OMX interface cards, as well as the central office telemetry (COTEL) card. The shelf grounding lug is also located under the left maintenance panel cover. [Figure 1-5](#) shows the maintenance panel with the cover removed.



DANGER
Risk of personal injury
The power, communications, and OMX interface cards inside the maintenance panel must only be removed by qualified personnel.

Figure 1-5
Optical Metro 5200 maintenance panel with the cover removed

OM0163p



Power

Power breakers, indicator lamps, an electrostatic discharge (ESD) grounding jack, and network interface connectors are accessible on the front of the maintenance panel without removing the maintenance panel cover.

The maintenance panel includes two power breakers:

- Power A
- Power B

Each power feed has a separate breaker. Lamps above each breakers indicate the status of the power feed. [Table 1-1](#) lists the meaning of the state of the indicator lamps.

Table 1-1
Optical Metro 5200 maintenance panel power indicator lamps

Indicator lamp	Color	State	Meaning
Power A	green/red	green	There is power from source A and the breaker is active (closed).
		red	There is power from source A and the breaker is tripped (open).
		off	There is no power from source A.
Power B	green/red	green	There is power from source B and the breaker is active (closed).
		red	There is power from source B and the breaker is tripped (open).
		off	There is no power from source B.

Power cards

The Optical Metro 5200 shelves each contain two power cards (Power A and Power B) that connect the shelf to an external –48V dc power source. Two power cards are used so that you can connect each shelf to two separate power sources, ensuring a redundant power supply.

Power return conductors from the A battery and the B battery are completely independent to provide A/B power separation. The power cards are system-specific, which means you cannot put a power card for a Optical Metro 5100 shelf into an Optical Metro 5200 shelf. For the product engineering code (PEC) related to the power card, refer to [“Optical Metro 5100/5200 ordering information”](#) of *Network Planning and Link Engineering*, 323-1701-110.

External power (–48V dc) connects to the power interface cards in the maintenance panel. The power cards provide circuit protection for the shelf and filter electromagnetic interference (EMI) and noise. In the Optical Metro 5200 shelf, the power cards and the electrical grounding lug are accessed by removing the left maintenance panel cover.

When you use a single power source, connect two power feeds from the one source to both power cards (Power A and Power B).

If an overcurrent condition occurs at the power input, the power breaker trips OFF (open). The power cannot be switched ON (closed) until the overcurrent condition is corrected.

Alarm indicators

Visual alarm indicators and alarm cut-off (ACO) are to the right of the power switches on the maintenance panel. The alarm indicators and cut-off are controlled by the visual alarm card (VAC). There are both visual and audible alarm indicators. Major and Critical alarms activate the audible alarm.

If a Critical or Major alarm is present, the ACO can be activated by pushing the ACO button (this causes the audible alarm to be silenced and the ACO LED will turn ON). Two conditions will cause the ACO to become de-activated:

- Both Critical and Major alarm LEDs are OFF (audible alarm silenced and ACO LED turns OFF)
- Critical or Major alarms LED transitions from OFF to ON (audible alarm sounds and ACO LED turns OFF).

Minor alarms are not connected to the ACO system.

[Table 1-2](#) lists the states of the alarm and ACO indicator lamps.

Table 1-2
Maintenance panel alarm indicator lamps

Indicator lamp	Color	State	Meaning
Critical	Red	On	Critical alarms are present.
		Off	Critical alarms are not present.
Major	Red	On	Major alarms are present.
		Off	Major alarms are not present.
Minor	Yellow	On	Minor alarms are present.
		Off	Minor alarms are not present.
ACO	Yellow	On	ACO button has been pressed.
		Off	The yellow lamp being off indicates that one of the following conditions exists: ACO button has not been pressed. ACO button was pressed but new audible alarms occurred after it was pressed. ACO button was pressed and audible alarm sources were cleared.

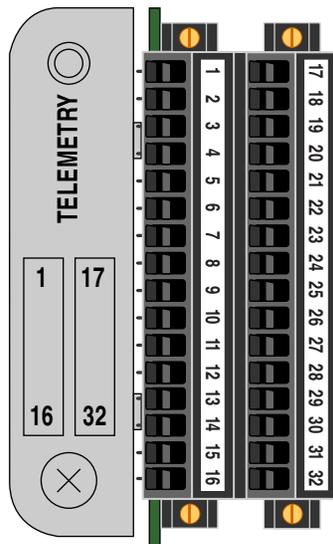
COTEL card

The COTEL card in the maintenance panel allows you to connect the Optical Metro 5200 visual and audible alarms to the central office. The COTEL card is on the left side of the small card cage under the left maintenance panel cover. The COTEL card has two 16-pin connectors with a wiring interface for 24-AWG wire (see [Figure 1-6](#)).

	<p>CAUTION Risk of equipment damage Do not remove the COTEL card. It is not hot-swappable. Otherwise you risk damaging equipment.</p>
---	---

Figure 1-6
COTEL card with 16-pin socket connectors

OM0097s



The COTEL card allows you to connect and monitor a maximum of four external devices, and respond to environmental conditions at the equipment site. For example, you can connect a water sensor to an input and a water pump to an output; when the sensor detects water at the equipment site, the System Manager will display an alarm. You can then activate the pump through the System Manager, and the alarm will clear when the water level returns to normal.

Note: The inputs and outputs are not tied together; when an input device raises an alarm, the output device will not be automatically activated. You must place the output device in the Released or Operational state in response to an alarm.

The System Manager allows you to specify the severity of the alarm for each input, as well as the alarm text.

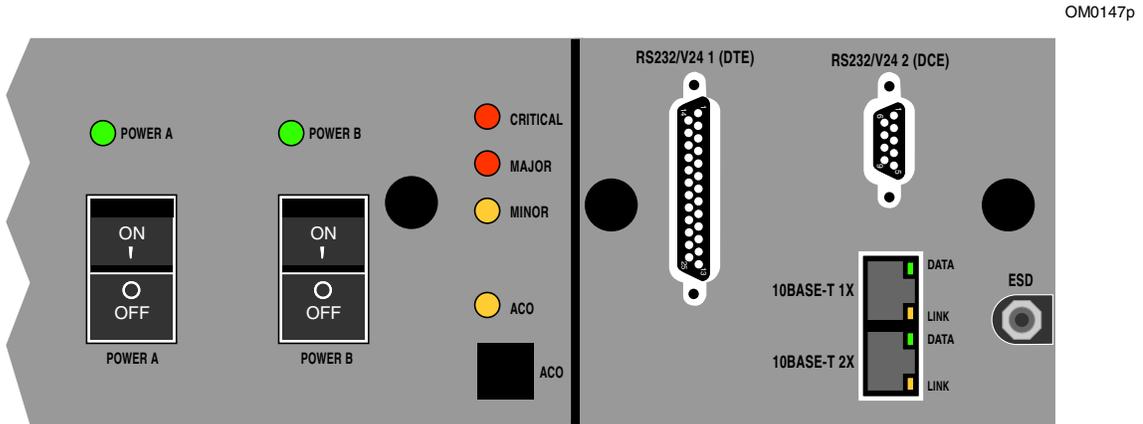
OMX interface card

The OMX interface card in the maintenance panel enables the Optical Metro 5200 System Manager to monitor passive optical components that are associated with a shelf. The two OMXI cards are to the right of the COTEL card under the left maintenance panel cover. Each OMXI card has two RJ45 connectors. Because there are only four ports available, the maximum number of optical components that can be monitored by a single shelf is four. The maximum number of optical components that can be monitored by a single shelf is 19 when the Equipment Inventory Unit (EIU) is used. For more information on the EIU, see the “[Equipment Inventory Unit](#)” chapter.

Connectors (right side of the maintenance panel)

The right side of the maintenance panel contains connectors for the modem, the System Manager, the Ethernet hub, and the ESD ground point. [Figure 1-7](#) shows these connectors.

Figure 1-7
Connectors on the maintenance panel



[Table 1-3](#) lists the connectors on the front of the maintenance panel and shelf chassis.

Table 1-3
Connectors on the maintenance panel faceplate and shelf chassis

TIA/EIA-232/V.24 1 (DTE)	RS232	Modem connection
TIA/EIA-232/V.24 2 (DCE)	RS232	Not supported
10Base-T 1X	RJ45	System management connection
10Base-T 2X	RJ45	Ethernet hub connection (for internal network communication only)
OMXI E	RJ45	interface data connections
OMXI W	RJ45	interface data connections
ESD	banana jack	Ground (ESD)

Note: Until the shelf has been commissioned, the 10Base-T 2X port is not functional, and the port ceases to function when a shelf is decommissioned.

[Table 1-4](#) lists the indicator lamps on the maintenance panel for the 10Base-T connectors.

Table 1-4
Maintenance panel 10Base-T indicator lamps

Indicator lamp	Color	State	Meaning
10Base-T 1X DATA	Green	Flashing	There is data present.
		Off	There is no data present.
10Base-T 1X LINK	Amber	On	There is a good connection.
		Off	There is not a good connection.
10Base-T 2X DATA	Green	Flashing	There is data present.
		Off	There is no data present.
10Base-T 2X LINK	Amber	On	There is a good connection.
		Off	There is not a good connection.

Fiber management trough

A fiber management trough is located below the cage. The trough consists of a shelf-width horizontal tray with a comb above it.

The fiber management trough holds the fiber-optic cables that are routed to and from the circuit packs that are installed in the card cage. The comb above the trough helps distribute and route fiber to the connectors on the circuit packs.

The grill of the cooling unit, which attaches to the shelf with two captive thumbscrews, extends above the cooling unit to cover the fiber management trough.

The fiber management comb is concealed behind the shelf cover, and is accessible when the shelf cover is removed from the shelf.

Shelf cover

The Optical Metro 5200 shelf has a removable cover that protects the card cage and fiber management comb and provides EMI shielding.

The shelf cover has two latches at the top, and mounts on two pivot pins located at the sides of the shelf above the fiber management trough.

When you are replacing the shelf cover, make sure that all optical fibers are fed through the fiber management trough to prevent pinching the fiber.

NEBS shelf extension

You can install the Network Equipment Building System (NEBS) shelf extension (Figure 1-8) onto an Optical Metro 5200 shelf to make it compliant with NEBS standards.

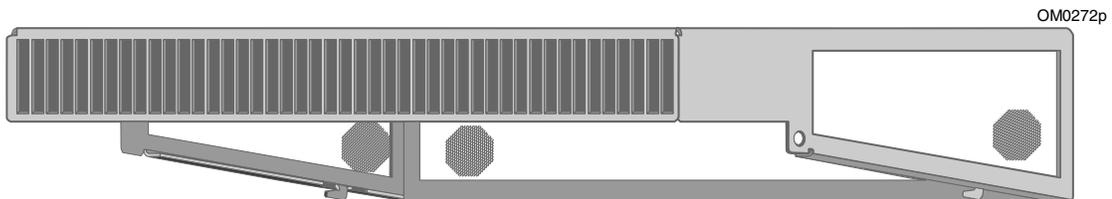
The shelf extension acts as an intershelf fire barrier, according to GR-63 Section 4. The requirement is that flames shall not escape from the boundaries of the equipment. The screening on the shelf extension prevents this from happening.

Use the NEBS Extension Shelf kit in conjunction with the following Optical Metro 5200 shelf types:

- Optical Metro 5200 shelf assembly (standard 12 U high)
- Optical Metro 5200 shelf assembly (modified for OMX variants, 11 U high)

Note: The NEBS Extension Shelf kit is not required for the Optical Metro 5200 shelf assembly (modified for OMX variants, 11 U high) Enhanced since this shelf type meets NEBS flame spread requirements without the NEBS Extension Shelf kit.

Figure 1-8
NEBS shelf extension



Product engineering code

For the product engineering codes (PEC) related to the NEBS shelf extension, refer to “[Optical Metro 5100/5200 ordering information](#)” of *Network Planning and Link Engineering*, 323-1701-110.

Air baffle

The use of the air baffle is optional. Without the air baffle, the exhaust air exits to the rear and sides of the shelf at the top. With the air baffle, no exhaust air exits to the sides. The air baffle can be configured to allow either front or rear exhaust. The air baffle can be used with the following Optical Metro 5200 shelf types:

- Optical Metro 5200 shelf assembly (standard 12 U high)
- Optical Metro 5200 shelf assembly (modified for OMX variants, 11 U high)

- Optical Metro 5200 shelf assembly (modified for OMX variants, 11 U high) Enhanced

Note: It is not possible to use both the air baffle and the NEBS Extension Shelf kit.

The air baffle uses up 1 U of rack space.

Product engineering codes

For all product engineering codes (PEC), see [“Optical Metro 5100/5200 ordering information” on page 13-1](#) in *Network Planning and Link Engineering*, 323-1701-110.

Optical Metro 5100 shelves

In this chapter

This chapter includes the following sections:

- [Shelf layout on page 2-1](#)
- [Power module on page 2-2](#)
- [Maintenance panel card on page 2-4](#)
- [Cooling unit on page 2-8](#)
- [Card cage on page 2-10](#)
- [Shelf cover on page 2-10](#)

Shelf layout

The Optical Metro 5100 shelf is a six-slot OADM shelf designed for single channel access applications. The Optical Metro 5100 shelf provides most of the functionality of the Optical Metro 5200 shelf, but is limited to at most four wavelengths per shelf when OTRs are used.

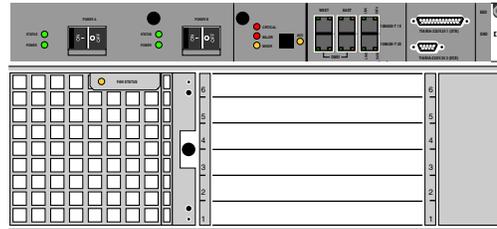
Product engineering code

For a list of the product engineering codes (PEC) related to the Optical Metro 5100 shelf and components for the Optical Metro 5100 shelf assembly, refer to [“Optical Metro 5100/5200 ordering information”](#) of *Network Planning and Link Engineering*, 323-1701-110.

Figure 2-1 shows an Optical Metro 5100 shelf.

Figure 2-1
Optical Metro 5100 shelf layout

OM1392t



The Optical Metro 5100 shelf is divided into the following areas:

- power module
- maintenance panel
- cooling unit
- card cage

Power module

The power breakers and related indicator lamps are located to the left of the maintenance panel faceplate.

There are two electrical power breakers which provide redundant power feeds to two power cards (Power A and Power B).

Each power card has a separate power feed. Indicator lamps to the left of the breakers indicate the status of the power feed.

Table 2-1 lists the indicator lamps.

Table 2-1
Optical Metro 5100 power indicator lamps

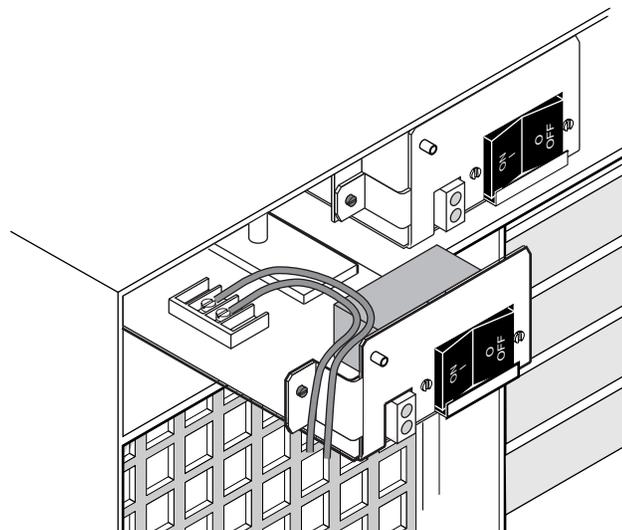
Indicator lamp	Color	State	Meaning
Power A	Green/red	Green	There is power from source A and the breaker is closed.
		Red	There is power from source A and the breaker is tripped (open).
		Off	There is no power from source A.
Power B	Green/red	Green	There is power from source B and the breaker is closed.
		Red	There is power from source B and the breaker is tripped (open).
		Off	There is no power from source B.

Power cards with A/B power separation

The Optical Metro 5100 shelves each contain two power cards (Power A and Power B) that connect the shelf to an external –48V dc power source. Two power cards are used so that you can connect each shelf to two separate power sources, ensuring a redundant power supply. Figure 2-2 shows the two cards that make up the power unit, plus the cabling for Power A.

Figure 2-2
Power cards in Optical Metro 5100 shelf

OM1094t



The power return conductors from the A battery and the B battery are completely independent from each other, to provide A/B power separation. The power cards are system-specific, which means you cannot put a power card for an Optical Metro 5100 shelf into an Optical Metro 5200 shelf.

The power card also serves to terminate the inter-card Supervisory Bus (SBUS) communications via the backplane.

Table 2-2 lists the power module PEC for the Optical Metro 5100 shelf.

Table 2-2
Optical Metro 5100 shelf power card PEC

Product engineering code	Description
NTPM53AA	Power module

External power (–48 V dc) connects to the power cards. The power cards provide circuit protection for the shelf and filter EMI and noise. The two power cards are accessible by removing the power cover.

When you use a single power source, connect two power feeds from the one source to both power cards (Power A and Power B).

If an overcurrent condition occurs at the power input, the power breaker trips (open). The power cannot be switched ON (closed) until the overcurrent condition is corrected.

Maintenance panel card

The maintenance panel faceplate is located at the upper right of the Optical Metro 5100 shelf, above the card cage.

The maintenance panel faceplate has Telcordia-compliant

- fault indicators
- alarm indicator lamps
- alarm cut-off control
- six RJ45 connectors (two for Ethernet connections and four for OMX connections)
- TIA/EIA-232/V.24 1 DTE connector
- TIA/EIA-232/V.24 2 DCE connector (not supported)

Figure 2-3 shows the maintenance panel faceplate and power breakers for the Optical Metro 5100 shelf.

Table 2-3 lists the states of the alarm and ACO indicator lamps.

Table 2-3
Maintenance panel alarm indicator lamps

Indicator lamp	Color	State	Meaning
Critical	Red	On	Critical alarms are present.
		Off	Critical alarms are not present.
Major	Red	On	Major alarms are present.
		Off	Major alarms are not present.
Minor	Yellow	On	Minor alarms are present.
		Off	Minor alarms are not present.
ACO	Yellow	On	ACO button has been pressed.
		Off	The yellow lamp being off indicates that one of the following conditions exists: ACO button has not been pressed. ACO button was pressed but new audible alarms occurred after it was pressed. ACO button was pressed and audible alarm sources were cleared.

COTEL connectors

The COTEL connectors provide the telemetry interface between the Optical Metro 5100 visual and audible alarms and the central office (see Figure 2-4). The COTEL connectors reside on a 36-pin connector located on the right side of the maintenance panel card, behind the faceplate. Remove the maintenance panel card and use 24-AWG wire to make the connections.

	<p>CAUTION Risk of equipment damage Do not remove the COTEL card. It is not hot-swappable. Otherwise, you risk damaging equipment.</p>
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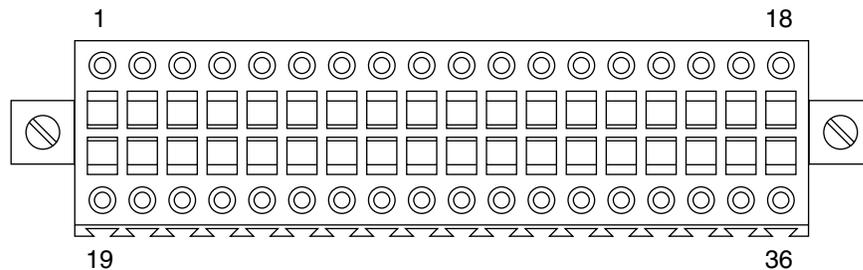
The COTEL connectors allow you to connect and monitor a maximum of eight external devices, and respond to environmental conditions at the equipment site. For example, you can connect a water sensor to an input and a water pump to an output; when the sensor detects water at the equipment site, the System Manager displays an alarm. You can then activate the pump through the System Manager, and the alarm will clear when the water level returns to normal.

Note: The inputs and outputs are not tied together; when an input device raises an alarm, the output device will not be automatically activated. You must place the output device in the Released or Operational state in response to an alarm.

The System Manager allows you to specify the severity of the alarm for eight inputs, as well as the alarm text for each shelf.

Figure 2-4
Telemetry connector

OM1055t



Connectors (on faceplate and shelf chassis)

The connectors for the modem, System Manager, Ethernet hub, and the optical devices are located on the maintenance panel faceplate. The ESD connector is on the shelf chassis, to the right of the maintenance panel faceplate. The terminal lug for grounding is directly beneath the ESD connector.

Figure 2-5
ESD and terminal lug detail

OM1212t

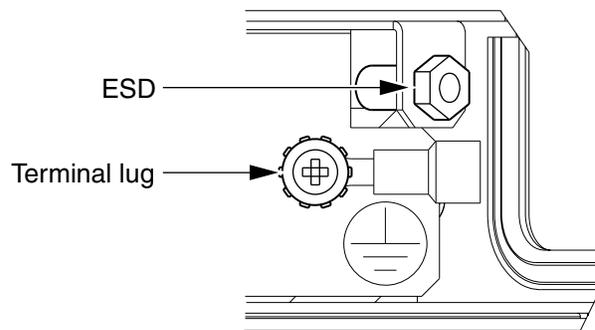


Table 2-4 lists the connectors on the maintenance panel faceplate and shelf chassis.

Table 2-4
Connectors on the maintenance panel faceplate and shelf chassis

Label	Type	Function
TIA/EIA-232/V.24 1 (DTE)	RS232	Modem connection
TIA/EIA-232/V.24 2 (DCE)	RS232	Not supported
10Base-T 1X	RJ45	System management connection
10Base-T 2X	RJ45	Ethernet hub connection (for internal network communication only)
OMXI E	RJ45	interface data connections
OMXI W	RJ45	interface data connections
ESD	banana jack	Ground (ESD)

Note: Until the shelf has been commissioned, the 10Base-T 2X port is not functional, and the port ceases to function when a shelf is decommissioned.

Table 2-5 lists the indicator lamps on the maintenance panel for the 10Base-T connectors.

Table 2-5
Maintenance panel 10Base-T indicator lamps

Indicator lamp	Color	State	Meaning
10Base-T 1X DATA	Green	Flashing	There is data present.
		Off	There is no data present.
10Base-T 1X LINK	Amber	On	There is a good connection.
		Off	There is not a good connection.
10Base-T 2X DATA	Green	Flashing	There is data present.
		Off	There is no data present.
10Base-T 2X LINK	Amber	On	There is a good connection.
		Off	There is not a good connection.

Cooling unit

Two fans in the cooling unit draw air through the front left of the shelf to cool the Optical Metro 5100 circuit packs. The air exits at the front right of the shelf.

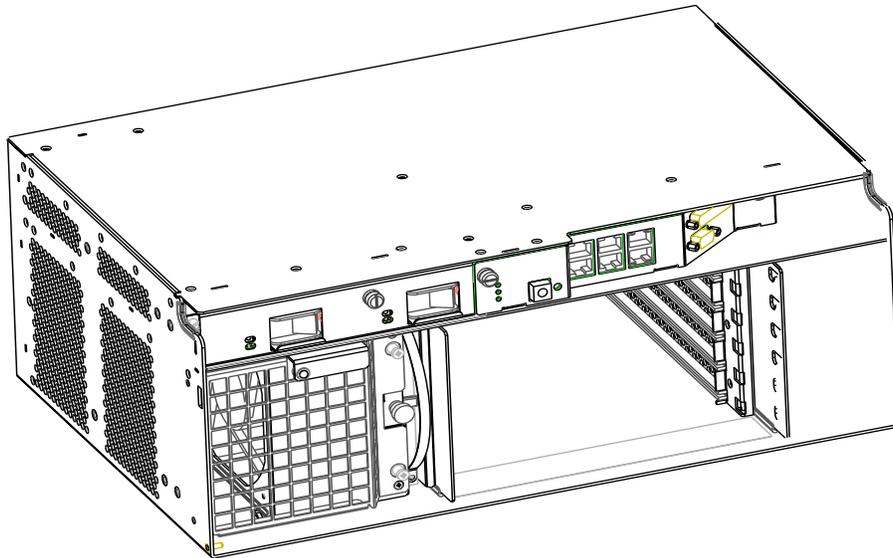
The cooling unit consists of two fans and an air filter, and is accessible after the shelf cover is removed. The air filter is located between the fans and the main card cage; it is separately accessible. When it is completely inserted, the cooling unit is powered by a connection on the backplane of the shelf.

Both the air filter and the cooling unit are field-replaceable. If one fan fails, the cooling unit must be replaced. You cannot replace individual fans.

Figure 2-6 shows the cooling unit.

Figure 2-6
Cooling unit and card cage in an Optical Metro 5100 shelf

OM1111t



Indicator lamp

Table 2-6 lists the states of the indicator lamp on the cooling unit.

Table 2-6
Cooling unit indicator lamp

Indicator lamp	Color	State	Meaning
Status	Green/red	Green	The unit has power and both fans are functioning.
		Red	One or both fans in the cooling unit are not functioning.
		Off	There is no power to the cooling unit.

Connectors

The cooling unit connects to the Optical Metro 5100 shelf through the backplane.

Location

The cooling unit is located below the maintenance panel and to the left of the card cage.

Product engineering codes

For the product engineering codes (PEC) related to the cooling unit, refer to [“Optical Metro 5100/5200 ordering information”](#) of *Network Planning and Link Engineering*, 323-1701-110.

Card cage

The Optical Metro 5100 card cage contains six slots. The circuit packs are inserted horizontally, with LED lamps to the left.

For equipping rules and slot assignments, see the [“Site requirements and equipping rules”](#) chapter in *Network Planning and Link Engineering*, 323-1701-110.

Shelf cover

The Optical Metro 5100 shelf has a removable cover that protects the card cage and provides EMI shielding.

The shelf cover has two latches at the top and mounts on two pivot pins located at the lower corners of the shelf.

Optical Metro 5100/5200 shelf installation kit

In this chapter

This chapter includes the following sections:

- [Installation kit types on page 3-1](#)
- [Vertical fiber brackets on page 3-1](#)
- [Mounting brackets on page 3-4](#)
- [Optical Metro 5100/5200 installation kits on page 3-9](#)

Installation kit types

For a list of installation kits and contents, refer to “[Optical Metro 5100/5200 ordering information](#)” of *Network Planning and Link Engineering*, 323-1701-110.

Vertical fiber brackets

Vertical fiber brackets are included with the Optical Metro 5200 shelf installation kit. The Optical Metro 5100 shelf does not use vertical fiber brackets.

The vertical fiber brackets are used to route patch cords. Vertical fiber brackets help protect cables and optical fibers from damage. Vertical fiber brackets also decrease the chance of having a signal interrupted because of excessive bend in the optical fiber.

Note: You can choose to not use the vertical fiber brackets if you plan to use another optical fiber management system.

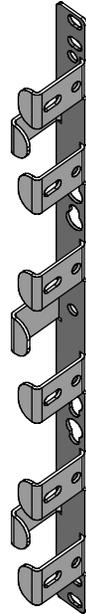
Nortel Networks ships one pair of vertical fiber brackets with each Optical Metro 5200 shelf.

[Figure 3-1](#) shows a vertical fiber bracket for the Optical Metro 5200 Shelf Assemblies (Standard 12 U and Variant 11 U).

Figure 3-1
Vertical fiber bracket for the Optical Metro 5200 shelves

OM0162s / OM0507t

Part # P0994186



Location of the vertical fiber brackets

Vertical fiber brackets are attached to the mounting brackets on the left and right sides of an Optical Metro 5200 shelf, after the mounting brackets are installed.

[Figure 3-2](#) shows the position of vertical fiber brackets on an Optical Metro 5200 Shelf Assembly (Standard 12 U). [Figure 3-3 on page 3-3](#) shows the position of the vertical fiber brackets on an Optical Metro 5200 shelf (Variant 11 U).

Figure 3-2
Vertical fiber brackets on an Optical Metro 5200 shelf (Standard 12 U)

OM0153t

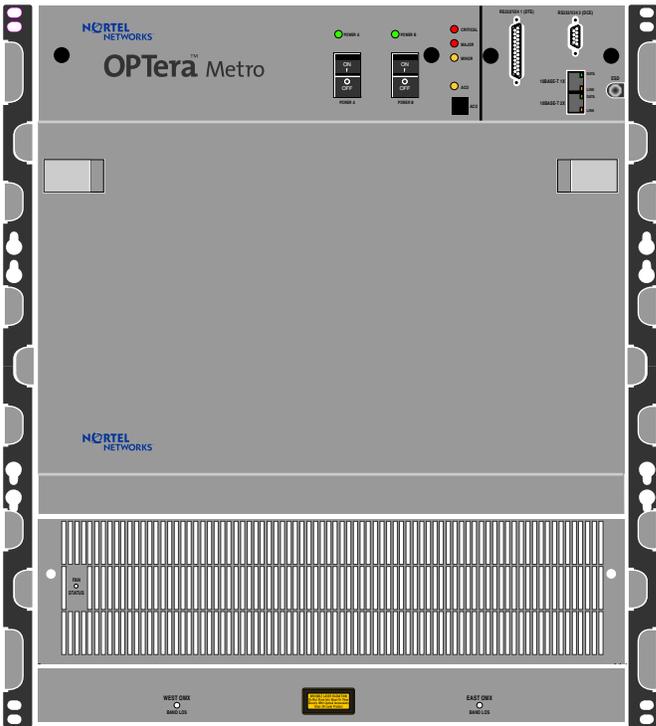
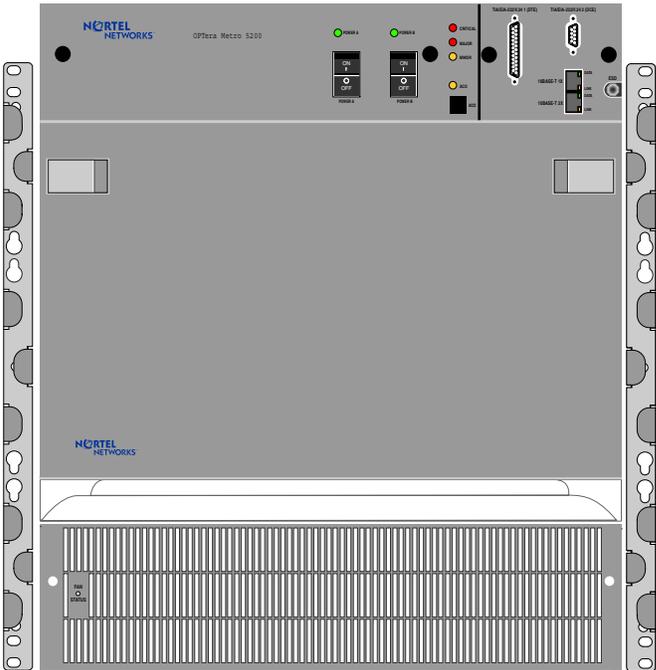


Figure 3-3
Vertical fiber brackets on an Optical Metro 5200 shelf (Variant 11 U)

OM0548p



Mounting brackets

Nortel Networks ships two sets of mounting brackets with each Optical Metro 5200 shelf, and three sets of mounting brackets with each Optical Metro 5100 shelf. Use mounting brackets to install an Optical Metro 5100/5200 shelf in an equipment rack or cabinet.

Optical Metro 5200 shelf mounting brackets

Two sets of two-way 19/23 brackets are available for installing an Optical Metro 5200 shelf in Electronics Industry Association (EIA) equipment racks. One set is for the Standard 12 U shelf, and the other is for the Variant 11 U shelf. The mounting brackets are included in the installation kit that comes with each shelf.

Each set of EIA mounting brackets can be used to mount the shelf in an equipment rack, as follows.

- EIA (for Standard 12 U)—Part # P0911049 is a two-way 19/23 bracket used to mount the shelf in racks with wide, universal or 25-mm hole spacing.
- EIA (for Variant 11 U)—Part # P0934632 is a two-way 19/23 bracket used to mount the shelf in racks with wide, universal or 25-mm hole spacing.

A set of 535-mm brackets are available for installing an Optical Metro 5200 shelf in European Telecommunications Standards Institute (ETSI) equipment racks or cabinets, as follows:

- ETSI (for Standard 12 U or Variant 11 U)—Part # P0934631 is a two-way 19/23 bracket used to mount the shelf in a 535 mm rack with 25-mm hole spacing.

Optical Metro 5100 shelf mounting brackets

Three sets of mounting brackets are provided for installing an Optical Metro 5100 shelf in an equipment rack or cabinet.

- EIA (standard)—Part # P0937953 is a two-way 19/23 bracket used to mount the shelf in racks with 25-mm hole spacing.
- EIA (metric)—Part # P0941357 is a two-way 19/23 bracket used to mount the shelf in racks with universal hole spacing.
- ETSI—Part # P0941107 is used to mount the shelf in racks with 25-mm hole spacing.

Note: The part number is stamped on each bracket for identification.

EIA mounting brackets

Figure 3-4 shows a cross-section of an Optical Metro 5100/5200 two-way EIA 19/23 mounting bracket.

Figure 3-4
Cross-section of an EIA two-way 19/23 shelf mounting bracket

OM0137t

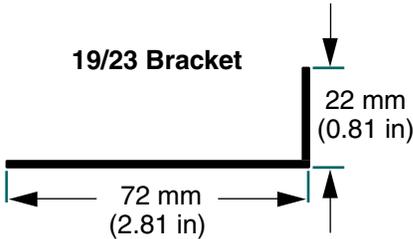


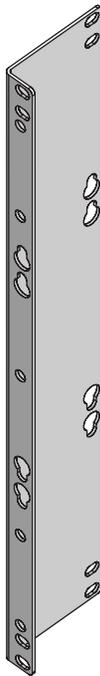
Figure 3-5 shows a full view of the 19/23 shelf mounting brackets for use with Standard 12 U and Variant 11 U shelves.

Figure 3-5
EIA two-way 19/23 mounting brackets for Optical Metro 5200 Standard 12 U and Variant 11 U shelves

Standard 12 U
-Part # P0911049



Variant 11 U
- Part # P0934632



OM0134s / OM0506t

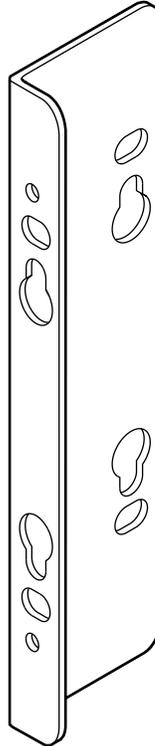
Figure 3-6 shows the two types of EIA 19/23 shelf mounting brackets for Optical Metro 5100 shelves.

Figure 3-6

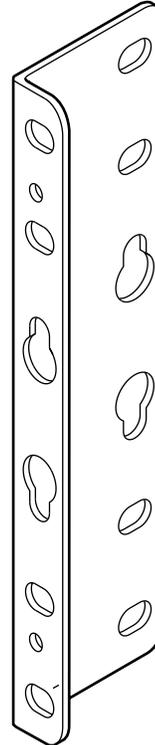
EIA two-way 19/23 mounting bracket for an Optical Metro 5100 shelf

OM1172p / OM1173p

EIA (standard)
-Part #P0937953



EIA (metric)
- Part # P0941357



ETSI mounting brackets

Figure 3-7 shows an ETSI mounting bracket for Optical Metro 5200 shelves.

Figure 3-7
ETSI mounting bracket for an Optical Metro 5200 shelf

Part # P0934631

OM0255s

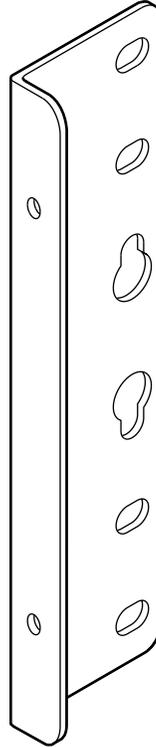


Figure 3-8 shows the ETSI mounting bracket for Optical Metro 5100 shelves.

Figure 3-8
ETSI mounting bracket for an Optical Metro 5100 shelf

OM1174p

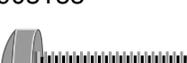
ETSI bracket
- Part # P0941107



Optical Metro 5100/5200 installation kits

Table 3-1 lists mounting hardware that is included in each of the three Optical Metro 5100/5200 installation kits.

Table 3-1
Mounting hardware included in installation kits

Part description	Included in the installation kit			Quantity	
	Optical Metro 5200 12 U shelf	Optical Metro 5200 11 U shelf	Optical Metro 5100 shelf	Optical Metro 5200	Optical Metro 5100
Phillips screw 8-32 X 3/16 in. Part # P0903398 	√	√	—	16	0
Phillips screw 10-32 X 3/4 in. Part # P0903373 	√	√	√	8	4
Phillips screw 12-24 X 3/4 in. Part # P0903127 	√	√	√	8	4
Phillips screw M5X20 mm Part #P0917375 	√	√	√	8	4
Phillips screw M6X20 mm Part # P0903155 	√	√	√	8	4
Phillips hex screw 12-24 X 1/2 in Part # P097F813 	√	√	√	10	4
Phillips screw 8-32 X 3/12 in. Part # P0841553 	—	—	√	0	4

3-10 Optical Metro 5100/5200 shelf installation kit

Table 3-1 (continued)
Mounting hardware included in installation kits

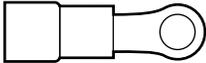
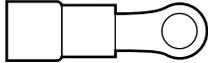
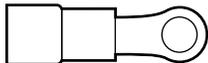
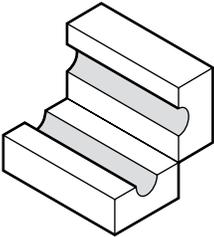
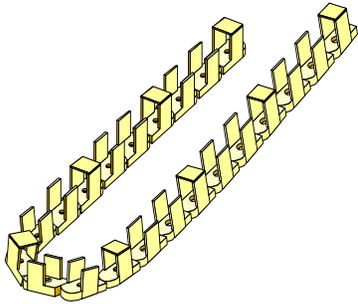
Part description	Included in the installation kit			Quantity	
	Optical Metro 5200 12 U shelf	Optical Metro 5200 11 U shelf	Optical Metro 5100 shelf	Optical Metro 5200	Optical Metro 5100
M6 clip Part # P0903211 	√	√	√	8	4
10-32 Clip nut Part # P0885593 	√	√	√	8	4
12-24 lock washer (clear plate) Part # P0903191 	√	√	√	8	4
M5 lock washer Part # P0903193 	√	√	√	8	4
M6 lock washer Part # P0903179 	√	√	√	8	4
12-24 lock washer (yellow plate) Part # P0183220 	√	√	√	10	4
Ring lug Part # A0288175 	√	√	—	4 (12-10)	0

Table 3-1 (continued)
Mounting hardware included in installation kits

Part description	Included in the installation kit			Quantity	
	Optical Metro 5200 12 U shelf	Optical Metro 5200 11 U shelf	Optical Metro 5100 shelf	Optical Metro 5200	Optical Metro 5100
Ring lug Part # A0291026 	—	—	√	0	2 (12-10)
Ring lug Part # A0288139 	—	—	√	0	2 (16-14)
Ferrite bead Part # A0376837 	√	√	√	2	2
OMX fiber guide Part # A0819083 	√	—	—	2	0

3-12 Optical Metro 5100/5200 shelf installation kit

Table 3-1 (continued)
Mounting hardware included in installation kits

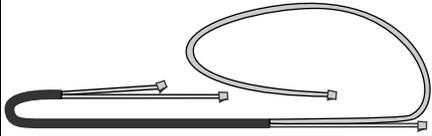
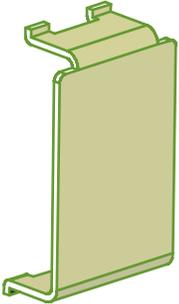
Part description	Included in the installation kit			Quantity	
	Optical Metro 5200 12 U shelf	Optical Metro 5200 11 U shelf	Optical Metro 5100 shelf	Optical Metro 5200	Optical Metro 5100
OMX cable (duplex RJ45-RJ45) Part # P0903967 (for OMX (Standard) trays) 	√	—	—	1	0
Circuit breaker cover Part # P0937373 	√	√	—	2	0
16-pin socket connector (1-16) Part # P0903963 16-pin socket connector (17-32) Part # P0903964 	√	√	—	1 each	0
36-pin socket connector Part # A0849276 	—	—	√	0	1
EIA (Standard) Mounting Bracket Part # P0937953 See Figure 3-6 on page 3-6	—	—	√	0	2

Table 3-1 (continued)
Mounting hardware included in installation kits

Part description	Included in the installation kit			Quantity	
	Optical Metro 5200 12 U shelf	Optical Metro 5200 11 U shelf	Optical Metro 5100 shelf	Optical Metro 5200	Optical Metro 5100
EIA (Metric) Mounting Bracket Part # P0941357 See Figure 3-6 on page 3-6	—	—	√	0	2
ETSI Mounting Bracket Part # P0941107 See Figure 3-8 on page 3-8	—	—	√	0	2
ETSI Mounting Bracket Part # P0934631 See Figure 3-7 on page 3-7	√	√	—	2	0
Vertical Fiber Bracket Part # P0994186 See Figure 3-1 on page 3-2	√	√	—	2	0
Caution tags Part # NTOH4405	√	—	—	8	0
Screw pan HD CR Type 1 DR Part # P0670942	√	√	—	10	0
Machine screw, pan HD Part # P0915441	√	√	—	10	0
CONN compression lug 10-14 AWG gauge 2 hole 0.625 SP Part # A0696250	√	√	—	2	0
CONN compression lug 10-14 AWG gauge 2 hole 1.000 S Part # A0724948	√	√	—	1	0
Lug, 6 AWG, 2 hole, 1/4" X 43 5/8" spacing, 54205" Part # A0297943	√	√	—	2	0

3-14 Optical Metro 5100/5200 shelf installation kit

Table 3-1 (continued)
Mounting hardware included in installation kits

Part description	Included in the installation kit			Quantity	
	Optical Metro 5200 12 U shelf	Optical Metro 5200 11 U shelf	Optical Metro 5100 shelf	Optical Metro 5200	Optical Metro 5100
CONN compression lug 6 AWG gauge 2 hole 1.000 spacing Part # A0772784	√	√	—	1	0
Power wire 6 AWG GRM/YEL stripe 7X0.0612 CU, XLPE INS Part # R0115565 (insulated stranded copper wire for grounding)	√	√	—	1	0
Power wire 10 AWG GRN/YEL single 105X30 CU XLPE INS Part # R0118776 (insulated stranded copper wire for grounding)	√	√	—	1	0

General circuit pack information

In this chapter

This chapter includes the following sections:

- [Circuit packs supported by Optical Metro 5100/5200 shelves on page 4-2](#)
- [Circuit pack interaction on page 4-3](#)
- [Using Gigabit Ethernet auto-negotiation on page 4-6](#)
- [Loopbacks on page 4-7](#)
- [Client-side conditioning on page 4-9](#)
- [Client-side conditioning holdoff times \(AOC\) on page 4-17](#)
- [Indicator lamp functionality on page 4-19](#)

Circuit packs supported by Optical Metro 5100/5200 shelves

Table 4-1 lists which circuit packs are supported by the Optical Metro 5100 and the Optical Metro 5200 shelves.

