



CHAPTER 10

Node Reference

This chapter explains the ONS 15454 dense wavelength division multiplexing (DWDM) node types that are available for the ONS 15454. The DWDM node type is determined by the type of amplifier and filter cards that are installed in an ONS 15454. The chapter also explains the DWDM automatic power control (APC), reconfigurable optical add/drop multiplexing (ROADM) power equalization, span loss verification, and automatic node setup (ANS) functions.



Note

Unless otherwise specified, “ONS 15454” refers to both ANSI and ETSI shelf assemblies.



Note

In this chapter, “OPT-BST” refers to the OPT-BST, OPT-BST-E, OPT-BST-L cards, and to the OPT-AMP-L and OPT-AMP-17-C cards when they are provisioned in OPT-LINE (optical booster) mode. “OPT-PRE” refers to the OPT-PRE card and to the OPT-AMP-L and OPT-AMP-17-C cards provisioned in OPT-PRE (pre-amplifier) mode.

Chapter topics include:

- [10.1 DWDM Node Configurations, page 10-1](#)
- [10.2 Supported Node Configurations for OPT-RAMP-C Card, page 10-19](#)
- [10.3 Supported Node Configurations for PSM Card, page 10-22](#)
- [10.4 Multishelf Node, page 10-25](#)
- [10.5 Optical Sides, page 10-27](#)
- [10.6 Configuring Mesh DWDM Networks, page 10-37](#)
- [10.7 DWDM Node Cabling, page 10-48](#)
- [10.8 Automatic Node Setup, page 10-64](#)
- [10.9 DWDM Functional View, page 10-71](#)

10.1 DWDM Node Configurations

The ONS 15454 supports the following DWDM node configurations: hub, terminal, optical add/drop multiplexing (OADM), reconfigurable OADM (ROADM), anti-amplified spontaneous emission (anti-ASE), line amplifier, optical service channel (OSC) regeneration line, multishelf nodes, and node

configurations for mesh networks. All node configurations can be provisioned with C-band or L-band cards except the OADM and anti-ASE nodes. These nodes require AD-xB-xx.x or AD-xC-xx.x cards, which are C-band only. All node configurations can be single-shelf or multishelf.

**Note**

The Cisco TransportPlanner tool creates a plan for amplifier placement and proper node equipment.

**Note**

To support multiple optical sides in mesh DWDM networks, east and west are no longer used to reference the left and right sides of the ONS 15454 shelf. If a network running a previous software release is upgraded to this release, west will be mapped to A and east to B. In two-sided nodes, such as a hub or ROADM node, Side A refers to Slots 1 through 6 and Side B refers to Slots 12 through 17. Terminal nodes have one side labeled “A,” regardless of which slots have cards installed. For more information about configuring the ONS 15454 in mesh DWDM networks, see the [“10.6 Configuring Mesh DWDM Networks” section on page 10-37](#).

10.1.1 Hub Node

A hub node is a single ONS 15454 node equipped with two TCC2/TCC2P cards and one of the following combinations:

- Two 32MUX-O cards and two 32DMX-O or 32DMX cards
- Two 32WSS cards and two 32DMX or 32DMX-O cards
- Two 32WSS-L cards and two 32DMX-L cards
- Two 40-WSS-C or 40-WSS-CE cards and two 40-DMX-C or 40DMX-CE cards

**Note**

The 32WSS/32WSS-L/40-WSS-C/40-WSS-CE and 32DMX/32DMX-L/40-DMX-C/40-DMX-CE cards are normally installed in ROADM nodes, but they can also be installed in hub and terminal nodes. If the cards are installed in a hub node, the 32WSS/32WSS-L/40-WSS-C/40-WSS-CE express ports (EXP RX and EXP TX) are not cabled.

A dispersion compensation unit (DCU) can also be added, if necessary. [Figure 10-1](#) shows a hub node configuration with 32MUX-O and 32DMX-O cards installed.

Figure 10-1 Hub Node Configuration Example with 32-Channel C-Band Cards

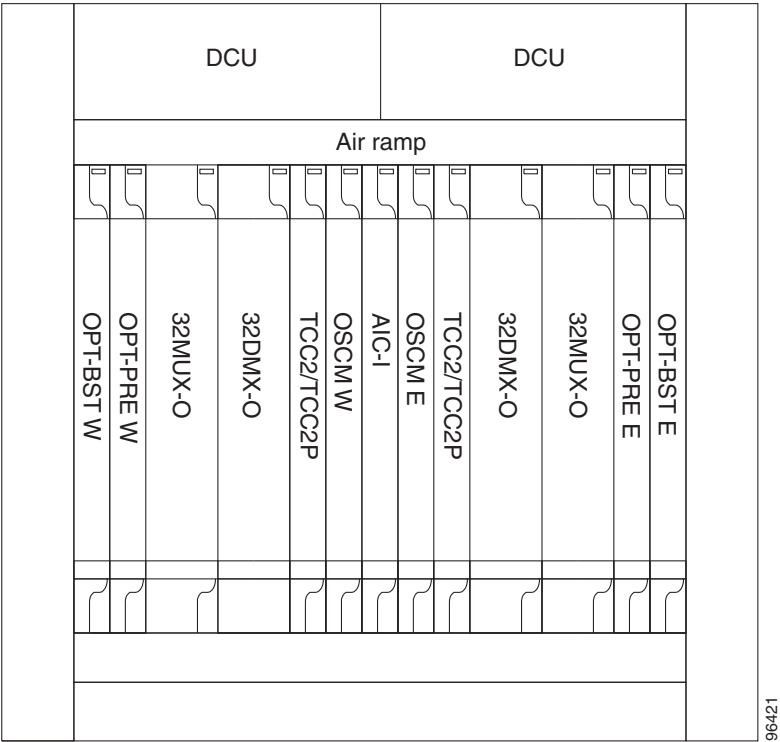


Figure 10-2 shows a 40-channel hub node configuration with 40-WSS-C cards installed.

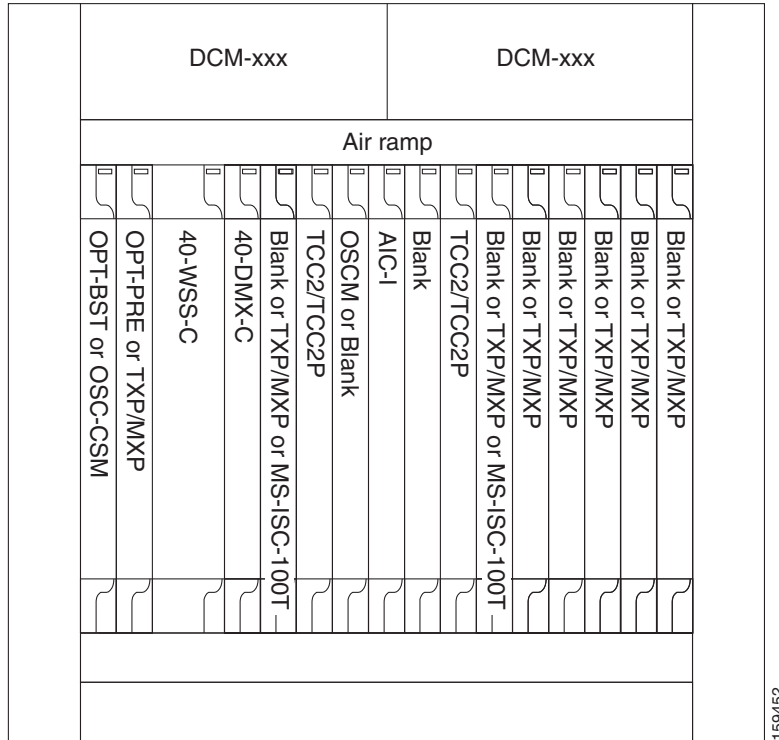
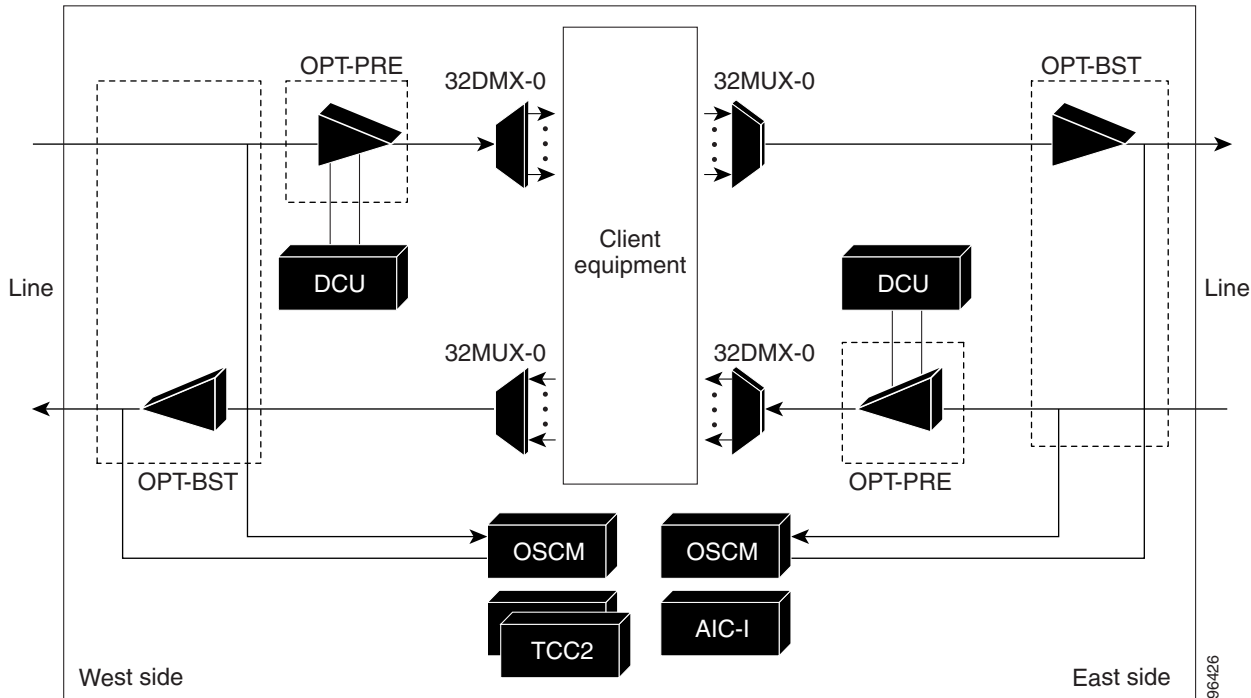
Figure 10-2 Hub Node Configuration Example with 40-WSS-C Cards

Figure 10-3 shows the channel flow for a hub node. Up to 32 channels from the client ports are multiplexed and equalized onto one fiber. Then, multiplexed channels are transmitted to the OPT-BST amplifier. The OPT-BST output is combined with an output signal from the OSCM card and transmitted to the other side.

Received signals are divided between the OSCM card and an OPT-PRE card. Dispersion compensation is applied to the signal received by the OPT-PRE amplifier, and it is then sent to the 32DMX-O card, which demultiplexes and attenuates the input signal.

Figure 10-3 Hub Node Channel Flow Example

10.1.2 Terminal Node

A terminal node is a single ONS 15454 node equipped with two TCC2/TCC2P cards and one of the following combinations:

- One 32MUX-O card and one 32DMX-O card
- One 32WSS card and either a 32DMX or a 32DMX-O card
- One 32WSS-L card and one 32DMX-L card
- One 40-WSS-C or 40-WSS-CE card and one 40-DMX-C or 40-DMX-CE card
- One 40-MUX-C and one 40-DMX-C or 40-DMX-CE card

Cards in the terminal nodes can be installed in Slots 1 through 6 or Slots 12 through 17. The side where cards are installed is always assigned as Side A. [Figure 10-4](#) shows an example of a terminal configuration with a 2MUX-O card installed. The channel flow for a terminal node is the same as the hub node ([Figure 10-3](#)).

Available	DCU
Air ramp	
Available	
Available	
Available	
Available	
Available	
Available	
TCC2/TCC2P	
Available	
AIC-1	
OSCM	
TCC2/TCC2P	
32DMX-O	
32MUX-O	
OPT-PRE	
OPT-BST	

Figure 10-5 shows an example of a terminal configuration with a 40-WSS-C card installed.