Table 4-1
Circuit packs supported by Optical Metro 5100/5200 shelves

Circuit pack type	Optical Metro 5100	Optical Metro 5200
OCI	√	√
OCLD	√	√
OTR 10 Gbit/s	—	√
OTR 10 Gbit/s Enhanced	√	√
OTR 2.5 Gbit/s	√	√
Muxponder 10 Gbit/s GbE/FC	√	√
Muxponder 10 Gbit/s GbE/FC VCAT	√	√
OCM	—	√
OSC	√	√
SP	√	√
OFA	—	√
APBE	—	√
OCLD filler cards (see Note)	√	√
LC filler cards (see Note)	√	√
OFA filler cards	—	√
Blank filler cards	√	√
<p>Note: OCLD filler cards are mandatory for Optical Metro 5200 shelves that are connected to OMX (Standard) trays to terminate the OMX pigtails. If you are using another OMX variant, the filler cards are optional, although they can be used for pre-fibering purposes between OMXs and slots that will potentially be equipped with OCLDs or OTRs in the future. Pre-fibering avoids having to re-open the OMX tray. The filler cards can also be used in Optical Metro 5100 shelves for pre-fibering purposes.</p>		

**CAUTION****Release 3.2 software baseline requirement**

All circuit packs installed on an Optical Metro 5100 shelf must meet the release 3.2 software baseline requirement. For details, contact Nortel Networks. Refer to the [“About this document”](#) chapter in this book for contact information.

For detailed specification information about individual circuit packs, refer to *Technical Specifications*, 323-1701-180. For slot assignments and equipping rules, refer to the [“Site requirements and equipping rules”](#) chapter in *Network Planning and Link Engineering*, 323-1701-110.

Circuit pack interaction

In Optical Metro 5200 WDM shelves, the OCM circuit pack manages connections. The OCM maps signals to and from OCI and OCLD circuit packs, or between OCLD circuit packs, maintains the shelf database in non-volatile memory and terminates the inter-card Supervisory Bus (SBUS) communications via the backplane.

The OCM circuit packs also carry the protection signal between the working and protection Muxponder circuit packs of a protected channel assignment. Muxponder protection is not available if an OCM circuit pack fails or is removed from the shelf.

In Optical Metro 5100 shelves, the OCM circuit pack is not required. Database support is offered on any two circuit packs located in slots 1 to 4 or 6.

OCLD/OCI circuit pack interaction

[Figure 4-1](#) shows the signal sequence and the methods of interconnection of the circuit packs when you install them in an Optical Metro 5200 shelf. [Figure 4-2](#) shows the signal sequence and the methods of interconnection of the circuit packs when you install them in an Optical Metro 5100 shelf. The OCI or SRM circuit packs connect to customer equipment. The client signal travels across the backplane through the OCM (if you have an Optical Metro 5200 shelf) and OCLD circuit packs to the multiplexer unit where it is sent to the network elements.

Figure 4-1
OCLD/OCI circuit pack interaction in Optical Metro 5200 shelves

OM0209p

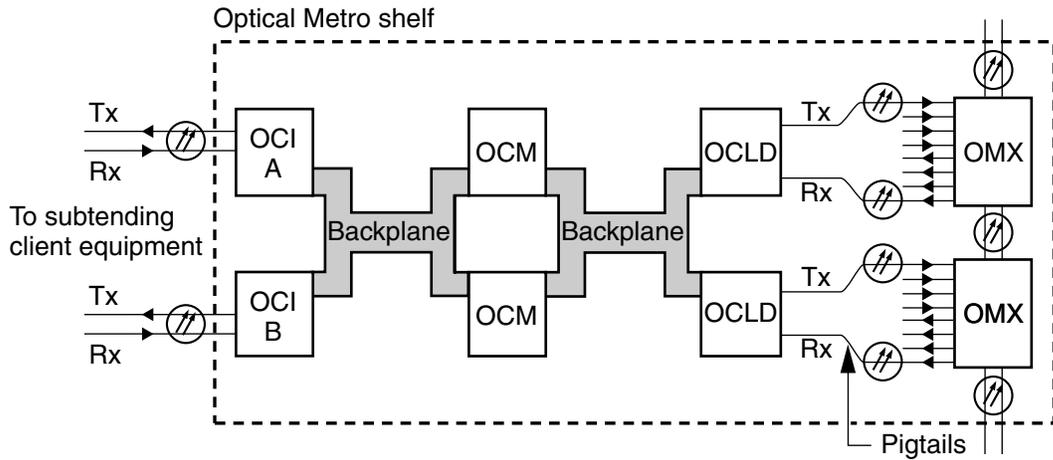
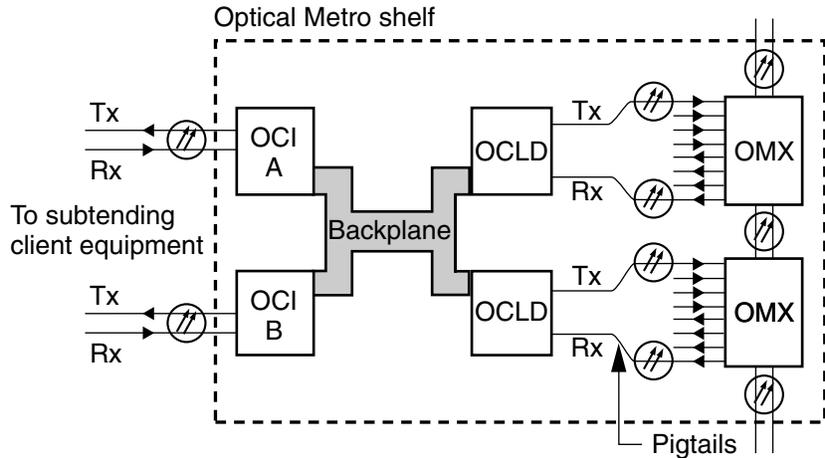


Figure 4-2
OCLD/OCI circuit pack interaction in Optical Metro 5100 shelves

OM1951

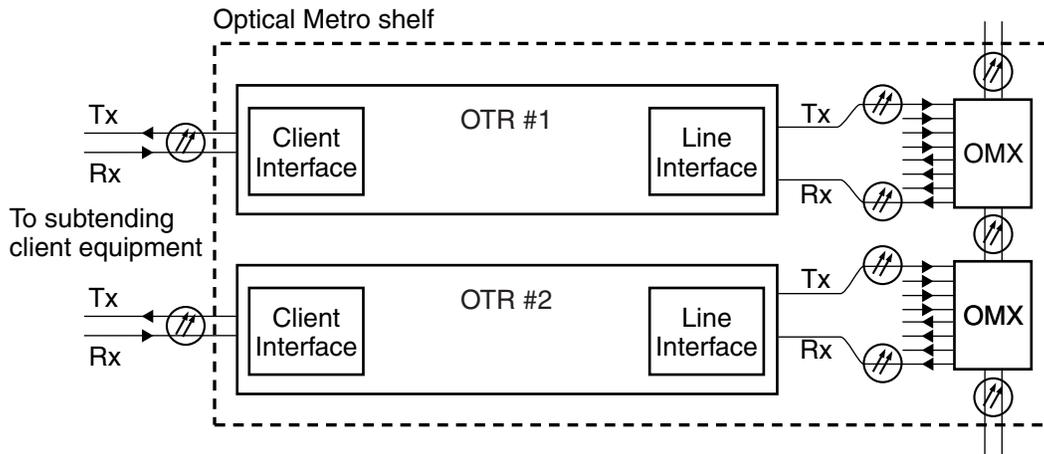


OTR circuit pack interaction

Figure 4-3 shows the signal sequence and the methods of interconnection of the OTR circuit packs when you install them in an Optical Metro 5200 or Optical Metro 5100 shelf. The OTR circuit packs connect to customer equipment through the client interface and to the multiplexer unit where the client signal is sent to the network elements through the line interface.

Figure 4-3
OTR circuit pack interaction in Optical Metro 5200 or Optical Metro 5100 shelves

OM1295p

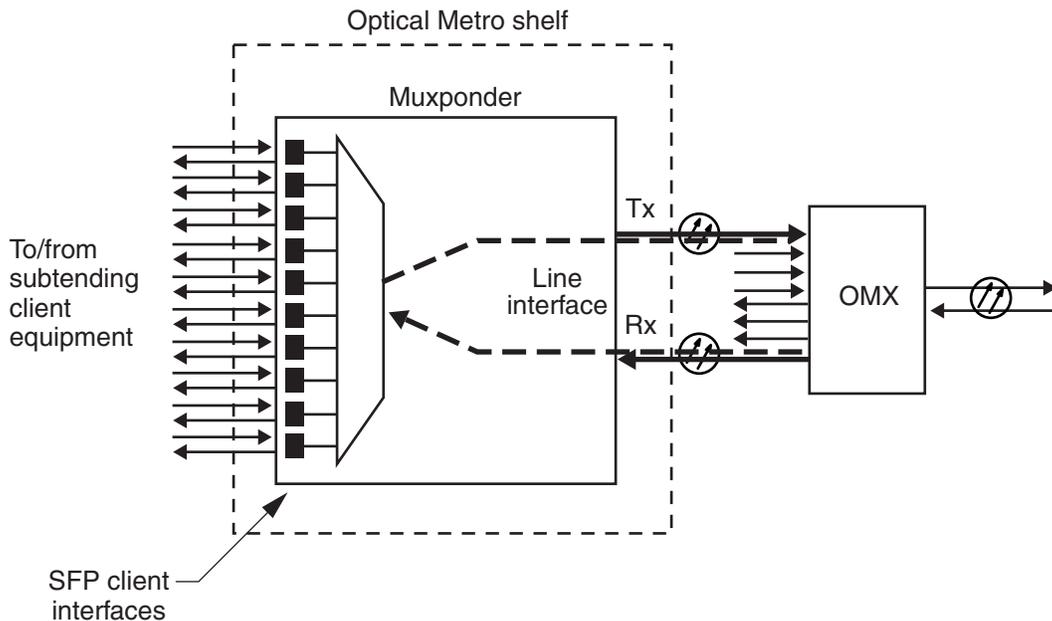


Muxponder circuit pack interaction

Figure 4-4 shows the signal sequence and the methods of interconnection of the Muxponder circuit packs when you install them in an Optical Metro shelf. The Muxponder circuit packs connect to the subtending equipment through small form factor pluggable (SFP) modules. Up to eight SFP modules can be equipped in the Muxponder 10 Gbit/s GbE/FC circuit pack. Up to ten SFP modules can be equipped in the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack. The Muxponder circuit packs connect to the DWDM optical ring through one line-side LC duplex connector.

Figure 4-4
Muxponder circuit pack interaction

OM2821p



Using Gigabit Ethernet auto-negotiation

Gigabit Ethernet routers that have auto-negotiation enabled may cause “Loss of Lock” or “Loss of Frame” alarms on Optical Metro 5100/5200 equipment. Some vendors’ Gigabit Ethernet equipment varies the frequency of the optical signal during auto-negotiation. Optical Metro 5100/5200 raises a “Loss of Lock” or “Loss of Frame” alarm when the frequency of the signal received from subtending equipment does not match the frequency of the protocol provisioned for the channel assignment. For more information on these alarms, see *Trouble Clearing and Alarm Reference Guide*, 323-1701-542.

Auto-negotiation is the method by which Ethernet routers communicate to determine link (connect) status such as line rate, and full duplex or half duplex. The original Ethernet standard called for a maximum link distance of five kilometers. The timers for auto-negotiation were set for this link distance. With the use of the Optical Metro 5100/5200, the link distances exceed five kilometers. As such, the auto-negotiation process times out before completion. Some equipment seems to reset the synch register when it restarts the auto-negotiation process. The Optical Metro 5100/5200 sees this as a variation in the bit pattern and indicates a “Loss of Lock” alarm.

Once auto-negotiation begins on a Gigabit Ethernet link that is carried over Optical Metro 5100/5200 equipment, the link may reset automatically or require user intervention depending on the subtending configuration.

Disabling the auto-negotiation feature on Gigabit Ethernet routers connected to Optical Metro 5100/5200 equipment may be required if other settings on the router do not resolve “Loss of Lock” or “Loss of Frame” issues.

This affects circuits that are carried on the following circuit packs:

- OCI 1.25 Gbit/s
- OCI GbE
- OTR 2.5 Gbit/s
- Muxponder (when using GFP-T)

This does not affect circuits that are carried on the following circuit packs:

- OCI SRM GbE/FC
- OCI SRM GbE/FC Enhanced
- OCI SRM GbE
- Muxponder (when using GFP-F)

Loopbacks

To support pre-service operations practices and test-related activities in some applications, SONET/SDH network elements may need to provide loopbacks for SONET/SDH and DS_n signals. In general, loopbacks involve the use of external test equipment to monitor the looped back signal.

Two types of loopback are available: terminal loopbacks and facility loopbacks (see [Figure 4-5 on page 4-9](#)). A terminal loopback connects the signal being fed to the transmitter to the associated receiver. A facility loopback connects the incoming received signal to the transmitter in the return direction.

In general, loopbacks interrupt the flow of traffic, change the normal transmission, and often require coordinated activity as two or more NEs are affected. Because of this potential impact on the network, the use of loopbacks in the SONET/SDH network as routine practice is discouraged.

[Table 4-2](#) indicates which loopback type is supported for specific circuit packs. For details on individual loopback on circuit packs, see the loopback section in each circuit pack description in this chapter.

Table 4-2
Supported loopbacks (per circuit pack type)

Circuit pack	Facility loopback	Terminal loopback
OCI	√	√
OCI SRM SONET/SDH	√ (see Note 1)	√ (see Note 2)
OCI SRM SONET/SDH LTE	√ (see Note 1)	√ (see Note 1)

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Table 4-2 (continued)
Supported loopbacks (per circuit pack type)

Circuit pack	Facility loopback	Terminal loopback
OCI SRM	√ (see Note 1)	√ (see Note 2)
OCI SRM ESCON - client-side port	√ (see Note 3)	√ (see Note 1)
OCI SRM GbE/FC - client-side port	√ (see Note 1)	√ (see Note 1)
OCI SRM GbE - client-side port	√ (see Note 1)	√ (see Note 1)
OCLD	√	√
OTR - client-side	√ (see Note 4)	Not supported
OTR - line-side	√ (see Note 4)	Not supported
Muxponder client-side port (see Note 5)	√ (see Note 4)	√ (see Note 6)
Muxponder line-side port	√ (see Note 4)	Not supported
OSC	√ (see Note 7)	Not supported

Note 1: Multiple ports can be independently enabled at the same time.

Note 2: Applies to all ports simultaneously, therefore all ports must be in an out-of-service (OOS) state.

Note 3: Applies to one client-side port at a time.

Note 4: Client- and line-side facility loopbacks cannot be enabled at the same time.

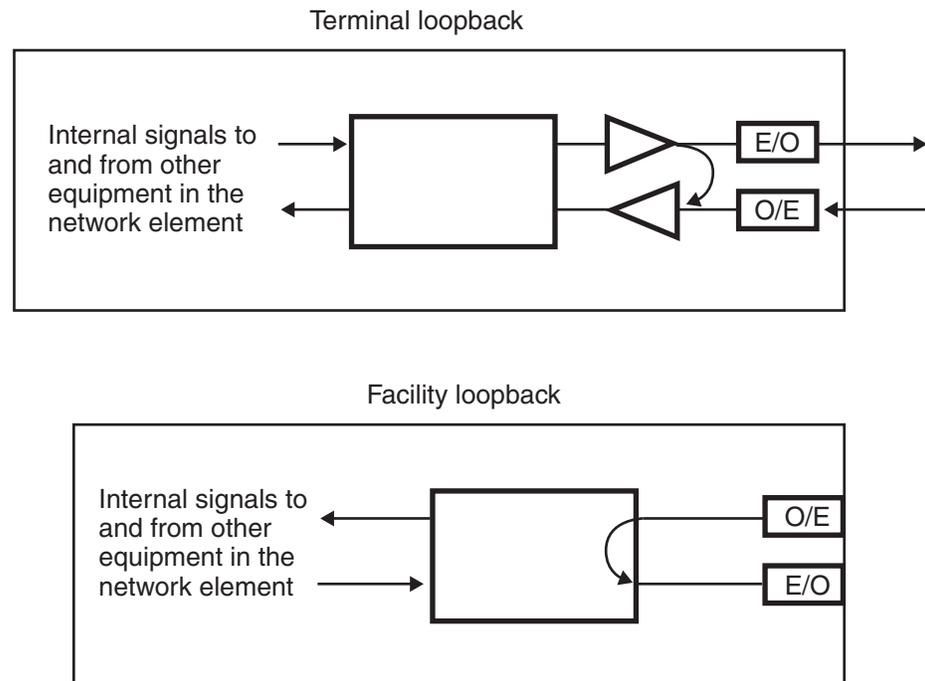
Note 5: Client-port loopbacks can be provisioned on unidirectional and bidirectional Gigabit Ethernet connections.

Note 6: Client-port terminal loopbacks do not require the SFP modules to be equipped in the Muxponder circuit pack.

Note 7: Not recommended because facility loopbacks on the OSC port can cause a loss of the communications path to the site. To clear the loopback, you must visit the site.

Figure 4-5
Terminal and facility loopbacks

OM2327



Client-side conditioning

[Table 4-3](#) summarizes the client-side signal conditioning applied on the client ports of OCI and OTR circuit packs upon different fault and provisioning conditions.

[Table 4-4 on page 4-13](#) summarizes the client-side signal conditioning applied on the client ports of Muxponder circuit packs upon different fault and provisioning conditions for bidirectional client types.

[Table 4-5 on page 4-15](#) summarizes the client-side signal conditioning applied on the client ports of Muxponder 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 circuit pack of a protected channel assignment or on the sole circuit pack of an unprotected channel assignment.

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Table 4-3
OCI and OTR client-side conditioning

Circuit pack	Condition	Protocol	Action
OCI SRM GbE/FC	<ul style="list-style-type: none"> • 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
	<ul style="list-style-type: none"> • Client-side facility OOS • Circuit pack failure • No channel assignment 	Any	Laser shutdown
OCI SRM GbE/FC Enhanced	<ul style="list-style-type: none"> • 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
	<ul style="list-style-type: none"> • Client-side facility OOS • Circuit pack failure • No channel assignment 	Any	Laser shutdown
<ul style="list-style-type: none"> • OCI 1.25 Gbit/s • OCI ISC • OCI GbE • OCI SONET/SDH • OCI SONET/SDH IR • OCI SRM GbE • OCI SRM • OCI SRM SONET/SDH • OTR 2.5 Gbit/s • OTR 10 Gbit/s 	<ul style="list-style-type: none"> • 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 	Any	Laser shutdown

Table 4-3 (continued)
OCI and OTR client-side conditioning

Circuit pack	Condition	Protocol	Action
<ul style="list-style-type: none"> • OCI 622 Mbit/s • OCI OC-48/STM-16 	<ul style="list-style-type: none"> • 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 	Any	SPS (Surrogate Payload Signal) Note: SPS is an Optical Metro 5100/5200 proprietary signal.
OCI SRM SONET/SDH LTE	<ul style="list-style-type: none"> • Line-side fault • Line-side facility OOS • Far-end client-side fault • Far-end client-side facility OOS 	Any	L-AIS/MS-AIS
	<ul style="list-style-type: none"> • Circuit pack failure 	Any	Laser shutdown
	<ul style="list-style-type: none"> • No channel assignment • No channel assignment at far-end OCI 	Any	Path Unequipped
OCI SRM ESCON	<ul style="list-style-type: none"> • 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 	Any	8B/10B error code
	<ul style="list-style-type: none"> • Client-side facility OOS • Circuit pack failure • No channel assignment 	Any	Laser shutdown

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Table 4-3 (continued)
OCI and OTR client-side conditioning

Circuit pack	Condition	Protocol	Action
OTR 10 Gbit/s Enhanced	<ul style="list-style-type: none"> • Line-side fault • Client-side facility OOS • Line-side facility OOS 	10 Gbit/s Ethernet LAN or 10 Gbit/s Clear Channel	Laser shutdown
	<ul style="list-style-type: none"> • Far-end client-side fault • Far-end client-side facility OOS • No channel assignment at far-end OTR 	OC-192, STM-64, or 10 Gbit/s Ethernet WAN	L-AIS/MS-AIS
	<ul style="list-style-type: none"> • Circuit pack failure • No channel assignment 	Any	Laser shutdown

Table 4-4
Muxponder client-side conditioning for bidirectional client types

Muxponder circuit pack type	Condition	Protocol	Encapsulation	Action
Muxponder 10 Gbit/s GbE/FC	<ul style="list-style-type: none"> • Line-side fault 	Gigabit Ethernet	GFP-T	Laser shutdown
	<ul style="list-style-type: none"> • 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 	FC-100, FC-200, FICON, FICON Express	GFP-T	8B/10B error code
	<ul style="list-style-type: none"> • Client-side facility OOS • Circuit pack failure • SFP failure • SFP OOS • No channel assignment 	Any	Any	Laser shutdown

Table 4-4 (continued)
Muxponder client-side conditioning for bidirectional client types

Muxponder circuit pack type	Condition	Protocol	Encapsulation	Action
Muxponder 10 Gbit/s GbE/FC VCAT	<ul style="list-style-type: none"> • Line-side fault • Loss of frame delineation 	Gigabit Ethernet	Any	Laser shutdown
	<ul style="list-style-type: none"> • 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 	FC-100, FC-200, FICON, FICON Express	GFP-T	8B/10B error code
	<ul style="list-style-type: none"> • Client-side facility OOS • Circuit pack failure • SFP failure • SFP OOS • No channel assignment 	Any	Any	Laser shutdown

Table 4-5
Muxponder client-side conditioning for unidirectional Gigabit Ethernet client types

Muxponder circuit pack type	Condition	Encapsulation	Action at uni-drop client port	Action at uni-add client port
Muxponder 10 Gbit/s GbE/FC	<ul style="list-style-type: none"> • 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
	<ul style="list-style-type: none"> • 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
	<ul style="list-style-type: none"> • 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 4-5 (continued)
Muxponder client-side conditioning for unidirectional Gigabit Ethernet client types

Muxponder circuit pack type	Condition	Encapsulation	Action at uni-drop client port	Action at uni-add client port
Muxponder 10 Gbit/s GbE/FC VCAT	<ul style="list-style-type: none"> Line-side fault in used direction 	GFP-T	Laser shutdown	8B/10B error code
	<ul style="list-style-type: none"> 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 	GFP-F	Laser shutdown	GbE idle frames
	<ul style="list-style-type: none"> Line-side fault in unused direction 	GFP-T	None	8B/10B error code
	<ul style="list-style-type: none"> 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 	GFP-F	None	GbE idle frames
	<ul style="list-style-type: none"> Client-side facility OOS at uni-add client port 	GFP-T or GFP-F	Laser shutdown	Laser shutdown

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 4-3 on page 4-10](#), [Table 4-4 on page 4-13](#) and [Table 4-5 on page 4-15](#). 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.

AOC is supported on the following circuit packs:

- OCI SRM GbE/FC
- OCI SRM GbE/FC Enhanced
- OCI SRM GbE
- Muxponder

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 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 4-6](#) for actions during the holdoff period.

Table 4-6
Actions during the holdoff period

Circuit pack type	Protocol	Encapsulation	Action
OCI SRM GbE/FC	Gigabit Ethernet	GFP-F	Gigabit Ethernet idles
	FC-100/FICON	GFP-T	8B/10B error code
OCI SRM GbE/FC Enhanced	Gigabit Ethernet	GFP-F	Gigabit Ethernet idles
	FC-100/FICON and subrate enabled	GFP-T	FC idles
	FC-100/FICON and subrate disabled	GFP-T	8B/10B error code
OCI SRM GbE	Gigabit Ethernet	GFP-F	Gigabit Ethernet idles

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Table 4-6 (continued)
Actions during the holdoff period

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

Indicator lamp functionality

Table 4-7 lists the lamp functionality for all circuit packs except the Muxponder circuit pack.

Table 4-8 on page 4-21 lists the lamp functionality for the Muxponder circuit pack.

Table 4-7
Indicator lamp functionality on all circuit packs except the Muxponder circuit pack

Indicator lamp	Color	Purpose
STATUS	Red/Green (bi-color)	<p>Indicates the operational state of the equipment. This lamp has the following states:</p> <ul style="list-style-type: none"> • 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. <p>Note: For the SP, this lamp is off when the circuit pack is initializing.</p> <ul style="list-style-type: none"> • Flashing — the circuit pack is the active database-carrying circuit pack during a database copy operation. <p>Note: Do not remove the active database-carrying circuit pack during the database copy to the standby circuit pack.</p>
Active (ACT)	Green	<p>Indicates circuit pack activity, and whether it is safe to pull the circuit pack without affecting traffic.</p> <ul style="list-style-type: none"> • OFF — no channels are provisioned, or the port facility is out of service • Green — a channel assignment is provisioned on a port and the port facility is in-service. • For the OCI SRM ESCON, Green ON indicates that at least one of the eight ports has the following conditions: <ul style="list-style-type: none"> — a channel assignment — its facility is in the in-service state • For the OSC, OFA and APBE, Green ON indicates that the port's facility is in the in-service state. • For the OCM, Green ON indicates that the equipment is in the in-service state. <p>Note: The Green state does not necessarily indicate that the circuit pack is carrying live traffic.</p>

Table 4-7 (continued)
Indicator lamp functionality on all circuit packs except the Muxponder circuit pack

Indicator lamp	Color	Purpose
LOS	Yellow	<p>Indicates the status of the received client optical signal.</p> <ul style="list-style-type: none"> • OFF — indicates that none of the following Rx facility faults are active on the port or the port facility is in the deleted state • For the OCI, OCI SRM, OCI SRM SONET/SDH, OCI SRM SONET/SDH LTE, OFA, OSC ports on the OSC, Yellow ON indicates that the port's facility is not in the deleted state and a Rx facility fault is active. • For the APBE, Yellow ON indicates that the port's facility is not in the deleted state and a LOS fault is active. • For the OCI SRM ESCON, Yellow ON indicates that at least one of the eight ports has the following conditions: <ul style="list-style-type: none"> — a Rx facility fault is active — its facility is not in the out-of-service state • For the OTR client-side, Yellow ON indicates that the port's facility is not in the deleted state and a Rx facility fault (except AIS or RDI) is active. • For the OTR line-side, Yellow ON indicates that the port's facility is not in the deleted state and a Rx facility fault (except AIS) is active. • For the OCLD, Yellow ON indicates that the port's facility is not in the deleted state and a Rx facility fault (except AIS or RDI) is active. • For the OCI SRM GbE, the OCI SRM GbE/FC, and the OCI SRM GbE/FC Enhanced, Yellow ON indicates that no optical signal is present or an invalid signal condition is present while the port's facility is not in the deleted state. Yellow ON indicates a Rx facility fault (except LAN Link Down).

Table 4-8
Indicator lamp functionality on the Muxponder circuit pack

Indicator lamp	Color	Description
STATUS	Red/Green (bi-color)	<p>Indicates the operational state of the equipment. This lamp has the following states:</p> <ul style="list-style-type: none"> • 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. <p>Note: Do not remove the active database-carrying circuit pack during the database copy to the standby circuit pack.</p>
Client ACTIVE	Red/Green (bi-color)	<p>Indicates a client port's ability to carry traffic. This lamp has the following states:</p> <ul style="list-style-type: none"> • 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	<p>Indicates the status of the received client optical signal. This lamp has two states:</p> <ul style="list-style-type: none"> • 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 4-8 (continued)
Indicator lamp functionality on the Muxponder circuit pack

Indicator lamp	Color	Description
DWDM Line ACTIVE	Green	Indicates the ability of the DWDM line to carry traffic. This lamp has the following states: <ul style="list-style-type: none">• 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. <ul style="list-style-type: none">• 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		

OCI circuit packs

In this chapter

This chapter includes the following sections:

- [Function and features on page 5-1](#)
- [Signal flow on page 5-43](#)
- [Faceplates on page 5-50](#)
- [Indicator lamps on page 5-56](#)
- [Loopbacks on page 5-57](#)
- [Cables and optical patch cords on page 5-64](#)
- [Location on page 5-64](#)
- [Product engineering codes on page 5-64](#)

Function and features

The optical-channel interface (OCI) circuit packs provide an interface between subtending equipment and the Optical Metro 5100/5200. You must use OCI circuit packs with optical channel laser detector (OCLD) circuit packs.

There are several OCI circuit pack types available, see [Table 5-1 on page 5-1](#).

[Table 5-1](#) shows the types of OCI circuit packs that are available.

Table 5-1
OCI circuit pack types

Circuit pack type	Slot width	Faceplate connector
OCI 622 Mbit/s 1310 nm	1	SC duplex
OCI 1.25 Gbit/s 1310 nm	1	SC duplex
OCI 1.25 Gbit/s 850 nm	1	SC duplex
OCI OC-48/STM-16 1310 nm	1	FC (x2)
OCI OC-48/STM-16 1310 nm	1	SC duplex

Table 5-1 (continued)
OCI circuit pack types

Circuit pack type	Slot width	Faceplate connector
OCI ISC 1310 nm	1	SC duplex
OCI GbE 1310 nm	1	SC duplex
OCI GbE 850 nm	1	SC duplex
OCI SONET/SDH 1310 nm (see Note)	1	SC duplex
OCI SONET/SDH IR 1310 nm	1	SC duplex
OCI SRM 1310 nm	1	MT-RJ duplex (x4)
OCI SRM 1310 nm LC	1	LC duplex (x4)
OCI SRM SONET/SDH 1310 nm	1	MT-RJ duplex (x4)
OCI SRM SONET/SDH LTE	1	LC duplex (x4)
OCI SRM ESCON 1310 nm	1	MPO-8xSC
OCI SRM GbE 1310 nm	1	LC duplex (x2)
OCI SRM GbE 850 nm	1	LC duplex (x2)
OCI SRM GbE/FC 1310 nm	1	LC duplex (x2)
OCI SRM GbE/FC 850 nm	1	LC duplex (x2)
OCI SRM GbE/FC Enhanced 1310 nm	1	LC duplex (x2)
OCI SRM GbE/FC Enhanced 850 nm	1	LC duplex (x2)
<p>Note: Hardware release 03 or higher of this circuit pack is the hardware baseline for an Optical Metro 5100 shelf. A HealthCheck query on an Optical Metro 5100 shelf that seats a prior version of NTOH10HJ indicates that the circuit pack is below the baseline.</p>		

In an Optical Metro 5200 shelf, the OCI circuit pack converts optical signals to electrical signals. The OCI sends the electrical signals to the optical channel manager (OCM). The OCM passes the signal to the optical channel laser and detector (OCLD). The OCLD uses the signal to modulate a narrowband, wavelength division multiplexer (WDM) laser. The signal from the OCLD WDM laser is passed to the optical multiplexer (OMX) using optical fiber patch cords. The OMXs then multiplex the optical signal with other signals.

In an Optical Metro 5100 shelf, the OCI performs optical to electrical and electrical to optical conversions for the Optical Metro 5100 shelf, and transmits signals directly to, or receives signals directly from the OCLD.



CAUTION

Release 3.2 software baseline requirement

All circuit packs installed on an Optical Metro 5100 shelf must meet the release 3.2 software baseline requirement. For details, contact Nortel Networks. Refer to the [“About this document”](#) chapter in this book for contact information.

Some OCI circuit packs are designed to support particular OCM and OCLD circuit packs, as outlined in [Table 5-2](#). While all OCIs are compatible with both Optical Metro 5100/5200 shelves, HW release 03 or higher of the SONET/SDH OCI circuit pack is the hardware baseline requirements for the Optical Metro 5100 shelf.

OCI compatibility

[Table 5-2](#) lists the compatibility of OCI circuit packs with OCM and OCLD circuit packs. For a list of supported protocols per circuit pack, see [“OCI circuit pack”](#) in *Technical Specifications*, 323-1701-180.

Table 5-2
Circuit pack compatibility

Circuit packs		OCM 1.25 Gbit/s (Optical Metro 5200)	OCM 2.5 Gbit/s (Optical Metro 5200)	OCLD 1.25 Gbit/s	OCLD 2.5 Gbit/s	OCLD 2.5 Gbit/s Flex or Universal
OCI 622 Mbit/s 1310 nm		√	√	√	—	√
OCI 1.25 Gbit/s 1310 nm		√	√	√	—	√
OCI 1.25 Gbit/s 850 nm		√	√	√	—	√
OCI OC-48/STM-16 1310 nm		—	√	—	√	√
OCI ISC 1310 nm		√	√	√	—	√
OCI GbE 1310 nm		√	√	√	—	√
OCI GbE 850 nm		√	√	√	—	√
OCI SONET/SDH IR 1310 nm	OC-3/STM-1 OC-12/STM-4	√	√	√	—	√
	OC-48/STM-16	—	√	—	√	√
OCI SONET/SDH 1310 nm	OC-3/STM-1 OC-12/STM-4	√	√	√	—	√
	OC-48/STM-16	—	√	—	√	√
OCI SRM 1310 nm		√	√	√	—	√

Table 5-2 (continued)
Circuit pack compatibility

Circuit packs	OCM 1.25 Gbit/s (Optical Metro 5200)	OCM 2.5 Gbit/s (Optical Metro 5200)	OCLD 1.25 Gbit/s	OCLD 2.5 Gbit/s	OCLD 2.5 Gbit/s Flex or Universal
OCI SRM 1310 nm LC	√	√	√	—	√
OCI SRM SONET/SDH 1310 nm	—	√	—	√	√
OCI SRM ESCON 1310 nm	—	√	—	—	√
OCI SRM GbE 1310 nm	—	√	—	—	√
OCI SRM GbE 850 nm	—	√	—	—	√
OCI SRM GbE/FC 1310 nm	—	√	—	—	√
OCI SRM GbE/FC 850 nm	—	√	—	—	√
OCI SRM GbE/FC Enhanced 1310 nm	—	√	—	—	√
OCI SRM GbE/FC Enhanced 850 nm	—	√	—	—	√
OCI SRM SONET/SDH LTE	—	√	—	—	√

Generic features

All types of OCI circuit packs have these features:

- support fault monitoring
- can be used with any protocol that meets these requirements:
 - is within the list of provisionable protocols
 - is within the optical power range of OCI circuit pack
 - contains data that is DC-balanced and has a minimum transition density

For detailed information on the provisionable protocols supported by these circuit packs, refer to the “OCI circuit pack” section in *Technical Specifications*, 323-1701-180.

OCI circuit packs (except the OCI SRM SONET/SDH LTE), which support the SONET/SDH protocols, are fully transparent with respect to SONET/SDH overhead bytes. That is, these OCI circuit packs do not overwrite, regenerate or change any of the SONET/SDH overhead bytes. Some bytes are used (A1, A2, and B1 bytes) for monitoring purposes.

The OCI SRM SONET/SDH LTE circuit pack allows most overhead bytes to pass through except for the following:

- A1/A2: always regenerated
- B1/B2: always recalculated
- H1/H2/H3: always regenerated (circuit pack performs pointer processing)
- S1: In line-timing mode, where one of the four clients, or aggregate interface, acts as the timing reference, the S1 byte from the selected timing reference is copied/translated to all outgoing ports, except for the return path of the timing reference port where DUS (DNU for SDH) is sent. If in Free-Run or Hold-Over mode, all S1 bytes are over-written with the quality of the on-board oscillator. An option exists to allow a user to force DUS (DNU for SDH) on a per-port basis.
- K2: transported transparently, except for 3 bits of K2 that are modified for conditioning of L-AIS (MS-AIS for SDH) and L-RDI (MS-RDI for SDH)
- Z0: always regenerated (for SONET STS-N, will be frame 2 to N count; for SDH STM-N, will be frame 2 to N count)
- M1: set to indicate (to the upstream LTE) the count of the interleaved-bit block errors that it has detected using the Line BIP-8 (B2) bytes

For further information on the specific circuit pack features, see

- [OCI 622 Mbit/s 1310 nm circuit pack features](#)
- [OCI 1.25 Gbit/s 1310 nm circuit pack features](#)
- [OCI 1.25 Gbit/s 850 nm circuit pack features](#)
- [OCI OC-48/STM-16 1310 nm circuit pack features](#)
- [OCI ISC 1310 nm circuit pack features](#)
- [OCI GbE 1310 nm circuit pack features](#)
- [OCI GbE 850 nm circuit pack features](#)
- [OCI SONET/SDH 1310 nm and OCI SONET/SDH IR 1310 nm circuit pack features](#)
- [OCI SRM 1310 nm circuit pack features](#)
- [OCI SRM 1310 nm LC circuit pack features](#)
- [OCI SRM SONET/SDH 1310 nm circuit pack features](#)
- [OCI SRM SONET/SDH LTE circuit pack features](#)
- [OCI SRM ESCON circuit pack features](#)
- [OCI SRM GbE 1310 nm circuit pack and OCI SRM GbE 850 nm circuit pack features](#)
- [OCI SRM GbE/FC 1310 nm circuit pack and OCI SRM GbE/FC 850 nm circuit pack features](#)

- [OCI SRM GbE/FC Enhanced 1310 nm circuit pack and OCI SRM GbE/FC Enhanced 850 nm circuit pack features](#)

OCI 622 Mbit/s 1310 nm circuit pack features

The OCI 622 Mbit/s 1310 nm circuit pack has following features:

- can be used with any protocol within the list of provisionable protocols
- supports single-mode fiber

For detailed information on the provisionable protocols supported by these circuit packs, refer to [Table 2-4 on page 2-19](#) in *Technical Specifications*, 323-1701-180.

OCI 1.25 Gbit/s 1310 nm circuit pack features

The OCI 1.25 Gbit/s 1310 nm has the following features:

- can be used with any protocol within the list of provisionable protocols
- supports both single-mode and multimode fiber

For detailed information on the provisionable protocols supported by this circuit pack, refer to [Table 2-3 on page 2-14](#) in *Technical Specifications*, 323-1701-180.

OCI 1.25 Gbit/s 850 nm circuit pack features

The OCI 1.25 Gbit/s 850 nm circuit pack has these features:

- supports FC-100, FICON, and Gigabit Ethernet
- supports multimode fiber

For detailed information on the provisionable protocols supported by this circuit pack, refer to [Table 2-8 on page 2-26](#) in *Technical Specifications*, 323-1701-180.

OCI OC-48/STM-16 1310 nm circuit pack features

The OCI OC-48/STM-16 1310 nm has the following features:

- supports OC-48/STM-16
- supports single-mode fiber
- provides monitoring of the Tx and Rx power levels

For detailed information on the provisionable protocols supported by this circuit pack, refer to [Table 2-5 on page 2-22](#) in *Technical Specifications*, 323-1701-180.

OCI ISC 1310 nm circuit pack features

The OCI ISC 1310 nm circuit pack has the following features:

- supports the ISC protocol
- supports open fiber control
- supports single-mode fiber

Note: Due to the nature of the Open Fiber Control (OFC) protocol, a link may take up to 12 seconds to re-initialize after a protection switch occurs.

For detailed information on the provisionable protocols supported by this circuit pack, refer to [Table 2-9 on page 2-27](#) in *Technical Specifications*, 323-1701-180.

OCI GbE 1310 nm circuit pack features

The OCI GbE 1310 nm circuit pack has these features:

- supports Gigabit Ethernet
- supports single-mode fiber
- provides monitoring of the Rx and Tx optical power levels

For detailed information on the provisionable protocols supported by this circuit pack, refer to [Table 2-10 on page 2-27](#) in *Technical Specifications*, 323-1701-180.

OCI GbE 850 nm circuit pack features

The OCI GbE 850 nm circuit pack has these features:

- supports Gigabit Ethernet
- supports multimode fiber
- provides monitoring of the Rx optical power levels

For detailed information on the provisionable protocols supported by this circuit pack, refer to [Table 2-11 on page 2-28](#) in *Technical Specifications*, 323-1701-180.

OCI SONET/SDH 1310 nm and OCI SONET/SDH IR 1310 nm circuit pack features

The OCI SONET/SDH 1310 nm circuit pack has these features:

- supports OC-3/12/48 SONET and STM-1/4/16 SDH protocols
- provides performance monitoring of Section (Regenerator Section for SDH) layer and Rx/Tx power levels
- supports single-mode fiber

OCI SONET/SDH IR 1310 supports intermediate reach with respect to Tx and Rx power at OC-48.

For detailed information on the provisionable protocols supported by this circuit pack, refer to [Table 2-6 on page 2-23](#) and [Table 2-7 on page 2-25](#) in *Technical Specifications*, 323-1701-180.

OCI SRM 1310 nm circuit pack features

The 1.25 Gbit/s subrate multiplexer (SRM) OCI circuit pack is designed for 1310 nm signals and has these features:

- supports both single-mode and multimode fiber
- supports PM (performance monitoring) of the aggregate signals
- physically connects four Tx/Rx ports from the subtending equipment to the Optical Metro 5100/5200, in a single circuit pack; it multiplexes these four incoming Rx signals into a single signal to the backplane, and demultiplexes the signal from the backplane into its constituent signals at the designated OADM site (Client Tx).

Note: The four signals multiplexed by an OCI SRM circuit pack in one shelf must all terminate on a corresponding OCI SRM circuit pack on the destination shelf. You cannot configure each of the multiplexed signals to drop at different shelves.

- The OCI SRM 1310 nm circuit pack supports both the bookended and the interoperable service layer topologies. For more information, see [“Implementing bookended topologies with sub-rate multiplex OCI or Muxponder circuit packs”](#) or [“Implementing interoperable topologies with OCI SRM 1310 nm and OCI SRM 1310 nm LC circuit packs”](#) in *Network Planning and Link Engineering*, 323-1701-110.

The OCI SRM circuit pack has four ports. Each port on the OCI SRM circuit pack has these features:

- bidirectional
- can be used with any protocol within the list of provisionable protocols

For detailed information on the provisionable protocols supported by this circuit pack, refer to [Table 2-12 on page 2-28](#) in *Technical Specifications*, 323-1701-180.

OCI SRM 1310 nm LC circuit pack features

Like the existing OCI SRM 1310 nm circuit pack, the OCI SRM 1310 nm LC circuit pack is a single-slot circuit pack that combines four short/intermediate reach 50~270 Mbit/s client signals into an aggregate 1.25 Gbit/s signal. This aggregate signal is transported through the Optical Metro systems on a single wavelength through the OCM and OCLD circuit packs. The OCI SRM 1310 nm LC circuit pack offers features in addition to those offered by the OCI SRM 1310 nm circuit pack.

The additional features supported by the OCI SRM 1310 nm LC circuit pack include:

- all four client signals have optical duplex LC type connectors
- new transceiver
- new faceplate

For detailed information on the provisionable protocols supported by this circuit packs, refer to [Table 2-12](#) in *Technical Specifications*, 323-1701-180.