Figure 10-5 Terminal Node Configuration with 40-WSS-C Cards Installed

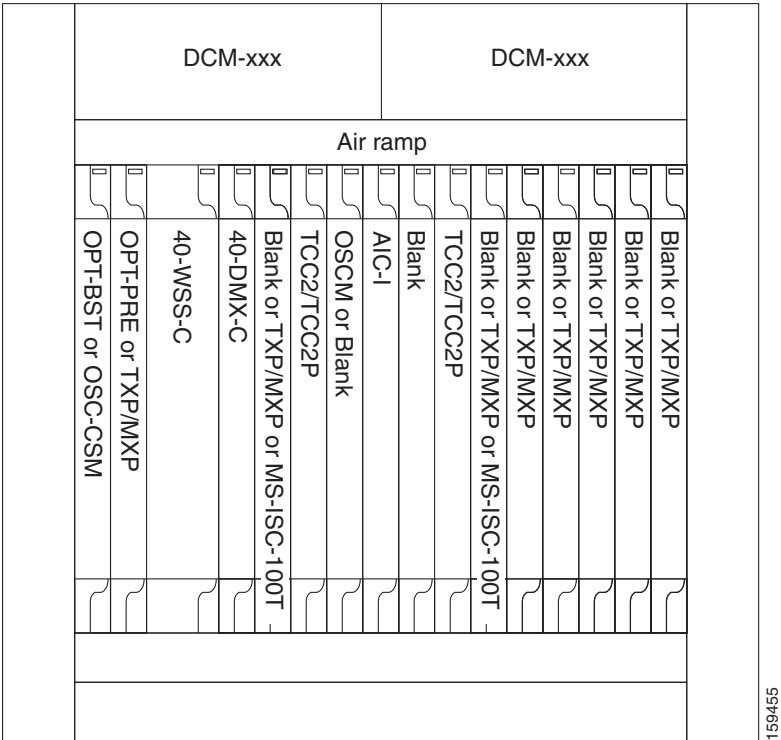
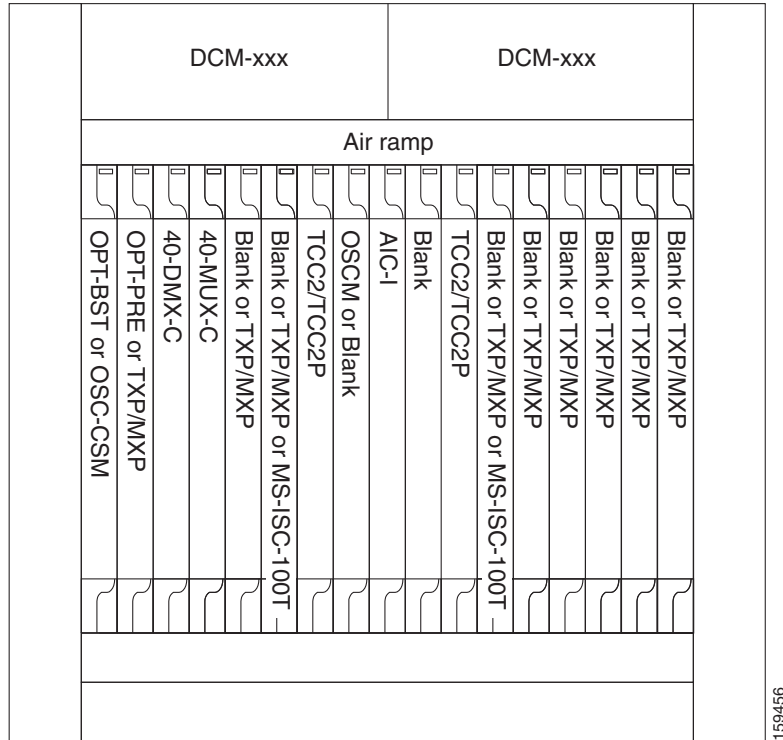


Figure 10-5 shows an example of a terminal configuration with a 40-MUX-C card installed.

Figure 10-6 Terminal Node with 40-MUX-C Cards Installed

10.1.3 OADM Node

An OADM node is a single ONS 15454 node equipped with cards installed on both sides and at least one AD-xC-xx.x card or one AD-xB-xx.x card and two TCC2/TCC2P cards. 32MUX-O/40-MUX-C or 32DMX-O/40-DMX-C/40-DMX-CE cards cannot be installed in an OADM node. In an OADM node, channels can be added or dropped independently from each direction and then passed through the reflected bands of all OADMs in the DWDM node (called express path). They can also be passed through one OADM card to another OADM card without using a TDM ITU-T line card (called optical pass-through) if an external patchcord is installed.

Unlike express path, an optical pass-through channel can be converted later to an add/drop channel in an altered ring without affecting another channel. OADM amplifier placement and required card placement is determined by the Cisco TransportPlanner tool or your site plan.

OADM nodes can be amplified or passive. In amplified OADMs, booster and preamplifier cards are installed on both sides of the node. [Figure 10-7](#) shows an example of an amplified OADM node configuration. In addition, OADM nodes can be asymmetric. Amplifiers may be installed in one side, but not the other. Or preamplifiers may be installed in one side, and a booster in the other.

Figure 10-7 Amplified OADM Node Configuration Example

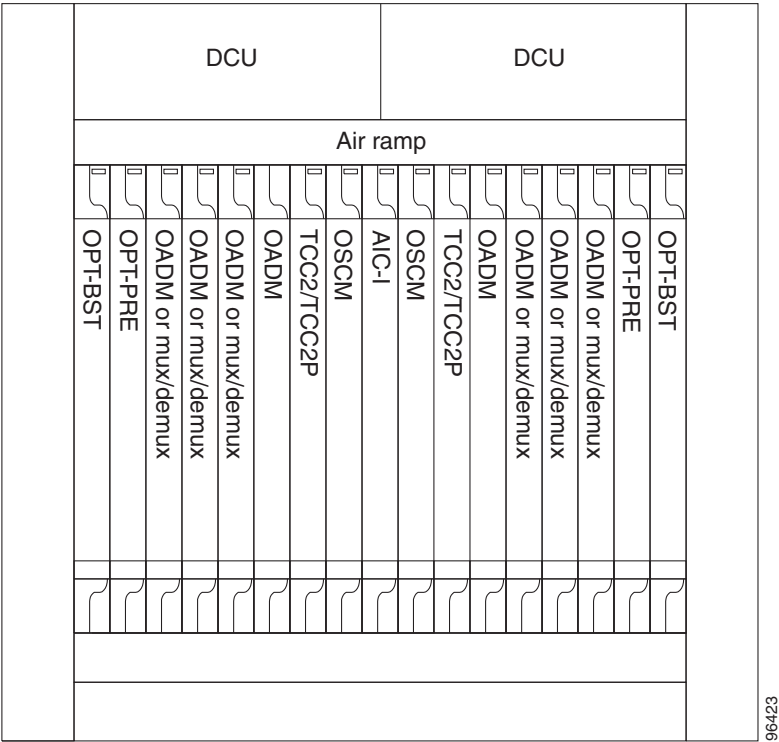


Figure 10-8 shows an example of the channel flow on the amplified OADM node. Since the 32-wavelength plan is based on eight bands (each band contains four channels), optical adding and dropping can be performed at the band level and/or at the channel level (meaning individual channels can be dropped).

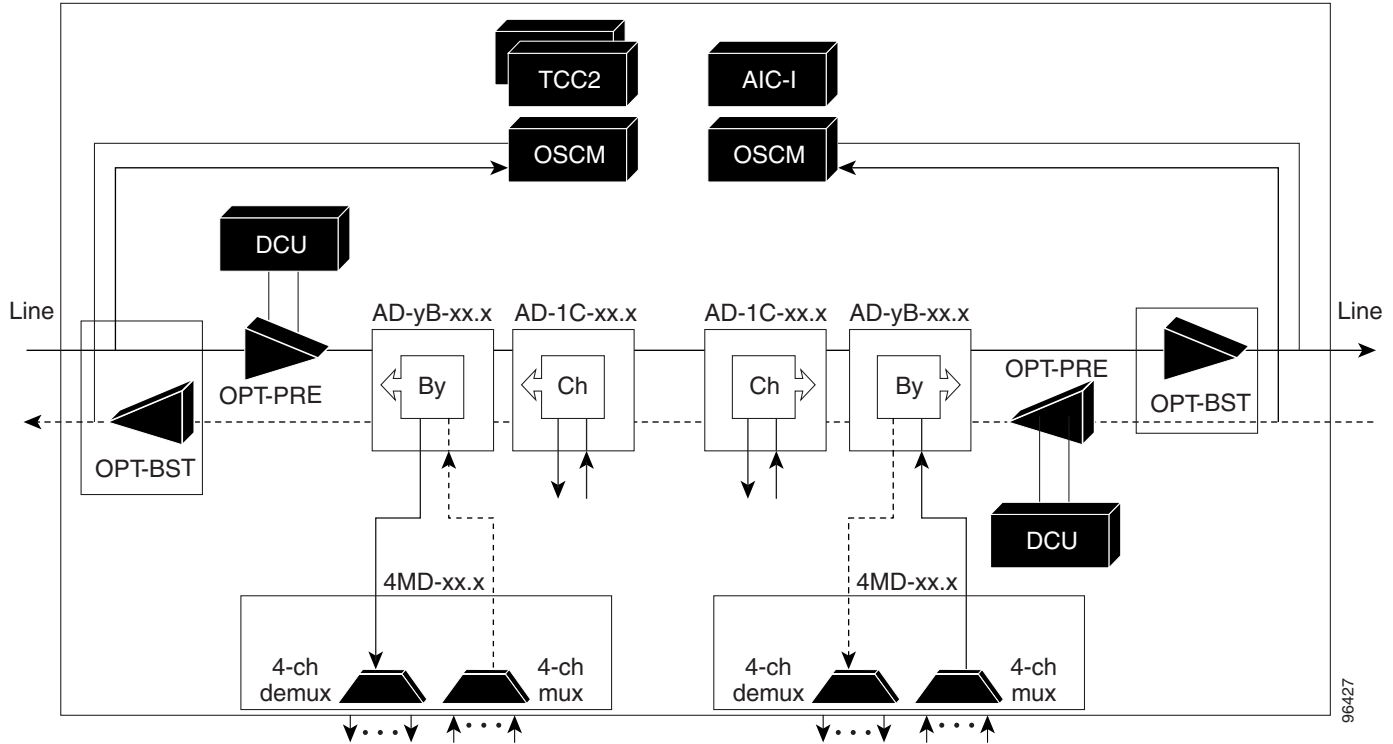
Figure 10-8 Amplified OADM Node Channel Flow Example

Figure 10-9 shows an example of a passive OADM node configuration. The passive OADM node is equipped with a band filter, one four-channel multiplexer/demultiplexer, and a channel filter on each side of the node.

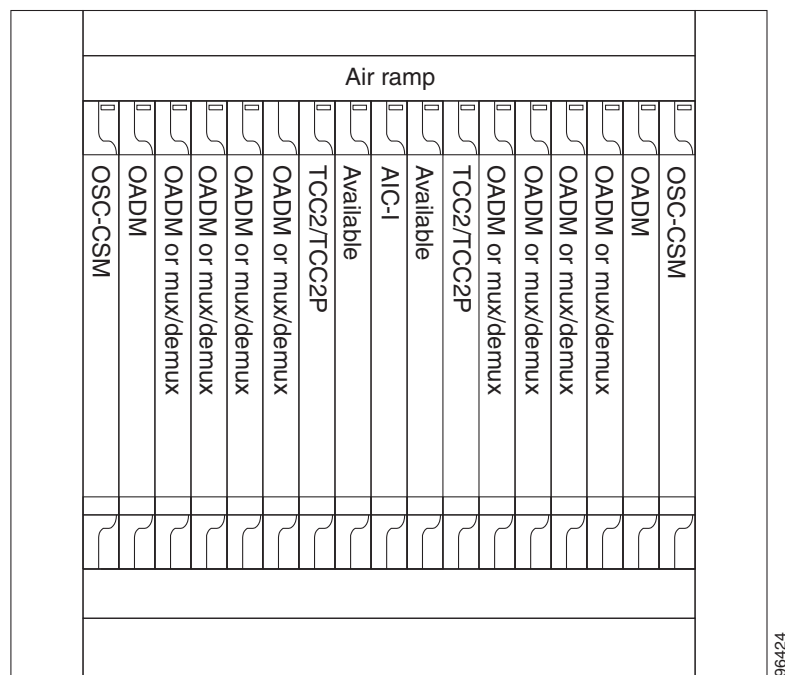
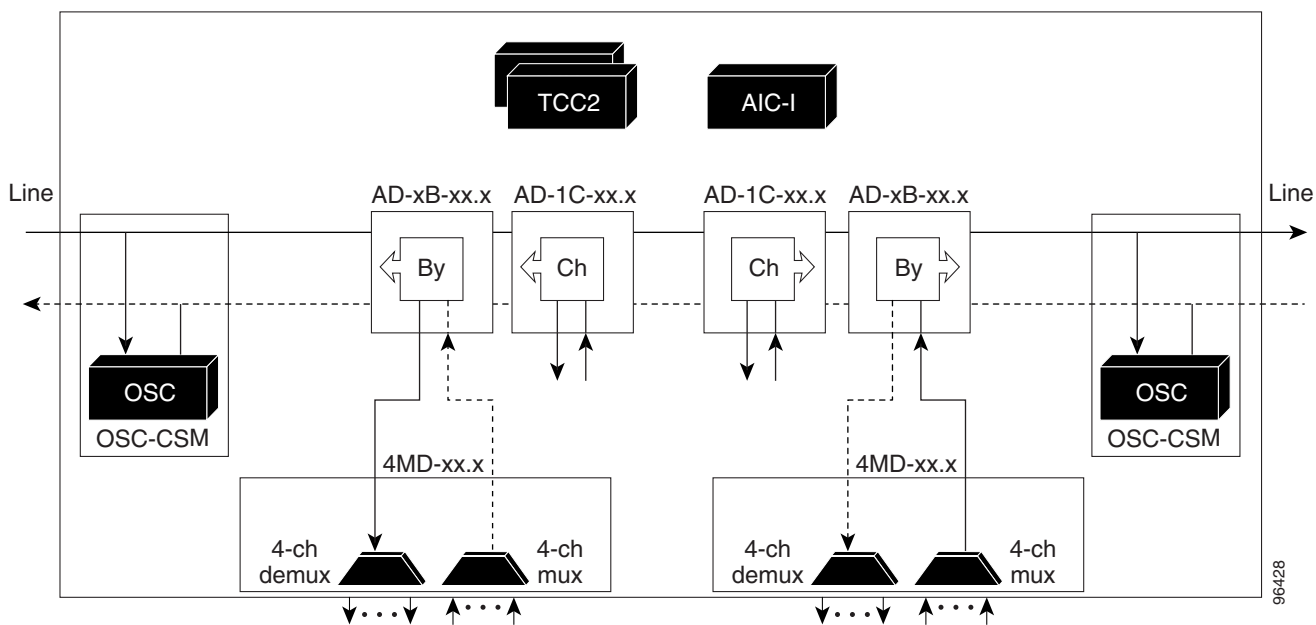
Figure 10-9 *Passive OADM Node Configuration Example*

Figure 10-10 shows an example of traffic flow on the passive OADM node. The signal flow of the channels is the same as the amplified OADM, except that the OSC-CSM card is used instead of the OPT-BST and OSCM cards.