OCI SRM SONET/SDH 1310 nm circuit pack features

The 2.5 Gbit/s SONET/SDH subrate multiplexer (SRM) OCI circuit pack is designed for 1310 nm signals and has the following capabilities:

- supports single-mode fiber
- physically connects four Tx/Rx ports from the subtending equipment to the Optical Metro 5100/5200 network, in a single circuit pack; the OCI SRM SONET/SDH 1310 nm circuit pack multiplexes these four incoming Rx signals into a single signal to the backplane, and demultiplexes the signal from the backplane into its constituent signals at the designated OADM site (Client Tx)

Note: The four signals multiplexed by a OCI SRM SONET/SDH circuit pack in one shelf must all terminate on a corresponding OCI SRM SONET/SDH circuit pack on the destination shelf. You cannot configure each of the multiplexed signals to drop at different shelves.

- The OCI SRM SONET/SDH circuit pack supports bookended topologies. For more information, see [“Implementing bookended topologies with sub-rate multiplex OCI or Muxponder circuit packs”](#) in *Network Planning and Link Engineering*, 323-1701-110.

The OCI SRM SONET/SDH circuit pack has four ports. Each port on the OCI SRM SONET/SDH circuit pack has the following features:

- bidirectional
- provides performance monitoring of Section (Regenerator Section for SDH) layer on each port
- supports OC-12/STM-4 protocols

For detailed information on the provisionable protocols supported by this circuit pack, refer to [Table 2-13 on page 2-33](#) in *Technical Specifications*, 323-1701-180.

Primary and secondary clock references

When you create a channel assignment for a OCI SRM SONET/SDH circuit pack, the first port that you select for a channel assignment is automatically used as the primary clock reference for the SONET/SDH signal. The second port that you select for a channel assignment is automatically used as the secondary clock reference for the SONET/SDH signal. You can change the clock references at any time after making channel assignments.

ATTENTION

If you use a OCI SRM SONET/SDH circuit pack, you must make sure that the four OC-12/STM-4 source signals come from a single SONET/SDH transport product that can be configured for either BITS synchronization or line timing. You cannot connect the OC-12/STM-4 signals to a OCI SRM SONET/SDH from a source that cannot function as a SONET/SDH transport product.

The four OC-12/STM-4 source traffic signals that are to be connected to the OCI SRM SONET/SDH must be frequency synchronous to a single internal clock source.

OCI SRM SONET/SDH LTE circuit pack features

The SONET/SDH subrate multiplexer (SRM) LTE OCI circuit pack has the following capabilities:

- supports single-mode and multimode fiber
- multiplexes four SONET/SDH client signals into an aggregate STS-48/STM-16 for transmission to the Optical Metro 5100/5200 line side via the backplane, OCM and OCLD circuit packs.
- supports client signals that can be a mixture of OC-3, OC-12, STM-1, and STM-4
- client signals can be independently timed because the circuit pack provides full pointer processing in both the mux and demux directions
- performance monitoring on client Rx (all four client ports) and aggregate Tx
- supports per port terminal and facility loopbacks on the client ports (enabling the debugging of a single port without impacting traffic on other ports)

- cross-connect management supports a fixed mapping from client ports to aggregate port:
 - Client port 1 mapped to STS 1-12
 - Client port 2 mapped to STS 13-24
 - Client port 3 mapped to STS 25-36
 - Client port 4 mapped to STS 37-48
- supports bookended topologies. For more information, see [“Implementing bookended topologies with sub-rate multiplex OCI or Muxponder circuit packs”](#) in *Network Planning and Link Engineering*, 323-1701-110.
- supports clock synchronization and synchronization status messaging (SSM):
 - provides line-timing mode for clock synchronization from any one of the client or aggregate signals, as well as self-timing from an on-board clock source (ST3 for SONET or SEC for SDH) per GR-1244, ITU-T G.812/813, with hitless timing restoration
 - The SONET/SDH Equipment Clock (SEC) provides frequency accuracy, pull-in/hold-in capabilities, and holdover performance as per GR-253, GR-1244 and G.813
 - Two clock synchronization sources can be provisioned: Primary and Secondary. Possible sources are: Client Port 1, Client Port 2, Client Port 3, Client Port 4, AG1 (Aggregate), or Internal clock
 - supports hitless clock source non-revertive switching (automatic and user-initiated). Clock source auto switch initiation criteria is: Client Rx signal fails (SF-L), LOS-L, LOF-L, LOL-L, AIS-L, frequency offset greater than +/- 12.0 ppm, DUS (DNU for SDH) or SMC SSM is received
 - ability to force DUS (DNU for SDH) on a per-port basis in the transmit direction
 - ability to query status of synchronization sources (good or bad). The ability to query transmitted SSM value is not supported unless DUS (DNU for SDH) is forced

The OCI SRM SONET/SDH LTE circuit pack has four client ports. Each client port on the OCI SRM SONET/SDH LTE circuit pack has the following features:

- bidirectional
- IR-1 compliant per GR-253-CORE
- S-1.1/4.1 compliant per ITU G.957

- supports the following SONET PMs in the Rx direction:
 - Section: CVS, ESS, SESS, SEFSS
 - Line: CVL, ESL, SESL, UASL, CVLFE, ESLFE, SESLFE, UASLFE
- supports the following SDH PMs in the Rx direction:
 - Regenerator Section (RS): EBS, ESS, SESS, OFSS
 - Multiplex Section (MS): EBL, ESL, SESL, UASL, EBLFE, ESLFE, SESLFE, UASLFE

The OCI SRM SONET/SDH LTE circuit pack also has an aggregate port which represents the aggregate signal towards the line side. This port has the following features:

- bidirectional
- supports the following SONET PMs in the Tx direction:
 - Section: CVS, ESS, SESS, SEFSS
 - Line: CVL, ESL, SESL, UASL, CVLFE, ESLFE, SESLFE, UASLFE
- supports the following SDH PMs in the Tx direction:
 - Regenerator Section (RS): EBS, ESS, SESS, OFSS
 - Multiplex Section (MS): EBL, ESL, SESL, UASL, EBLFE, ESLFE, SESLFE, UASLFE

For detailed information on the provisionable protocols supported by this circuit pack, refer to [Table 2-19 on page 2-36](#) in *Technical Specifications*, 323-1701-180.

OCI SRM ESCON circuit pack features

The OCI SRM ESCON circuit pack has the following features:

- eight independent bidirectional client ports, each providing ESCON/SBCON compliant 1310 nm MMF receive and transmit physical layer interfaces to the subtending equipment.

Note: The eight signals multiplexed by an OCI SRM ESCON circuit pack in one shelf must all terminate on a corresponding OCI SRM ESCON circuit pack on the destination shelf. You cannot configure each of the multiplexed signals to drop at different shelves.

- transparent transport of error-free 200 Mbps ESCON/SBCON traffic.

Note 1: Up to two idle characters may be added or deleted between frames for rate adaptation, according to the rules of ANSI X3.296, section 7.2.

Note 2: All received 8B10B codeword violation characters are replaced by an equivalent exception character, C0.7.

- multiplexing of up to eight client signals into a single wavelength at 2.488 Gbps using a proprietary wrapper to allow line-side BIP-8 performance monitoring.
- supports multimode fiber by way of Multi-fiber Push On (MPO) optical connectors and ribbon fiber to connect to the subtending equipment.
Note: Nortel Networks recommends using the patch panel (NT0H43CA) to enable compatibility between SC and MPO connectors if Optical Metro 5100/5200 shelves are equipped with OCI SRM ESCON circuit packs.
- fault monitoring on a per-port basis.
- supports per port terminal and facility loopbacks on the client ports (enabling the debugging of a single port without impacting traffic on other ports)
- supports the following 8B/10B PMs on the ingress client channels: Code Violation (CV), ES, SES, UAS
- supports the following line-side PMs: Aggregate signal BIP-8 (B1 byte) counter and per port BIP-8 (B3 byte) counter.
- supports both the bookended and the interoperable service layer topologies. For more information, see [“Implementing bookended topologies with sub-rate multiplex OCI or Muxponder circuit packs”](#) or [“Implementing interoperable topologies with OCI SRM 1310 nm and OCI SRM 1310 nm LC circuit packs”](#) in *Network Planning and Link Engineering*, 323-1701-110.

For detailed information on the provisionable protocols supported by this circuit pack, refer to [Table 2-14 on page 2-33](#) in *Technical Specifications*, 323-1701-180.

OCI SRM GbE 1310 nm circuit pack and OCI SRM GbE 850 nm circuit pack features

The OCI SRM GbE (1310 nm or 850 nm) circuit pack is a single-slot circuit pack that aggregates up to two Gigabit Ethernet client signals onto an STS-48/STM-16 signal that is transported through the Optical Metro 5100/5200 and SONET/SDH networks on a single wavelength. The OCI SRM GbE circuit pack is a cost-reduced version of the OCI SRM GbE/FC circuit pack that only supports GbE client signals.

The OCI SRM GbE circuit pack has all the Gigabit Ethernet features of the OCI SRM GbE/FC circuit pack. In summary, the OCI SRM GbE circuit pack has the following features:

- support for a maximum of two Gigabit Ethernet client signals
- support for bookended and interoperable service layer topologies. For more information, see [“Implementing bookended topologies with sub-rate multiplex OCI or Muxponder circuit packs”](#) in *Network Planning and Link Engineering*, 323-1701-110.
- implementation of SONET/SDH virtual concatenation and client-side flow control, so a percentage of available STS-48/STM-16 bandwidth on the line-side can be dedicated to each client
- implement GFP framing compliant to G.7041 to map client services to SONET/SHD signals using virtual concatenation
- a 1310 nm single-mode client interface on the OCI SRM GbE 1310 nm circuit pack for 1000BASE-LX compliant client signals, and an 850 nm multimode client interface on the OCI SRM GbE 850 nm circuit pack for 1000BASE-SX compliant client signals.
- support for individual port terminal and facility loopbacks on client ports to enable debugging of a single port without affecting traffic on other ports
- support for SONET/SDH Section, Line, and Path performance monitoring on the aggregate port
- support for generic interface Operation Measurements (OM) on the LAN and WAN ports
- support for Gigabit Ethernet-specific Operational Measurements (OM) on the LAN ports
- support for Gigabit Ethernet Performance Measurements (PM) on the LAN and WAN ports

Note: The optical power performance parameters are not provided for the client interfaces on the OCI SRM GbE circuit pack.

- support for all existing OCI SRM GbE/FC circuit pack alarms except for those specific to Fibre Channel and FICON.
- Ethernet frames (up to 9600 bytes) and VLAN tagged frames (802.1q) are processed and mapped into SONET/SDH using Frame GFP (Generic Framing Procedure).
- two timing modes (complies with GR253 - SONET Timing Generation Specification): local timing and loop timing.

All Gigabit Ethernet specific features described in [“OCI SRM GbE/FC 1310 nm circuit pack and OCI SRM GbE/FC 850 nm circuit pack features”](#) on page 5-15 apply to the OCI SRM GbE 1310 nm and OCI SRM GbE 850 nm circuit

packs. For more information on Gigabit Ethernet specific features, refer to the [“OCI SRM GbE/FC 1310 nm circuit pack and OCI SRM GbE/FC 850 nm circuit pack features”](#) section.

OCI SRM GbE/FC 1310 nm circuit pack and OCI SRM GbE/FC 850 nm circuit pack features

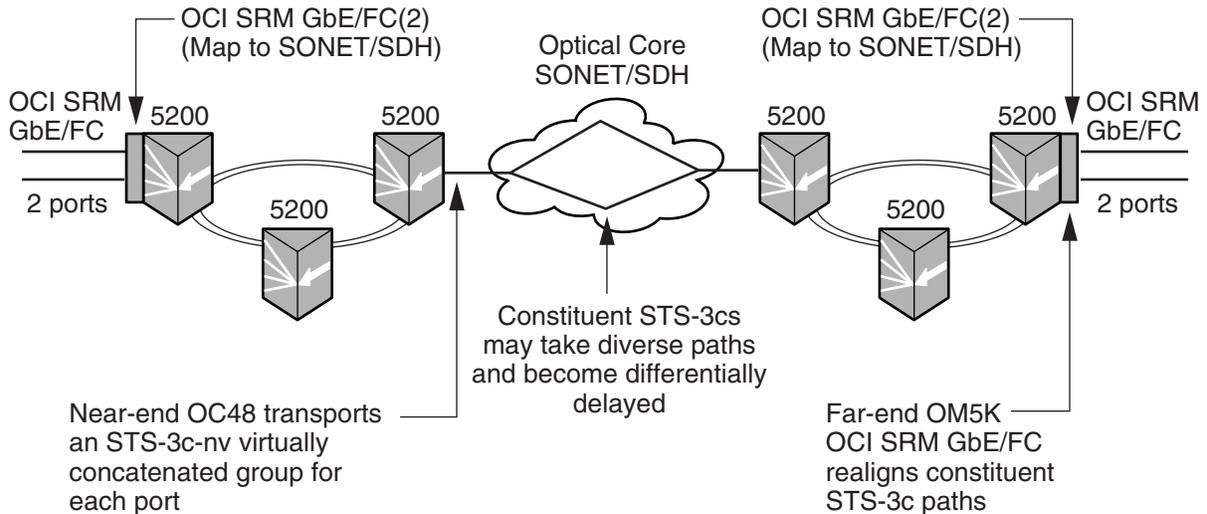
The OCI SRM Gigabit Ethernet/Fibre Channel (GbE/FC) aggregates up to two client interface signals onto a STS-48/STM-16 signal to be transported on a single wavelength over the Optical Metro 5100/5200 system and has the following features:

- each of the two client interfaces can be independently configured as FICON, FC-100, or Gigabit Ethernet
- 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
- configuration of one client interface does not impact the traffic performance of the other
- supports both the bookended and interoperable service layer topologies. For more information, see [“Implementing bookended topologies with sub-rate multiplex OCI or Muxponder circuit packs”](#) in *Network Planning and Link Engineering*, 323-1701-110.
- implements SONET/SDH virtual concatenation and client-side flow control, so that a percentage of the overall STS-48/STM-16 bandwidth available on the line-side can be dedicated to each client
- supports 1310 nm single-mode (on the OCI SRM GbE/FC 1310 nm circuit pack) and 850 nm (on the OCI SRM GbE/FC 850 nm circuit pack) multimode client-side interfaces
- supports per port terminal and facility loopbacks on the client ports (enabling the debugging of a single port without impacting traffic on other ports)
- supports SONET/SDH Section, Line, and Path performance monitoring on the aggregate port
- supports generic interface Operation Measurements (OMs) on the LAN and WAN ports
- supports Gigabit Ethernet-specific Operational Measurements (OMs) on the LAN ports
- supports Gigabit Ethernet Performance Measurements (PMs) on the LAN and WAN ports

- supports FC-100/FICON Performance Measurements (PMs) on the LAN ports
- supports diverse routing, allowing constituent paths of a VCAT group to diversely routed in a SONET/SDH network and reconstituted at the far end OCI SRM GbE/FC with differential delays of up to 14 ms (see [Figure 5-1](#))

Figure 5-1
Diverse routing

OM2279

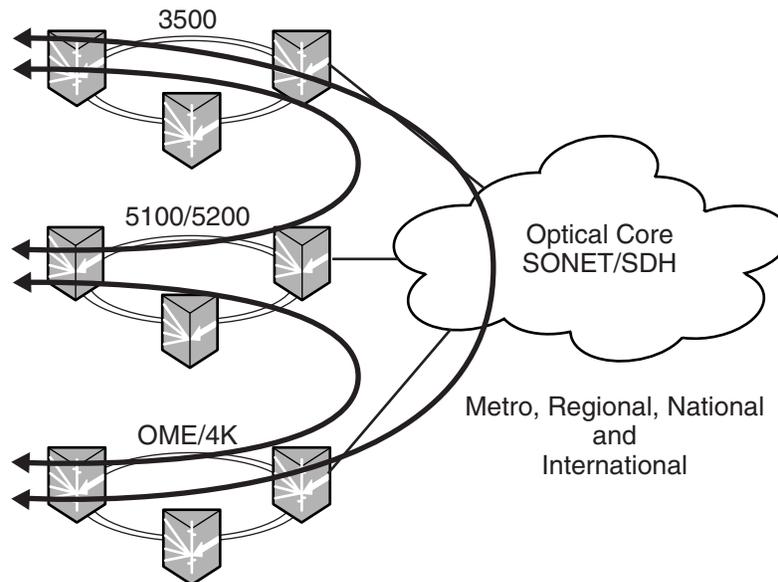


- allows interworking with Optical Metro 3000, Optical Metro 4000, and Optical Multiservice Edge (OME) GbE/FC circuit packs.
 - use of Generic Framing Procedure (GFP) Client Management Frames (CMF) conditioning for client signal failures
 - CMF conditioning to indicate remote frame delineation errors

The internetworking topology, which applies only to SONET/SDH interop model, allows a GbE/FC client signal to enter the WAN on an Optical Metro 5100/5200 OCI SRM GbE/FC port and leave the WAN on an Optical Metro 3000, Optical Metro 4000, and Optical Multiservice Edge (OME) GbE/FC circuit pack (see [Figure 5-2](#)).

**Figure 5-2
Interworking**

OM2280



- supports latency management - client port interfaces support a round trip latency measurement (RTDELAY) that returns the network latency to an accuracy of +/- 1 ms.

For detailed information on the provisionable protocols supported by this circuit pack, refer to [Table 2-15 on page 2-34](#) in *Technical Specifications*, 323-1701-180.

GbE/FC Aggregate Facility

- The OCI SRM GbE/FC aggregate facility can be provisioned as either SONET or SDH and defaults to SONET.
- The Transport Structure can be provisioned as either contiguously concatenated (c-cat) or virtually concatenated (v-cat) for both SDH and SONET signals on the aggregate facility.
- The OCI SRM GbE/FC supports Gigabit Ethernet subrate for the following contiguously concatenated bandwidth assignment: STS-12c/VC-4-4c.
- The OCI SRM GbE/FC supports Gigabit Ethernet and FC-100/FICON full rate for the following contiguously concatenated bandwidth assignments: STS-24c/VC-4-8c, STS-48c/VC-4-16c.
- For contiguously concatenated groups, client port 1 circuits start on STS number 1 (or VC-4 number 1) and client port 2 circuits start on STS number 25 (or VC-4 number 9).

- For Gigabit Ethernet and FC-100/FICON full rate, the OCI SRM GbE/FC supports STS-48c bandwidth assignments exclusively for client port 1. Client port 2 bandwidth assignments must be deleted before assignment to client port 1.
- The OCI SRM GbE/FC supports virtually concatenated bandwidth assignments from 1 to 7 STS-3c/VC-4 circuits for Gigabit Ethernet.
- The OCI SRM GbE/FC supports virtually concatenated bandwidth assignments of 6 STS-3c/VC-4 circuits for FC-100/FICON.

Table 5-3 displays the fixed mapping assignments that apply to the virtually concatenated groups.

Table 5-3
Fixed mapping assignments

SONET			SDH		
Number of STS-3c circuits	Port 1 circuits	Port 2 circuits	Number of VC-4 circuits	Port 1 circuits	Port 2 circuits
1	1-3	25-27	1	1	9
2	1-6	25-30	2	1-2	9-10
3	1-9	25-33	3	1-3	9-11
4	1-12	25-36	4	1-4	9-12
5	1-15	25-39	5	1-5	9-13
6	1-18	25-42	6	1-6	9-14
7	1-21	25-45	7	1-7	9-15

- The sequence numbers assigned to the members of a virtually concatenated group is in ascending order according to STS number. For example, for SONET, an STS-3c x 3v on client port 2 assigns sequence number 0 to the STS-3c starting at STS number 25, sequence number 1 to the STS-3c starting at STS number 28 and sequence number 2 to the STS-3c starting at STS number 31. For example, for SDH, an VC-4 x 3v on client port 2 assigns sequence number 0 to the VC-4 path 9, sequence number 1 to the VC-4 path 10 and sequence number 2 to VC-4 path 11.
- Table 5-4 displays the mix of virtually concatenated and contiguously concatenated payload configurations between ports supported on the OCI SRM GbE/FC.

Table 5-4
Mix of virtually concatenated and contiguously concatenated payload configurations between ports

SONET		SDH	
Port 1	Port 2	Port 1	Port 2
STS-3c x nV (n in [1..7])	STS-3c x nV (n in [1..7])	VC-4 x nV (n in [1..7])	VC-4 x nV (n in [1..7])
STS-12c	STS-12c STS-24c	STM-4	STM-4 STM-8
STS-24c	STS-12c STS-24c	STM-8	STM-4 STM-8
STS-48c	-	STM-16	-

GbE/FC aggregate facility clock

- The OCI SRM GbE/FC supports both local free-run and loop-time SONET/SDH clocking. The clocking mode is configurable and defaults to local free-run.
- In free-run mode, the backplane transmit clock is synchronous with the OCI SRM GbE/FC local clock reference and is within 10 ppm of 2.488320 GHz.
- In loop-time mode, the backplane transmit clock is synchronous with the OCI SRM GbE/FC backplane receive clock received from the active OCLD circuit pack.
- In loop-time mode, if lock cannot be established with the backplane receive clock, the backplane transmit clock enters hold-off mode where it holds indefinitely to within 20 ppm of the last locked frequency.
- In bookend configurations, at least one OCI SRM GbE/FC in each point-to-point pairing must be in free-run mode.

Gigabit Ethernet LAN Interface

- To permit the origination of pause frames, the OCI SRM GbE/FC has one MAC address per port. The port MAC addresses is displayed on the NE user interface as the PHYSADDR attribute of the Gigabit Ethernet port facility.
- Gigabit Ethernet ports support Ethernet auto-negotiation with the local Ethernet link partner as per clause 37 of IEEE 802.3-2000.
- Auto-negotiation is enabled by default but can be disabled.

Note: Nortel Networks recommends that auto-negotiation be turned on for GbE services carried on the OCI SRM GbE/FC circuit pack (therefore auto-negotiation is enabled by default).

- Gigabit Ethernet ports are not transparent to Ethernet auto-negotiation. Auto-negotiation is not be passed across the WAN link.
- Gigabit Ethernet port auto-negotiation only supports the base configuration page. The next page bit is always cleared.
- Gigabit Ethernet port auto-negotiation advertises support for full duplex only (full duplex bit set, half duplex bit cleared).
- Gigabit Ethernet port auto-negotiation advertises either no pause, asymmetric pause toward the link partner or symmetric pause capabilities, depending on the value of the FLOWCTRL attribute. This attribute is editable to NONE (to advertise flow control is not supported), to ASYM (default) (to advertise asymmetric flow control toward the link partner is supported) or to SYM (to advertise symmetric flow control or asymmetric flow control toward the local device is supported). This attribute is ignored when auto-negotiation is disabled.
- Gigabit Ethernet port remote fault bits of the auto-negotiation configuration page are always set to 0b00.
- If the local link partner advertises support for half duplex only, the auto-negotiation process fails. This triggers the “LAN link down” alarm against the corresponding client port.
- When auto-negotiation is enabled and in a COMPLETED state, the negotiated capabilities are indicated in the ANETHDPX (FULL), ANSPEED (1000), ANPAUSETX (ENABLE, DISABLE) and ANPAUSERX (ENABLE, DISABLE) read-only attributes. When auto-negotiation is disabled, these attributes return the nil value.
- When auto-negotiation is enabled, the advertised link partner capabilities are indicated in the ADVETHPDX (HALF, FULL, BOTH, NOTAVAIL), ADVSPEED (NOTAVAIL) and ADVFLOWCTRL (NONE, SYM, ASYM, BOTH, NOTAVAIL) read-only attributes. When auto-negotiation is disabled, these attributes return the nil value.
- Loss-less local flow control for distances up to 5 km is supported.
- When auto-negotiation is enabled, the PAUSERXOVERRIDE attribute is used to override (disable) the negotiated PAUSE receive. It is a read-only attribute. The only possible value is ENABLE, meaning that received PAUSE frames are not acted upon. They are discarded or passed through transparently, depending on the value of the PASSCTRL attribute. This attribute is ignored when auto-negotiation is disabled.
- When auto-negotiation is disabled, the PAUSETX attribute of the Ethernet facility is used to explicitly control the flow control toward the link partner (PAUSE transmission). It is editable to ENABLE (default) or DISABLE. This attribute is ignored when auto-negotiation is enabled. The PAUSERX attribute of the Ethernet facility is used to explicitly control the flow

control toward the local device (PAUSE reception). It is a read-only attribute. The only possible value is DISABLE. These attributes are ignored when auto-negotiation is enabled.

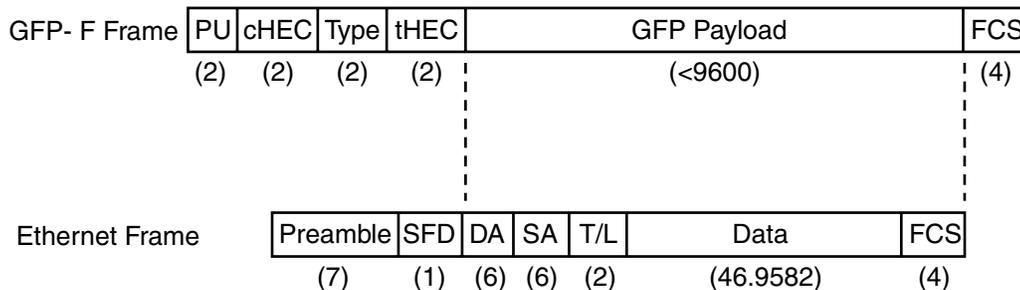
- The MTU attribute of the Ethernet facility is used to set the supported MTU. It may be set to 1600 (default) and 9600 bytes.
- The PASSCTRL attribute of the Ethernet facility is used to determine if received Ethernet control frames (T/L=0x8808) are discarded or passed through transparently. It is editable to DISABLE (default) or ENABLE. Discarded control frames are counted as INFRAMESDISCDS.

WAN interface

- Gigabit Ethernet encapsulation is framed GFP as according to G.7041 (see [Figure 5-3](#)).

Figure 5-3
Gigabit Ethernet encapsulation GFP framed

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- FC symbols are encoded into a GFP-T frame as per G.7041 section 8. 8B/10B symbols are encoded into 64B/65B blocks (a form of symbol compression where DC balancing, error code and disparity information is lost but D and K values are preserved - achieving almost 20% compression). Eight 64B/65B blocks are grouped together as a “super block”. Each super block has an error correcting 16-bit CRC appended. Finally several super-blocks are grouped into a GFP-T frame. The GFP-T frame looks like the GFP-F frame except that the GFP FCS is not appended since each super block is already error protected. The type field is set to indicate transparent mapped FC or FICON as appropriate.
- In Gigabit Ethernet mode, the framed GFP frames are transmitted with payload FCS. The Payload FCS Indicator (PFI) field of the type header is always transmitted as 0b1 to indicate the GFP payload FCS is present.
- In Gigabit Ethernet mode, the framed GFP packets are transmitted with a user payload identifier type of “Frame-Mapped Ethernet” – 0b00000001.
- The Ethernet preamble and the frame delimiters are not included in the GFP-F frame.
- The Ethernet LAN FCS is included in the GFP-F frame.

- For all GFP frames, the Extension Header Identifier (EXI) field of the type header is always transmitted as 0b0000 to indicate the null extension header is used.
- FC-100/FICON encapsulation is transparent GFP as per G.7041.
- FC-100/FICON encapsulation is transmitted without the payload FCS. The Payload FCS Indicator (PFI) field of the type header is always transmitted as 0b0 to indicate the GFP payload FCS is not present.
- In FC-100 mode, the GFP frames are transmitted with a user payload identifier type of “Transparent Fibre Channel” – 0b00000011.
- In FICON mode, the GFP frames are transmitted with a user payload identifier type of “Transparent FICON” – 0b00000100.

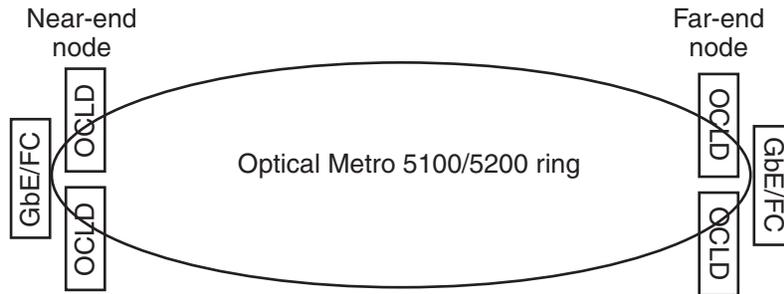
GFP Laser Conditioning for the Gigabit Ethernet protocol

When a line failure is detected by the GbE/FC circuit pack at the near-end node (see Figure 5-4), P-AIS or GFP CMF is conditioned on the WAN side. Also, when a failure occurs within the Optical Metro 5100/5200 ring, P-AIS is conditioned and is received by the far-end node GbE/FC circuit pack.

While the GbE/FC laser at the far-end node is still on and the P-AIS or GFP CMF is received, idle frames are sent to the subtending equipment. If the P-AIS or GFP CMF condition persists for longer than the AOC holdoff time, the GbE/FC laser at the far-end node will shut off.

The AOC holdoff time is implemented to prevent Optical Metro 5100/5200 protection switches from impacting the subtending equipment. During an Optical Metro 5100/5200 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.

**Figure 5-4
GFP Laser Conditioning example**



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GFP Laser Conditioning exception for Gigabit Ethernet protocol

The GbE/FC laser at the far-end node (see [Figure 5-4](#)) will not shut off as described in the preceding section under a specific condition to prevent the following deadlock scenario:

- 1 Auto-Negotiation (AN) is enabled at both the near-end node and far-end node GbE/FC circuit pack
- 2 The GbE/FC TX fibers are pulled at both ends
- 3 100 ms later both ends declare LAN Link Down and assert AIS-P or GFP CMF conditioning
- 4 Both ends then shut down their lasers due to the far end AIS-P or GFP CMF conditioning
- 5 The GbE/FC TX fibers are restored
- 6 LAN Link Down cannot clear due to far-end AIS-P or GFP CMF conditioning causing local laser shutdown and preventing AN from completing
- 7 Deadlock

To prevent this deadlock scenario, the laser will not shut off if a LAN Link Down (LLD) condition is detected before the AIS-P or GFP CMF conditioning is detected.

- 1 Auto-Negotiation (AN) is enabled at both the near-end node and far-end node GbE/FC circuit pack
- 2 The GbE/FC TX fibers are pulled at both ends
- 3 100 ms later both ends declare LAN Link Down and assert AIS-P or GFP CMF conditioning
- 4 Both ends then do NOT shut down their lasers due to the far-end AIS-P or GFP CMF conditioning because the existing LLD has not been cleared
- 5 The GbE/FC TX fibers are restored
- 6 LAN Link Down clears
- 7 AIS-P or GFP CMF conditioning is removed
- 8 Normal traffic resumes

GFP Laser Conditioning for the Fibre Channel protocol

When a line failure is detected by the GbE/FC circuit pack at the near-end node (see [Figure 5-4](#)), P-AIS or GFP CMF is conditioned on the WAN side. Also, when a failure occurs within the Optical Metro 5100/5200 ring, P-AIS is conditioned and is received by the far-end node GbE/FC circuit pack.

While the GbE/FC laser at the far-end node is still on and the P-AIS or GFP CMF is received, with subrate/extended reach is disabled, 8B10B invalid codes are sent to the subtending equipment. With subrate/extended reach is enabled the hardware will send FC IDLEs.

If the P-AIS or GFP CMF condition persists, with subrate/extended reach disabled 8B10B invalid codes continue to be sent. With subrate/extended reach enabled a burst of 8B10B invalid codes for 100msec will be sent to far-end node.

The GbE/FC laser at the far-end node never shuts off. 8B10B invalid codes received by the subtending equipment cause the buffer credits to be lost and the link to go down.

During an Optical Metro 5100/5200 protection switch, 8B10B invalid codes are sent. As a result of the outage caused by the protection switch (<50 ms), the buffer credits may be lost to the point where the link may come down.

When the switch completes, buffer credits will be restored.

Laser shutdown vs. 10B_ERR conditioning

10B_ERR conditioning is used for the Fibre Channel protocol (as opposed to laser shutdown) since it is dictated by the GFP standard for transparent mapping, which is the mapping used for Fibre Channel on the GbE/FC circuit pack. This type of conditioning also has the advantage of avoiding a deadlock scenario that exists with some FC switches. These switches produce proprietary coding with invalid transmission word sync when they experience a Loss of Signal (LOS). This results in an LOS deadlock across the WAN.

For the Gigabit Ethernet protocol, the GbE/FC mapping is framed mapped GFP. In this case, the typical laser shutdown conditioning is used.

Figure 5-5, Figure 5-6, and Figure 5-7 show examples of error detection and recovery on the GbE/FC circuit pack when using the Fibre Channel protocol.

Figure 5-5
Example 1 - Far-end error

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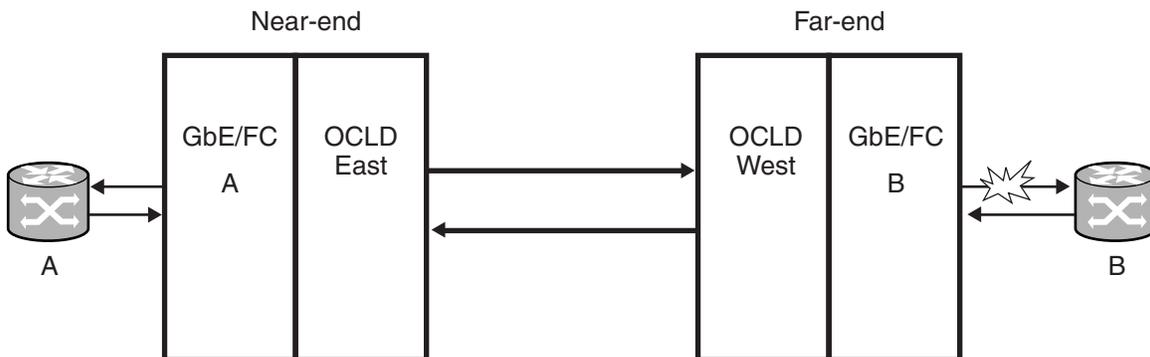


Table 5-5
Example 1 explained: Detection and recovery

Detection	Recovery
GbE/FC B Tx fiber to client B is broken. Client B generates LOS alarm.	GbE/FC B Tx fiber to client B is restored. Client B clears LOS alarm.
Client B send Link Not Operational primitive to GbE/FC B.	Client B start a link recovery procedure with Client A is started.
If subrate/extended reach is enabled, GbE/FC B detects LANLinkDown.	If subrate/extended reach enabled GbE/FC B LANLinkDown alarm clears.
GbE/FC B passes Link Not Operational primitive to GbE/FC A.	—
GbE/FC A passes Link Not Operational primitive to Client A.	—
Client A detects Link Not Operational primitive and returns a Link Offline primitive to the GbE/FC A.	—

Figure 5-6
Example 2 - Near-end error

OM2294

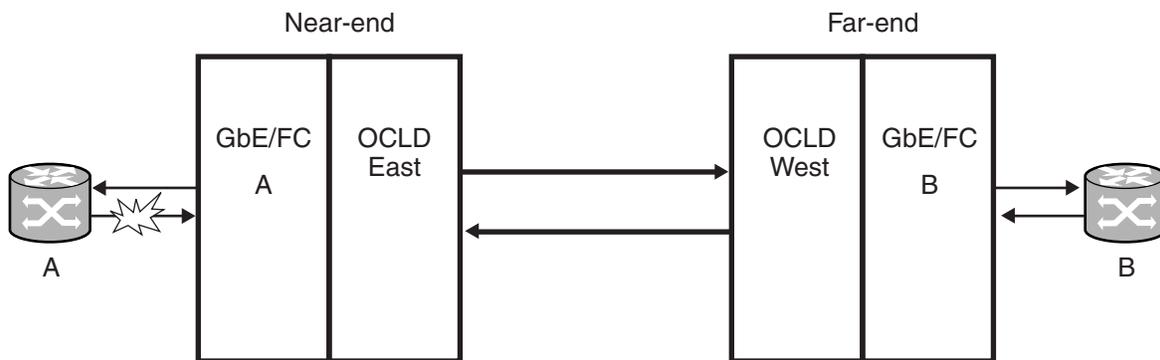


Table 5-6
Example 2 explained: Detection and recovery

Detection	Recovery
GbE/FC A Tx fiber to client A is broken. GbE/FC A detects client port LOS.	GbE/FC A Tx fiber to client A is restored. GbE/FC A clears client port LOS alarm.
If GFP conditioning is enabled, GbE/FC A sends CMF CSF conditioning to GbE/FC B. GbE/FC B detect CMF CSF and applies FC conditioning to Client B. If GFP conditioning is disabled, GbE/FC A injects AIS-P to GbE/FC B. GbE/FC B detects AIS-P and applies FC conditioning to Client B. (See Note)	If GFP conditioning is enabled, GbE/FC A removed CMF CSF conditioning to GbE/FC B. GbE/FC B clears CMF CSF and removes FC conditioning to Client B. If GFP conditioning is disabled, GbE/FC A removed AIS-P conditioning to GbE/FC B. GbE/FC B clears AIS-P and removes conditioning to Client B.
Client B sends a Link Reset Request primitive to start an FC link recovery	Client A starts an FC link recovery procedure to Client B.
Note: In Release 6.0, GFP conditioning CMF is not supported. Instead, AIS-P is sent in paths towards GbE/FC B.	

Figure 5-7
Example 3 - Inter-node error

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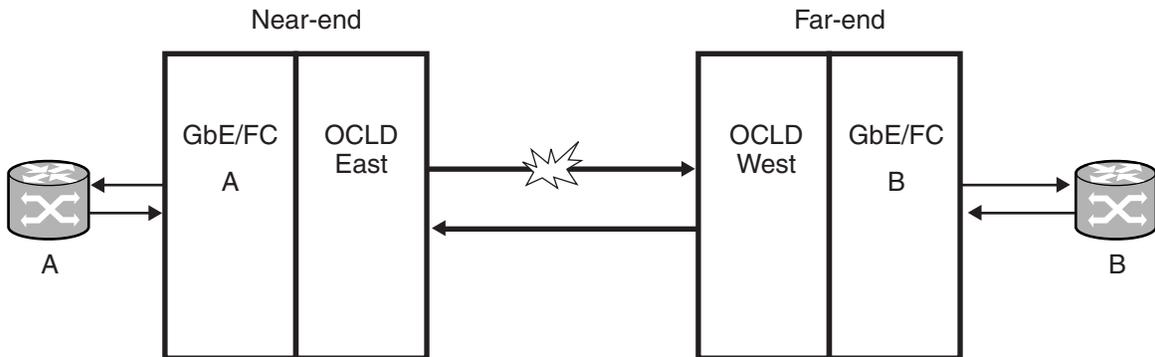


Table 5-7
Example 3 explained: Detection and recovery

Detection	Recovery
WAN link is failed (fiber is cut from near-end node to far-end node). OCLD West detects LOS.	WAN link is recovered (fiber is repaired from near-end node to far-end node). OCLD West clears LOS.
LTE block within GbE/FC B conditions AIS-P on all paths.	LTE block within GbE/FC B removes AIS-P on all paths.
PTE blocks within GbE/FC B detects AIS-P.	PTE block within GbE/FC B clears AIS-P for all the paths and removes the FC conditioning to Client B.
GbE/FC B detects AIS-P and applies FC conditioning to Client B.	Client B starts an FC link recovery procedure with Client A.
Client B sends Link Not Operational primitive to GbE/FC B.	—
GbE/FC B passes Link Not Operational primitive to GbE/FC A.	—
Client A detects Link Not Operational primitive from GbE/FC A.	—
Client A sends Link Offline primitive to GbE/FC A.	—
Note: The GbE/FC is a path-terminating equipment (PTE), but has a line-terminating (LTE) function within it.	

Gigabit Ethernet protocol - GFP CMF (Control Management Frames) conditioning vs. AIS-P conditioning for client signal failures

Conditioning is required so that the two Ethernet switches/routers interconnected through the Optical Metro 5100/5200 system declare Link Down on their respective ports when one port detects a Link Down failure.

The following are the impacts if the client switch/router does not take the link down:

- The switch/router will continue to send traffic and control protocol packets into the broken link.
- The traffic will be re-routed after bridging/routing protocols timeout (typically 20 seconds for STP, 40 seconds for OSPF).
- If link aggregation is used between switches then the protocol may detect link failures rapidly.
- MPLS switches may run fast hello polls (for example, 5 ms) and detect link failures rapidly.
- Network behavior will vary, depending upon protocols running over the link. This may result in longer periods of traffic loss than when the client takes the link down

If the client switch/router takes the link down:

- This may trigger rapid re-route of traffic (for example, Multi-Link Trunking on Passport 8600)
- In general, no guarantee that client will re-route any faster than when the link is not taken down
- Network behavior will be similar to directly-connected clients

Release 6.0 did not support GFP CMF conditioning, instead AIS-P conditioning was used. However, Release 6.1 and higher support both GFP CMF conditioning and AIS-P conditioning. When the GFP conditioning parameters in the GbE/FC facility screen is set to Enable, then GFP CMF conditioning is used. When it is set to Disable, AIS-P conditioning is used. This feature allows a GbE/FC circuit pack running in a Release 6.0 shelf to interwork with a GbE/FC circuit pack running in a Release 6.1 or higher shelf. The GbE/FC facility at both ends of the connection must have this parameter set to the same value; otherwise incorrect operation will result.

GFP CMF conditioning:

- Allows client failures to be decoupled from SONET failures
- Reduces the number of alarms in V-CAT and SONET interop configurations
- Provides better fault isolation than AIS-P conditioning
- Enables other vendor and other Nortel products (for example, Optical Metro 3500, DX, OME) GFP/GE interoperability.

Figure 5-8, Figure 5-9, and Figure 5-10 show examples of error detection and recovery on the GbE/FC circuit pack (when using the Gigabit Ethernet protocol).

Example 1

Figure 5-8
Example 1 - far-end error

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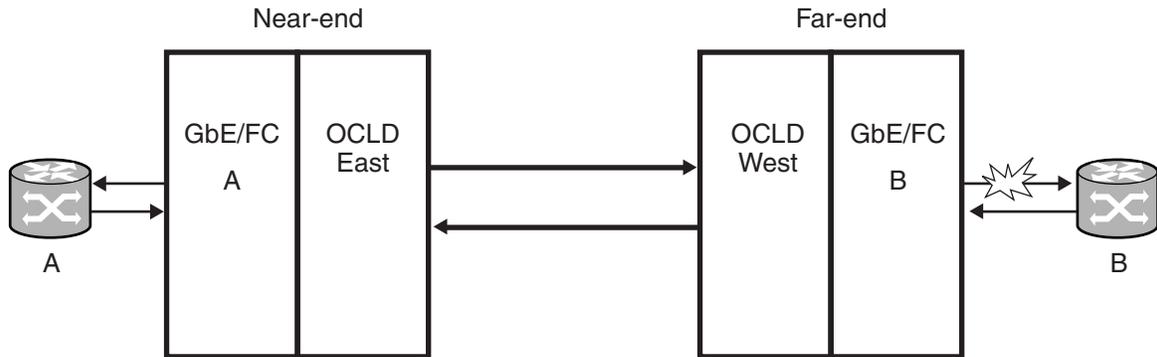


Table 5-8 explains the scenario shown in Figure 5-8.