Figure 10-10 *Passive OADM Node Channel Flow Example*

10.1.4 ROADM Node

A ROADM node adds and drops wavelengths without changing the physical fiber connections. A ROADM node is equipped with two TCC2/TCC2P cards and one of the following combinations:

- Two 32WSS cards and, optionally, two 32DMX or 32DMX-O cards
- Two 32WSS-L cards and, optionally, two 32DMX-L cards
- Two 40-WSS-C or 40-WSS-CE cards and, optionally, two 40-DMX-C or 40-DMX-CE cards

Transponders (TXPs) and muxponders (MXPs) can be installed in Slots 6 and 12 and, if amplification is not used, in any open slot.



Note

Although not required, 32DMX-O can be used in an ROADM node. Cisco TransportPlanner automatically chooses the demultiplexer card that is best for the ROADM node based on the network requirements.

Figure 10-11 shows an example of an amplified ROADM node configuration with 32DMX cards installed.

Figure 10-11 ROADM Node with 32DMX Cards Installed

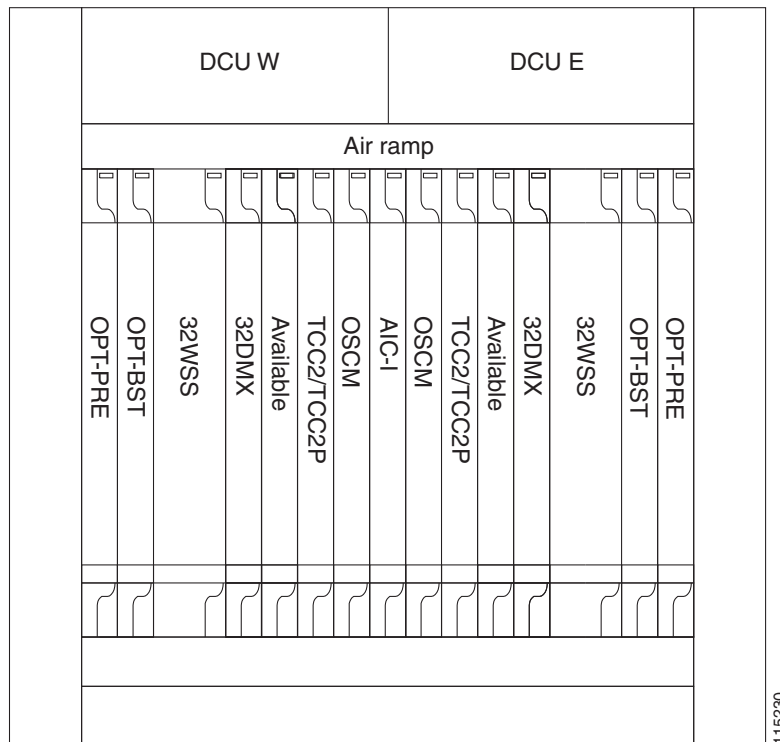


Figure 10-12 shows an example of an amplified ROADM node configuration with 40-WSS-C cards installed.

Figure 10-12 ROADM Node with 40-WSS-C Cards Installed

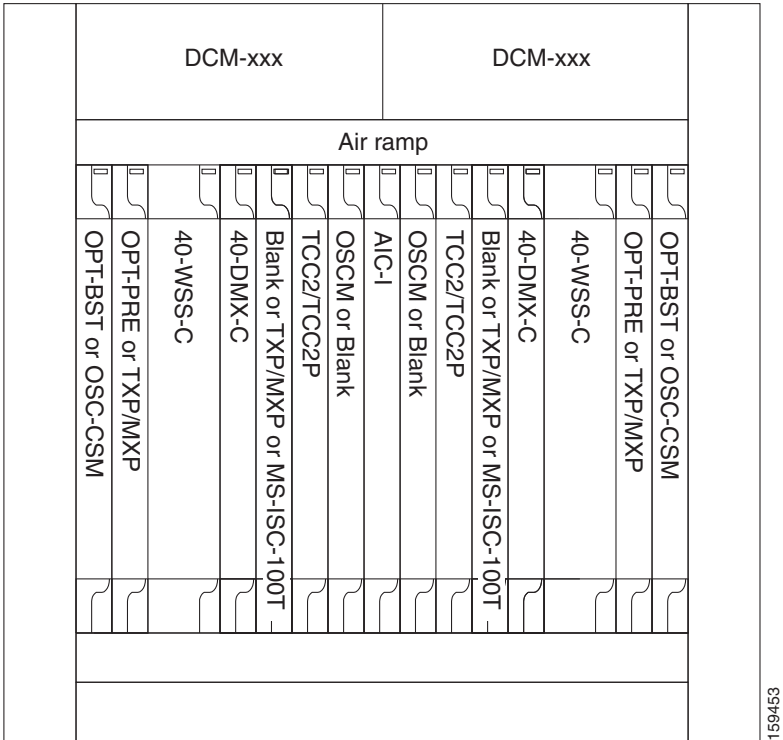


Figure 10-13 shows an example of an ROADM node with 32WSS-L and 32DMX-L cards installed.

Figure 10-13 ROADM Node with 32WSS-L and 32DMX-L Cards Installed

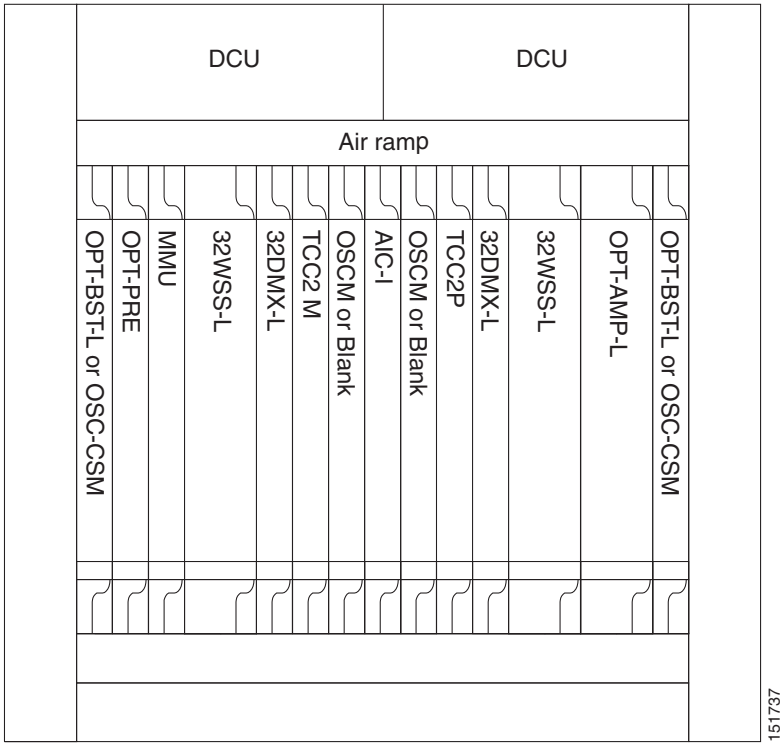
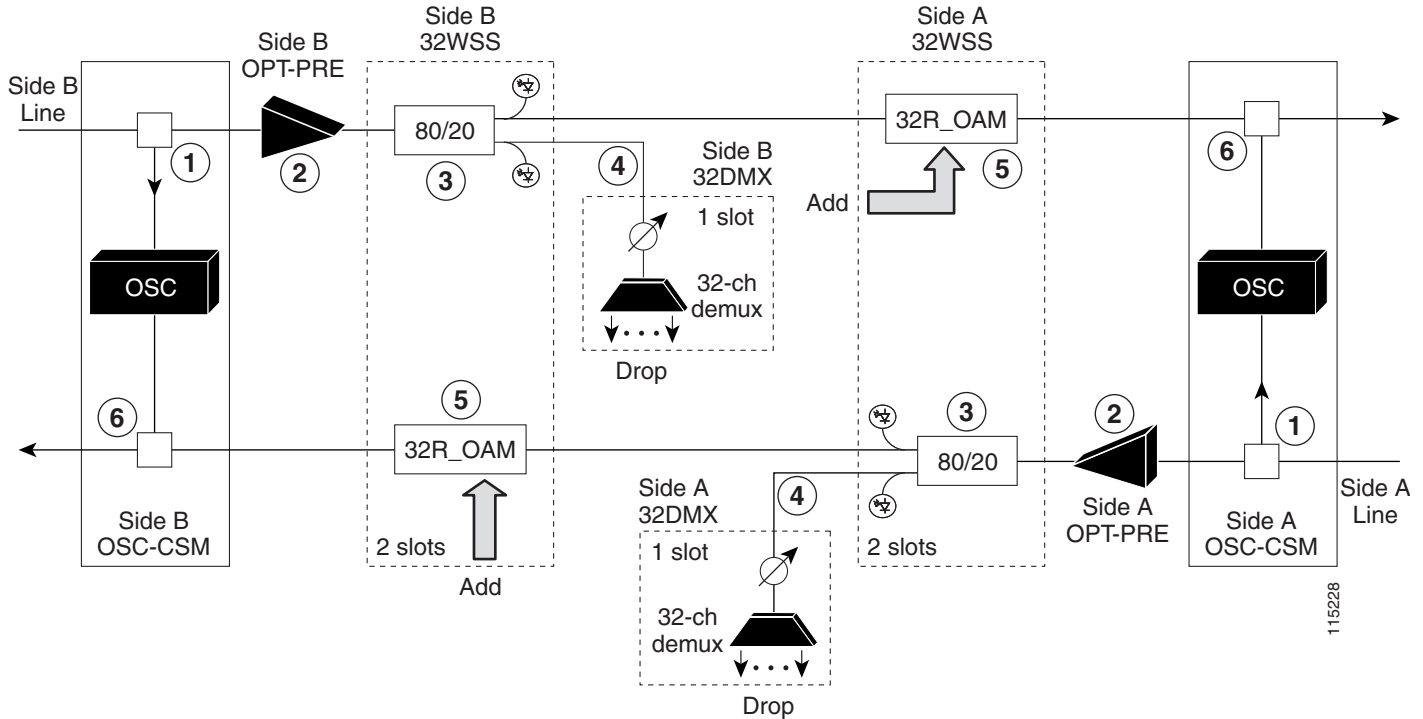


Figure 10-14 shows an example of an ROADM optical signal flow from Side A to Side B. The optical signal flow from Side B to Side A follows an identical path through the Side B OSC-CSM and 32WSS or 40-WSS-C cards. In this example, OSC-CSM cards are installed so OPT-BSTs are not needed.

Figure 10-14 ROADM Optical Signal Flow Example

115228

1	The OSC-CSM receives the optical signal. It separates the optical service channel from the optical payload and sends the payload to the OPT-PRE module.
2	The OPT-PRE compensates for chromatic dispersion, amplifies the optical payload, and sends it to the 32WSS or 40-WSS-C/40-WSS-CE.
3	The 32WSS or 40-WSS-C/40-WSS-CE splits the signal into two components. The 80 percent component is sent to the DROP-TX port and the 20 percent component is sent to the EXP-TX port.
4	The drop component goes to the 32DMX card or 40-DMX-C/40-DMX-CE card where it is demultiplexed and dropped.
5	The express wavelength aggregate signal goes to the 32WSS or 40-WSS-C/40-WSS-CE on the other side where it is demultiplexed. Channels are stopped or forwarded based upon their switch states. Forwarded wavelengths are merged with those coming from the ADD path and sent to the OSC-CSM module.
6	The OSC-CSM combines the multiplexed payload with the OSC and sends the signal out the transmission line.

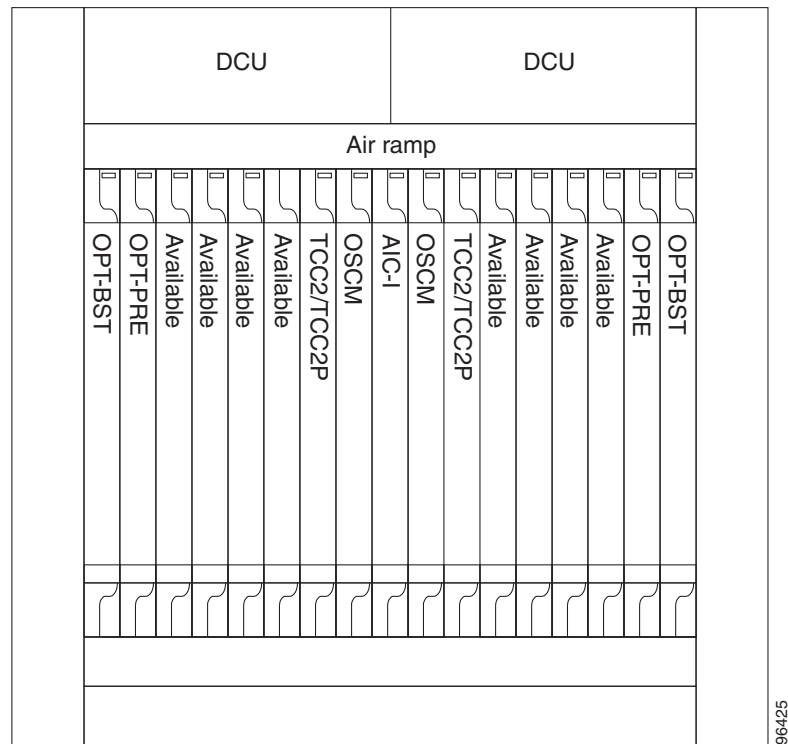
10.1.5 Anti-ASE Node

In a mesh ring network, the ONS 15454 requires a node configuration that prevents ASE accumulation and lasing. An anti-ASE node can be created by configuring a hub node or an OADM node with some modifications. No channels can travel through the express path, but they can be demultiplexed and dropped at the channel level on one side and added and multiplexed on the other side.

The hub node is the preferred node configuration when some channels are connected in pass-through mode. For rings that require a limited number of channels, combine AD-xB-xx.x and 4MD-xx.x cards, or cascade AD-xC-xx.x cards. See [Figure 10-8 on page 10-10](#).

[Figure 10-15](#) shows an anti-ASE node that uses all wavelengths in the pass-through mode. Use Cisco TransportPlanner to determine the best configuration for anti-ASE nodes.