Table 5-8
Example 1 explained: Detection and recovery

Detection	Recovery
1 - GbE/FC B TX fiber to client B is broken	1 - GbE/FC B TX fiber is restored
2 - Client B initiates AN	2 - AN between GbE/FC B and client B completes
3 - GbE/FC B detects AN that does not complete (TX fiber is cut)	3 - GbE/FC B removes GFP conditioning (CMF)
4 - GbE/FC B conditions using GFP conditioning (CMF) to GbE/FC A (see Note)	4 - GbE/FC A detects GFP conditioning (CMF) removal or client data frame arrival and removes laser shutdown conditioning
5 - GbE/FC A detects GFP conditioning (CMF) and shuts down client laser (see Note)	5 - AN completes between GbE/FC A and client A and end-to-end traffic is restored
6 - Client A detects signal loss and enters AN cycle that does not complete due to laser shut down on GbE/FC A	—
Note: In Release 6.0, GFP CMF conditioning is not supported. Instead, AIS-P is sent in paths towards GbE/FC A. GbE/FC A detects AIS-P and shuts down the laser for the affected client port. Release 6.1 and higher support both GFP CMF conditioning and AIS-P conditioning for the error detection and recovery example described in Table 5-8.	

Example 2

Figure 5-9
Example 2 - near-end error

OM2294

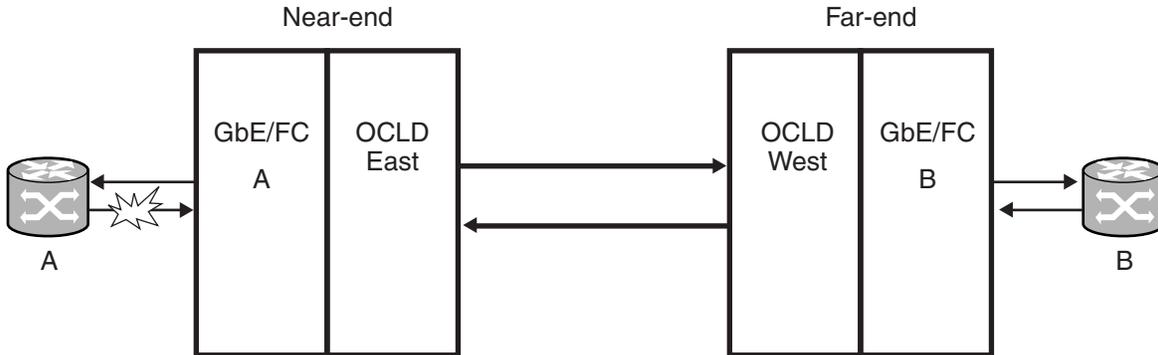


Table 5-9 explains the scenario shown in Figure 5-9.

Table 5-9
Example 2 explained: Detection and recovery

Detection	Recovery
1 - GbE/FC A TX fiber to client A is broken	1 - GbE/FC A RX fiber is restored
2 - GbE/FC detects client port LOS and initiates an AN cycle that will not complete	2 - AN between GbE/FC A and client A completes
3 - GbE/FC A conditions using GFP conditioning (CMF) to GbE/FC B (see Note)	3 - GbE/FC A removes GFP conditioning (CMF)
4 - GbE/FC B detects GFP conditioning (CMF) and shuts down client laser (see Note)	4 - GbE/FC B detects GFP conditioning (CMF) removal or client data frame arrival and removes laser shutdown conditioning
5 - Client B detects signal loss and enters AN cycle that does not complete due to laser shut down on GbE/FC B	5 - AN completes between GbE/FC B and client B and end-to-end traffic is restored
<p>Note: In Release 6.0, GFP conditioning CMF is not supported. Instead, AIS-P is sent in paths towards GbE/FC B. GbE/FC B detects AIS-P and shuts down the laser for the affected client port. Release 6.1 and higher support both GFP CMF conditioning and AIS-P conditioning for the error detection and recovery example described in Table 5-9.</p>	

Example 3

Figure 5-10
Example 3 - inter-node error

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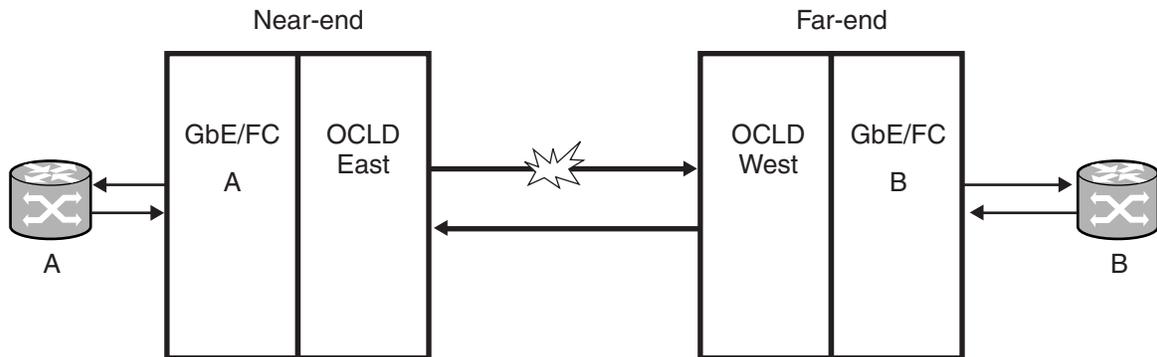


Table 5-10 explains the scenario shown in Figure 5-10.

Table 5-10
Example 3 explained: Detection and recovery

Detection	Recovery
1 - WAN link is failed (fiber is cut from near-end node to far-end node)	1 - WAN link fiber is restored
2 - OCLD West detects LOS	2 - OCLD West detects signal recovery
3 - GbE/FC B LTE block conditions AIS-P on paths	3 - GbE/FC B LTE block removes AIS-P on paths
4 - GbE/FC B PTE block detects AIS-P	4 - GbE/FC B PTE block detects AIS-P removal
5 - GbE/FC B shuts down laser for affected client port	5 - GbE/FC B restores laser for affected client port
6 - Client B detects loss of GE signals and enters AN cycle that will not complete while WAN failure exists	6 - AN cycle completes between GbE/FC B and client B
7 - GbE/FC B PTE block conditions RDI-P back towards GbE/FC A	7 - GbE/FC B PTE block removes RDI-P conditioning towards GbE/FC A
8 - GbE/FC A PTE block detects RDI-P	8 - GbE/FC A PTE block detects RDI-P removal

Table 5-10 (continued)**Example 3 explained: Detection and recovery**

Detection	Recovery
9 - GbE/FC A shuts down laser on affected client port	9 - GbE/FC A restores laser on affected client port
10 - Client A enters AN cycle that will not complete while WAN failure exists	10 - AN cycle completes between GbE/FC A and client A
Note: The GbE/FC is a path-terminating equipment (PTE) but has a line-terminating equipment (LTE) function within it.	

Generic Operation Measurements (OMs)

[Table 5-11](#) displays the generic OMs supported for the OCI SRM GbE/FC, OCI SRM GbE/FC Enhanced and OCI SRM GbE circuit packs.

Table 5-11
Generic OMs supported on the OCI SRM GbE/FC, OCI SRM GbE/FC Enhanced and OCI SRM GbE circuit packs

Generic OM Counter	Gigabit Ethernet		FC-100/FICON (see Note 1)	
	LAN (see Note 2)	WAN	LAN (see Note 2)	WAN
InFrames	Total number of frames received (including errored frames)	Total number of GFP frames received (including errored frames but excluding CMFs)	Total number of Class 2, 3, and F FC frames received. Note: Only available on the OCI SRM GbE/FC Enhanced circuit pack.	Total number of super-blocks received
InFramesErr	Total number of frames with <ul style="list-style-type: none"> • FCS errors • fragments • jabbers 	Total number of GFP frames received with FCS errors or with invalid HEC	Not supported	Total number of super-blocks with uncorrectable errors
InFramesDiscds (see Note 3)	Total number of frames discarded when the ingress FIFO overflows. Ingress FIFO overflows can occur when Ethernet PAUSETX flow control is disabled and that the Gigabit Ethernet is mapped into a substrate WAN bandwidth.	Always returns 0 since frames are not discarded at the WAN input	Not supported. System Manager displays "N/A".	Not supported. System Manager displays "N/A".

Table 5-11 (continued)

Generic OMs supported on the OCI SRM GbE/FC, OCI SRM GbE/FC Enhanced and OCI SRM GbE circuit packs

Generic OM Counter	Gigabit Ethernet		FC-100/FICON (see Note 1)	
	LAN (see Note 2)	WAN	LAN (see Note 2)	WAN
InOctets	Total number of frame octets received including the DA, SA, T/L, data and LAN FCS fields	Total number of octets received (including errored frames). Includes GFP/HEC headers and payload FCS. Does not include octets from Client Management Frames (CMF).	Total number of octets received in FC frames excluding SOF and EOF primitives	Not supported
InOctetsErr	Not supported. System Manager displays "N/A".	Not supported. System Manager displays "N/A".	Total number of disparity errors and symbol errors	Not supported. System Manager displays "N/A".
OutFrames	Total number of frames transmitted	Total number of GE frames transmitted via GFP to the Optical Metro 5100/5200 network	Total number of Class 2, 3, and F FC frames transmitted. Note: Only available on the OCI SRM GbE/FC Enhanced circuit pack.	Total number of super-blocks transmitted
OutFramesErr	Total number of errored GE frames transmitted via GFP	Always reads 0 since the hardware never forwards errored frames to the WAN	Not supported	Always reads 0 since the hardware never forwards errored super-blocks to the WAN
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.	Always reads 0	Not supported. System Manager displays "N/A".	Not supported. System Manager displays "N/A".

Table 5-11 (continued)

Generic OMs supported on the OCI SRM GbE/FC, OCI SRM GbE/FC Enhanced and OCI SRM GbE circuit packs

Generic OM Counter	Gigabit Ethernet		FC-100/FICON (see Note 1)	
	LAN (see Note 2)	WAN	LAN (see Note 2)	WAN
OutOctets	Total number of frame octets transmitted including the DA, SA, T/L, data and LAN FCS fields	Total number of octets transmitted (includes GFP/HEC headers and payload FCS)	Total number of octets transmitted in FC frames excluding SOF and EOF primitives	Not supported. System Manager displays "N/A".
OutOctetsErr	Not supported. System Manager displays "N/A".	Always reads 0 since the hardware never forwards errored frames to the WAN	Total number of Tx 10B_ERR	Not supported. System Manager displays "N/A".
<p>Note 1: The protocol is not supported on the OCI SRM GbE circuit pack.</p> <p>Note 2: The LAN port is identified as "optical" in the System Manager Performance Monitoring interface.</p> <p>Note 3: Count is missing when 64 byte frame size is chosen with 100% utilization and 1-v V-Cat transport structure.</p>				

Ethernet Operational Measurements (OMs)

[Table 5-12](#) displays the Ethernet OMs supported by the OCI SRM GbE/FC, OCI SRM GbE/FC Enhanced, and OCI SRM GbE circuit packs.

Table 5-12

Ethernet OM counters supported on the OCI SRM GbE/Fc, OCI SRM GbE/FC Enhanced and OCI SRM GbE circuit packs

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	Total number of frames for which the reception fails because of an internal MAC sub-layer receive error.
CarrierSenseErr	Since this counter does not apply to full duplex, a value of 0 will always be returned.
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.
FrameTooShort	Total number of frames whose total length, including FCS, is less than 64 bytes but have no FCS error.
InternalMACTxErr	Total number of frames for which the transmission fails because of an internal MAC sub-layer transmit error.
SymbolErr	Total number of GMII data reception errors.

Table 5-12 (continued)
Ethernet OM counters supported on the OCI SRM GbE/Fc, OCI SRM GbE/FC Enhanced and OCI SRM GbE circuit packs

Ethernet OM Counter	LAN (see Note)
InPauseFrames	Total number of MAC control frames received with an op-code indicating a PAUSE frame.
OutPauseFrames	Total number of OCI SRM GbE/FC 1310nm/850nm 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.
Fragments	Total number of frames whose length, including FCS, is less than 64 bytes that have an FCS error.
ControlFrames	Total number of frames that contain any MAC control frames (typically indicated by the "Type" field in the Ethernet header with a value of 0x8808).
Note: The LAN port is identified as "optical" in the System Manager Performance Monitoring interface.	

Gigabit Ethernet Performance Parameters (PPs)

Each port supports the Gigabit Ethernet PPs on both the LAN side and WAN side of the port as shown in [Table 5-13](#).

**Table 5-13
Gigabit Ethernet performance parameters**

Gigabit Ethernet PPs	LAN	WAN
ES	A second where at least one InFramesErr occurred or a loss of signal or loss of sync event occurred.	A second where at least one InFramesErr occurred or a loss of frame delineation event occurred.
SES	A second where InFramesErr/InFrames > 0.01 (> 1% of frames are errored) or a loss of signal or loss of sync event occurred. Seconds where INFRAMES = 0 are not considered SES unless there is a loss of signal, loss of sync or a LAN link down event	A value of 0 will always be returned except when mismatch frame types are received from the WAN – in this case some seconds that should only be ES may be counted as SES. Seconds where InFrames = 0 are not considered SES unless there is a loss of frame delineation event.
UAS	Number of seconds that the GE service is unavailable. The GE service is unavailable at the onset of 10 +/- 0.5 consecutive SES seconds. It returns to availability at the onset of 10 +/- 0.5 consecutive seconds without SES.	Number of seconds that the GE service is unavailable. The GE service is unavailable at the onset of 10 +/- 0.5 consecutive SES seconds. It returns to availability at the onset of 10 +/- 0.5 consecutive seconds without SES.

FC-100/FICON Performance Parameters (PPs)

Each LAN port supports the FC-100/FICON PPs on both the LAN side and WAN side of the port as shown in [Table 5-14](#).

Table 5-14
FC-100/FICON performance parameters

FC-100/FICON PPs	LAN	WAN
CV	An 8B/10B invalid code (symbol error) or disparity error	-
ES	A second where at least one invalid code or disparity error occurred or a loss of signal or loss of sync event occurred.	A second where at least one uncorrectable errored super block or loss of frame delineation (LFD) defect occurred.
SES	A second where more than 106 invalid codes or disparity errors (corresponding to an error rate of 10E-6) have occurred or a loss of signal or loss of sync event occurred.	A second containing two or more errored super blocks or a second where at least one LFD defect occurred.
UAS	Number of seconds that the FC-100/FICON service is unavailable. The FC-100/FICON service is unavailable at the onset of 10 +/- 0.5 consecutive SES seconds. It returns to availability at the onset of 10 +/- 0.5 consecutive seconds without SES.	Number of seconds that the FC-100/FICON service is unavailable. The FC-100/FICON service is unavailable at the onset of 10 +/- 0.5 consecutive SES seconds. It returns to availability at the onset of 10 +/- 0.5 consecutive seconds without SES.

SONET/SDH Performance Parameters (PPs)

The aggregate port supports the SONET/SDH PPs as shown in [Table 5-15](#).

Table 5-15
SONET/SDH performance parameters

Aggregate PP mode	PPs supported
SONET	Section PPs: CVS, ESS, SESS, SEFS.
	Line PPs: CVL, CV-LFE, ESL, ES-LFE, SESL, SES-LFE, UASL, UAS-LFE.
	Path PPs: CVP, CV-PFE, ESP, ES-PFE, SESP, SES-PFE, UASP, UAS-PFE.
SDH	Section PPs: EBS, ESS, SESS, OFSS.
	Line PPs: EBL, EB-LFE, ESL, ES-LFE, SESL, SES-LFE, UASL, UAS-LFE.
	Path PPs: EBP, EB-PFE, ESP, ES-PFE, SESP, SES-PFE, UASP, UAS-PFE.

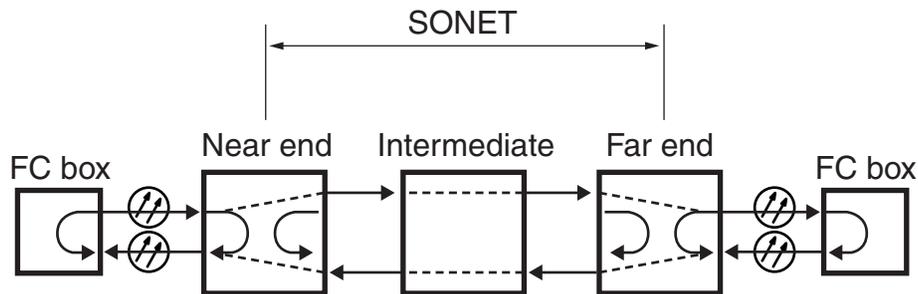
OCI SRM GbE/FC Enhanced 1310 nm circuit pack and OCI SRM GbE/FC Enhanced 850 nm circuit pack features

The OCI SRM Gigabit Ethernet/Fibre Channel (GbE/FC) Enhanced aggregates up to two client interface signals onto a STS-48/STM-16 signal to be transported on a single wavelength over the Optical Metro 5100/5200 system and has all the features of the OCI SRM GbE/FC nm circuit pack (see [“OCI SRM GbE/FC 1310 nm circuit pack and OCI SRM GbE/FC 850 nm circuit pack features”](#) on page 5-15), along with the following features:

- provides a Fibre Channel (FC) extension solution, allowing data centers to be 900 km apart at full rate and 5400 km apart for STS-3c/STM-1 subrate
 - signal flow control loop is divided into three flow control loops
 - At each end, FC flow control loops are maintained by hardware intervention in the FC traffic
 - In the center of the network, a proprietary flow control loop is maintained by hardware. Each end has sufficient buffering in the egress direction to accommodate WAN delays
 - the near-end NE constantly provides acknowledgement until it receives back pressure from either the far-end client (communicated by the proprietary flow control) or the near-end WAN FIFO (in the subrate case); see [Figure 5-11](#)

Figure 5-11
FC extended reach solution

OM24921



- the FC extended reach allows inter-working with Optical Metro 3000. See [“Fibre Channel extended reach/buffer credits interworking”](#) on page 5-41
- allows FC WAN subrate bandwidth provisioning for the following bandwidth assignments:
 - STS-12c/VC-4-4c contiguously concatenated
 - STS-3c x nV/VC-4 x nV virtually concatenated (where n is 1 to 7)
- support of FC specific parameters on a per port basis:
 - subrate Enable/Disable (default is Disable)

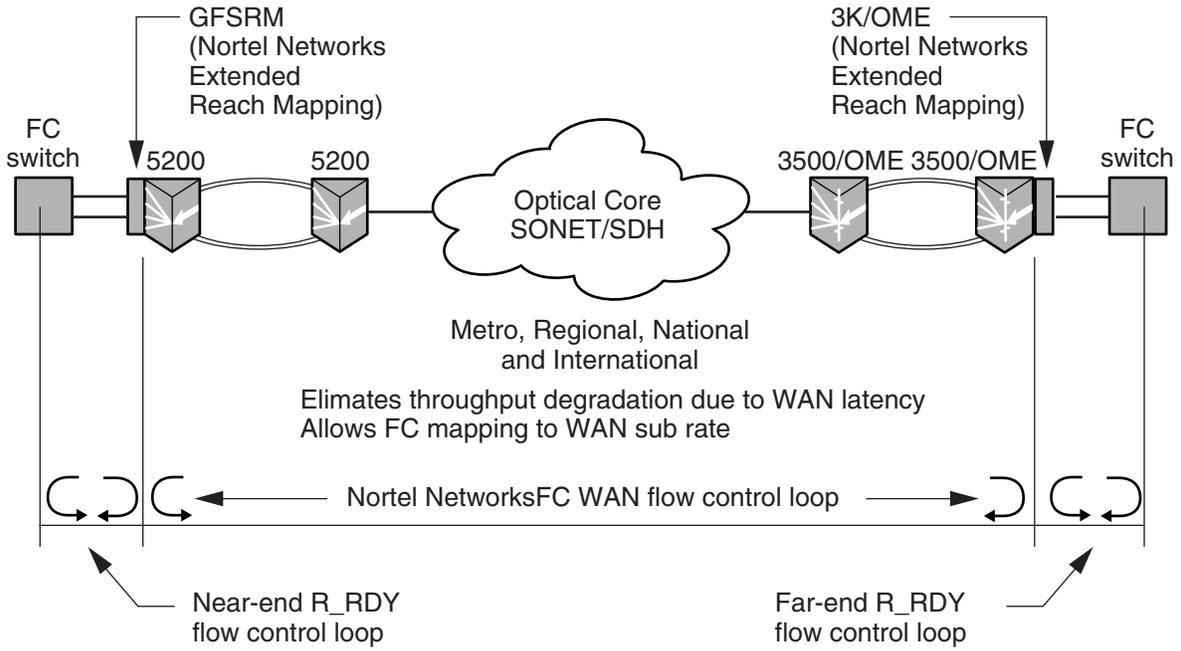
- extended reach Enable/Disable (default is Disable)
 - setting SUBRATE/EXTREACH to DISABLE/DISABLE causes FC to be transparently mapped to GFP-T as per the G.7041 standards. This requires full-rate WAN bandwidth
 - setting SUBRATE/EXTREACH to ENABLE/ENABLE causes FC to be transparently mapped to GFP-T using the Nortel Networks proprietary extended reach method. This does not require full-rate WAN bandwidth
- FC link state
 - the FCLINKSTATE attribute of the FC facility indicates the current FC link state (snooped). It corresponds to the standard FC link state (as per FC-PH). It is a read-only attribute. Possible values are ACTIVE, RECOVERY, FAILED, OFF LINE or UNKNOWN
- Buffer to Buffer Credits (BBC)
 - the BBC attribute of the FC facility indicates the snooped Buffer-to-Buffer credit used by the attached FC devices. It is a read-only attribute, with the possible values of 1...65536 or UNKNOWN. This information is only available when EXTREACH is set to ENABLE
- BBC override
 - The BBCOVERRIDE attribute of the FC facility overrides the snooped Buffer-to-Buffer credit value. The possible values are 0 (default - no override) or 1, 2, 4, 8, 16, 32, 64, or 128. This information is only valid when EXTREACH is set to ENABLE

Fibre Channel extended reach/buffer credits interworking

Interoperability of the enhanced FC extended reach/buffer credits with the Optical Metro 3000 is also supported. See [Figure 5-12](#).

Figure 5-12
FC enhanced/buffer credits interop

OM2281t



For detailed information on the provisionable protocols supported by this circuit pack, refer to [Table 2-17 on page 2-35](#) in *Technical Specifications*, 323-1701-180.

Signal flow

Figure 5-13 shows the signal flow through the following OCI circuit packs:

- OCI 622 Mbit/s 1310 nm
- OCI 1.25 Gbit/s 1310 nm
- OCI 1.25 Gbit/s 850 nm
- OCI OC-48/STM-16 1310 nm
- OCI ISC 1310 nm
- OCI GbE 1310 nm
- OCI GbE 850 nm

Figure 5-13
OCI signal flow

OM0001t

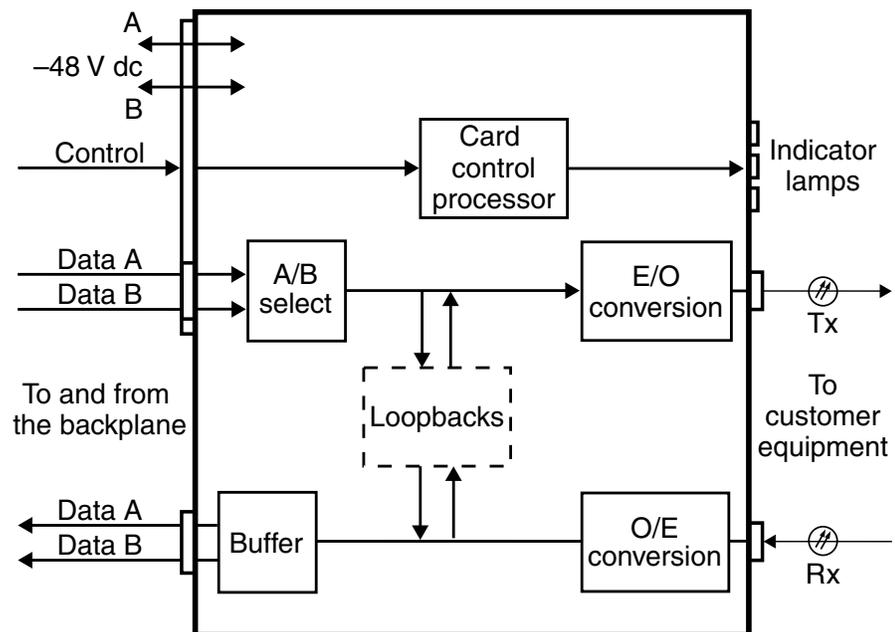


Figure 5-14 shows the signal flow through the OCI SONET/SDH and OCI IR SONET/SDH circuit packs.

Figure 5-14
OCI SONET/SDH and OCI SONET/SDH IR signal flow

OM0116p

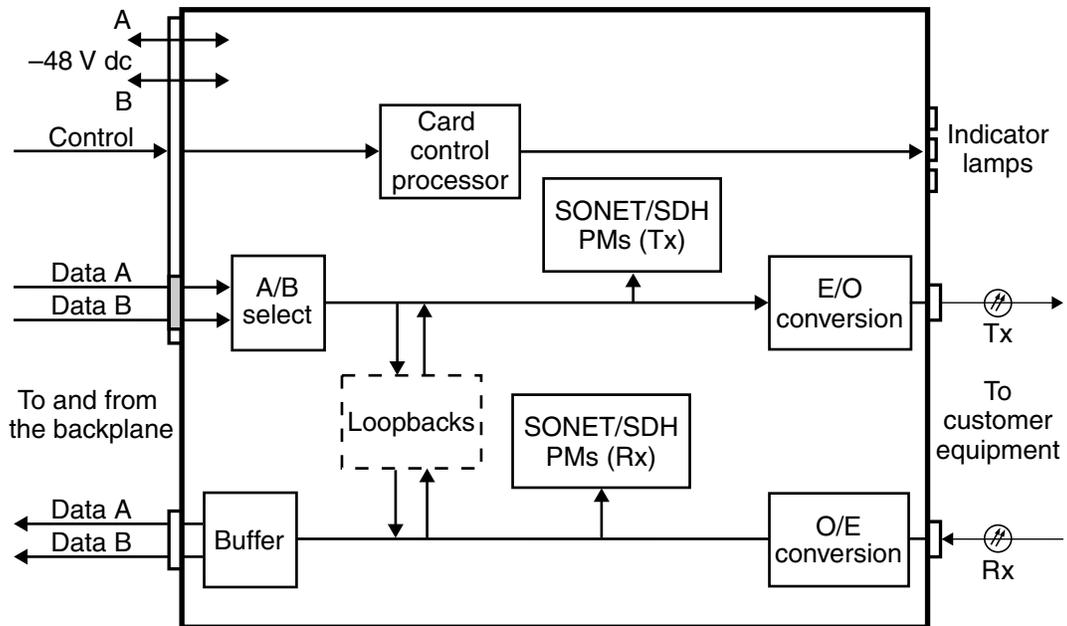


Figure 5-15 shows the signal flow through the OCI SRM 1310 nm circuit pack and OCI SRM 1310 nm LC circuit pack.

Figure 5-15
OCI SRM signal flow

OM0271p

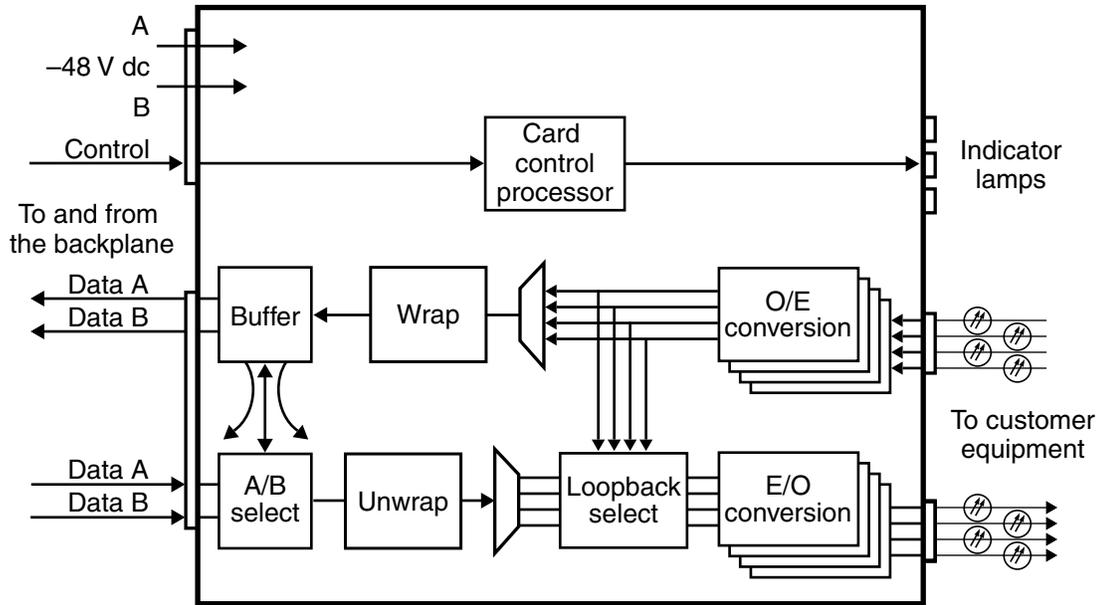


Figure 5-16 shows the signal flow through the OCI SRM SONET/SDH circuit pack.

Figure 5-16
OCI SRM SONET/SDH signal flow

OM0333p

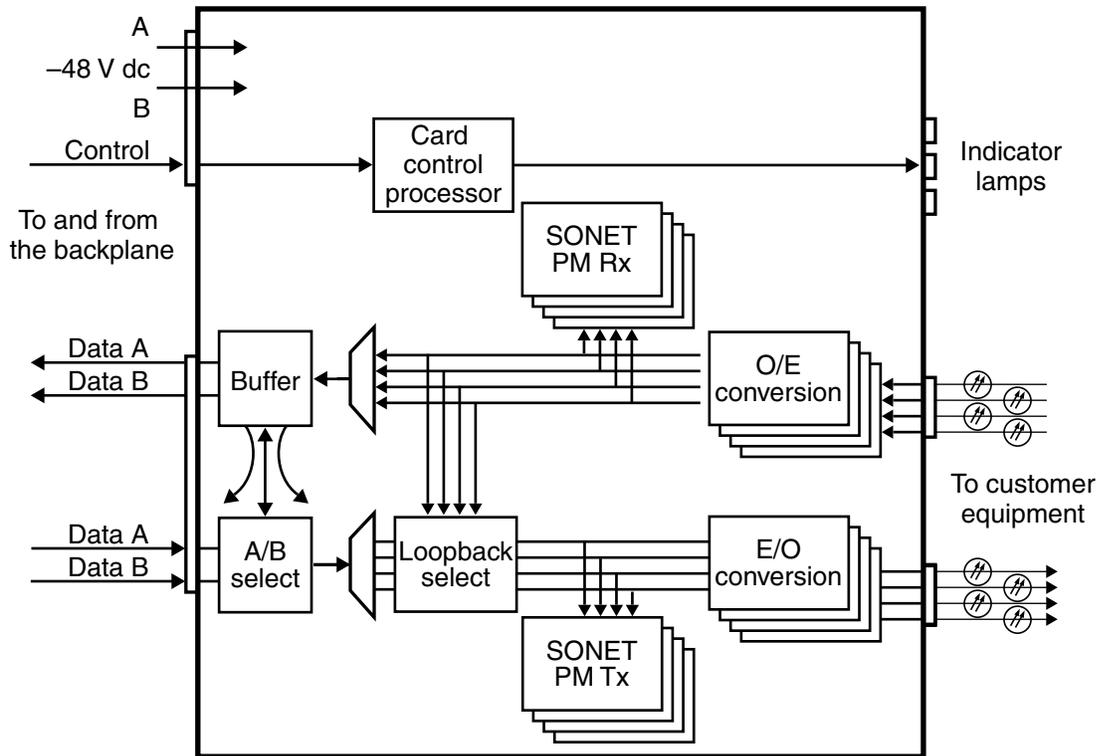


Figure 5-17 shows the signal flow through the OCI SRM SONET/SDH LTE circuit pack.

Figure 5-17
OCI SRM SONET/SDH LTE circuit pack signal flow

OM2541p

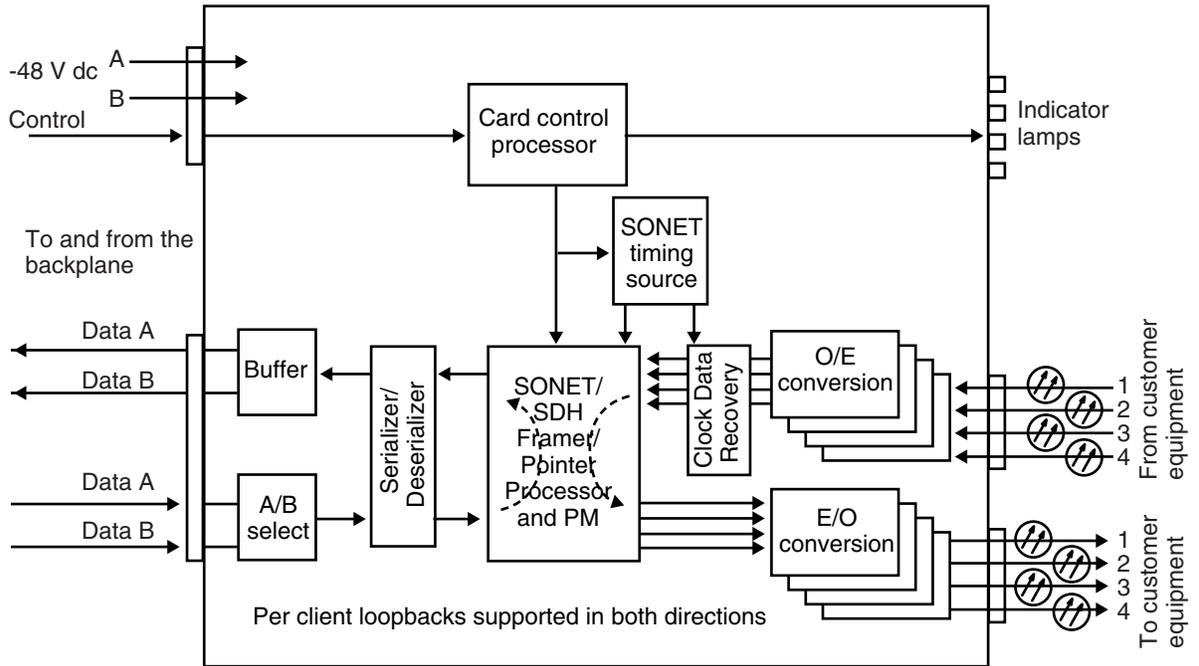


Figure 5-18 shows the signal flow through the OCI SRM ESCON circuit pack.

Figure 5-18
OCI SRM ESCON signal flow

OM1827

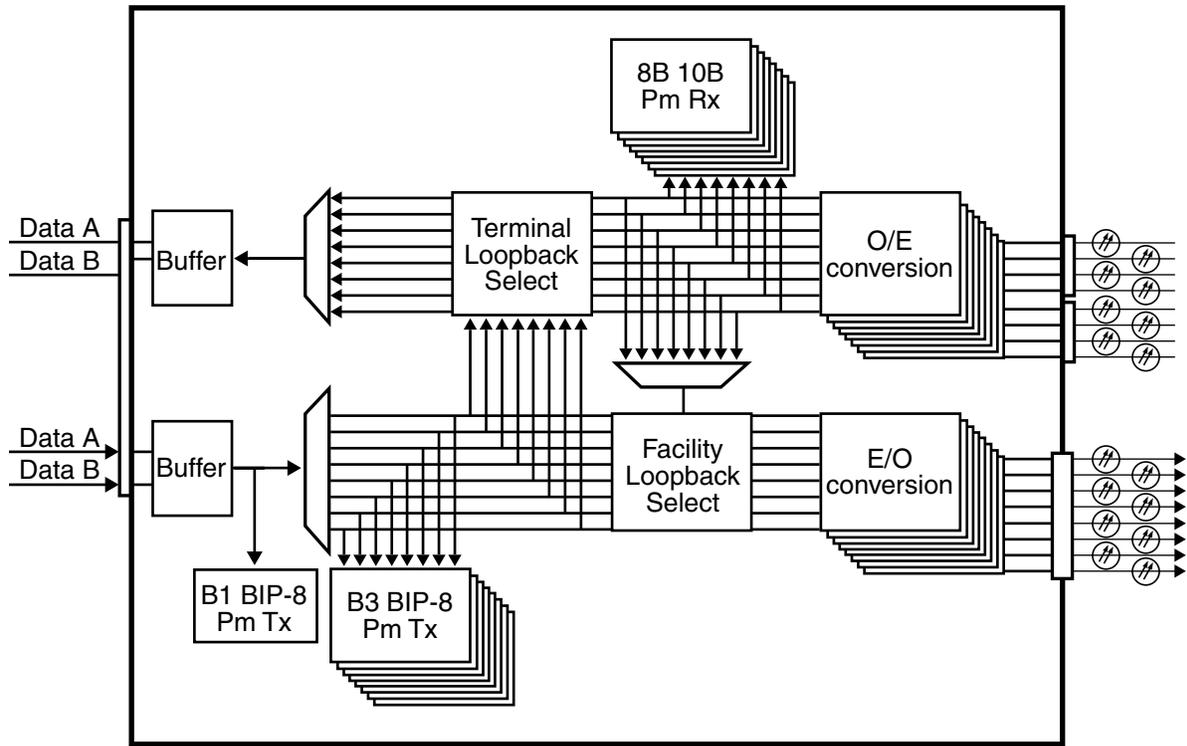
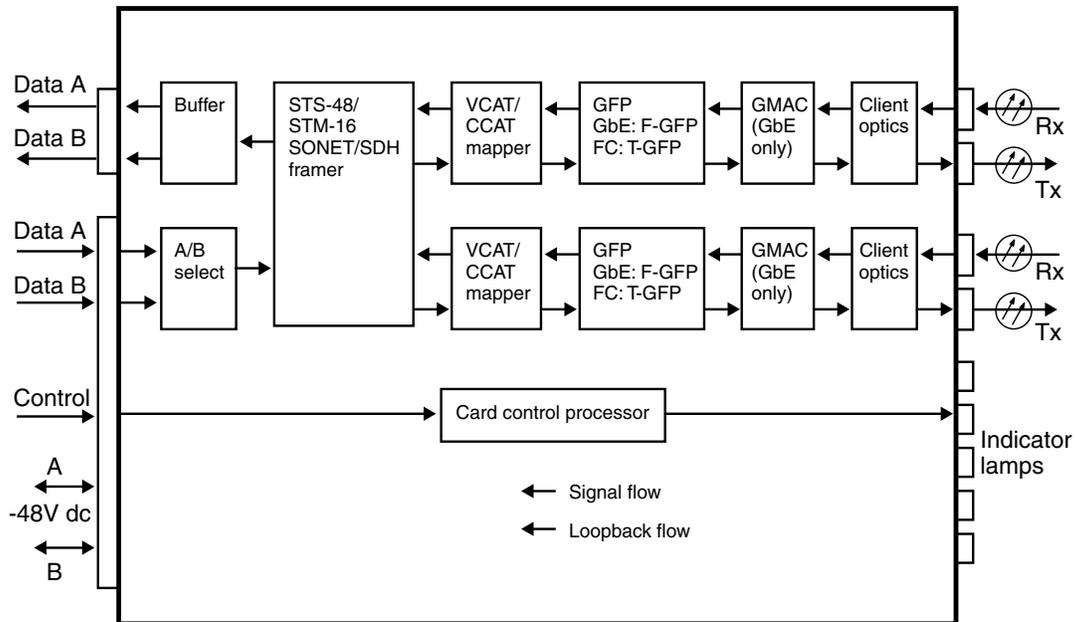


Figure 5-19 shows the signal flow through the OCI SRM GbE 1310 nm/850 nm, the OCI SRM GbE/FC 1310 nm/850 nm or the OCI SRM GbE/FC Enhanced 1310 nm/850 nm circuit pack.

Note: The OCI SRM GbE 1310 nm/850 nm does not support FC client signals. In Figure 5-19 the GFP block for the OCI SRM 1310 nm/850 nm is F-GFP for GbE only.

Figure 5-19
OCI SRM GbE 1310 nm, OCI SRM GbE 850 nm, OCI SRM GbE/FC 1310 nm, OCI SRM GbE/FC 850 nm, OCI SRM GbE/FC Enhanced 1310 nm, OCI SRM GbE/FC Enhanced 850 nm signal flow

OM1948p



Faceplates

Figure 5-20 to Figure 5-25 show the faceplates for the different types of OCI.

Figure 5-20
Faceplate of an OCI 1.25 Gbit/s, OCI OC-48/STM-16 2.5 Gbit/s, and OCI OC-48/STM-16 2.5 Gbit/s circuit pack

OM2241t

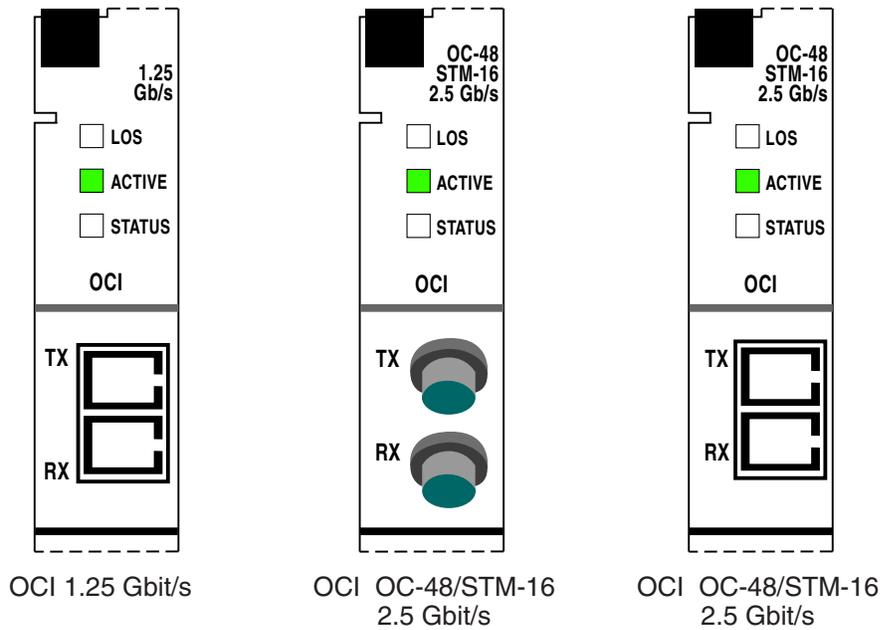
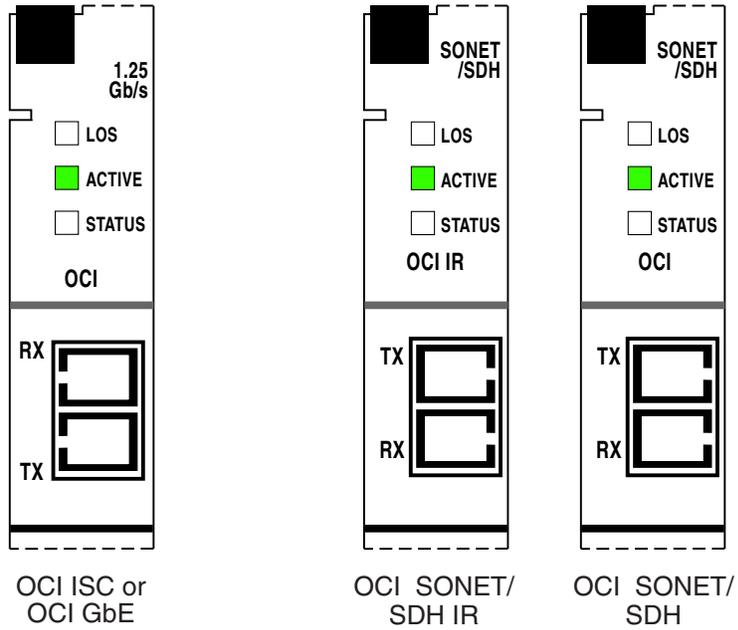


Figure 5-21
Faceplate of an OCI ISC or OCI GbE, OCI SONET/SDH IR and a OCI SONET/SDH circuit pack

OM2242t



Note: On the OCI ISC or OCI GbE circuit pack, the Rx port is on the top and the Tx port is on the bottom. The Rx and Tx ports are reversed when compared to most OCI circuit packs.