78-18377-02

Figure 10-16 Line Amplifier Node Configuration Example

10.1.7 OSC Regeneration Node

The OSC regeneration node is added to the DWDM networks for two purposes:

- To electrically regenerate the OSC channel whenever the span links are 37 dB or longer and payload amplification and add/drop capabilities are not present. Cisco TransportPlanner places an OSC regeneration node in spans longer than 37 dB. The span between the OSC regeneration node and the next DWDM network site cannot be longer than 31 dB.
- To add data communications network (DCN) capability wherever needed within the network.

OSC regeneration nodes require two OSC-CSM cards, as shown in [Figure 10-17](#). The cards are installed in each side of the shelf.

Figure 10-17 OSC Regeneration Line Node Configuration Example

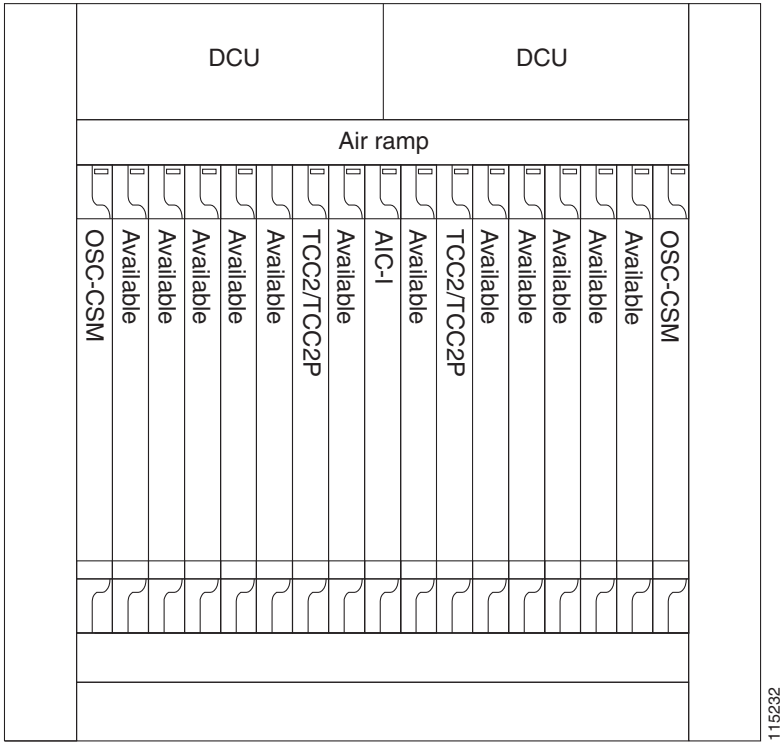
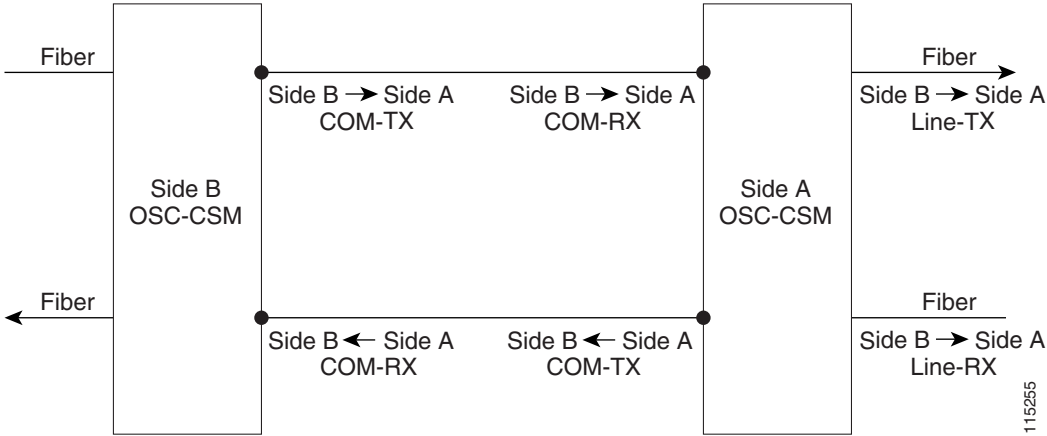


Figure 10-18 shows the OSC regeneration line node signal flow.

Figure 10-18 OSC Regeneration Line Node Flow



10.2 Supported Node Configurations for OPT-RAMP-C Card

The OPT-RAMP-C card can be equipped in the following NE type configurations:

- C-band odd systems:
 - C-band terminal site with 32-MUX-O and 32-DMX-O cards
 - C-band hub node with 32-MUX-O and 32-DMX-O cards
 - C-band fixed OADM node
 - C-band line site
 - C-band 32-channel reconfigurable OADM (ROADM)
 - C-band terminal site using a 32-WSS and 32-DMX cards
 - C-band flexible terminal site using AD-xC cards
 - C-band hub node using a 32-WSS and 32-DMX cards
 - C-band 40-channel ROADM
 - C-band terminal site using a 40-WSS-C and 40-DMX-C cards
 - C-band terminal site using 40-MUX-C and 40-DMX-C cards
 - C-band hub node using a 40-WSS-C and 40-DMX-C cards
 - C-band up to 4 degree mesh node
 - C-band up to 8 degree mesh node
 - C-band multiring/mesh with MMU node
 - C-band 4 degree multiring/mesh node (MMU based)
- C-band odd and even systems:
 - C-band 64-channel terminal site
 - C-band 72-channel terminal site
 - C-band 80-channel terminal site
 - C-band 64-channel hub site
 - C-band 72-channel hub site
 - C-band 80-channel hub site
 - C-band 64-channel ROADM site
 - C-band 72-channel ROADM site
 - C-band 80-channel ROADM site

The following amplifier cards are defined as booster or preamplifiers:

- Booster:
 - OPT-BST
 - OPT-BST-E
 - OPT-AMP-17-C
 - OPT-AMP-C

- Preamplifier:
 - OPT-PRE
 - OPT-AMP-C
 - OPT-BST
 - OPT-BST-E

**Note**

When the booster is not needed, it must be replaced with an OSC-CSM card.

The maximum number of shelves that can be aggregated in a multishelf node are:

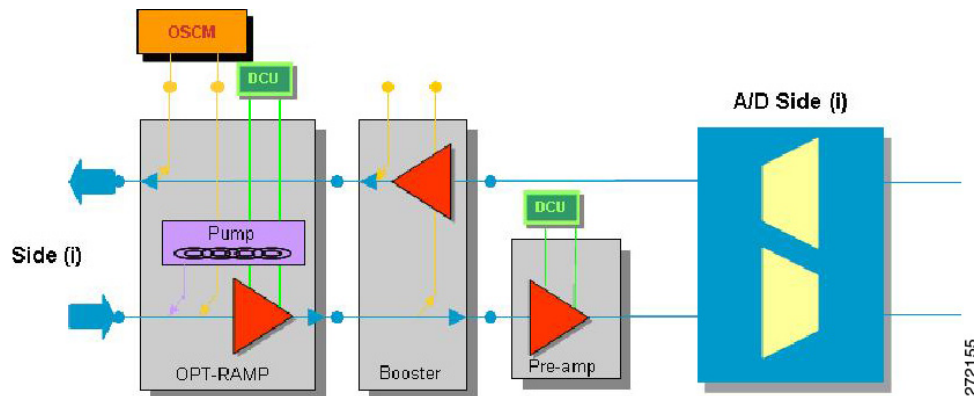
- Eight, if the MS-ISC-100T switch card is used.
- Twelve, if an external Catalyst 2950 switch is used.