Figure 5-22
Faceplate of an OCI SRM, OCI SRM SONET/SDH, or OCI SRM ESCON circuit pack

OM2243t

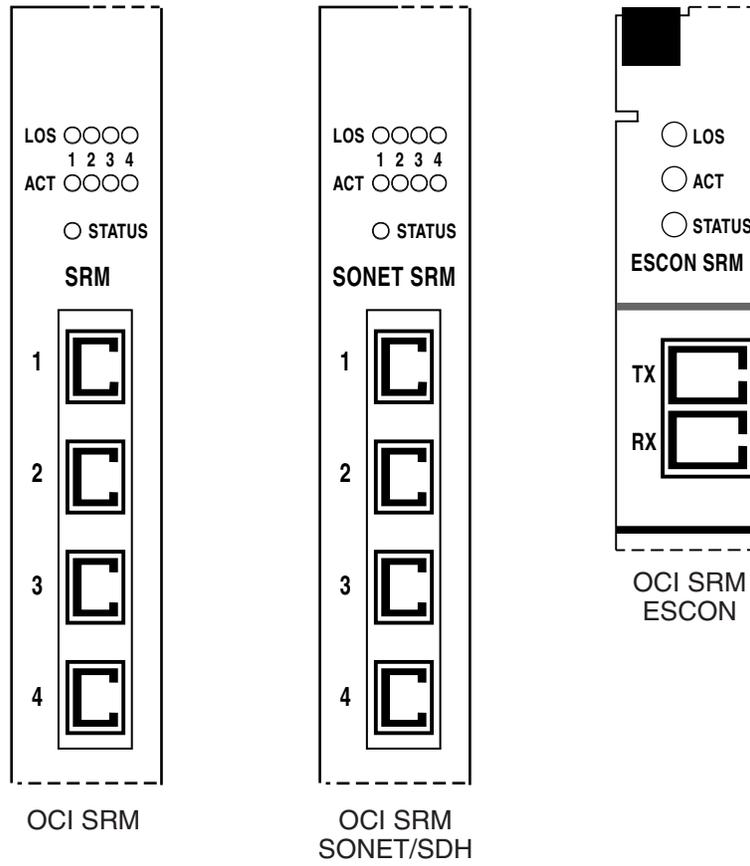


Figure 5-23
Faceplate of an OCI SRM 1310 nm LC circuit pack

OM2377t

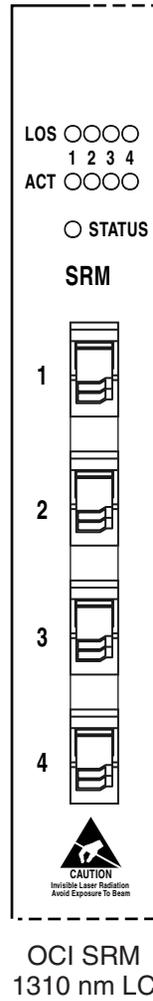


Figure 5-24
Faceplate of an OCI SRM SONET/SDH LTE circuit pack

OM2282

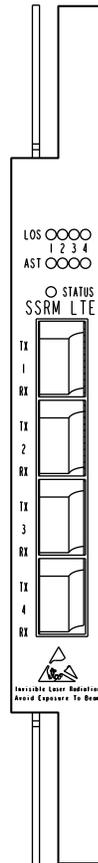
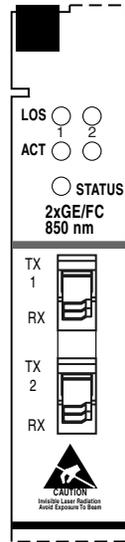
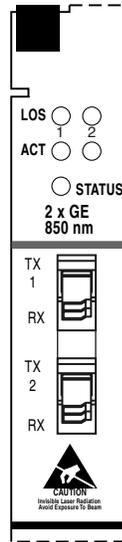


Figure 5-25
Faceplate of an OCI SRM GbE 1310 nm/850 nm, an OCI SRM GbE/FC
1310 nm/850 nm and an OCI SRM GbE/FC Enhanced 1310 nm/850 nm circuit
pack

OM1935t



OCI SRM
GbE/FC



OCI SRM
GbE

Indicator lamps

OCI circuit packs have the following lamp on the faceplate:

- LOS
- ACTIVE
- STATUS

OCI SRM, OCI SRM SONET/SDH, and OCI SRM SONET/SDH LTE circuit packs have the following lamps on the faceplate:

- four LOS lamps (one for each port)
- four ACT (active) lamps (one for each port)
- one STATUS lamp

OCI SRM ESCON circuit packs have the following lamps on the faceplate:

- one LOS lamp (for all 8 ports)
- one ACT (active) lamp (for all 8 ports)
- one STATUS lamp

Note: The OCI SRM ESCON circuit pack has one LOS lamp for all eight of its client-side facilities. The lamp is lit if any of the eight client-side facilities is not receiving a valid signal. Unused SRM ESCON ports should be put in a deleted state. Leaving unused ports in the OOS state will leave the LOS lamp lit.

OCI SRM GbE 1310 nm/850 nm, OCI SRM GbE/FC 1310 nm/850 nm, and OCI SRM GbE/FC Enhanced 1310 nm/850 nm have the following lamps on the faceplate:

- two LOS lamps (one for each client port)
- two ACT (active) lamps (one for each client port)
- one STATUS lamp

For indicator lamp functionality, see [Table 4-7 on page 4-19](#).

Loopbacks

Refer to the following figures for loopback examples on OCI circuit packs:

- OCI circuit packs, see [Figure 5-26 on page 5-58](#)
- OCI SRM ESCON circuit packs, see [Figure 5-27 on page 5-59](#)
- OCI SRM GbE and OCI SRM GbE/FC circuit packs with GFP Conditioning set to Disabled, see [Figure 5-28 on page 5-60](#)

Note: The OCI SRM GbE 1310 nm/850 nm does not support FC client signals. In [Figure 5-28](#), 8B10B error codes for FC client signals are not sent out on the client port.

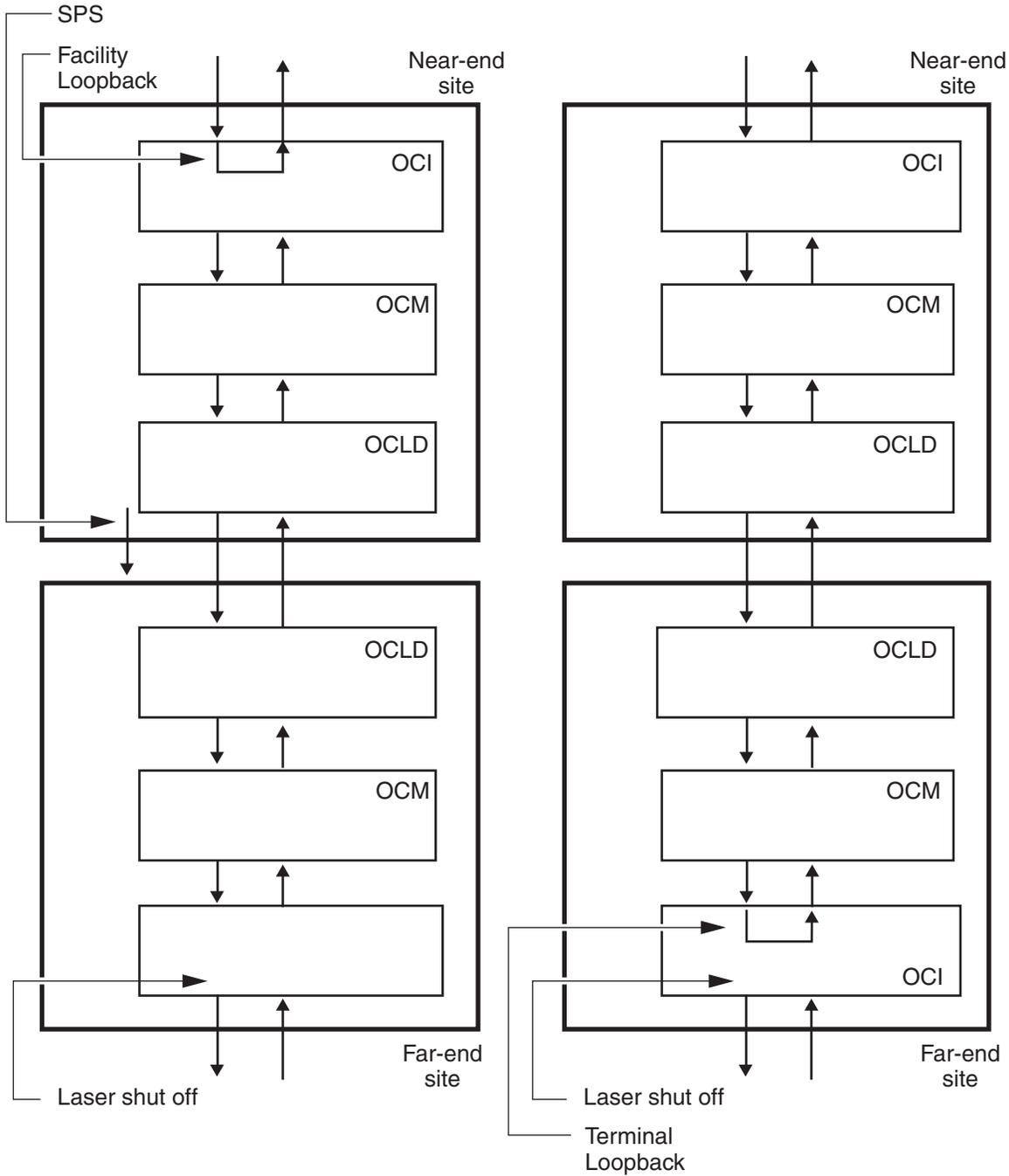
- OCI SRM GbE and OCI SRM GbE/FC circuit packs with GFP Conditioning set to Enabled, see [Figure 5-29 on page 5-61](#)

Note: The OCI SRM GbE 1310 nm/850 nm does not support FC client signals. In [Figure 5-29](#), 8B10B error codes for FC client signals are not sent out on the client port.

- OCI SRM SONET/SDH LTE circuit packs, see [Figure 5-30 on page 5-62](#)
- OCI SRM 1310 nm, OCI SRM 1310 nm LC, and OCI SRM SONET/SDH circuit packs, see [Figure 5-31 on page 5-63](#)

Note: The OCI SRM 1310 nm, the OCI SRM 1310 nm LC and the OCI SRM SONET/SDH circuit packs only support terminal loopback on all ports simultaneously. Per port terminal loopback is not supported on these circuit packs.

Figure 5-26
OCI loopbacks



Legend

SPS = Surrogate Payload

Figure 5-27
OCI SRM ESCON loopbacks

OM2329

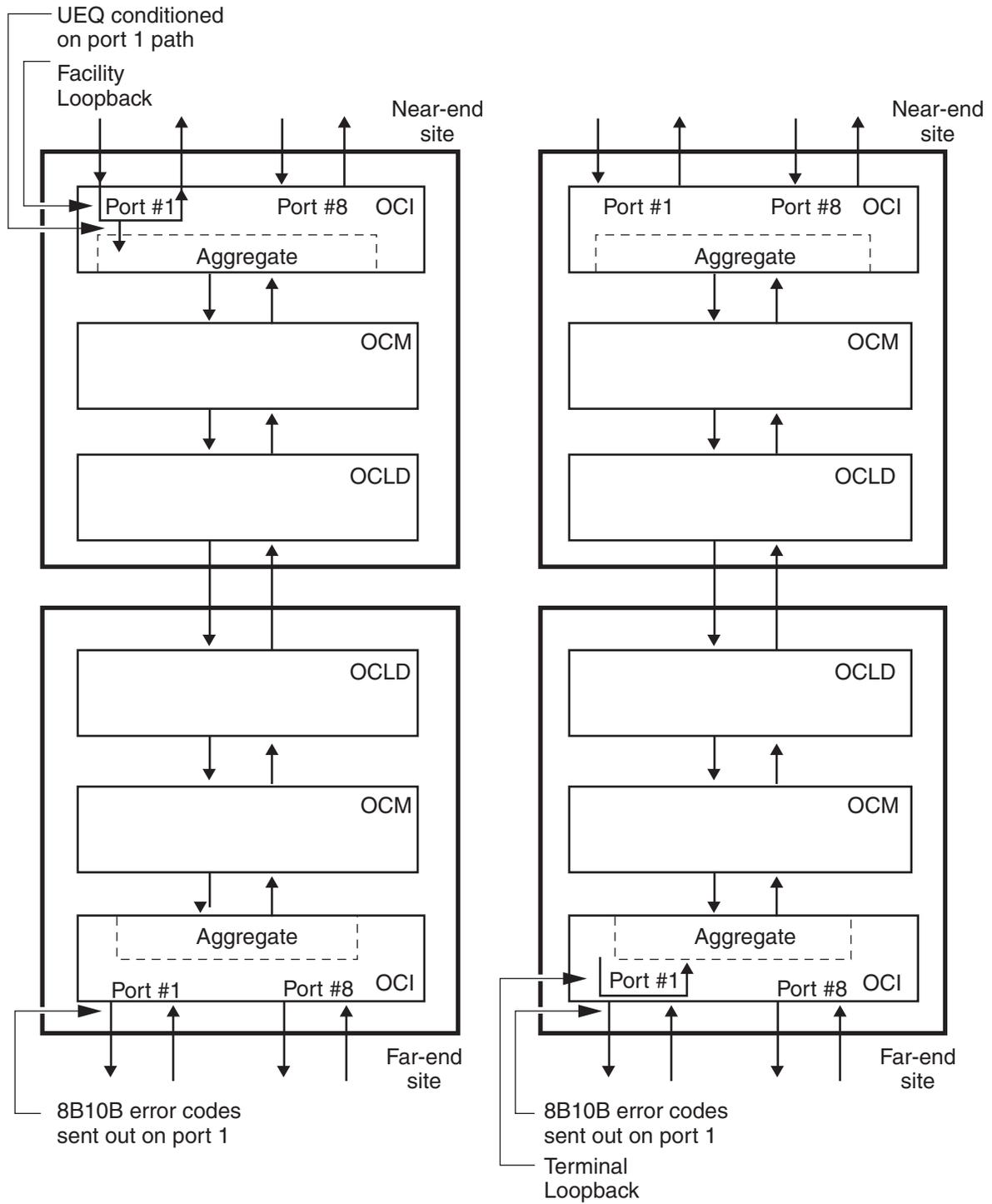


Figure 5-28
OCI SRM GbE and OCI SRM GbE/FC loopbacks with GFP conditioning set to Disabled

OM2330

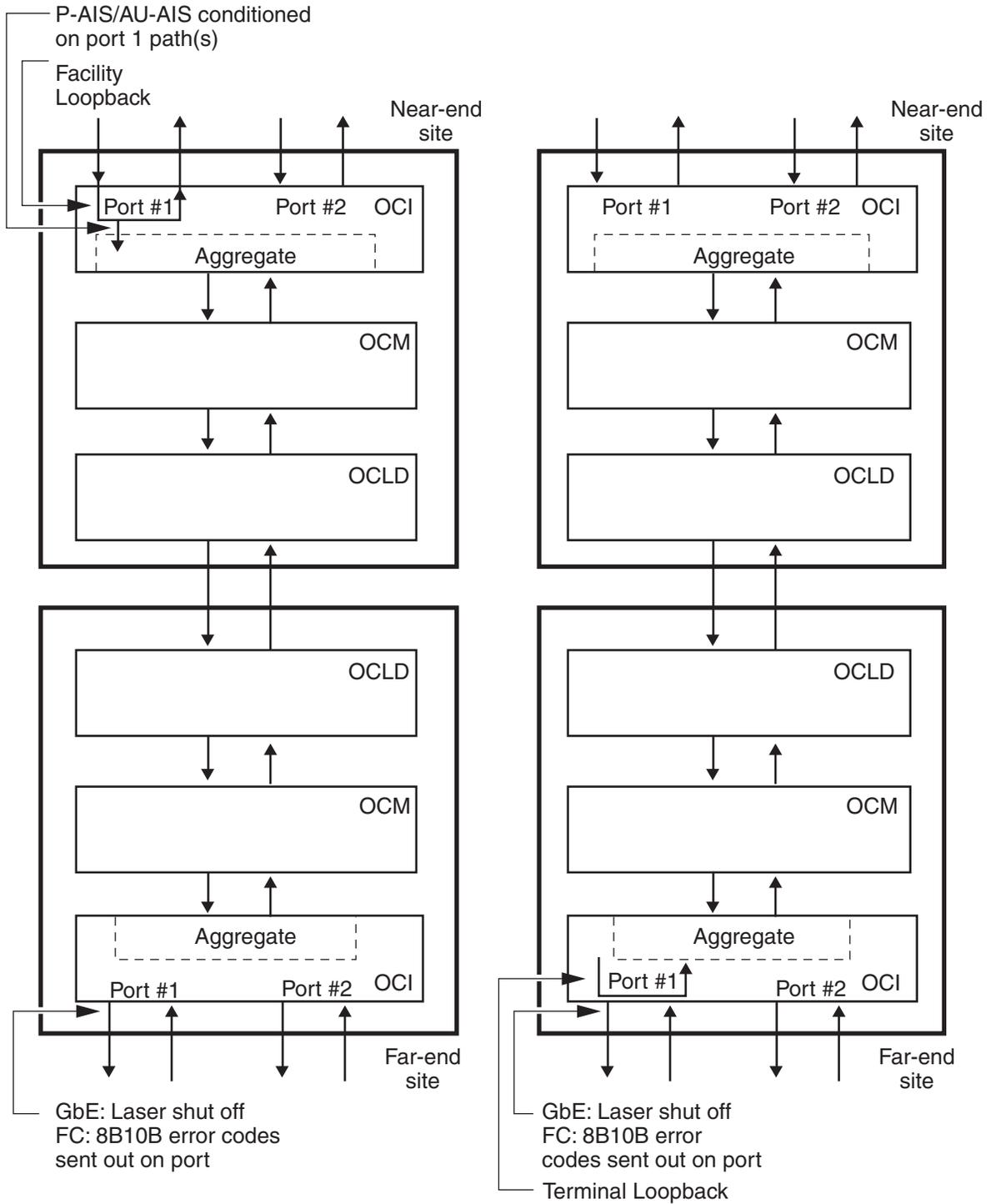


Figure 5-29
OCI SRM GbE and OCI SRM GbE/FC loopbacks with GFP conditioning set to Enabled

OM2331

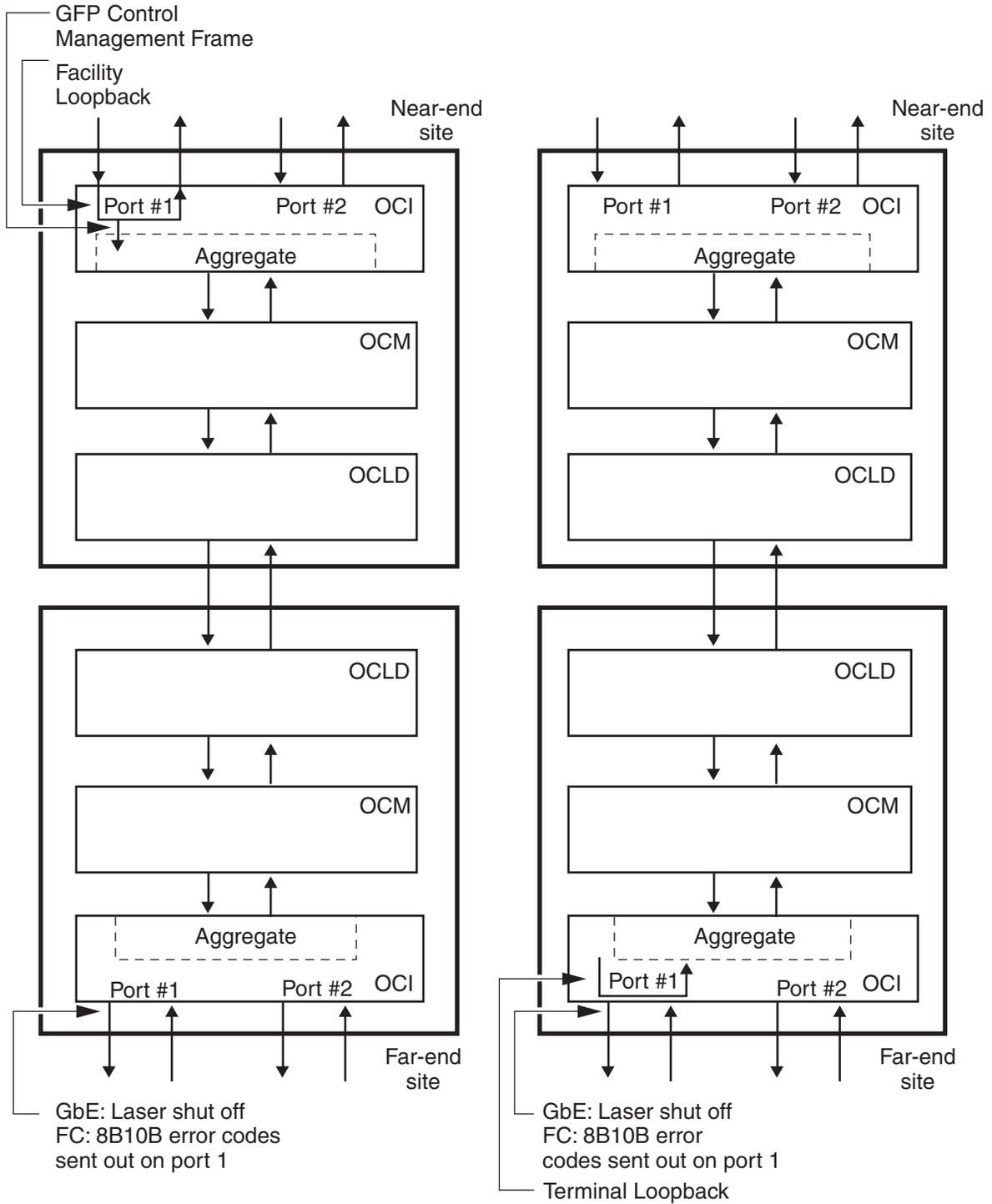


Figure 5-30
OCI SRM SONET/SDH LTE loopbacks

OM2332

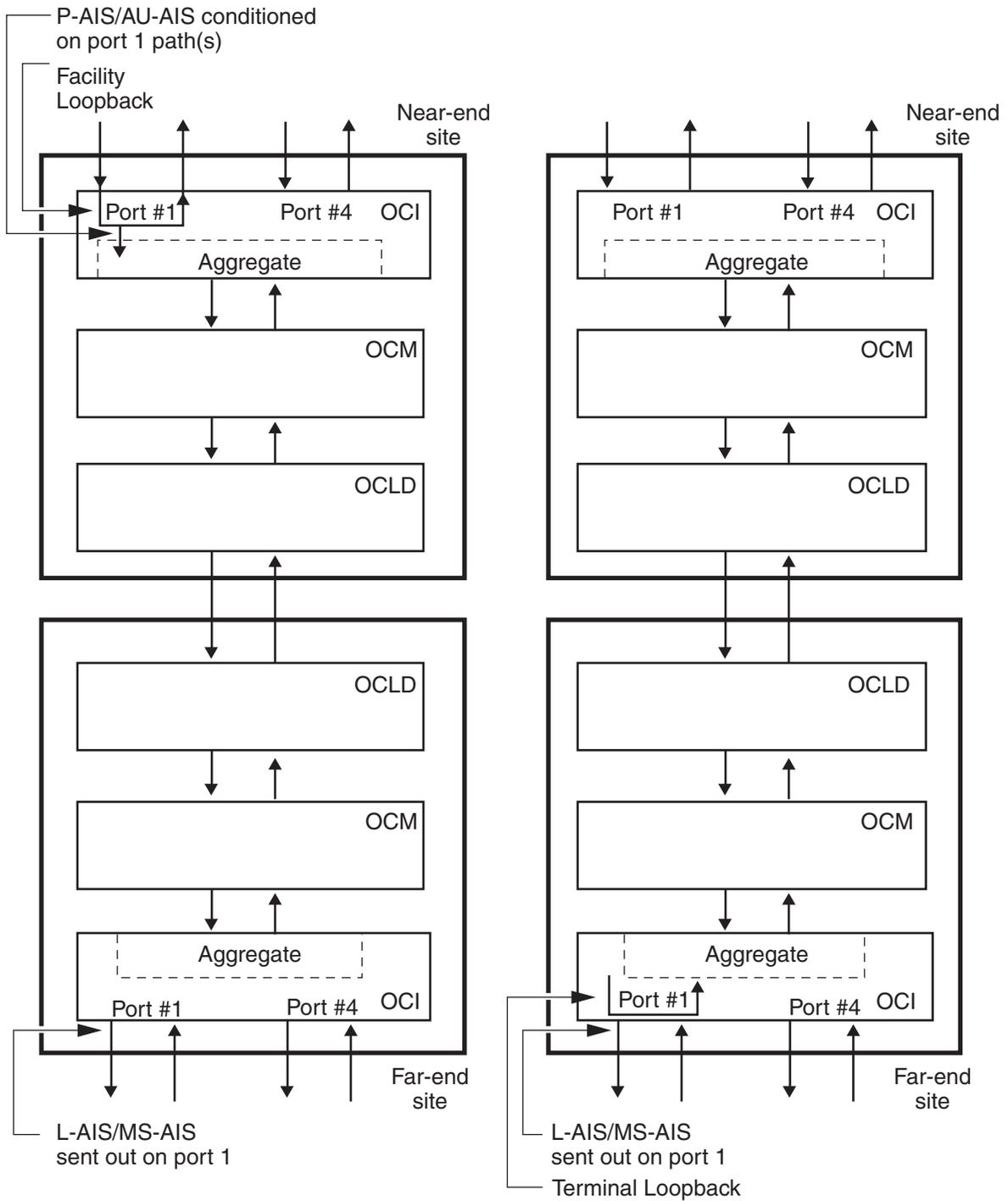
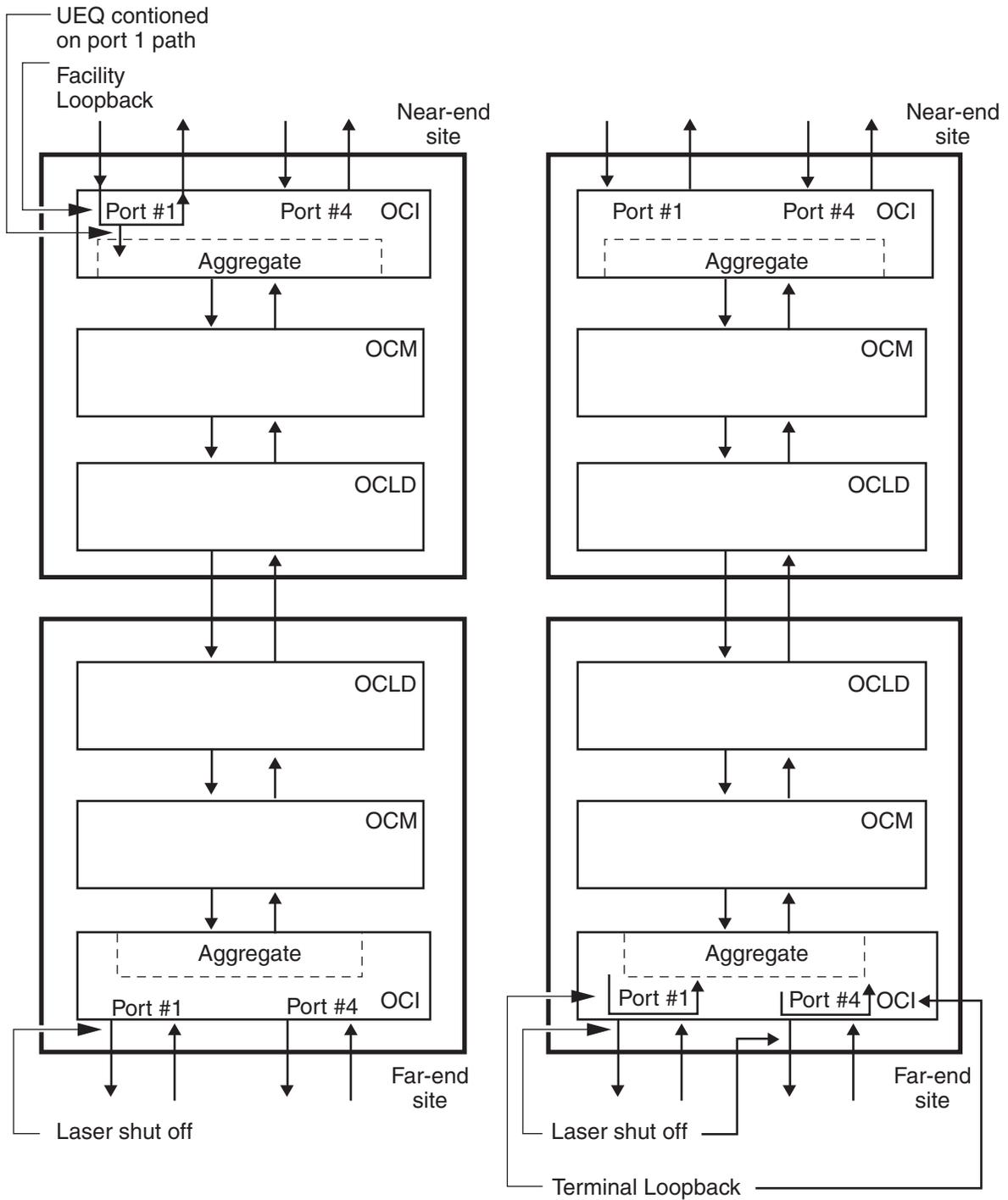


Figure 5-31
OCI SRM 1310 nm, OCI SRM 1310 nm LC, and OCI SRM SONET/SDH loopbacks

OM2333



Cables and optical patch cords

For information on cables and optical patch cords, refer to [“Cables and optical patch cords”](#) on [page 21-1](#).

Location

For slot assignments and equipping rules, refer to the [“Site requirements and equipping rules”](#) chapter in *Network Planning and Link Engineering*, 323-1701-110.

Product engineering codes

For a list of the product engineering codes (PEC), refer to [“Optical Metro 5100/5200 ordering information”](#) of *Network Planning and Link Engineering*, 323-1701-110.

OCLD circuit packs

In this chapter

This chapter includes the following sections:

- [Function and features on page 6-1](#)
- [Signal flow on page 6-5](#)
- [Faceplates on page 6-5](#)
- [Indicator lamps on page 6-8](#)
- [Loopbacks on page 6-8](#)
- [Cables and optical patch cords on page 6-10](#)
- [Location on page 6-10](#)
- [Product engineering codes on page 6-10](#)

Function and features

The Optical Channel Laser and Detector (OCLD) circuit pack is available to interface to the line side of an Optical Metro 5100/5200 network. OCLD circuit packs always interface to a single wavelength on the line side. One of these circuit packs is always found at each of the two endpoints of an optical channel although more may be at intermediate points along the optical channel.

The OCLD circuit pack performs electrical-to-optical and optical-to-electrical conversions on a per-channel basis. The OCLD passes electrical signals to and receives electrical signals from the OCI circuit pack directly in the Optical Metro 5100, and indirectly through the OCM circuit pack in the Optical Metro 5200. The bit rate received by the OCI circuit pack is not altered by the OCLD. There is no bit stuffing or overhead addition performed by the OCLD circuit pack.

Several OCLD circuit pack types are available (see [Table 6-1 on page 6-3](#)). The OCLD 2.5 Gbit/s Flex family supports 200 GHz DWDM, 100 GHz DWDM, ITU CWDM and CWDM applications. For 200 GHz DWDM, it uses three different circuit pack types to support normal, extended reach and extended metro applications. The OCLD 2.5 Gbit/s Universal family supports

one circuit pack type that can be used in all three applications. The OCLD 2.5 Gbit/s Universal family circuit packs do not support 100 GHz DWDM, ITU CWDM, and CWDM applications.

For a list of features available on the various OCLD types, see [Table 6-2 on page 6-4](#).

Channel assignments between OCI and OCLD circuit packs establish the signal flow between the client side signal and the line side wavelength at the end points of an optical channel. These channel assignments map the client signal onto a specific wavelength.

Channel assignments between OCLD circuit packs at intermediate points along the optical channel are used if the signal-carrying wavelength requires regeneration. Establishing a signal flow from one OCLD to another forces an electrical pass-through at a shelf. Both OCLDs have the same OSID (Optical System Identifier) value.

Channel assignments between OCLDs are also used to bridge a signal from one Optical Metro 5100/5200 system to another. In this case, the two OCLDs have different OSID (Optical System Identifier) values.

OCLD circuit packs provide a per-wavelength data communication channel or optical supervisory channel (PWOSC). The data communication channel terminates everywhere the wavelength itself terminates and passes through everywhere the wavelength itself passes through. The OCLD circuit pack data communication channel operates at 128 kilobits per second. The PWOSC is superimposed on the payload signal using DPSK modulation. For all OCLD types except OCLD 2.5 Gbit/s Universal, when the PWOSC is disabled on a circuit pack using System Manager or TL1, PPP (Point-to-Point Protocol) is disabled on that circuit pack and, as a result, no data communications traffic is sent over it. The DPSK modulation is not disabled when the PWOSC is disabled. For the OCLD 2.5 Gbit/s Universal circuit pack type, the DPSK modulation is disabled when the PWOSC is disabled.

DWDM OCLD circuit packs are identified by wavelength band (BAND 1 to BAND 8) and by channel within the wavelength band (CH1 to CH4) on the circuit pack faceplate. CWDM OCLD circuit packs are identified by Band on the circuit pack faceplate. ITU CWDM OCLD circuit packs are identified by Wavelength on the circuit pack faceplate. 100 GHz OCLD circuit packs are identified by wavelength group (Group 1 to Group 9) and by channel within the wavelength group (CH1 to CH4) on the circuit pack faceplate as well as a DWDM 100 GHz label. The wavelengths of the Common Photonic Layer 100 GHz wavelength plan are divided into nine groups of four channels that have corresponding band and channel assignments on Optical Metro 5100/5200.

Note: OCLD 2.5 Gbit/s Flex 100 GHz circuit packs cannot be connected to Optical Metro 5100/5200 OMXs, only to Common Photonic Layer equipment.

For the compatibility matrix with OCI and OCM circuit packs, refer to [Figure 5-2 on page 5-17](#).

For the compatibility matrix between OCLD types and other line side circuit packs, refer to *Technical Specifications*, 323-1701-180.

Table 6-1
OCLD circuit pack types

OCLD family	Circuit pack type	Bit rate	Spacing	Reach
OCLD 1.25 Gbit/s	OCLD 1.25 Gbit/s	Variable 16 Mbit/s - 1.25 Gbit/s	DWDM - 200 GHz 32 wavelengths - 16 in C-band and 16 in L-band	110 km
	OCLD 1.25 Gbit/s Extended Reach		175 km	
	OCLD 1.25 Gbit/s CWDM		CWDM - 800 GHz 8 wavelengths	80 km
OCLD 2.5 Gbit/s	OCLD 2.5 Gbit/s	Fixed 2.48832 Gbit/s	DWDM - 200 GHz 32 wavelengths - 16 in C-band and 16 in L-band	110 km
	OCLD 2.5 Gbit/s Extended Reach		175 km	
	OCLD 2.5 Gbit/s CWDM		CWDM - 800 GHz 8 wavelengths	80 km
OCLD 2.5 Gbit/s Flex	OCLD 2.5 Gbit/s Flex	Variable 16 Mbit/s - 2.48832 Gbit/s	DWDM - 200 GHz 32 wavelengths - 16 in C-band and 16 in L-band	110 km
	OCLD 2.5 Gbit/s Flex Extended Reach		DWDM - 200 GHz 32 wavelengths - 16 in C-band and 16 in L-band	175 km
	OCLD 2.5 Gbit/s Flex Extended Metro		DWDM - 200 GHz 32 wavelengths - 16 in C-band and 16 in L-band	350 km (C-band) 200 km (L-band)
	OCLD 2.5 Gbit/s Flex 100 GHz		DWDM - 100 GHz 36 C-band wavelengths	200 km
	OCLD 2.5 Gbit/s Flex CWDM		CWDM - 800 GHz	80 km
	OCLD 2.5 Gbit/s Flex ITU CWDM		ITU CWDM - 800 GHz	80 km
OCLD 2.5 Gbit/s Universal	OCLD 2.5 Gbit/s Universal	Variable 16 Mbit/s - 2.48832 Gbit/s	DWDM - 200 GHz 32 wavelengths - 16 in C-band and 16 in L-band	350 km (C-band) 200 km (L-band)

6-4 OCLD circuit packs

Table 6-2
OCLD circuit pack features

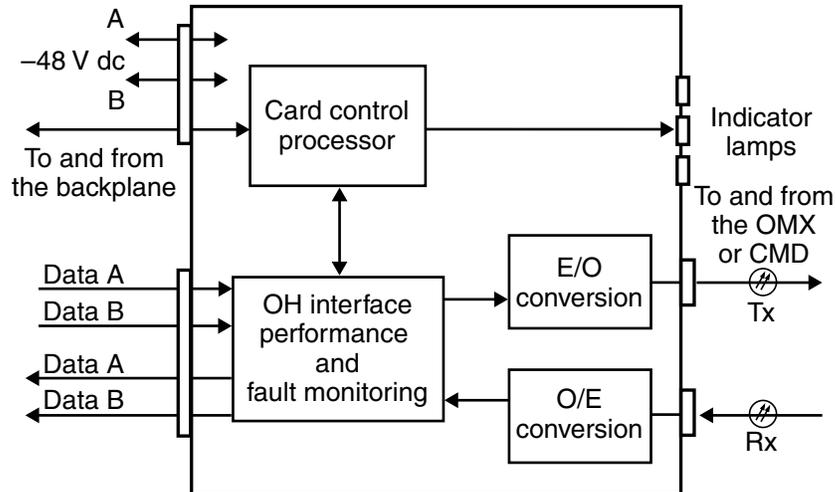
Feature	OCLD 1.25 Gbit/s OCLD 2.5 Gbit/s	OCLD 2.5 Gbit/s Flex	OCLD 2.5 Gbit/s Universal
1 slot width	√	√	√
SC connectors (Tx and Rx)	√	Not supported	Not supported
LC connectors (Tx and Rx)	Not supported	√	√
Facility and terminal loopbacks	√	√	√
Optical power monitoring and TCAs on the TX and Rx interfaces	√	√	√
Automatic Laser Shutdown (ALS)	√	√ (See Note)	√
Tx/Rx Section SONET/SDH and 8B10B Performance Monitoring	Not supported	√	√
SONET/SDH AIS and RDI alarming	Not supported	√	√
Note: The ALS feature on the OCLD 2.5 Gbit/s Flex 100 GHz circuit pack is disabled			

Signal flow

Figure 6-1 shows the signal flow through the OCLD circuit pack.

Figure 6-1
OCLD signal flow

OM00071



Faceplates

Figure 6-2 shows a OCLD 1.25 Gbit/s circuit pack, Figure 6-3 shows a OCLD 2.5 Gbit/s circuit pack, and Figure 6-4 shows a OCLD 2.5 Gbit/s Flex circuit pack. Figure 6-5 shows a OCLD 2.5 Gbit/s Universal circuit pack.

Note: Seat circuit packs horizontally in the Optical Metro 5100 shelf, with LED lamps to the left.

Figure 6-2
Faceplate of a OCLD 1.25 Gbit/s circuit pack

OM0008s

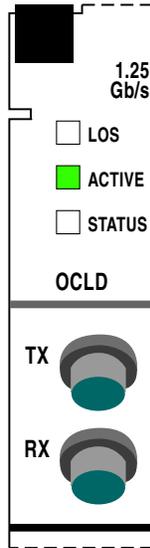


Figure 6-3
Faceplate of an OCLD 2.5 Gbit/s circuit pack

OM1325t

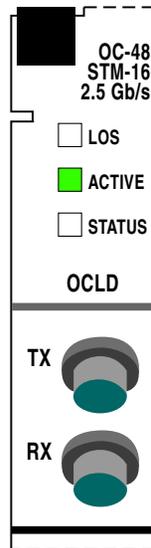


Figure 6-4
Faceplate of an OCLD 2.5 Gbit/s Flex circuit pack

OM1326t

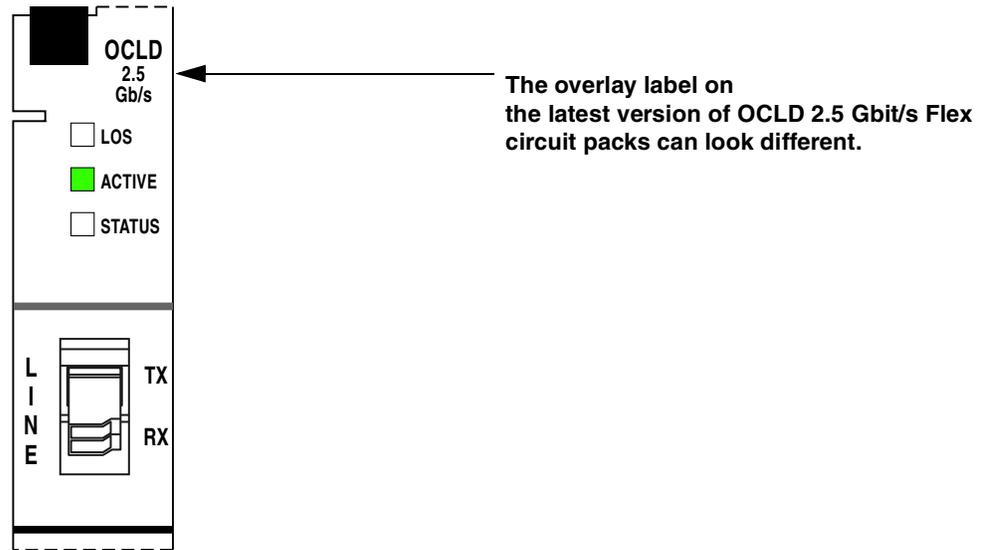


Figure 6-5
Faceplate of an OCLD 2.5 Gbit/s Universal circuit pack

OM2811t.jpg



Indicator lamps

OCLD circuit packs have the following lamps on the faceplate:

- LOS
- ACTIVE
- STATUS

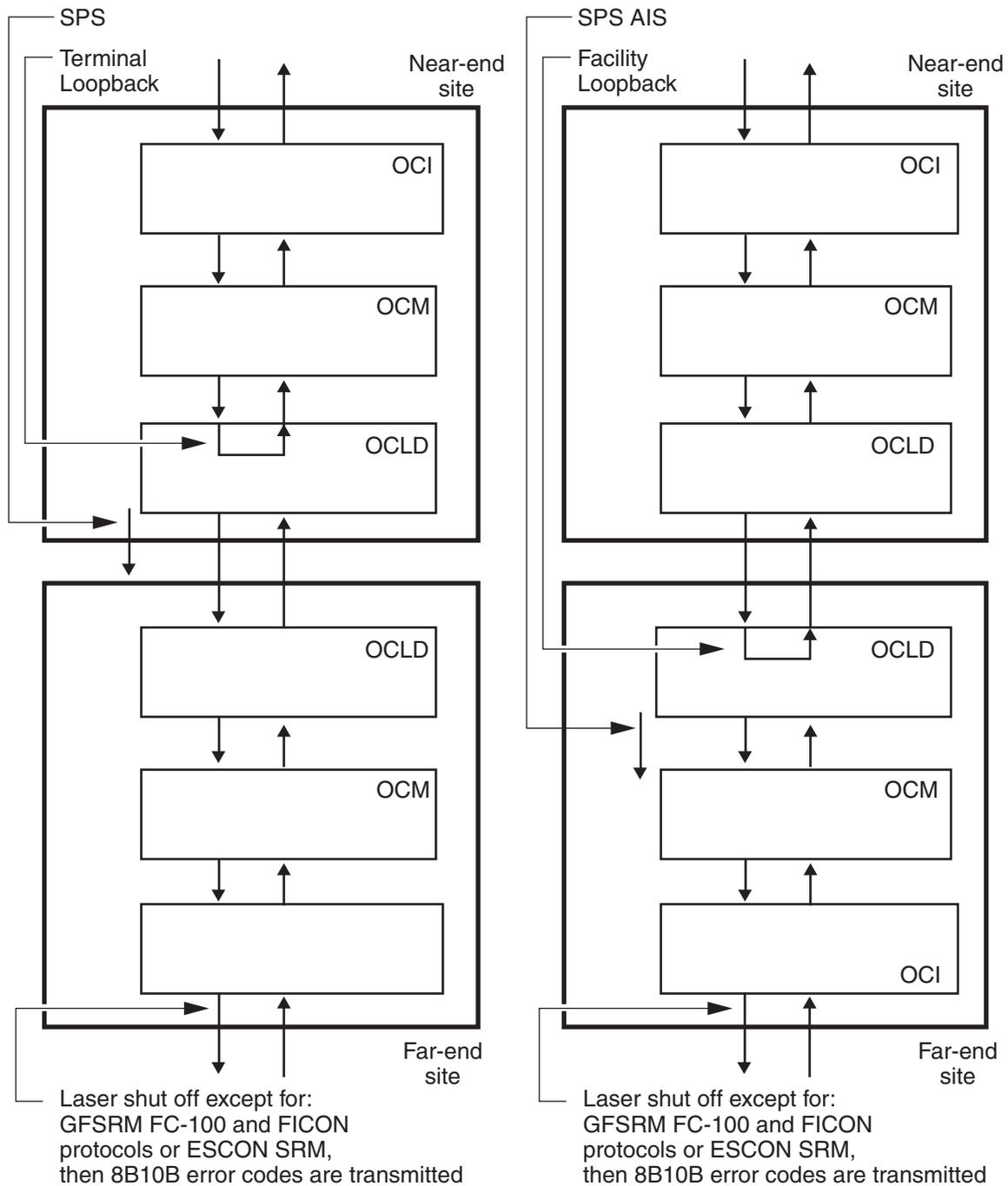
For indicator lamp functionality, see [Table 4-7 on page 4-19](#).

Loopbacks

See [Figure 6-6](#) for an example of loopbacks on an OCLD circuit pack.

Figure 6-6
OCLD loopbacks

OM2334



Legend

SPS = Surrogate Payload

Cables and optical patch cords

For information on cables and optical patch cords, refer to “[Cables and optical patch cords](#)” on [page 21-1](#).

Location

For slot assignments and equipping rules, refer to the “[Site requirements and equipping rules](#)” chapter in *Network Planning and Link Engineering*, 323-1701-110.

Product engineering codes

For a list of the product engineering codes (PEC), refer to “[Optical Metro 5100/5200 ordering information](#)” of *Network Planning and Link Engineering*, 323-1701-110.

OTR circuit packs

In this chapter

This chapter includes the following:

- [Function and features on page 7-1](#)
- [Signal flow on page 7-10](#)
- [Faceplates on page 7-11](#)
- [Indicator lamps on page 7-14](#)
- [Loopbacks on page 7-14](#)
- [Cables and optical patch cords on page 7-19](#)
- [Location on page 7-19](#)
- [Product engineering codes on page 7-19](#)

Function and features

The Optical Transponder (OTR) circuit pack is available to interface to the line side of an Optical Metro 5100/5200 network. OTR circuit packs always interface to a single wavelength on the line side. One of these circuit packs is always found at each of the two endpoints of an optical channel.

The OTR circuit packs appear both as a client side interface circuit pack and a line side interface circuit pack. These circuit packs provide both these interfaces by mapping directly from the client interface onto a wavelength.

OTR 2.5 Gbit/s circuit packs

The OTR 2.5 Gbit/s is a one-slot circuit pack that combines the functions of an OCI and an OCLD into a single circuit pack. This circuit pack acts as an on-ramp, off-ramp circuit pack for client equipment onto the line side of an Optical Metro 5100/5200 network without passing through an OCM.

Note: OCM circuit packs are required in Optical Metro 5200 shelves populated with the OTR 2.5 Gbit/s circuit pack to maintain the shelf database in non-volatile memory and to terminate the inter-card Supervisory Bus (SBUS) communications through the backplane. SBUS is

responsible for sending the status of a particular circuit pack and the status of the incoming and outgoing signals of the circuit pack to other circuit packs in the Optical Metro 5200 network.

The bit rate received from the client equipment is not altered by the OTR 2.5 Gbit/s. No bit stuffing or overhead addition is performed by the OTR 2.5 Gbit/s circuit pack. The OTR 2.5 Gbit/s is capable of supporting the same protocols and same line side link engineering as the OCLD 2.5 Gbit/s Flex/Universal circuit packs.

Several OTR 2.5 Gbit/s circuit pack types are available (see [Table 7-1 on page 7-4](#)). The OTR 2.5 Gbit/s Flex family supports 200 GHz DWDM, 100 GHz DWDM, ITU CWDM and CWDM applications. For 200 GHz DWDM, it uses three different circuit pack types to support normal, extended reach and extended metro applications. The OTR 2.5 Gbit/s Universal family supports one circuit pack type that can be used in all three applications. The OTR 2.5 Gbit/s Universal family circuit packs do not support 100 GHz DWDM, ITU CWDM, and CWDM applications.

For a list of features available on the various OTR 2.5 Gbit/s types, see [Table 7-2 on page 7-5](#).

Channel assignments provisioned on OTR 2.5 Gbit/s circuit packs establish the signal flow between the client side signal and the line side wavelength at the end points of an optical channel. These channel assignments map the client signal onto a specific wavelength. The association between the circuit packs at intermediate points along the optical channel for signal regeneration or for bridging networks is established using OCLD 2.5 Gbit/s Flex/Universal circuit packs.

OTR 2.5 Gbit/s circuit packs provide a per-wavelength data communication channel or optical supervisory channel (PWOSC). The data communication channel terminates everywhere the wavelength itself terminates and passes through everywhere the wavelength itself passes through. The OTR 2.5 Gbit/s circuit pack data communication channel operates at 128 kilobits per second. The PWOSC is superimposed on the payload signal using DPSK modulation. For all OTR 2.5 Gbit/s types except OTR 2.5 Gbit/s Universal, when the PWOSC is disabled on a circuit pack using System Manager or TL1, PPP (Point-to-Point Protocol) is disabled on that circuit pack and as a result, no data communications traffic is sent over it. The DPSK modulation is not disabled when the PWOSC is disabled. For the OTR 2.5 Gbit/s Universal circuit pack type, the DPSK modulation is disabled when the PWOSC is disabled.

DWDM OTR 2.5 Gbit/s circuit packs are identified by wavelength band (BAND 1 to BAND 8) and by channel within the wavelength band (CH1 to CH4) on the circuit pack faceplate. CWDM OTR 2.5 Gbit/s circuit packs are identified by Band on the circuit pack faceplate. ITU CWDM OTR 2.5 Gbit/s

circuit packs are identified by Wavelength on the circuit pack faceplate. 100 GHz OTR 2.5 Gbit/s circuit packs are identified by wavelength group (Group 1 to Group 9) and by channel within the wavelength group (CH1 to CH4) on the circuit pack faceplate as well as a DWDM 100 GHz label. The wavelengths of the Common Photonic Layer 100 GHz wavelength plan are divided in nine groups of four channels that have corresponding band and channel assignments on Optical Metro 5100/5200.

Note: OTR 2.5 Gbit/s 100 GHz circuit packs cannot be connected to Optical Metro 5100/5200 OMXs, only to Common Photonic Layer equipment.

For the compatibility matrix between OTR 2.5 Gbit/s types and other line side circuit packs, refer to *Technical Specifications*, 323-1701-180.

7-4 OTR circuit packs

Table 7-1
OTR 2.5 Gbit/s circuit pack types

OTR 2.5 Gbit/s family	Circuit pack type	Client and Line bit rate	Spacing	Reach
OTR 2.5 Gbit/s Flex	OTR 2.5 Gbit/s Flex 1310 nm	Variable 622.08 - 2488.32 Mbit/s	DWDM - 200 GHz 32 wavelengths - 16 in C-band and 16 in L-band	110 km
	OTR 2.5 Gbit/s Flex 850 nm	Variable 1.0625 - 2.125 Gbit/s		
	OTR 2.5 Gbit/s Flex Extended Reach 1310 nm	Variable 622.08 - 2488.32 Mbit/s	DWDM - 200 GHz 32 wavelengths - 16 in C-band and 16 in L-band	175 km
	OTR 2.5 Gbit/s Flex Extended Reach 850 nm	Variable 1.0625 - 2.125 Gbit/s		
	OTR 2.5 Gbit/s Flex Extended Metro 1310 nm	Variable 622.08 - 2488.32 Mbit/s	DWDM - 200 GHz 32 wavelengths - 16 in C-band and 16 in L-band	350 km (C-band) 200 km (L-band)
	OTR 2.5 Gbit/s Flex Extended Metro 850 nm	Variable 1.0625 - 2.125 Gbit/s		
	OTR 2.5 Gbit/s Flex 100 GHz 1310 nm	Variable 155.52 - 2488.32 Mbit/s	DWDM - 100 GHz 36 C-band wavelengths	200 km
	OTR 2.5 Gbit/s Flex 100 GHz 850 nm	Variable 1.0625 - 2.125 Gbit/s		
	OTR 2.5 Gbit/s Flex CWDM 1310 nm	Variable 622.08 - 2488.32 Mbit/s	CWDM - 800 GHz	80 km
	OTR 2.5 Gbit/s Flex CWDM 850 nm	Variable 1.0625 - 2.125 Gbit/s		
	OTR 2.5 Gbit/s Flex ITU CWDM 1310 nm	Variable 155.52 - 2488.32 Mbit/s	ITU CWDM - 800 GHz	80 km
	OTR 2.5 Gbit/s Flex ITU CWDM 850 nm	Variable 1.0625 - 2.125 Gbit/s		
OTR 2.5 Gbit/s Universal	OTR 2.5 Gbit/s Universal 1310 nm	Variable 155.52 - 2488.32 Mbit/s	DWDM - 200 GHz 32 wavelengths - 16 in C-band and 16 in L-band	350 km (C-band) 200 km (L-band)
	OTR 2.5 Gbit/s Universal 850 nm	Variable 1.0625 - 2.125 Gbit/s		

Table 7-2
OTR 2.5 Gbit/s features

Feature	OTR 2.5 Gbit/s Flex	OTR 2.5 Gbit/s Universal
1 slot width	√	√
LC connectors (Tx and Rx on line side and Tx and Rx on client side)	√	√
Facility loopbacks on the client side and line side interfaces	√	√
Optical power monitoring and TCAs on the TX and Rx interfaces of the client side and line side interfaces	√	√
Automatic Laser Shutdown (ALS)	√ (See Note)	√
Tx/Rx Section SONET/SDH and 8B10B Performance Monitoring on the client side interface	√	√
SONET/SDH AIS and RDI alarming on the client side interface	√	√
Fully transparent with respect to SONET/SDH overhead bytes. That is, the circuit pack does not overwrite, regenerate or change any of the SONET/SDH overhead bytes. Some bytes are used (A1, A2, and B1 bytes) for monitoring purposes.	√	√
Note: The ALS feature on the OTR 2.5 Gbit/s Flex 100 GHz circuit pack is disabled.		

OTR 10 Gbit/s circuit packs

The OTR 10 Gbit/s is a two-slot circuit pack. This circuit pack acts as an on-ramp, off-ramp circuit pack for client equipment onto the line side of an Optical Metro 5100/5200 network without passing through an OCM.

Note: OCM circuit packs are required in Optical Metro 5200 shelves populated with the OTR 10 Gbit/s circuit pack to maintain the shelf database in non-volatile memory and to terminate the inter-card Supervisory Bus (SBUS) communications through the backplane. SBUS is responsible for sending the status of a particular circuit pack and the status of the incoming and outgoing signals of the circuit pack to other circuit packs in the Optical Metro 5200 network.

The bit rate received from the client equipment is altered by the OTR 10 Gbit/s since the client equipment signal is digitally wrapped into a G.709 signal.

For the OTR 10 Gbit/s family, the Digital Wrapper efficiently interfaces wrapper data domain to client data domain by providing synchronous payload mapping and de-mapping functions according to ITU G.709 March 2000 draft. The FEC implementation is fully G.709 compliant RS(255, 239) code. Only the line side is forward error correction (FEC) protected.

For the OTR 10 Gbit/s Enhanced family, the Digital Wrapper has the following capabilities:

- efficiently interfaces wrapper data domain to client data domain by providing synchronous payload mapping and de-mapping functions according to ITU G.709 March 2003 for the OC-192, STM-64, 10 GbE WAN PHY and 10G Clear Channel protocols
- bit rate of 10.709225316 Gbit/s (7% wrapped) for the OC-192, STM-64, 10 GbE WAN PHY and 10G Clear Channel protocols and 10.733 Gbit/s (4% proprietarily wrapped) for the 10 GbE LAN PHY protocol.
- Reed-Solomon (255, 239) FEC as defined in G.709 for the OC-192, STM-64, 10 GbE WAN PHY and 10G Clear Channel protocols
- Proprietary Concatenated Enhanced FEC supported for the 10 GbE LAN PHY protocol. The enhanced FEC uses 4% FEC Overhead (the G.709 FEC uses 7% FEC OH). This design allows a 10GE LAN signal (10.32 Gbit/s) to be digitally wrapped at almost the same line bit rate as the WAN mode (about 10.7 Gbit/s) bit rate, instead of having 11.1 Gbit/s if 7% were used. The enhanced FEC is better at dealing with random errors but also has acceptable burst error correction: up to 264 bit errors through byte interleaving. The enhanced FEC also has very good coding gain (2.9dBQ): performance similar to the G.709 FEC is achieved using only 4% FEC OH, which permits similar link engineering for both LAN and SONET/SDH/WAN modes.

The OTR 10 Gbit/s Enhanced family of circuit packs supports the following OTN (Optical Transport Network) functionality:

- supports OTU-2 framing. Client signals are mapped as follows:
 - Client-signal -> OPU-2 -> ODU-2 -> OTU-2
 - supports the insertion of client payload type within the OPU-2 Payload Type (PT) byte (PSI[0]) of the Payload Structure Identifier (PSI)
 - for SONET/SDH/WAN/Clear Channel, payload type mapping is set to “Bit Synchronous STM-N mapping (0x03)”. For LAN PHY signal, the payload type is set to “Experimental (0x01)”.
- supports OTN PMs / Fault monitoring:
 - supports monitoring of OTU-2 BIP-8, OTU-2 BDI and ODU-2 AIS
- supports OTN signal conditioning:
 - supports the insertion of OTU-2 BDI and ODU-2 AIS conditioning signals
- supports OTN communications:
 - supports GCC0 for overhead communications channel between the line-side interface of OTR 10 Gbit/s Enhanced circuit packs

Several OTR 10 Gbit/s circuit pack types are available (see [Table 7-3 on page 7-8](#)).

For a list of features available on the various OTR 10 Gbit/s types, see [Table 7-4 on page 7-8](#).

Channel assignments provisioned on OTR 10 Gbit/s circuit packs establish the signal flow between the client side signal and the line side wavelength at the end points of an optical channel. These channel assignments map the client signal onto a specific wavelength. The association between the circuit packs at intermediate points along the optical channel for signal regeneration or for bridging networks is established via physical connection using OTR 10 Gbit/s Enhanced circuit packs.

The OTR 10 Gbit/s data communication channel operates at 1.3 Mbit/s using the GCC0 bytes of the digital wrapper signal.

DWDM OTR 10 Gbit/s circuit packs are identified by wavelength band (BAND 1 to BAND 8) and by channel within the wavelength band (CH1 to CH4) on the circuit pack faceplate. 100 GHz OTR 10 Gbit/s circuit packs are identified by wavelength group (Group 1 to Group 9) and by channel within the wavelength group (CH1 to CH4) on the circuit pack faceplate as well as a DWDM 100 GHz label. The wavelengths of the Common Photonic Layer 100 GHz wavelength plan are divided into nine groups of four channels that have corresponding band and channel assignments on Optical Metro 5100/5200.

7-8 OTR circuit packs

Note: OTR 10 Gbit/s 100 GHz circuit packs cannot be connected to Optical Metro 5100/5200 OMXs, only to Common Photonic Layer equipment.

For the compatibility matrix between OTR 10 Gbit/s types and other line side circuit packs, refer to Technical Specifications, 323-1701-180.

**Table 7-3
OTR 10 Gbit/s circuit pack types**

OTR 10 Gbit/s family	Circuit pack type	Client bit rate		Line bit rate		Spacing	Reach
		Min.	Max.	Min.	Max.		
OTR 10 Gbit/s	OTR 10 Gbit/s	9.95328 Gbit/s	9.95328 Gbit/s	10.6642 Gbit/s	10.6642 Gbit/s	DWDM - 200 GHz 16 wavelengths in C-band	60 km
OTR 10 Gbit/s Enhanced	OTR 10 Gbit/s Enhanced	9.95328 Gbit/s	10.3125 Gbit/s	10.709225 Gbit/s	10.733408 Gbit/s	DWDM - 200 GHz 32 wavelengths - 16 in C-band and 16 in L-band	110 km
	OTR 10 Gbit/s Enhanced 100 GHz	9.95328 Gbit/s	10.3125 Gbit/s	10.709225 Gbit/s	10.733408 Gbit/s	DWDM - 100 GHz 36 C-band wavelengths	

**Table 7-4
OTR 10 Gbit/s circuit pack features**

Feature	OTR 10 Gbit/s	OTR 10 Gbit/s Enhanced
2 slot width	√	√
LC connectors (Tx and Rx on line side and Tx and Rx on client side)	√	√
3R operation (re-shape, re-amplify, and re-time), in which the clock from all incoming data is recovered and the data to the recovered clock is re-timed to reduce jitter	√	√
Client side protocol support	OC-192, STM-64, 10G Clear Channel, 10 GbE WAN PHY	OC-192, STM-64, 10G Clear Channel, 10 GbE WAN PHY, 10 GbE LAN PHY
Facility loopbacks on the client side and line side interfaces	√	√
Optical power monitoring and TCAs on the TX and Rx interfaces of the client side and line side interfaces	√	√
Automatic Laser Shutdown (ALS)	√	√ (See Note)
Tx/Rx Section SONET/SDH on the client side interface	√	√
Rx Line SONET/SDH on the client side interface	Not supported	√
Ethernet PMs on the client side interface: — 64B66B (Rx direction): CV, ES, SES, UAS	Not supported	√

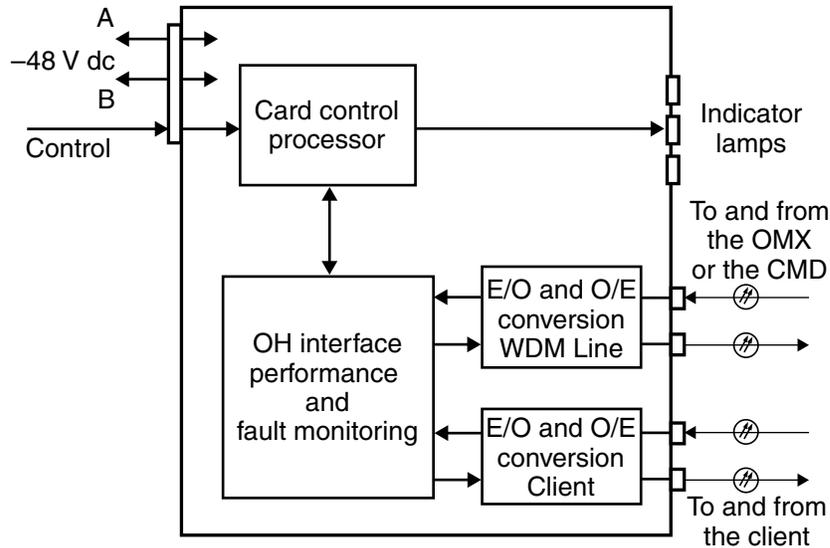
Table 7-4 (continued)
OTR 10 Gbit/s circuit pack features

Feature	OTR 10 Gbit/s	OTR 10 Gbit/s Enhanced
Ethernet Operation Measurements (OMs) on the client side interface: — InFrames — OutFrames — FCSError — FrameTooLong — FrameTooShort	Not supported	√
FEC PMs on the line side interface (Rx direction): — FEC-CE: number of corrected errors — FEC-UF: number of uncorrected frames	Not supported	√
Digital Wrapper PMs on the line side interface: — Section (Rx direction): CV, ES, and SES	Not supported	√
Digital Wrapper PMs on the line side interface: — Section (Rx direction): CV, ES, and SES	Not supported	√
SONET/SDH AIS and RDI alarming on the client side interface	√	√
Digital wrapper Alarm Indication Signal (AIS) injection and detection	√	√
In-band mixing with OCLD 2.5 Gbit/s, OCLD 2.5 Gbit/s Flex/Universal, OTR 2.5 Gbit/s Flex/Universal	Not supported	√
SONET/SDH/WAN client side interface signal conditioning (instead of laser shutdown) allowing for easier service connection and testing	Not supported	√
Fully transparent with respect to SONET/SDH overhead bytes. The circuit pack does not overwrite, regenerate or change any of the SONET/SDH overhead bytes. Some bytes are used (A1, A2, and B1 bytes) for monitoring purposes. For the OTR 10 Gbit/s Enhanced, the K2 byte is transported transparently except for 3 bits of K2 that are modified for conditioning of L-AIS (MS-AIS for SDH).	√	√
Note: The ALS feature on the OTR 10 Gbit/s Enhanced 100 GHz circuit pack is disabled.		

Signal flow

Figure 7-1 shows the signal flow through the OTR circuit pack.

Figure 7-1
OTR signal flow



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The OTR has two interfaces:

- line
- client

The line interface performs optical-to-electrical conversion on the incoming signals from the line and electrical-to-optical conversion on the signals from the client. The interface then sends the converted signals from the line to the client using the client interface and signals from the client to the line, respectively.

The client interface performs optical-to-electrical conversion on the incoming signals from the client and electrical-to-optical conversion on the signals from the line. The interface then sends the converted signals from the client to the line using the line interface and signals from the line to the client, respectively.

Faceplates

Figure 7-2 shows the faceplate of the OTR 10 Gbit/s.

Figure 7-2
Faceplate of the OTR 10 Gbit/s circuit pack

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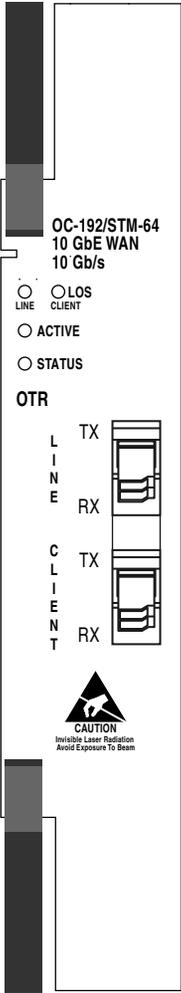


Figure 7-3 shows the faceplate of the OTR 10 Gbit/s Enhanced.

Figure 7-3
Faceplate of the OTR 10 Gbit/s Enhanced circuit pack

OM2324

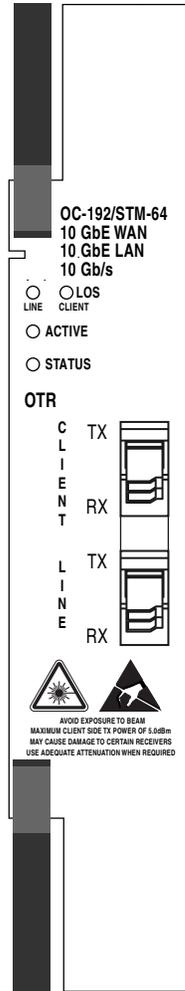


Figure 7-4 shows the faceplate of the OTR 2.5 Gbit/s Flex circuit pack.

Figure 7-4
Faceplate of the OTR 2.5 Gbit/s Flex circuit pack

OM1311t

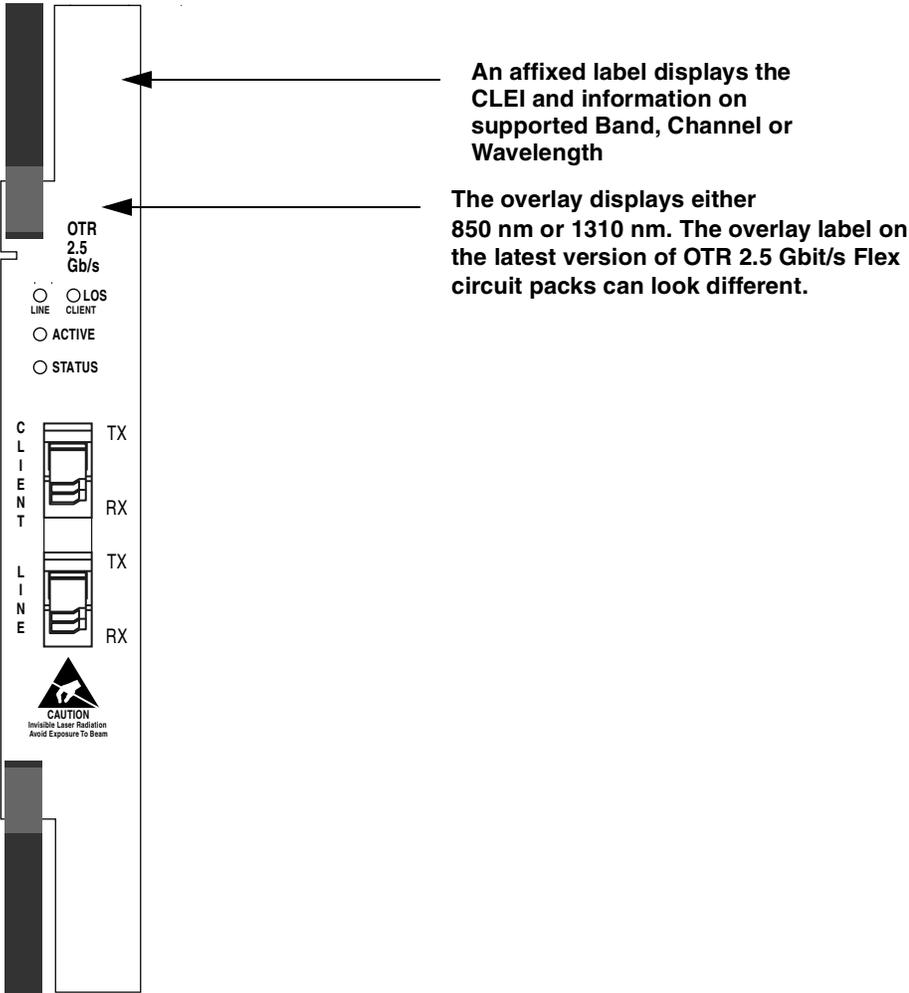


Figure 7-5 shows the faceplate of the OTR 2.5 Gbit/s Universal circuit pack.

Figure 7-5
OTR 2.5 Gbit/s Universal circuit pack

OM2810t.jpg



Indicator lamps

OTR circuit packs have the following lamps on the faceplate:

- two LOS lamps (one for the client-side port and one for the line-side port)
- one ACTIVE lamp
- one STATUS lamp

For indicator lamp functionality, see [Table 4-7 on page 4-19](#).

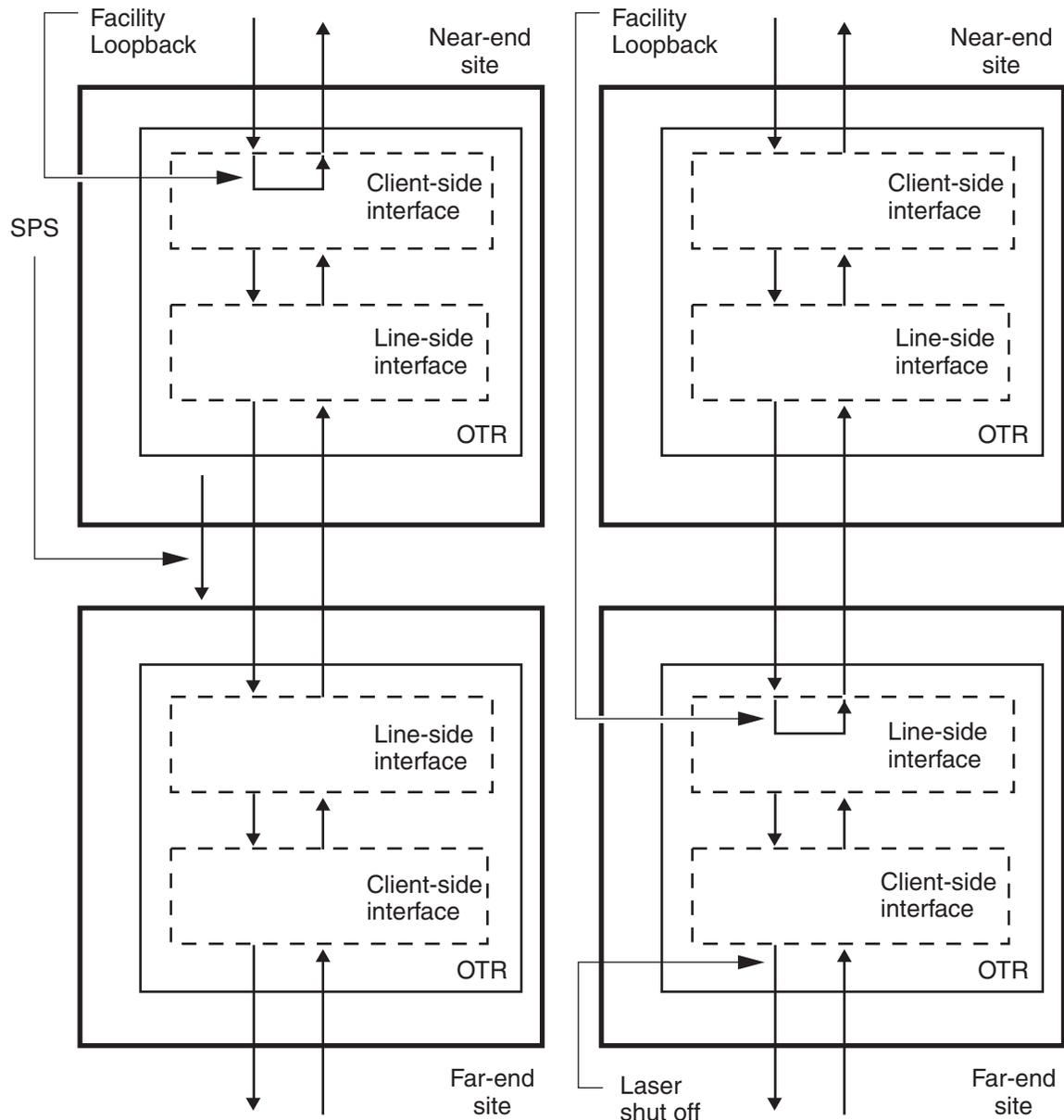
Loopbacks

See the following figures for examples of loopbacks with OTR circuit packs:

- OTR 2.5 Gbit/s, see [Figure 7-6 on page 7-15](#)
- OTR 10 Gbit/s, see [Figure 7-7 on page 7-16](#)
- OTR 10 Gbit/s Enhanced using 10 Gbit/s Ethernet LAN and 10 Gbit/s Clear Channel protocols, see [Figure 7-8 on page 7-17](#)
- OTR 10 Gbit/s Enhanced using OC-192, STM-64 and 10 Gbit/s Ethernet WAN protocols, see [Figure 7-9 on page 7-18](#)

Figure 7-6
OTR 2.5 Gbit/s loopbacks

OM2820



Note 1: OTR terminal loopback is not supported.

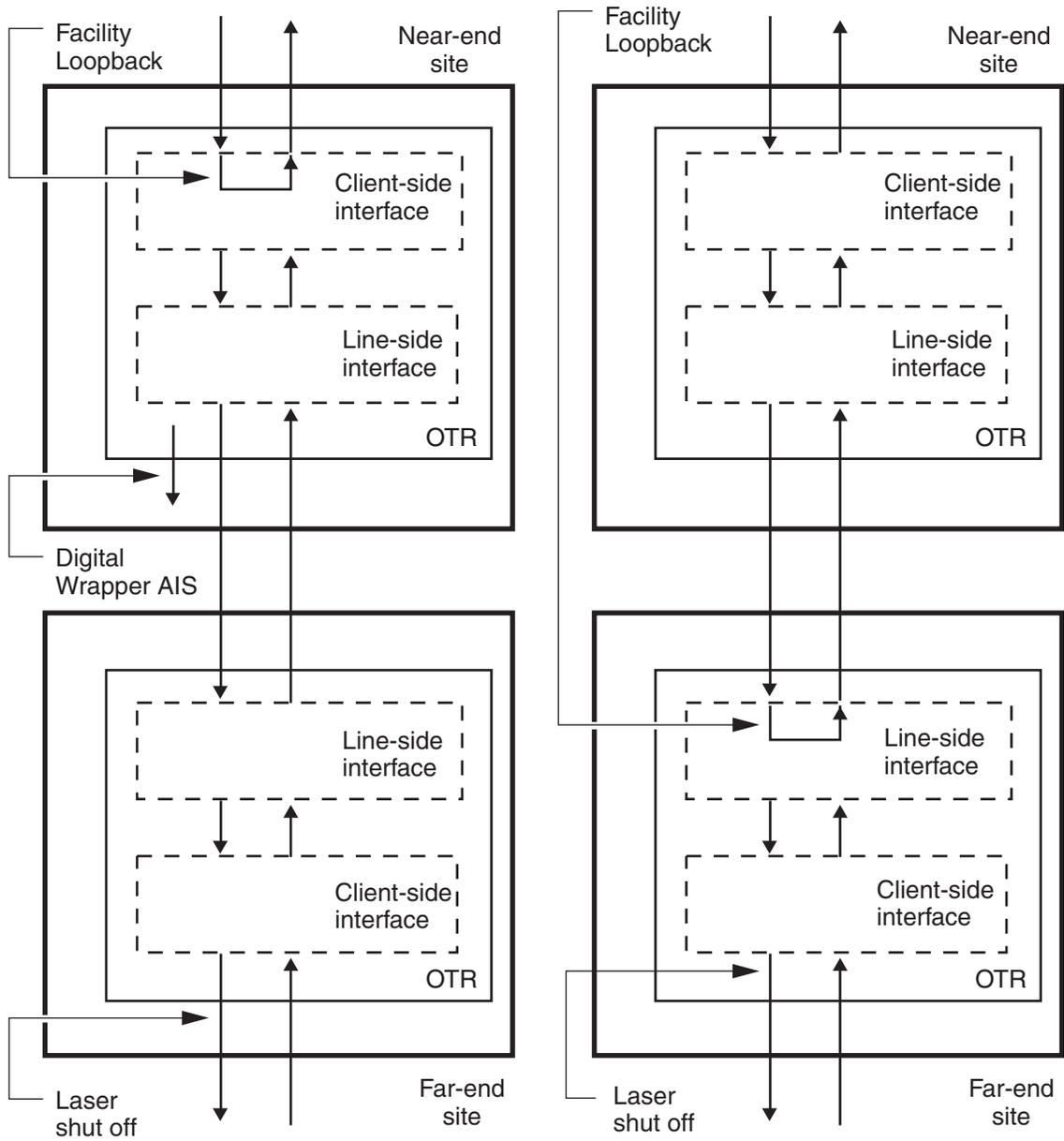
Note 2: The client and line-side loopbacks cannot be enabled at the same time.

Note 3: When a client facility loopback is active on the OTR 2.5Gbit/s circuit pack, a Surrogate Payload Signal (SPS) is injected on the line side.

Note 4: Previous versions of the OTR 2.5 Flex circuit packs can behave differently when a client facility loopback is active.

Figure 7-7
OTR 10 Gbit/s loopbacks

OM2336

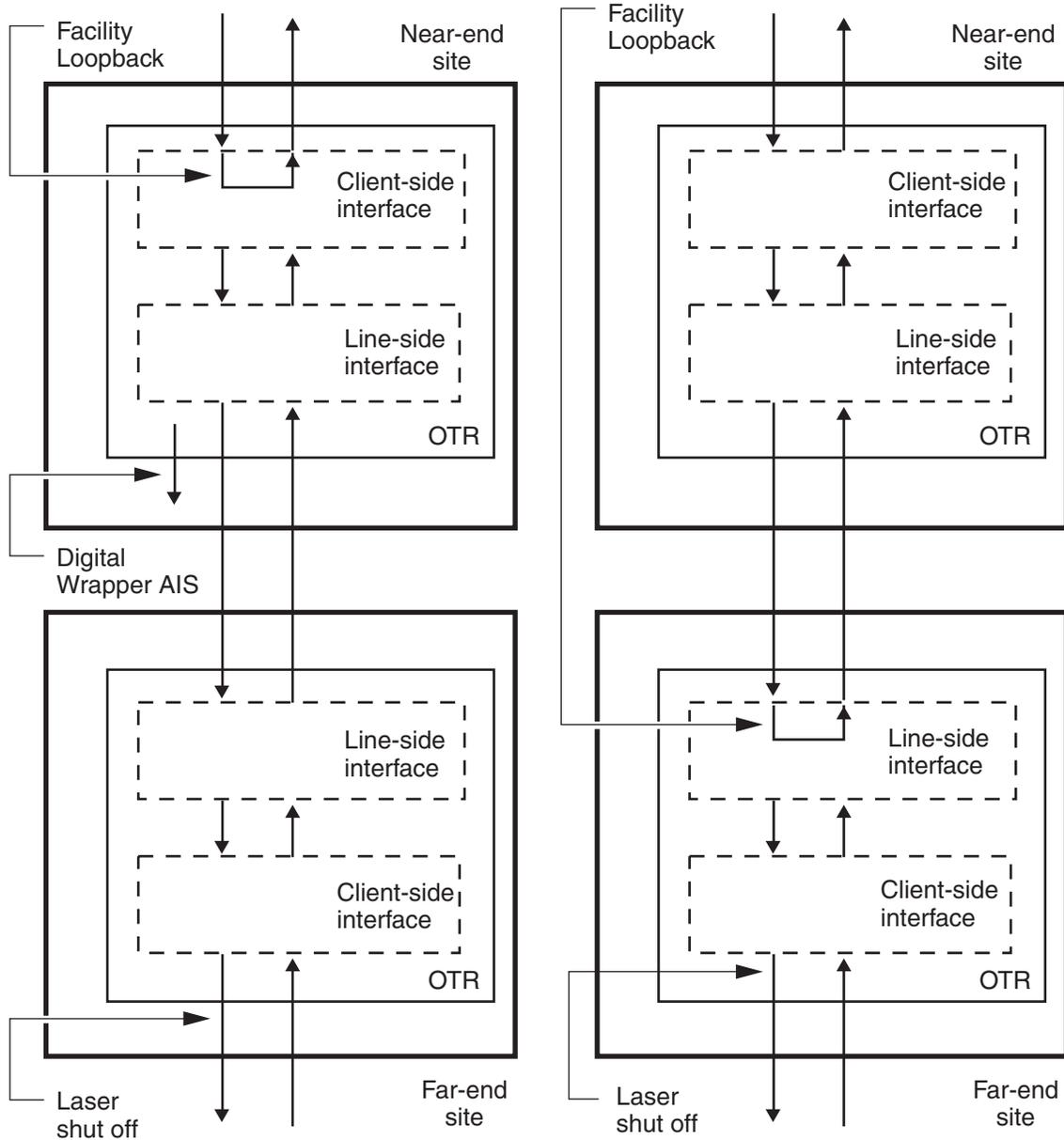


Note 1: OTR terminal loopback is not supported.

Note 2: The client and line-side loopbacks cannot be enabled at the same time.

Figure 7-8
OTR 10 Gbit/s Enhanced loopback using 10 Gbit/s Ethernet LAN and 10 Gbit/s Clear Channel protocols

OM06757

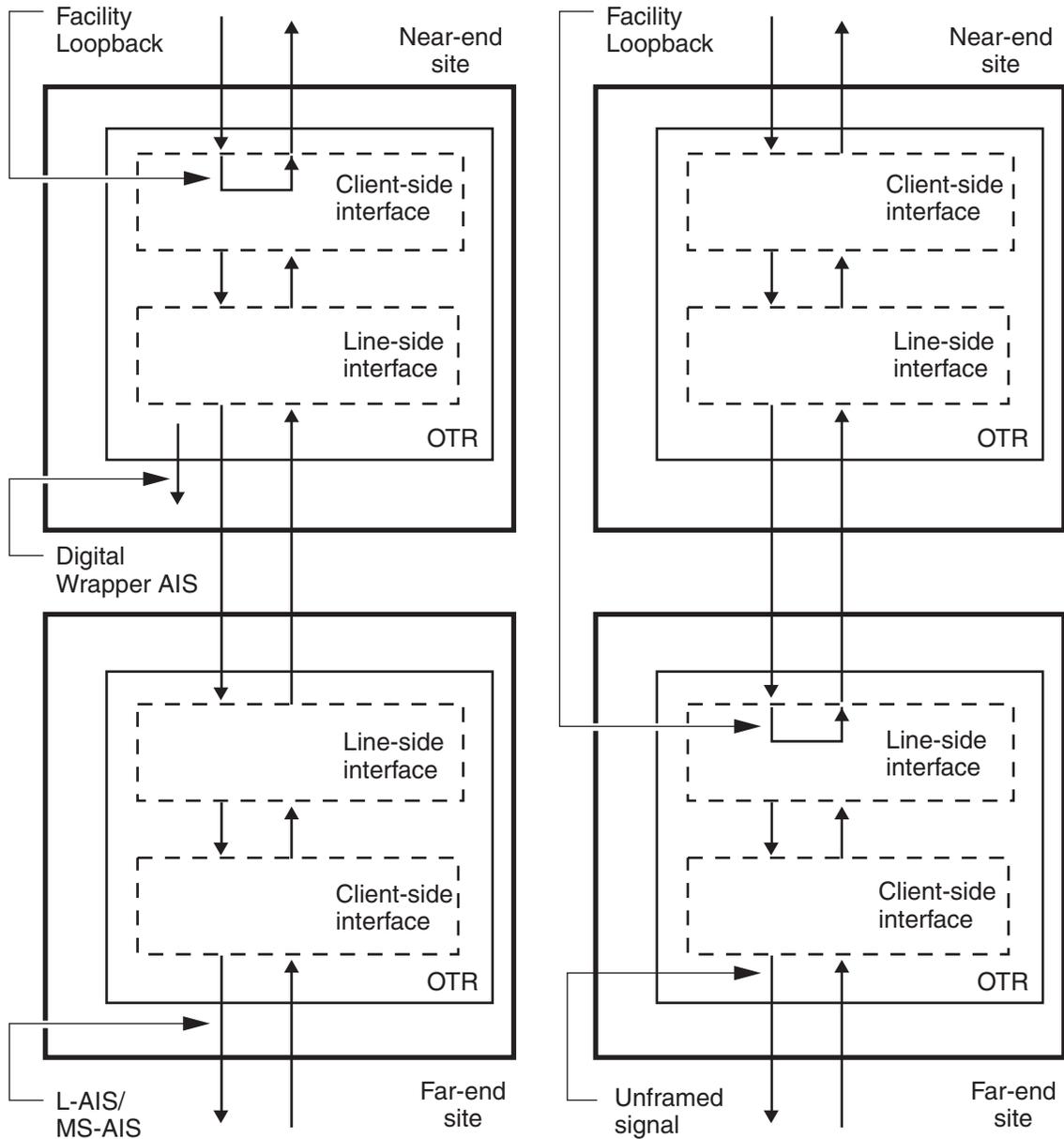


Note 1: OTR terminal loopback is not supported.

Note 2: The client and line-side loopbacks cannot be enabled at the same time.

Figure 7-9
OTR 10 Gbit/s Enhanced loopbacks using OC-192, STM-64 and 10 Gbit/s Ethernet WAN protocols

OM06758



Note 1: OTR terminal loopback is not supported.

Note 2: The client and line-side loopbacks cannot be enabled at the same time.

Note 3: The OTR 10 Gbit/s enhanced circuit pack does not perform any conditioning (that is AIS is not sent out the line-side TX interface) when a line-side facility loopback is active. Instead an unframed signal is sent out the client-side TX interface.

Cables and optical patch cords

For information on cables and optical patch cords, refer to [“Cables and optical patch cords”](#) on [page 21-1](#).

Location

For slot assignments and equipping rules, refer to the [“Site requirements and equipping rules”](#) chapter in *Network Planning and Link Engineering*, 323-1701-110.

Product engineering codes

For a list of the product engineering codes (PEC), refer to [“Optical Metro 5100/5200 ordering information”](#) of *Network Planning and Link Engineering*, 323-1701-110.

Muxponder circuit packs

In this chapter

This chapter includes the following sections:

- [Function and features on page 8-1](#)
- [Signal flow on page 8-44](#)
- [Faceplates on page 8-46](#)
- [Indicator lamps on page 8-48](#)
- [Loopbacks on page 8-48](#)
- [Cables and optical patch cords on page 8-51](#)
- [Location on page 8-51](#)
- [Product engineering codes on page 8-51](#)

Function and features

The Muxponder circuit pack is available to interface to the line side of an Optical Metro 5100/5200 network. Muxponder circuit packs always interface to a single wavelength on the line side. One of these circuit packs is always found at each of the two endpoints of an optical channel.

The Muxponder circuit packs appear both as a client side interface circuit pack and a line side interface circuit pack. These circuit packs provide both these interfaces by mapping directly from the client interface onto a wavelength.

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 Muxponder 10 Gbit/s GbE/FC circuit pack supports eight client ports). The client ports can be a mixture of the following 8B/10B encoded protocols:

- Gigabit Ethernet
- FC-100 or FICON
- FC-200 or FICON Express

The client ports are then aggregated to STS-192/STM-64 using frame or transparent GFP. The STS-192/STM-64 signal is digitally wrapped within an ITU-T G.709-compliant signal.

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 (FEC) 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 circuit packs

Client interfaces to the Muxponder are provided by the Small Form Factor Pluggable (SFP) module, which you must equip. Two types of SFPs are supported:

- a 1310 nm SFP (NTTP06CF) interface
- a 850 nm SFP (NTTP06AF) interface

Several Muxponder circuit pack types are available (see [Table 8-1 on page 8-4](#)).

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.

For a list of features available on the various Muxponder types, see [Table 8-2 on page 8-5](#).

Channel assignments provisioned on Muxponder circuit packs establish the signal flow between the client side signal and the line side wavelength at the end points of an optical channel. These channel assignments map the client signal onto a specific wavelength. The association between the circuit packs at intermediate points along the optical channel for signal regeneration or for bridging networks is established via physical connection using OTR 10 Gbit/s Enhanced circuit packs.

The Muxponder data communication channel operates at 1.3 Mbit/s using the GCC0 bytes of the digital wrapper signal.

DWDM Muxponder circuit packs are identified by wavelength band (BAND 1 to BAND 8) and by channel within the wavelength band (CH1 to CH4) on the circuit pack faceplate. 100 GHz Muxponder circuit packs are identified by wavelength group (Group 1 to Group 9) and by channel within the wavelength group (CH1 to CH4) on the circuit pack faceplate as well as a DWDM 100 GHz label. The wavelengths of the Common Photonic Layer 100 GHz wavelength plan are divided in nine groups of four channels that have corresponding band and channel assignments on Optical Metro 5100/5200.

Note: Muxponder 100 GHz circuit packs cannot be connected to Optical Metro 5100/5200 OMXs, only to Common Photonic Layer equipment.

OCM 2.5 Gbit/s circuit packs are required in Optical Metro 5200 shelves populated with the Muxponder circuit pack to maintain the shelf database in non-volatile memory and to terminate the inter-card Supervisory Bus (SBUS) communications through the backplane. SBUS is responsible for sending the status of a particular circuit pack and the status of the incoming and outgoing signals of the circuit pack to other circuit packs in the Optical Metro 5200 network.

The OCM circuit packs carry the protection signal between the working and protection Muxponder circuit packs of a protected channel assignment.

For the compatibility matrix between Muxponder types and other circuit packs, refer to *Technical Specifications*, 323-1701-180.

8-4 Muxponder circuit packs

Table 8-1
Muxponder circuit pack types

Muxponder family	Circuit pack type	Client bit rate		Line bit rate		Spacing	Reach
		Min.	Max.	Min.	Max.		
Muxponder 10 Gbit/s GbE/FC	Muxponder 10 Gbit/s GbE/FC	1.0625 Gbit/s	2.125 Gbit/s	10.709225 Gbit/s	10.709225 Gbit/s	DWDM - 200 GHz 32 wavelengths - 16 in C-band and 16 in L-band	110 km
	Muxponder 10 Gbit/s GbE/FC 100 GHz					DWDM - 100 GHz 36 C-band wavelengths	
Muxponder 10 Gbit/s GbE/FC VCAT	Muxponder 10 Gbit/s GbE/FC VCAT	1.0625 Gbit/s	2.125 Gbit/s	10.709225 Gbit/s	10.709225 Gbit/s	DWDM - 200 GHz 32 wavelengths - 16 in C-band and 16 in L-band	110 km
	Muxponder 10 Gbit/s GbE Uni-add					DWDM - 100 GHz 36 C-band wavelengths	
	Muxponder 10 Gbit/s GbE Uni-drop						
	Muxponder 10 Gbit/s GbE/FC VCAT 100 GHz						
	Muxponder 10 Gbit/s GbE Uni-add 100 GHz						
	Muxponder 10 Gbit/s GbE Uni-drop 100 GHz						

Table 8-2
Muxponder circuit pack feature summary

Feature	Muxponder 10 Gbit/s GbE/FC	Muxponder 10 Gbit/s GbE/FC VCAT
2 slot width	√	√
LC connectors	√	√
Number of supported services per circuit pack	8	10
Client side protocol support See Note 1 , Note 2 and Note 3	GbE, FC-100, FICON, FC-200, FICON Express	GbE, FC-100, FICON, FC-200, FICON Express
Bookended topologies See "Supported configurations and topologies" in NTP 323-1701-110 for information on network topologies	√	√
Interoperability topologies See "Supported configurations and topologies" in NTP 323-1701-110 for information on network topologies	Limited	√
Protection schemes See "1+1 line-side APS protection" on page 8-38 for more information	1+1	1+1
Fibre Channel GFP mappings	GFP-T	GFP-T
Gigabit Ethernet GFP mappings	GFP-T	GFP-F (default) or GFP-T
Path mappings (provisioning and alarming) See "Path mappings for the Muxponder 10 Gbit/s GbE/FC circuit pack" on page 8-10 and "Path mappings for the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack" on page 8-12 for more information	Fixed	Flexible
Contiguous concatenation (see Note 4)	√	√
Virtual concatenation (provisioning and alarming) (see Note 4)	Not supported	√
Gigabit Ethernet sub-rate support (Bandwidth resolution is STS-3/VC-4)	Not supported	√ (when using GFP-F)
Gigabit Ethernet Uni-add and Uni-drop channel assignments See "Unidirectional and bidirectional Gigabit Ethernet traffic support" on page 8-18 for more information	Full-rate (GFP-T)	Full-rate (when using GFP-T) and Full-rate or sub-rate (when using GFP-F)
AN/Pause support See "Auto-negotiation" on page 8-20 and "Pause capability" on page 8-21 for more information	Not supported	√ (when using GFP-F)
GFP-T MTU settings See "Jumbo frame support" on page 8-21 for more information	Any frame size passed (see Note 5)	Any frame size passed (see Note 5)
GFP-F MTU settings See "Jumbo frame support" on page 8-21 for more information	Not applicable	1600 (default) or 9600
Detailed defect and detailed event queries See "Detailed defect and detailed event query for summary path alarms" on page 8-38 for more information	√	√
Digital Wrapper PMs See "Facility PMs" on page 8-25 for more information	√	√
Client PMs See "Facility PMs" on page 8-25 for more information	√	√

8-6 Muxponder circuit packs

Table 8-2 (continued)
Muxponder circuit pack feature summary

Feature	Muxponder 10 Gbit/s GbE/FC	Muxponder 10 Gbit/s GbE/FC VCAT
Path PMs See "Facility PMs" on page 8-25 for more information	Not supported	√
Section PMs See "Facility PMs" on page 8-25 for more information	√	√
Line PMs See "Facility PMs" on page 8-25 for more information	√	√
Optical power monitoring on the TX and Rx interfaces of the client side and line side interfaces; optical power monitoring TCAs available on the line-side only See "Equipment PMs" on page 8-32 for more information	√	√
Generic and Ethernet Operational Measurements See "Operational Measurements (OMs)" on page 8-32 for more information	Not supported	√
Automatic Laser Shutdown (ALS)	√ (see Note 6)	√ (see Note 6)
Facility loopbacks on both the client-side and line-side interfaces and terminal loopbacks on the client-side interfaces See "Loopbacks" on page 8-48 for more information	√	√
Local and loop timing modes See "Clock synchronization" on page 8-42 for more information	√	√
In-band mixing with OCLD 2.5 Gbit/s Flex, OTR 2.5 Gbit/s Flex, OCLD 2.5 Gbit/s Universal, OTR 2.5 Gbit/s Universal and OTR 10 Gbit/s Enhanced	√	√
AOC (Automatic Output Control) provisionable conditioning holdoff (0 to 1000 ms in 100 ms granularity) See "Client-side conditioning holdoff times (AOC)" on page 4-17 for more information	√	√
Signal fail switching	√	√
GbE Preamble and Start of Frame Delimiter transparency (GFP-T) See Table 8-9 on page 8-22	√	√
GbE Preamble and Start of Frame Delimiter transparency (GFP-F) See Table 8-9 on page 8-22	Not supported	√ (provisionable)

Table 8-2 (continued)
Muxponder circuit pack feature summary

Feature	Muxponder 10 Gbit/s GbE/FC	Muxponder 10 Gbit/s GbE/FC VCAT
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.	√	√
Round trip delay measurement	√	√
<p>Note 1: Gigabit Ethernet client interface is designed to interwork with equipment compliant to IEEE 802.3 CSMA/CD access method and physical layer specifications, 2000.</p> <p>Note 2: Fibre Channel client interface is designed to interwork with equipment compliant to ANSI Fibre Channel Physical Interfaces (FC-P1) Revision 13, 2001. Vendor-defined flow control for Fibre Channel that is not defined within the standard is not supported. The 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.</p> <p>Note 3: 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 port provisioned as FC-100 must be manually set to 1G (FC-100) -Muxponder port provisioned as FC-200 must be manually set to 2G (FC-200)</p> <p>Note 4: For the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack, each client interface can be independently configured as C-cat or V-cat.</p> <p>Note 5: 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.</p> <p>Note 6: The ALS feature on the Muxponder 100 GHz circuit packs is disabled.</p>		

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 process 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 8-3](#) lists the various GFP UPI (User Payload Identifier) codes used.

Table 8-3
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

Table 8-3 (continued)
GFP UPI codes and handling

Circuit pack type	Client protocol	UPI code	Encapsulation	Transports
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
<p>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.</p>				

Path mappings for the Muxponder 10 Gbit/s GbE/FC circuit pack

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 8-4](#) lists the fixed-mapping assignments for the STS-24c/VC-4-8c and STS-48c/VC-4-16c contiguously concatenated groups

Table 8-4
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
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

Table 8-4 (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
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				

Path mappings for the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

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 (Table 8-5):

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

Table 8-5
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 client-side ports. This is 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 they cannot be used to provision an STS-12c.
- All provisionable paths are STS-3c/VC-4 aligned. 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 8-6 on page 8-13](#) and [Table 8-7 on page 8-14](#)).

Table 8-6
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 $n=0\dots63$	$n = 1$ 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 8-6 (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: 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 8-7
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 8-7 (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	<ul style="list-style-type: none"> • SONET: All V-cat paths can start at $3n+1$, where $n=0\dots63$ • SDH: All V-cat paths can start at n, where $n=1\dots64$ • 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	<ul style="list-style-type: none"> • SONET: All V-cat paths can start at $3n+1$, where $n=0\dots63$ • SDH: All V-cat paths can start at n, where $n=1\dots64$ • 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 8-7 (continued)
Flexible V-cat mapping assignments for the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

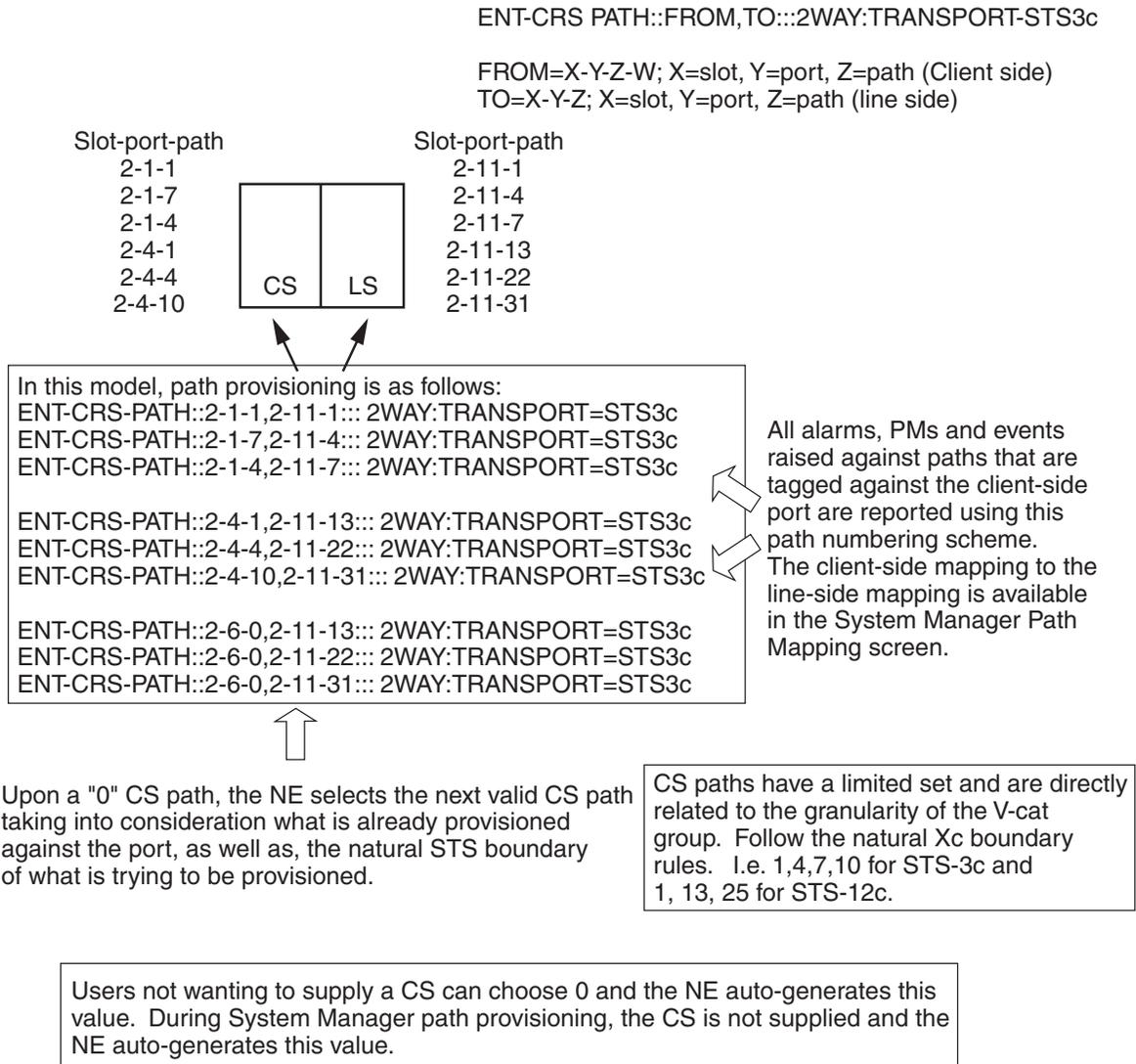
Port Assignment Rate	Encapsulation	SONET Transport Structure	SDH Transport Structure	Port to Path Mapping (Flex vs Fixed)	Allowed SONET/SDH paths and rules
FC-200 FICON Express	GFP-T	STS-3c-12v	VC-4-12v	Flex	<ul style="list-style-type: none"> • SONET: All V-cat paths can start at $3n+1$, where $n=0\dots63$ • SDH: All V-cat paths can start at n, where $n=1\dots64$ • 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	
<p>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.</p>					

Path numbering model

The path numbering model is as shown in Figure 8-1. Since alarm and PM details are raised against a logical client-side path, the System Manager Path Summary screen can be used to correlate the client-side paths to the line-side paths.

Figure 8-1
Path numbering model

OM2736p



Gigabit Ethernet features

Unidirectional and bidirectional Gigabit Ethernet traffic support

Unidirectional and bidirectional Gigabit Ethernet traffic is supported on all client ports of the Muxponder 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 circuit pack. See [Figure 8-2 on page 8-19](#) 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 link is always bidirectional. This is valid for unidirectional and bidirectional client traffic.

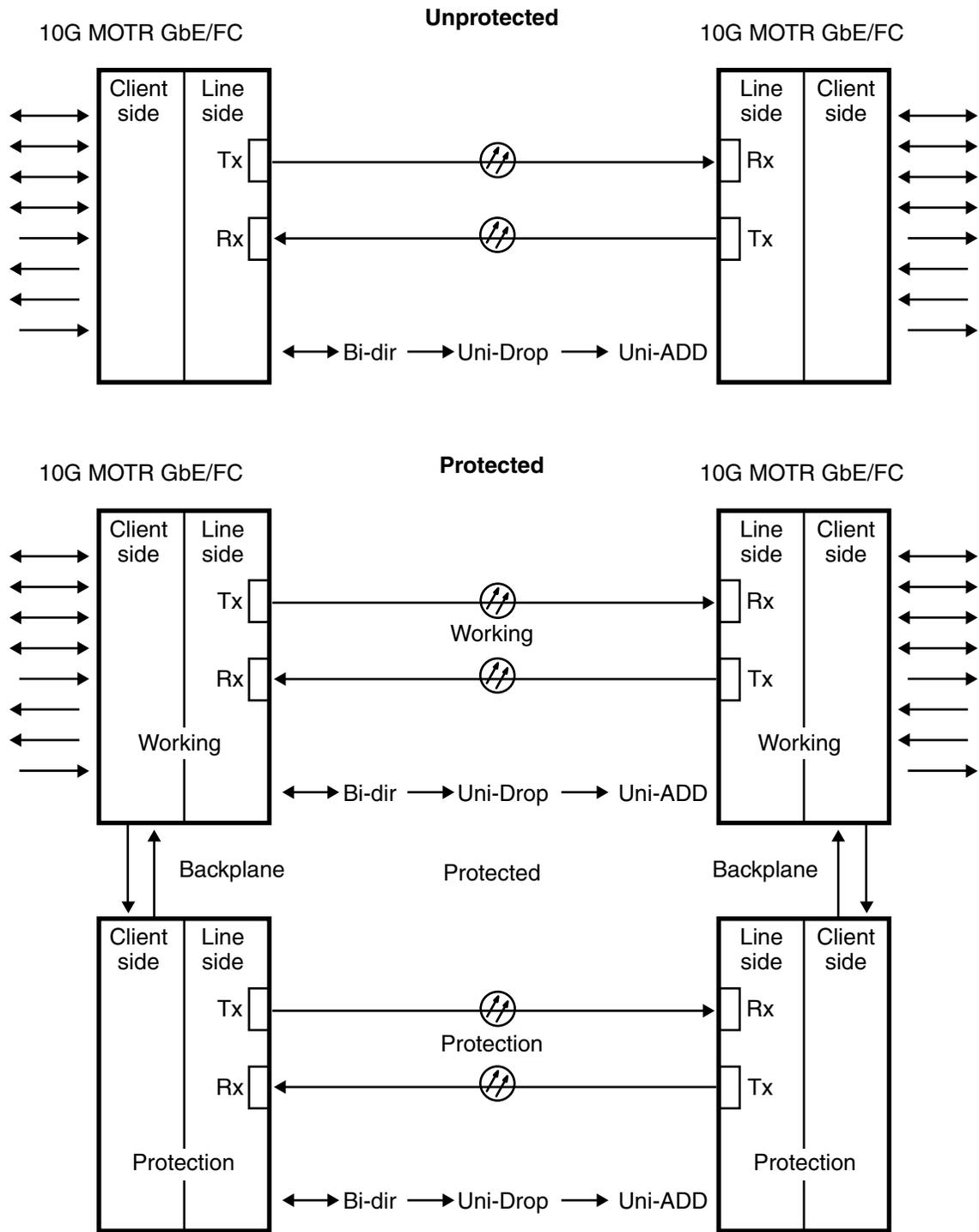
See [Table 8-8 on page 8-18](#) to determine the traffic types supported for each Muxponder circuit pack type.

Table 8-8
Muxponder circuit pack types and traffic types supported

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

Figure 8-2
Unidirectional and bidirectional unprotected and protected configurations

OM2390p



In a unidirectional port assignment, an internal loopback on the corresponding path is automatically performed at the uni-drop site 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 continues 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 designed to allow Ethernet peers that share a link segment to exchange capabilities and automatically resolve the most efficient mutually compatible configuration.

The Muxponder circuit pack operates in different ways with regards to auto-negotiation, depending on whether the Gigabit Ethernet signal is provisioned to be encapsulated using GFP-F or GFP-T.

- When using GFP-T, the Muxponder 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 8-9 on page 8-22](#).
- 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 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 circuit pack is transparent with respect to pause. Incoming control frames (such as pause frames) are transparently passed through. 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 8-9 on page 8-22](#).
- When using GFP-F and unidirectional connections, 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 circuit pack operates in different ways with regards to jumbo frame support, depending on whether the Gigabit Ethernet signal is provisioned to be encapsulated using GFP-F or GFP-T.

- When using GFP-T, any size frame is passed through the Muxponder 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 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 circuit pack connection. In addition, the Muxponder circuit pack is transparent to VLAN tags (IEEE 802.1Q) and priority fields (IEEE 802.1P).

Table 8-9
Gigabit Ethernet attributes on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

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 Mbit/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.
PAUSERXOVERRIDE (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).

Table 8-9 (continued)
Gigabit Ethernet attributes on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

Name	Values (See Note 1)	Access	Definition
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.
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.

Table 8-9 (continued)
Gigabit Ethernet attributes on the Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

Name	Values (See Note 1)	Access	Definition
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	<p>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.</p> <p>Enable: preamble is transparently passed through</p> <p>Disable: preamble is processed and removed</p>
<p>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.</p> <p>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 PAUSERXOVERRIDE 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.</p> <p>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.</p> <p>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.</p>			

Performance Monitoring

Facility PMs

The Muxponder circuit pack supports the facility performance parameters detailed in [Table 8-10](#). The Gigabit Ethernet and FC/FICON Facility PP definitions are included in [Table 8-11 on page 8-27](#).

TCAs are available for each PP.

Table 8-10

Supported Facility PMs and Performance Parameters on the Muxponder circuit pack

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 (see Note 1)	Tx	Not applicable (see Note 2)	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 3 and Note 4)

Table 8-10 (continued)
Supported Facility PMs and Performance Parameters on the Muxponder circuit pack

Port number	Port type	Direction	PM Mode	Protocols and GFP mapping	Facility PPs
11 (Line facility)	Optical	Rx	SONET/Digital 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: Path PMs are not available on the Muxponder 10 Gbit/s GbE/FC circuit pack.

Note 2: 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 3: 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 4: 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 8-11
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 8-13 on page 8-33 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.
		GigE WAN	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 8-11 (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 FICONEXPRESS 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 8-11 (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 8-13 on page 8-33 for InFramesErr definition.
				SES	A second where InFramesErr/InFrames > 0.01 (> 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 8-13 on page 8-33 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 8-11 (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 8-13 on page 8-33 for InFramesErr definition.
				SES	A second where $\text{InFramesErr}/\text{InFrames} > 0.01$ ($> 1\%$ of frames are errored) or a loss of signal or loss of sync event occurred Note 1: Seconds where $\text{InFrames} = 0$ shall not be considered SES unless there is a loss of signal or loss of sync event. Note 2: See Table 8-13 on page 8-33 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 8-11 (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 FICONEXPRESS 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 circuit pack supports the equipment performance monitoring detailed in [Table 8-12](#).

Table 8-12
Supported Equipment PMs on the Muxponder circuit pack

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 (the Muxponder 10 Gbit/s GbE/FC circuit pack does not support OMs). All counters are 64-bit counters except where noted.

- See [Table 8-13 on page 8-33](#) for Generic OMs supported for the Gigabit Ethernet protocol
- See [Table 8-14 on page 8-35](#) for Generic OMs supported for the FC-100, FC-200, FICON and FICON Express protocols
- See [Table 8-15 on page 8-36](#) for Ethernet OMs

Table 8-13
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 <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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 8-13 (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 8-13 (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 the number of InFrames on the WAN side and the 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 8-14

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 8-14 (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 8-15
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 8-15 (continued)
Ethernet OM counters supported on the Muxponder 10 Gbit/s GbE/FC VCAT

Ethernet OM Counter	LAN (see Note)
FrameTooLong	<p>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.</p> <p>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.</p>
FrameTooShort	<p>Total number of frames whose length, including FCS, is less than 64 bytes but did not have an FCS error.</p>
InternalMACTxErr	<p>Not supported</p>
SymbolErr	<p>Not supported</p>
InPauseFrames	<p>Not supported.</p>
OutPauseFrames	<p>Total number of Muxponder port originated MAC control frames transmitted with an op-code indicating a PAUSE frame.</p>
Jabbers	<p>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.</p> <p>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.</p>
Fragments	<p>Total number of frames whose length, including FCS, is less than 64 bytes that have an FCS error.</p>
ControlFrames	<p>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.</p>
<p>Note: The LAN port is identified as optical in the System Manager Performance Monitoring interface.</p>	

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.

1+1 line-side APS protection

The Muxponder 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 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 connection, one Muxponder 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 circuit pack can have a protection mate in the West plane and vice-versa. The working and protection Muxponder 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 8-3 on page 8-39](#) illustrates line-side protection on a Muxponder circuit pack connection on an Optical Metro 5200 shelf. [Figure 8-4 on page 8-40](#) illustrates line-side protection on a Muxponder circuit pack connection on an Optical Metro 5100 shelf.

Note: In 1+1 line-side protection, the protection Muxponder circuit pack is not equipped with SFP client interfaces.

Figure 8-3
Line-side protection on an Optical Metro 5200 shelf

OM2830p

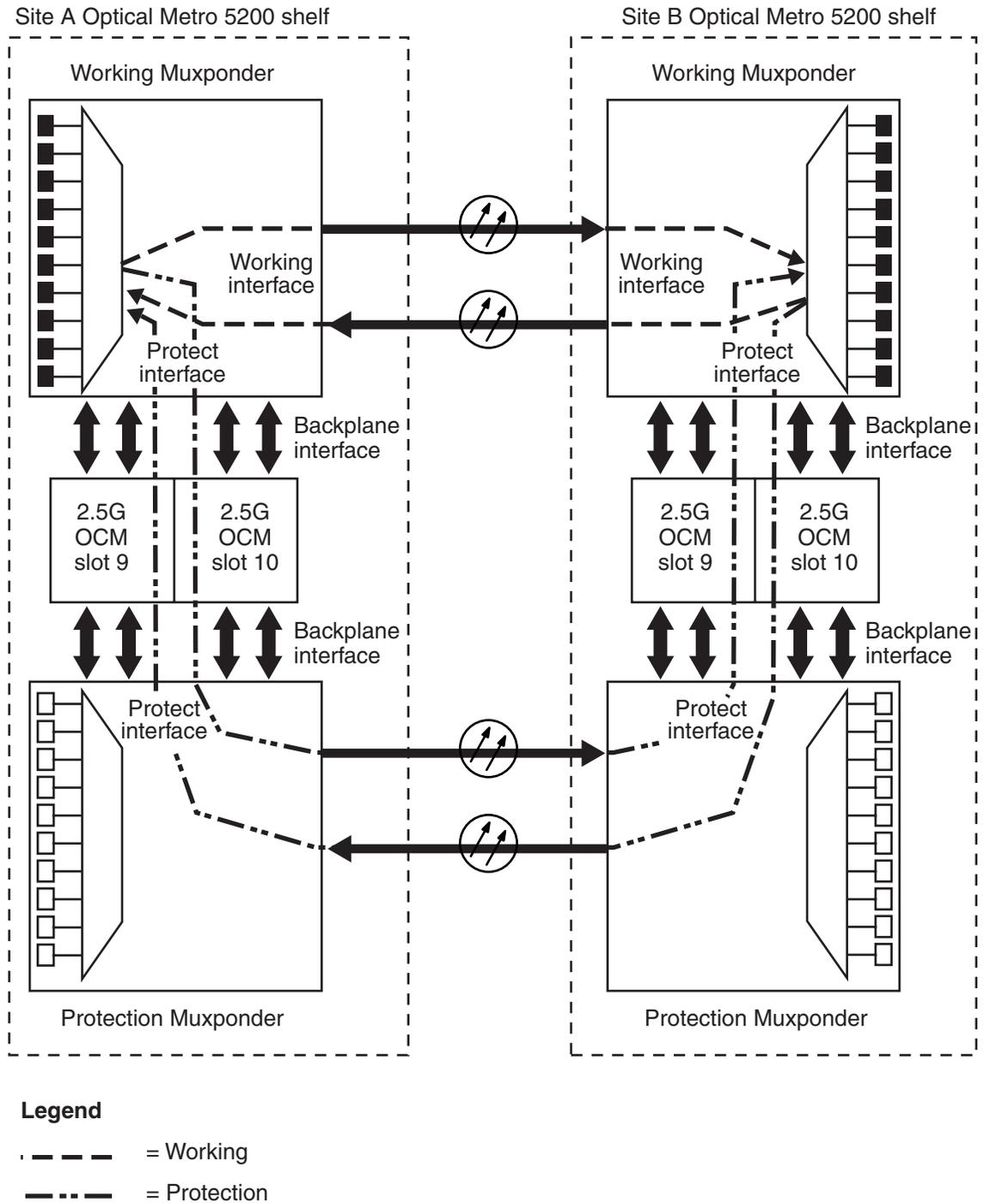
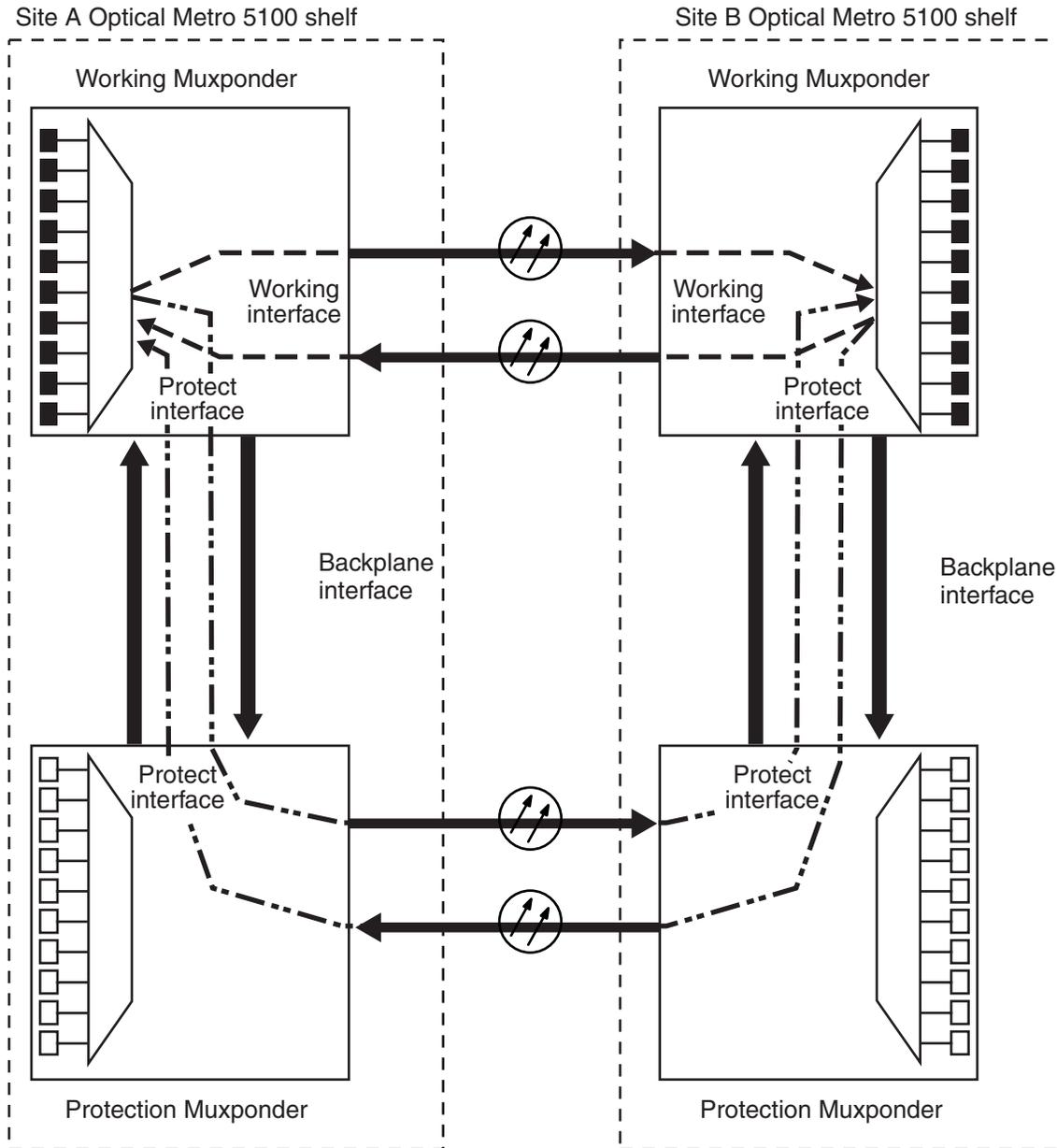


Figure 8-4
Line-side protection on an Optical Metro 5100 shelf

OM2831p



Legend

- - - = Working
- = Protection

Protection switching is enabled using the Automatic Protection Switching (APS) protocol. The APS protocol implementation on the Muxponder 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 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 that is experiencing intermittent problems. The Wait-to-Restore parameter is provisionable from 1 to 12 minutes in 1-minute increments.

The Muxponder 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.

The following protection switch requests are supported on the Muxponder 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 circuit pack protection switch time complies with the Bellcore GR-253 standard.

Clock synchronization

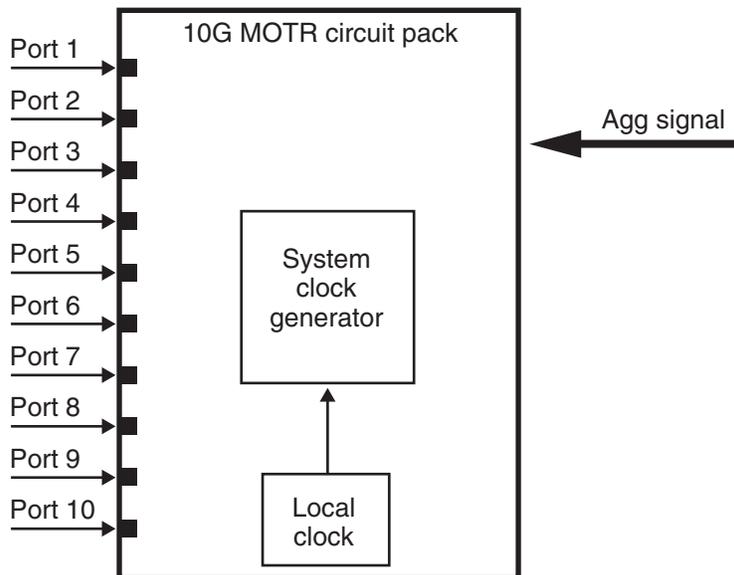
The Muxponder circuit pack supports:

- 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 circuit pack. [Figure 8-5](#) shows an example of local timing.

Figure 8-5
Muxponder line timing

OM2370p



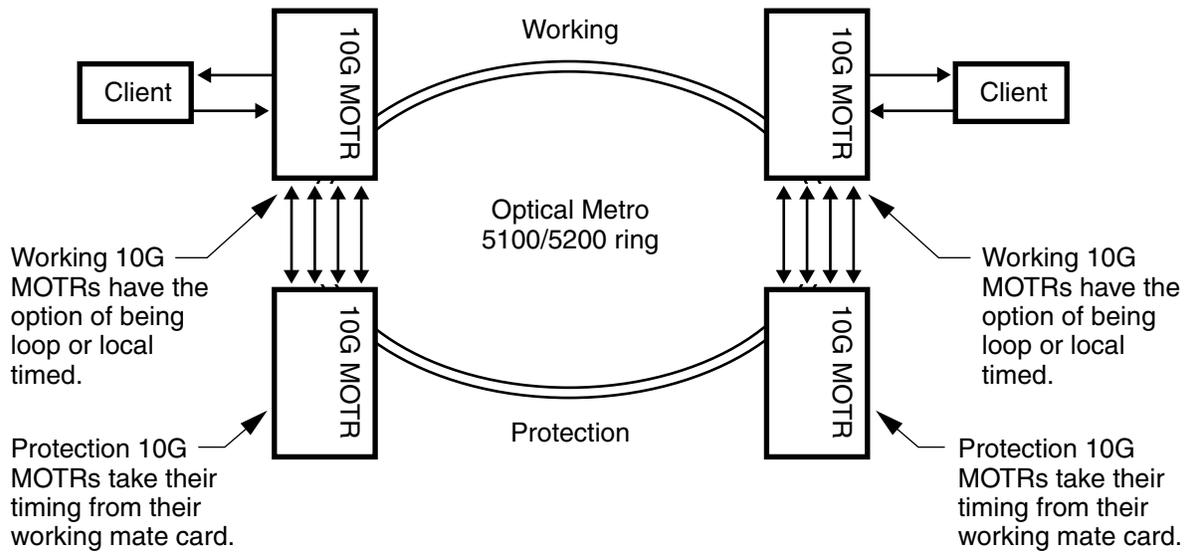
Local clock used
as timing reference
for circuit pack

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 circuit pack derives its timing from the working circuit pack through the backplane (see [Figure 8-6 on page 8-43](#)).

Figure 8-6
Synchronization provisioning for protected Muxponder configuration

OM2391p



Synchronization considerations

The following synchronization considerations apply when deploying the Muxponder circuit pack:

- In a bookended configuration, at least one Muxponder 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.

Signal flow

Figure 8-7 on page 8-45 shows the signal flow and interconnection of the Muxponder 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 Muxponder 10 Gbit/s GbE/FC circuit pack supports nine interfaces:

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

The line interface performs 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 perform 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.

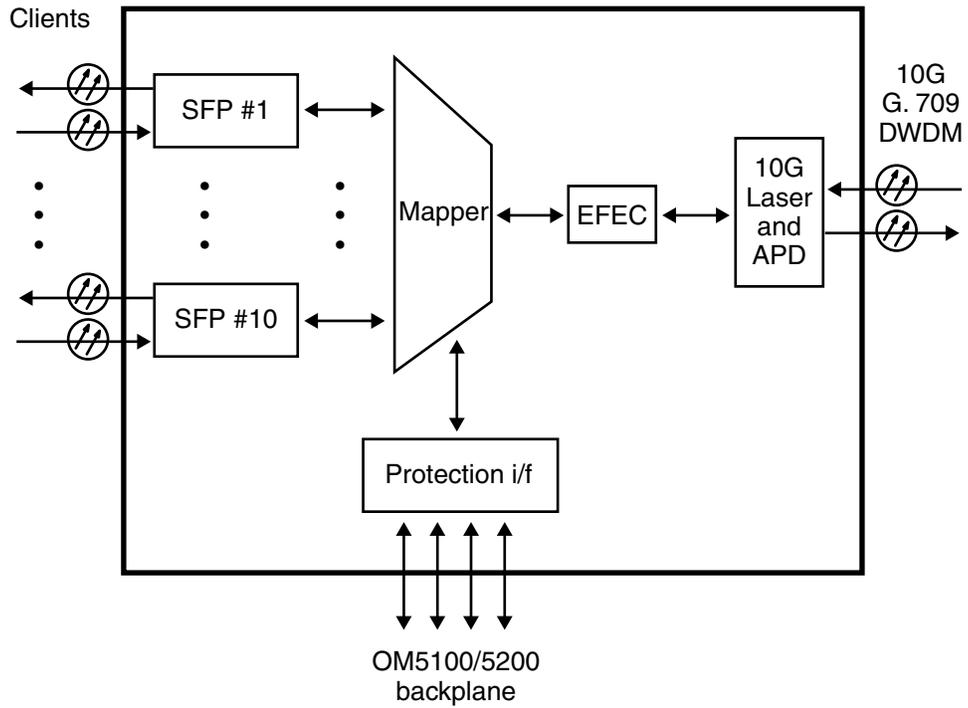
The mapper multiplexes client data to a SONET/SDH STS-192/STM-64 bitstream. A protection interface is also provided by the Optical Metro 5100/5200 backplane for line-side protection switching.

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 8-7
Muxponder signal flow

OM2387p



Faceplates

Figure 8-8 shows the faceplate of the Muxponder 10 Gbit/s GbE/FC.

Figure 8-8
Muxponder 10 Gbit/s GbE/FC circuit pack

OM2658p.jpg

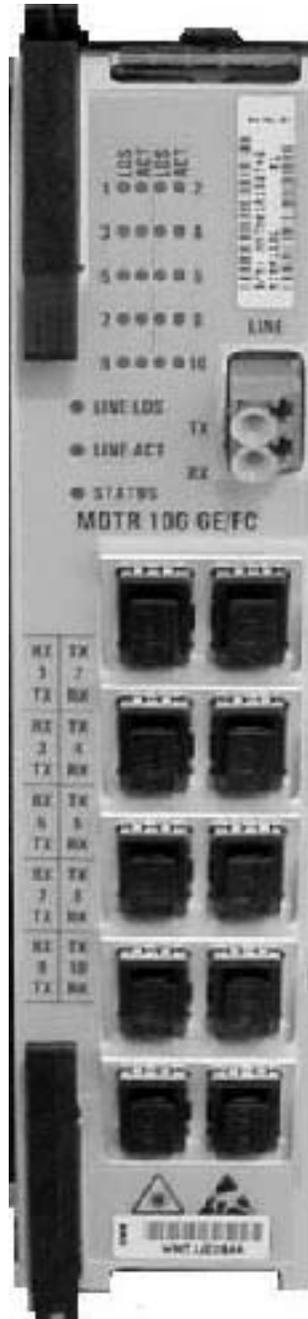
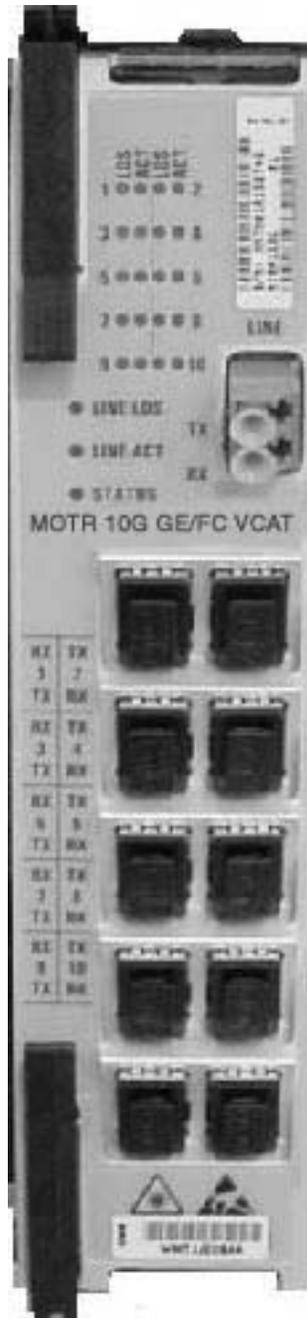


Figure 8-9 shows the faceplate of the Muxponder 10 Gbit/s GbE/FC VCAT.

Figure 8-9
Muxponder 10 Gbit/s GbE/FC VCAT circuit pack

OM2807p.jpg



Indicator lamps

The Muxponder circuit pack has the following lamps on the faceplate:

- ten Client LOS indicator lamps for the client interfaces
- ten Client Active indicator lamps for the client interfaces
- one DWDM Line LOS indicator lamp for the line interface
- one DWDM Line Active indicator lamp for the line interface
- one STATUS indicator lamp for the circuit pack

For indicator lamp functionality, see [Table 4-8 on page 4-21](#).

Loopbacks

The Muxponder circuit pack supports both client-port loopbacks and line-side loopbacks are supported. See [Figure 8-10 on page 8-50](#) 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 circuit pack.

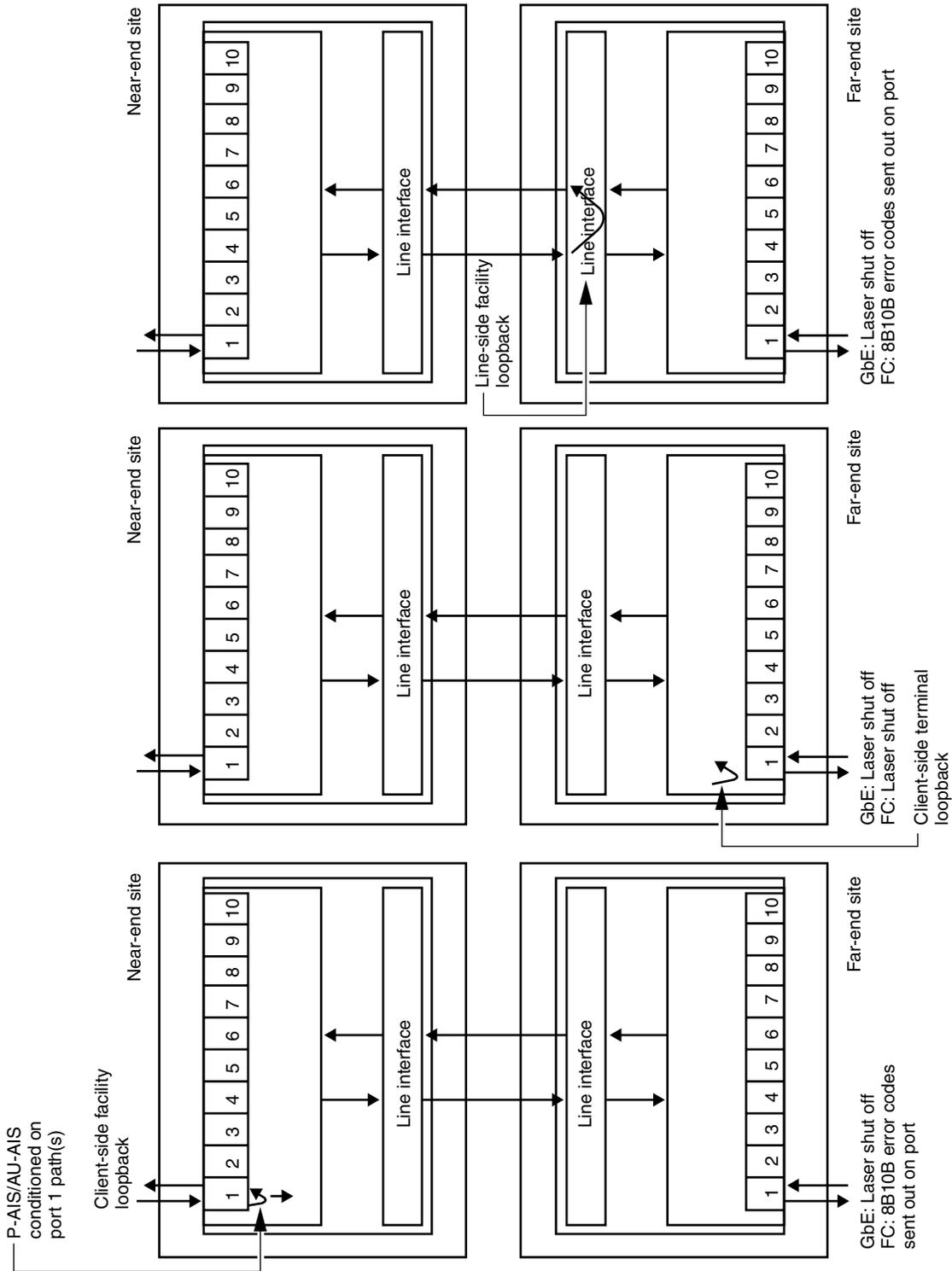
The Muxponder 10 Gbit/s GbE/FC circuit pack also supports line-side facility loopbacks. Before provisioning a line-side facility loopback, you must release all client terminal and facility loopbacks, provision a channel assignment, and set all client and line facilities out-of-service. If all client 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 (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 circuit pack, refer to *Provisioning and Operating Procedures*, 323-1701-310.

Figure 8-10
Supported loopback configurations for the Muxponder circuit pack

OM2708p



Cables and optical patch cords

For information on cables and optical patch cords, refer to [“Cables and optical patch cords”](#) on [page 21-1](#).

Location

For slot assignments and equipping rules, refer to the [“Site requirements and equipping rules”](#) chapter in *Network Planning and Link Engineering*, 323-1701-110.

Product engineering codes

For a list of the product engineering codes (PEC), refer to [“Optical Metro 5100/5200 ordering information”](#) of *Network Planning and Link Engineering*, 323-1701-110.

OCM circuit packs

In this chapter

This chapter includes the following sections:

- [Function and features on page 9-1](#)
- [Signal flow on page 9-2](#)
- [Faceplates on page 9-3](#)
- [Indicator lamps on page 9-3](#)
- [Loopbacks on page 9-3](#)
- [Cables and optical patch cords on page 9-3](#)
- [Location on page 9-3](#)
- [Product engineering codes on page 9-4](#)

Function and features

The OCM circuit pack does path protection switching in an Optical Metro 5200 shelf and manages the connections between the OCI and OCLD circuit packs. It switches paths as the result of optical fiber cuts, shelf failure, or performance degradation. Because the OCM circuit pack does path protection switching at the channel level, other channels in the wavelength band are not disrupted when a switch occurs.

The OCM terminates the intercard Supervisory Bus (SBUS) communications via the backplane. The SBUS is responsible for sending the status of a particular circuit pack and the status of the incoming and outgoing signals of the circuit pack to other circuit packs in an Optical Metro 5200 shelf.

The OCM circuit pack maintains the shelf database in non-volatile memory allowing for rapid traffic restoration in the event of a shelf power failure and restoration.

The OCM circuit packs carry the protection signal between the working and protection Muxponder circuit packs of a protected channel assignment.

Two types of OCM circuit pack are available, see [Table 9-1 on page 9-2](#).

For the compatibility matrix with OCI and OCM circuit packs, refer to [Figure 5-2 on page 5-17](#).

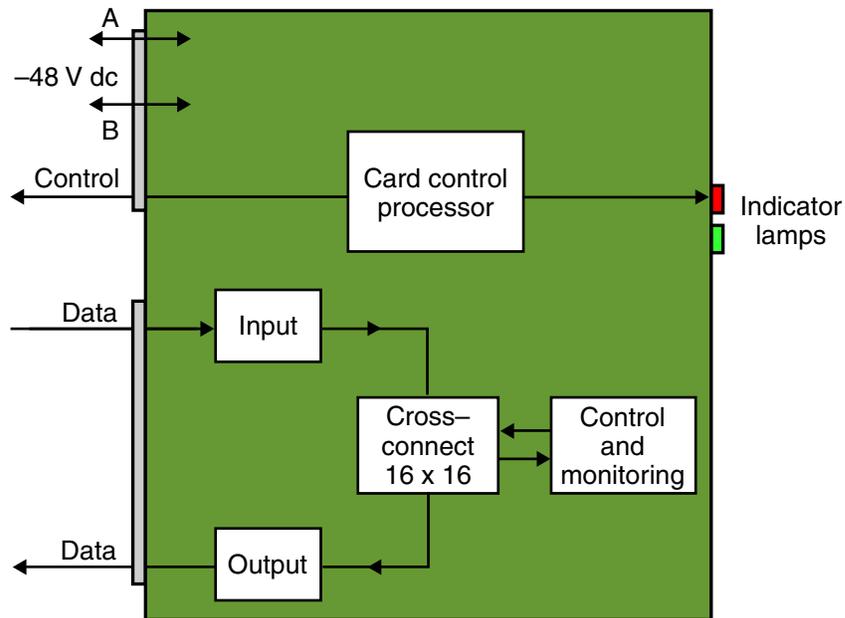
Table 9-1
OCM circuit pack types

Type of circuit pack	Slot width	Faceplate connector
OCM 1.25 Gbit/s	1	none
OCM 2.5 Gbit/s	1	none

Signal flow

[Figure 9-1](#) shows the signal flow through the OCM circuit pack.

Figure 9-1
OCM signal flow



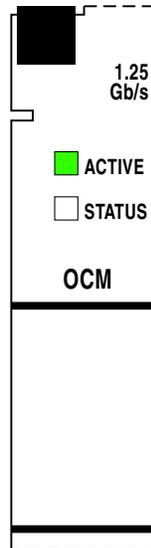
OM00051

Faceplates

Figure 9-2 shows the faceplate of an OCM circuit pack.

Figure 9-2
Faceplate of an OCM circuit pack

OM0006s



Indicator lamps

OCMs have the following indicator lamps on the faceplate:

- ACTIVE
- STATUS

For indicator lamp functionality, see [Table 4-7 on page 4-19](#).

Loopbacks

OCM circuit packs do not support loopbacks.

Cables and optical patch cords

No cables or optical patch cords are associated with OCM circuit packs.

Location

For slot assignments and equipping rules, refer to the [“Site requirements and equipping rules”](#) chapter in *Network Planning and Link Engineering*, 323-1701-110.

Product engineering codes

For a list of the product engineering codes (PEC), refer to [“Optical Metro 5100/5200 ordering information”](#) of *Network Planning and Link Engineering*, 323-1701-110.

OSC circuit packs

In this chapter

This chapter includes the following sections:

- [Function and features on page 10-1](#)
- [Signal flow on page 10-2](#)
- [Faceplates on page 10-3](#)
- [Indicator lamps on page 10-4](#)
- [Loopbacks on page 10-4](#)
- [Cables and optical patch cords on page 10-5](#)
- [Location on page 10-5](#)
- [Product engineering codes on page 10-5](#)

Function and features

The Optical Supervisory Channel (OSC) circuit pack is an optional single-slot circuit pack in the Optical Metro 5100/5200 shelf.

At sites requiring an OSC, the OSC transmits and receives an 1510 nm optical supervisory channel as well as a communication management channel called the wayside channel (WSC).

The OSC circuit pack has the following functions:

- allows you to enable intersite fault sectionalization on fiber cuts and link activity for Optical Metro 5100/5200 shelves
- allows you to enable or disable intrasite fault sectionalization at each site on an Optical Metro 5100/5200 ring
- provides remote access to OFA sites (line amplifiers)
- enables monitoring of a ring from a site where no traffic is added or dropped (See [Note](#))
- supports a transparent data communication pipe for the customer's own management traffic using a 100Base-FX multimode interface

10-2 OSC circuit packs

- allows software to have visibility of every shelf in a mesh configuration from any other shelf in the network through the overhead channel

Note: A monitoring site refers to a site on a ring where only the OSC circuit packs, OSC trays, SP, and two OCM circuit packs are deployed in the shelf. No traffic-carrying circuit packs or OMXs are used at a monitoring site. The site is used only to monitor and control the ring.

One OSC circuit pack type is available (see [Table 10-1](#)).

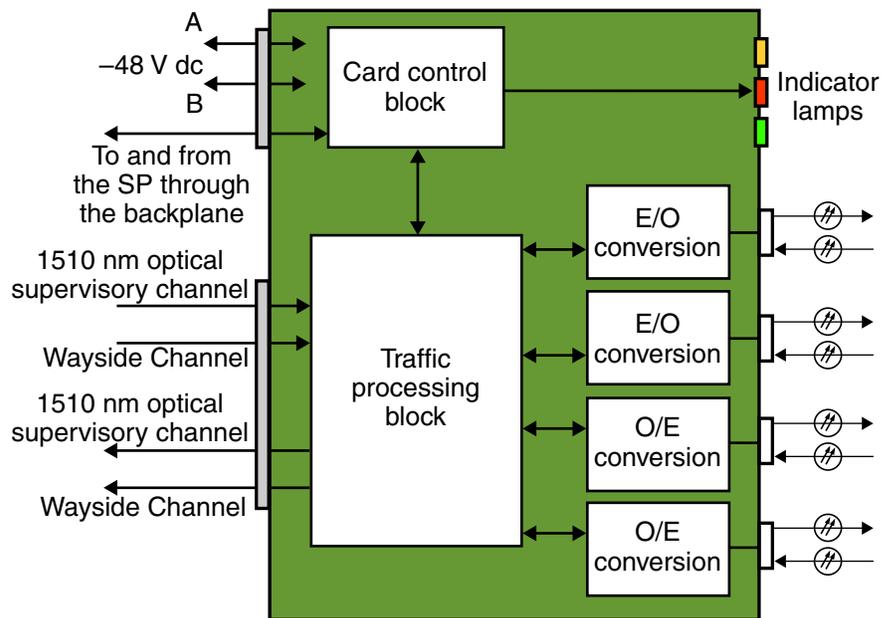
Table 10-1
OSC circuit pack types

Type of circuit pack	Slot width	Faceplate connector
OSC	1	LC - 4 for OSC channels and 4 for WSC channels

Signal flow

[Figure 10-1](#) shows the signal flow in the OSC circuit pack.

Figure 10-1
OSC circuit pack signal flow



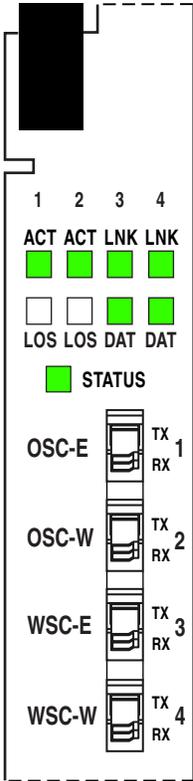
OM04611

Faceplates

Figure 10-2 shows the faceplate of an OSC circuit pack.

Figure 10-2
Faceplate of the OSC circuit pack

OM0482s



Indicator lamps

OSC circuit packs have the following indicator lamps on the faceplate:

- LOS
- ACT
- LNK
- DAT

The OSC circuit pack faceplate provides

- two LOS lamps and two ACT (ACTIVE) lamps, one for each OSC port
- two LNK (LINK) lamps and two DAT (DATA) lamps, one for each WSC port

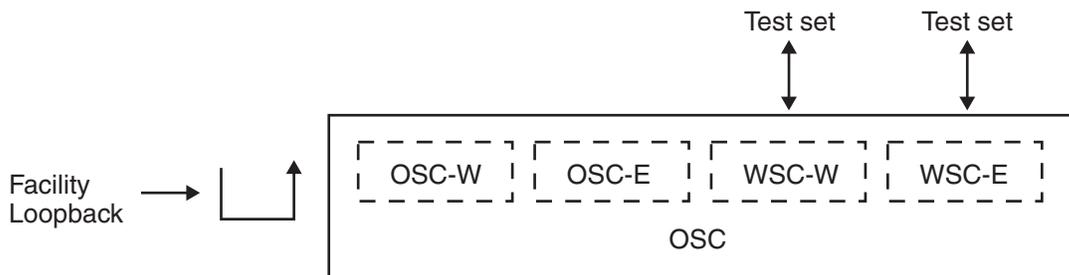
For indicator lamp functionality, see [Table 4-7 on page 4-19](#). For the WSC port indicator lamps, the LNK lamp is ON when the Ethernet link is up and the port facility is the in-service state. If the link is down or if the port facility is in the out-of-service state, the LNK lamp is OFF. The DAT LED is turned on for at least 20 milliseconds when data is transmitted or received on the port.

Loopbacks

See [Figure 10-3](#) OSC circuit pack loopback functionality.

Figure 10-3
OSC loopback

OM2339



Note: OSC port facility loopbacks can cause loss of the communications path to the site. To clear the loopback you need to visit the site. It is recommended not to use OSC port facility loopbacks.

Cables and optical patch cords

For a list of the product engineering codes (PEC), refer to [“Optical Metro 5100/5200 ordering information”](#) of *Network Planning and Link Engineering*, 323-1701-110.

Location

For slot assignments and equipping rules, refer to the [“Site requirements and equipping rules”](#) chapter in *Network Planning and Link Engineering*, 323-1701-110.

Product engineering codes

For a list of the product engineering codes (PEC), refer to [“Optical Metro 5100/5200 ordering information”](#) of *Network Planning and Link Engineering*, 323-1701-110.

SP circuit packs

In this chapter

This chapter includes the following sections:

- [Function and features on page 11-1](#)
- [Signal flow on page 11-2](#)
- [OM0009t on page 11-2](#)
- [OM0010s on page 11-3](#)
- [Loopbacks on page 11-3](#)
- [Cables and optical patch cords on page 11-3](#)
- [Location on page 11-3](#)
- [Product engineering codes on page 11-3](#)

Function and features

The shelf processor (SP) circuit pack manages communication functions for Optical Metro 5100/5200 shelves. One SP circuit pack is required for each Optical Metro 5100/5200 shelf.

ATTENTION

The SP must meet the minimum software baseline of release 3.2 for an Optical Metro 5100 shelf. If the SP carries an earlier software load, the Optical Metro 5100 shelf will fail to initialize.

The SP provides:

- local management
- alarm consolidation and telemetry connections
- software and configuration management
- shelf visibility
- performance monitoring
- inventory control for the shelf

11-2 SP circuit packs

- system communication
- protection switch control for OTR circuit pack

The SP circuit pack monitors all the circuit packs in the shelf to determine the state of the Optical Metro 5100/5200. Each circuit pack determines its state from feedback at different system monitoring points and then communicates its state to the SP circuit pack.

One SP circuit pack type is available (see [Table 11-1](#)).

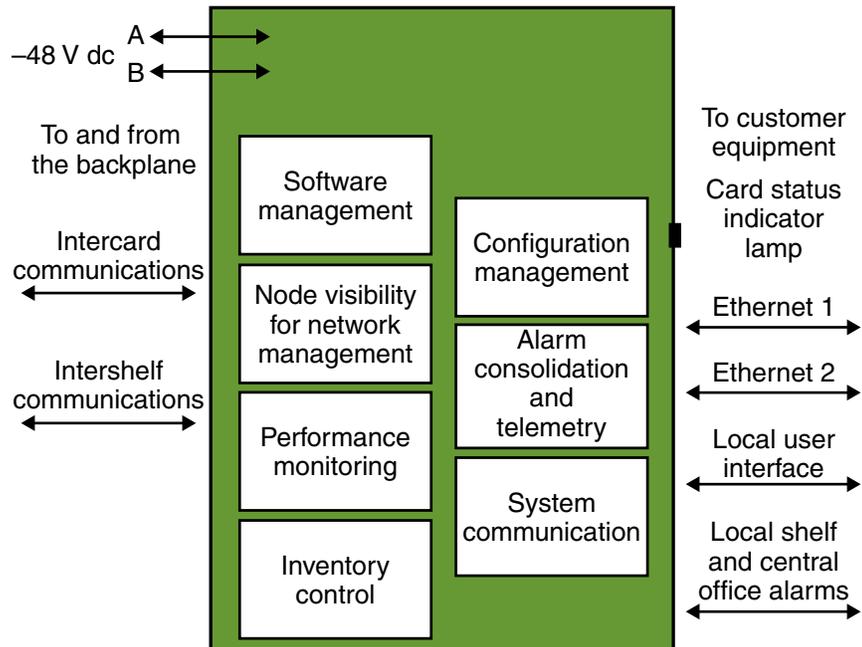
Table 11-1
SP circuit pack types

Type of circuit pack	Slot width	Faceplate connector
SP	1	none

Signal flow

[Figure 11-1](#) shows the signal flow through the SP circuit pack.

Figure 11-1
SP signal flow



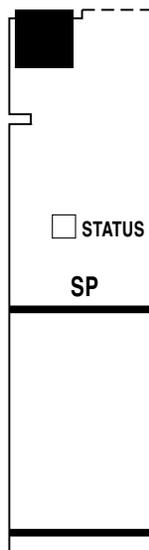
OM0009t

Faceplates

[Figure 11-2](#) shows the faceplate of an SP circuit pack.

Figure 11-2
Faceplate of an SP circuit pack

OM0010s



Indicator lamps

SP circuit packs have the STATUS indicator lamp on the faceplate.

For indicator lamp functionality, see [Table 4-7 on page 4-19](#).

Loopbacks

SP circuit packs do not support loopbacks.

Cables and optical patch cords

There are no cables or optical patch cords associated with SP circuit packs.

Location

For slot assignments and equipping rules, refer to the “[Site requirements and equipping rules](#)” chapter in *Network Planning and Link Engineering*, 323-1701-110.

Product engineering codes

For a list of the product engineering codes (PEC), refer to “[Optical Metro 5100/5200 ordering information](#)” of *Network Planning and Link Engineering*, 323-1701-110.

OFA circuit packs

In this chapter

This chapter includes the following sections:

- [Function and features on page 12-1](#)
- [Signal flow on page 12-4](#)
- [Faceplates on page 12-6](#)
- [Indicator lamps on page 12-9](#)
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Function and features

The optical-fiber amplifier (OFA) circuit pack is a circuit pack specific to the Optical Metro 5200 shelf. The OFA uses an erbium doped fiber amplifier (EDFA) to amplify C-band or L-band signals.

The OFA VGA uses an embedded eVOA (electrically controlled variable optical attenuator) to provide amplifier band power control.

Several OFA circuit pack types are available (see [Table 12-1](#)).

Table 12-1
OFA circuit pack types

OFA family	Circuit pack type	Slot width	Faceplate connector
OFA Standard	OFA Standard C-band	4	SC for Tx and Rx interfaces
	OFA Standard L-band		

Table 12-1 (continued)
OFA circuit pack types

OFA family	Circuit pack type	Slot width	Faceplate connector
OFA HIP	OFA HIP C-band	4	SC for Tx and Rx interfaces
	OFA HIP L-band		SC for input monitor interface
OFA VGA	OFA VGA C-band	3	SC for Tx and Rx interfaces
	OFA VGA L-band		LC for input monitor and output monitor interface

Generic circuit pack features

All OFA types have the following features:

- provide protocol and bit-rate independent optical amplification of the wavelengths for the C-band or L-band
- provide receive and transmit optical interfaces to the Optical Metro 5200 ring for the C-band or L-band
- provide a backplane interface common to the Optical Metro 5200 network
- provide the common S-Bus software and hardware interface to allow intercard communications within the shelf

OFA HIP (High Input Power) circuit pack features

The OFA HIP circuit pack has the following added features when compared to the OFA Standard circuit pack:

- higher input power (up to -7 dBm compared to -11 dBm for the OFA Standard) to allow a higher number of cascaded amplifiers in a network without degrading the OSNR
- improved transient response to prevent the possible impact on the gain of the adjacent channel when a channel is added or dropped
- an optical input monitor tap to examine the wavelengths to be amplified. The value of the monitor port varies by circuit pack. A label is attached below the port that indicates the difference (in dBs) between the signal power and the actual input signal power ($\text{dB} < \text{input signal power}$).

OFA VGA (Variable Gain Amplifier) circuit pack features

The OFA VGA circuit pack has the following added features when compared to the OFA Standard or OFA HIP circuit packs:

- 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.

Note: -2 dBm is the input power at maximum gain. At minimum gain the maximum input power is +8 dBm

- 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). The gain can be adjusted from a remote location (APBE-like control scheme). Although the APBE provides per-band power control, the OFA VGA provides amplifier-band power control. 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.
- an extra faceplate connector for the output monitor interface

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 in which many amplifiers need to be cascaded
- in systems in which the operational functionality of the eVOA is required

Due to the smaller gain, a solution using OFA VGA circuit packs generally requires 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.

Note: 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.

Circuit pack interaction

Deployment of the OFA circuit packs requires some form of optical power equalization, such as APBE, ECT, and distributed equalization. For more information about equalization, refer to the [“Supported configurations”](#) chapter in *Network Planning and Link Engineering*, 323-1701-110.

Performance monitoring

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

All OFA types support the equipment performance monitoring listed in [Table 12-2](#).

Table 12-2
Supported equipment PMs

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

Signal flow

[Figure 12-1](#) shows the signal flow for the OFA Standard and OFA HIP circuit packs.

Figure 12-1
OFA Standard and OFA HIP signal flow

OM1273t

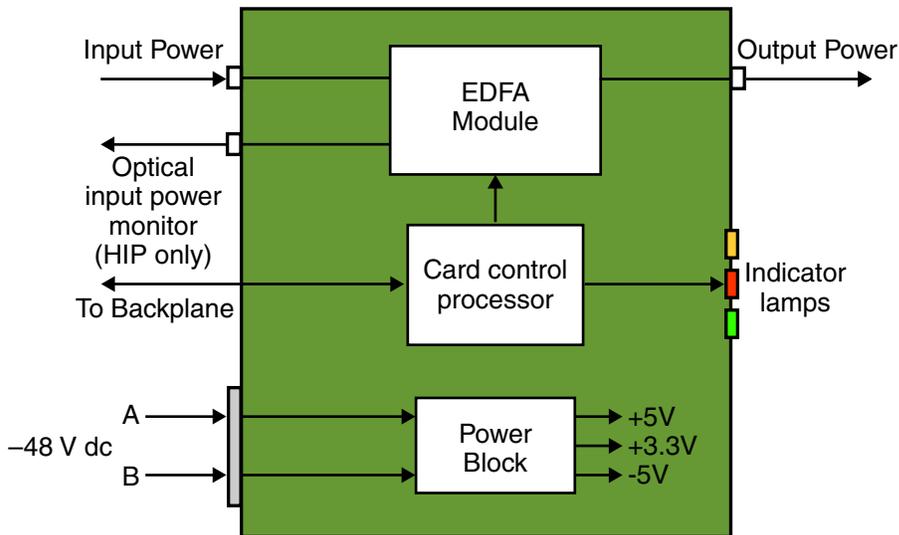
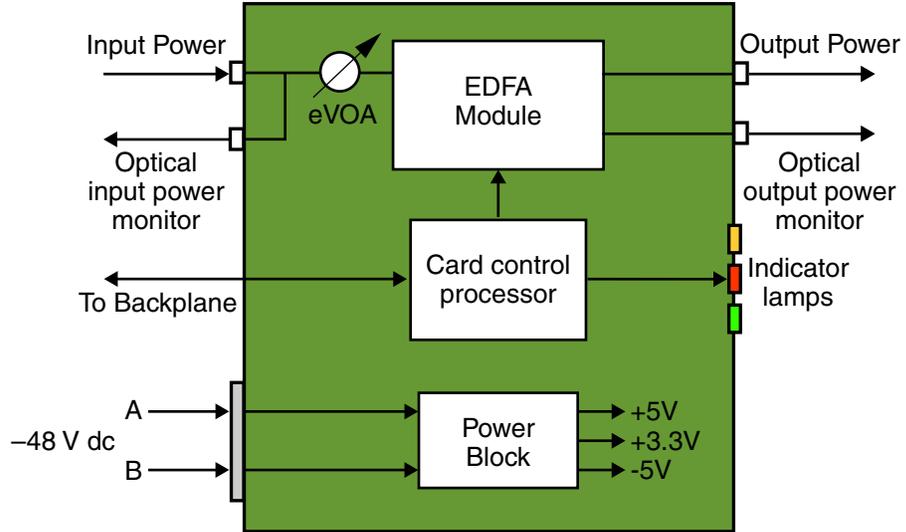


Figure 12-2 shows the signal flow for the OFA VGA circuit pack.

Figure 12-2
OFA VGA circuit pack signal flow

OM2709p



Faceplates

Figure 12-3 shows the faceplate of a OFA Standard circuit pack.

Figure 12-3
OFA Standard circuit pack

OM0011t

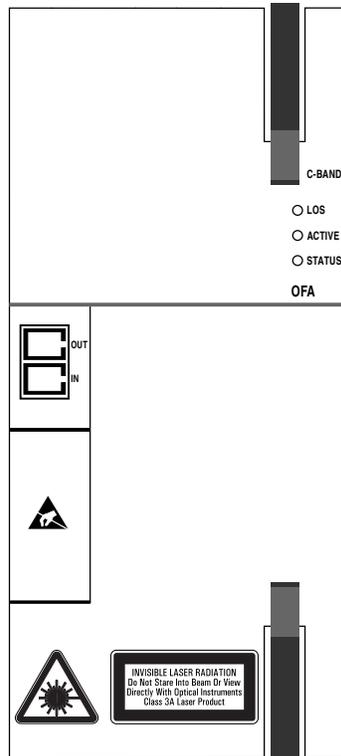
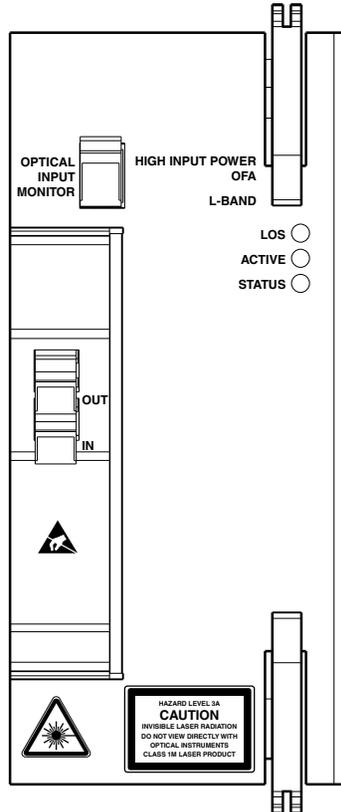


Figure 12-4 shows the faceplate of a OFA HIP circuit pack.

Figure 12-4
OFA HIP circuit pack

OM12721



Indicator lamps

OFA circuit packs have the following indicator lamps on the faceplate:

- LOS
- ACTIVE
- STATUS

For indicator lamp functionality, see [Table 4-7 on page 4-19](#).

Loopbacks

OFA circuit packs do not support loopbacks.

Cables and optical patch cords

For a list of the product engineering codes (PEC), refer to [“Optical Metro 5100/5200 ordering information”](#) of *Network Planning and Link Engineering*, 323-1701-110.

Location

For slot assignments and equipping rules, refer to the [“Site requirements and equipping rules”](#) chapter in *Network Planning and Link Engineering*, 323-1701-110.

Product engineering codes

For a list of the product engineering codes (PEC), refer to [“Optical Metro 5100/5200 ordering information”](#) of *Network Planning and Link Engineering*, 323-1701-110.

APBE circuit packs

In this chapter

This chapter includes the following sections:

- [Function and features on page 13-1](#)
- [Signal flow on page 13-3](#)
- [Faceplates on page 13-4](#)
- [Indicator lamps on page 13-5](#)
- [Loopbacks on page 13-5](#)
- [Cables and optical patch cords on page 13-5](#)
- [Location on page 13-5](#)
- [Product engineering codes on page 13-5](#)

Function and features

The Active Per Band Equalizer (APBE) is a two-slot wide circuit pack used in an Optical Metro 5200 shelf. APBEs provide centralized power management for C-band or L-band traffic in an amplified network. APBE circuit packs provide optical power control, at the band level, for each of the four bands applicable to the type of APBE.

Several APBE circuit pack types are available (see [Table 13-1](#)).

Table 13-1
APBE circuit pack types

APBE family	Circuit pack type	Slot width	Faceplate connector
APBE	APBE C-band	2	LC for Tx and Rx interfaces
	APBE L-band		
APBE Enhanced	APBE Enhanced C-band	2	LC for Tx and Rx interfaces
	APBE Enhanced L-band		

The APBE Enhanced circuit pack is equivalent to the APBE circuit pack with improved insertion loss.

The APBE and APBE Enhanced are interchangeable. Use the procedure 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.

APBE circuit packs have the following features:

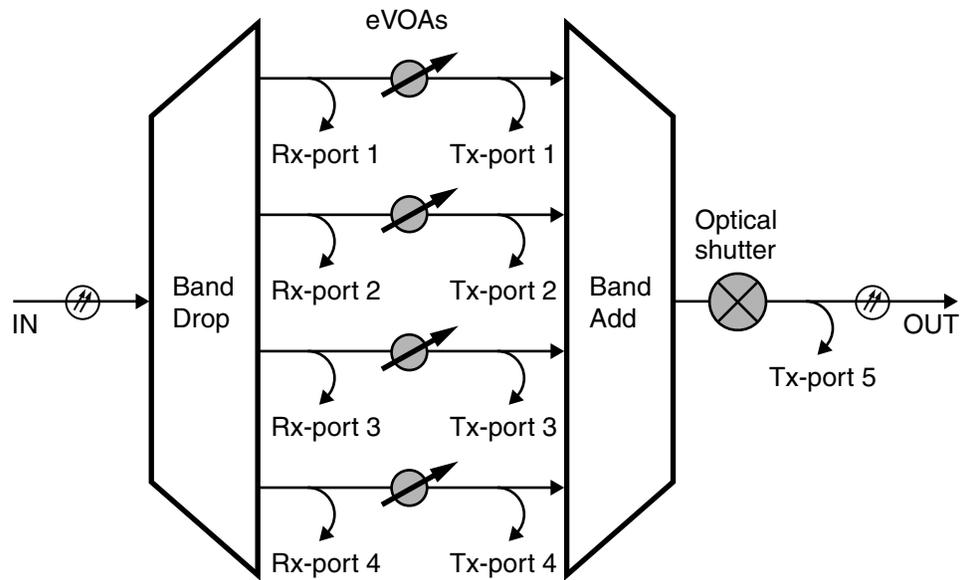
- band demultiplexing filters to split the incoming optical signals into four bands
- four variable optical attenuators (VOAs) to control the optical power of the bands
- band multiplexing filters to recombine bands after attenuation
- an optical shutter that blocks light (for the APBE circuit pack) and VOA technology that produces high attenuation (for the APBE Enhanced circuit pack) during circuit pack removal, power failures and circuit pack failures
- optical power monitoring on the input and output signal for each band without affecting traffic
- optical power monitoring on the aggregate output signal
- signal power can be remotely attenuated using the Optical Metro 5200 System Manager, or through a TL1 interface
- performance monitoring and alarms on the optical power of the input and output signals

Signal flow

Figure 13-1 shows the signal flow for the APBE circuit pack.

Figure 13-1
APBE signal flow

OM0920t



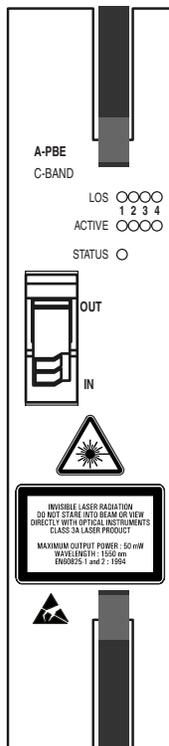
Note: The optical shutter is not present in the APBE Enhanced circuit pack. The APBE Enhanced circuit pack uses a different VOA technology that produces high attenuation similar to an optical shutter.

Faceplates

Figure 13-2 shows the faceplate of an APBE circuit pack.

Figure 13-2
Faceplate of APBE circuit pack

OM0905t



Indicator lamps

The APBE circuit pack has the following indicator lamps on the faceplate:

- four LOS lamps (one for each eVOA port)
- four ACT (active) lamps (one for each eVOA port)
- one STATUS lamp

For indicator lamp functionality, see [Table 4-7 on page 4-19](#).

Loopbacks

APBE circuit packs do not support loopbacks.

Cables and optical patch cords

For information on cables and optical patch cords, refer to [“Cables and optical patch cords” on page 21-1](#).

Location

For slot assignments and equipping rules, refer to the [“Site requirements and equipping rules”](#) chapter in *Network Planning and Link Engineering*, 323-1701-110.

Product engineering codes

For a list of the product engineering codes (PEC), refer to [“Optical Metro 5100/5200 ordering information”](#) of *Network Planning and Link Engineering*, 323-1701-110.

Filler cards

In this chapter

This chapter includes the following sections:

- [Function and features on page 14-1](#)
- [Location on page 14-2](#)
- [Product engineering codes on page 14-2](#)

Function and features

Filler cards are installed in slots of the shelf that do not have active circuit packs. Filler cards also enable forced air cooling.

ATTENTION

Filler cards must be installed in slots of the shelf that do not have active circuit packs. Do not leave unused circuit packs in a shelf.

Several Filler card types are available (see [Table 14-1](#)).

Table 14-1
Filler card types

Filler card type	Slot width	Faceplate connector
OCLD filler card	1	FC for Tx and Rx interfaces
LC filler card	1	LC for Tx and Rx interfaces
OFA filler card	1	SC for Tx and Rx interfaces
Blank filler card	1	None

OCLD filler cards

OCLD filler cards have FC connectors on the faceplate. The OCLD filler card is mandatory if you are using the OMX (Standard) tray to hold unused pigtailed. The OCLD filler card can also be used in any shelf if you want to pre-fiber any OMX variant other than the OMX (Standard) tray.

Note: Pre-fiber is an optional exercise. It is not mandatory.

LC filler cards

LC filler cards have LC connectors on the faceplate. The LC filler card is used if you want to pre-fiber any OMX variant other than the OMX (Standard) tray.

Note: Pre-fibering is an optional exercise. It is not mandatory.

OFA filler cards

OFA filler cards have SC connectors on the faceplate that are used to connect unused patchcords from the ECT. If you have an ECT installed with an OFA shelf, you must install one OFA filler card, and three blank filler cards, for every group of four unused slots in the OFA shelf.

Blank filler cards

Blank filler cards have no connectors, and are installed in all other unused slots.

Location

For slot assignments and equipping rules, refer to the [“Site requirements and equipping rules”](#) chapter in *Network Planning and Link Engineering*, 323-1701-110.

Product engineering codes

For a list of the product engineering codes (PEC), refer to [“Optical Metro 5100/5200 ordering information”](#) of *Network Planning and Link Engineering*, 323-1701-110.

Nortel

Optical Metro 5100/5200

Hardware Description, Part 1 of 2

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