10.2.1 OPT-RAMP-C Card in an Add/Drop Node

When the OPT-RAMP-C card is equipped in an add/drop node, the booster amplifier is mandatory and cannot be replaced by an OSC-CSM card. The preamplifier is an OPT-BST, OPT-BST-E, or OPT-AMP-C card, and must be cabled as a unidirectional card. Note that the COM-TX and LINE-RX ports must not be used for any other connections.

Figure 10-19 shows the OPT-RAMP-C card in an add/drop node.

Figure 10-19 OPT-RAMP-C Card in an Add/Drop Node



When required, a DCN extension can be used on A/D Side (i). Side(i) can be equipped with the following cards:

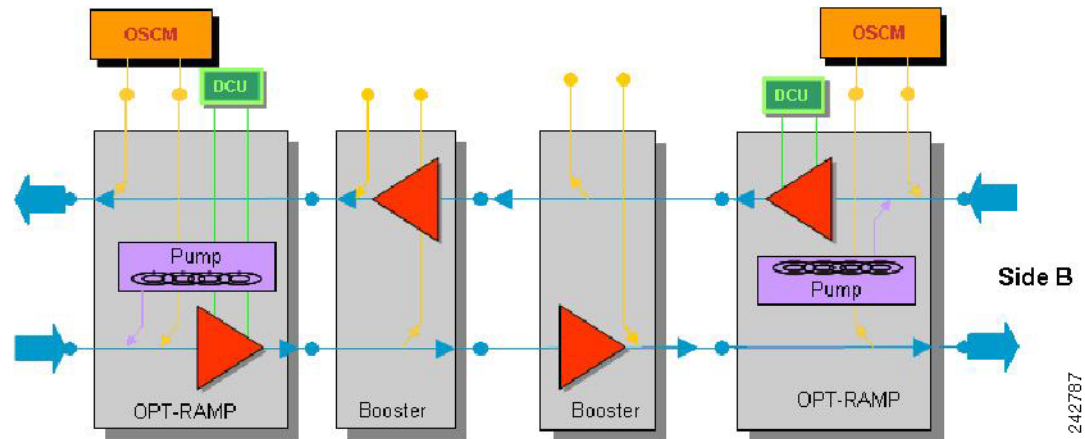
- WSS + DMX
- AD-xC
- WXC + MUX + DMX

10.2.2 OPT-RAMP-C Card in a Line Site Node with Booster Amplification

The OPT-RAMP-C card can be equipped in a line site node with a booster amplifier in the following configurations:

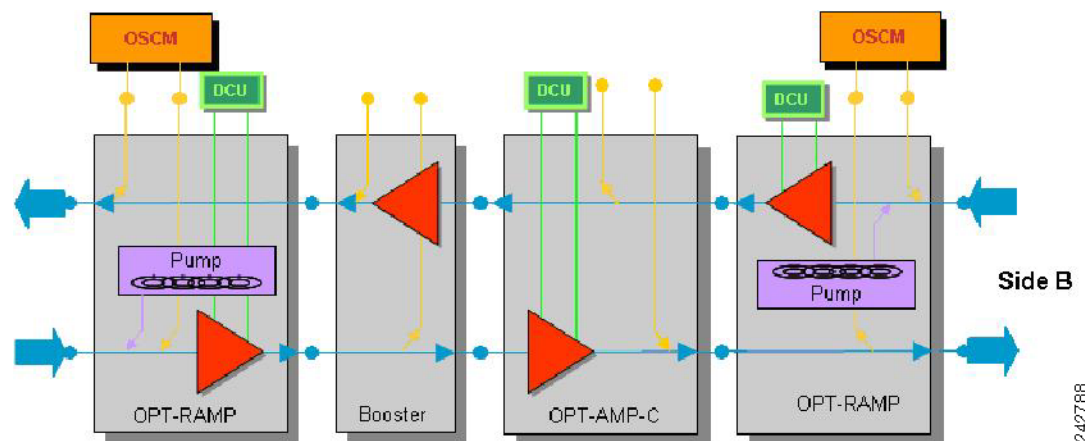
- The OPT-BST and OPT-BST-E can be used as booster in a line site node with OPT-RAMP-C. The booster cards need to be cabled as bidirectional units. [Figure 10-20](#) shows the OPT-RAMP-C card in a line site configuration.

Figure 10-20 OPT-RAMP-C Card in a Line Site Configuration

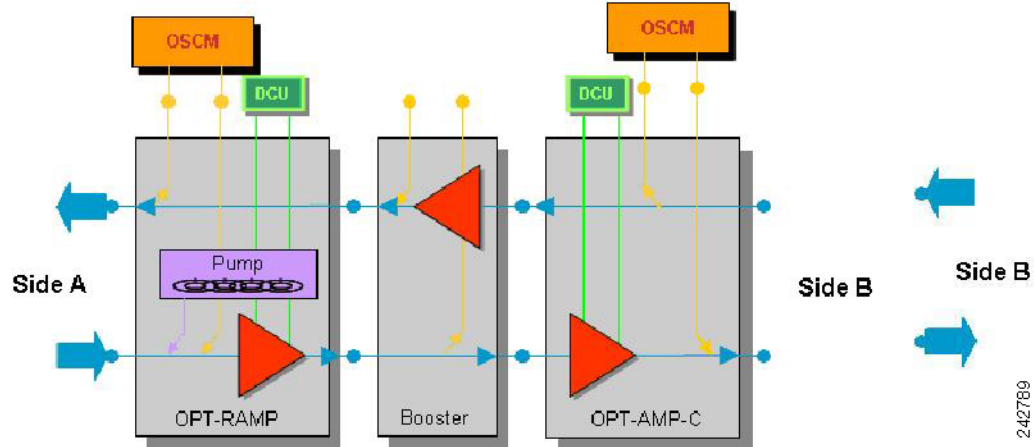


- The OPT-AMP-C can be used as a booster in a line site node with OPT-RAMP-C and needs to be cabled as a bidirectional unit. An additional DCU unit can be equipped between the OPT-AMP-C DC ports. [Figure 10-21](#) shows a line site configured with OPT-AMP-C and an additional DCU unit.

Figure 10-21 Line Site Configured with OPT-AMP-C



- A line site can be configured with OPT-RAMP-C on one side only. [Figure 10-22](#) shows the line site configured with OPT-RAMP-C on side A only. The booster is configured on side B.

Figure 10-22 Line Site with OPT-RAMP-C On One Side

In all configurations, the booster amplifier facing the OPT-RAMP-C card is mandatory for safety reasons.

10.3 Supported Node Configurations for PSM Card

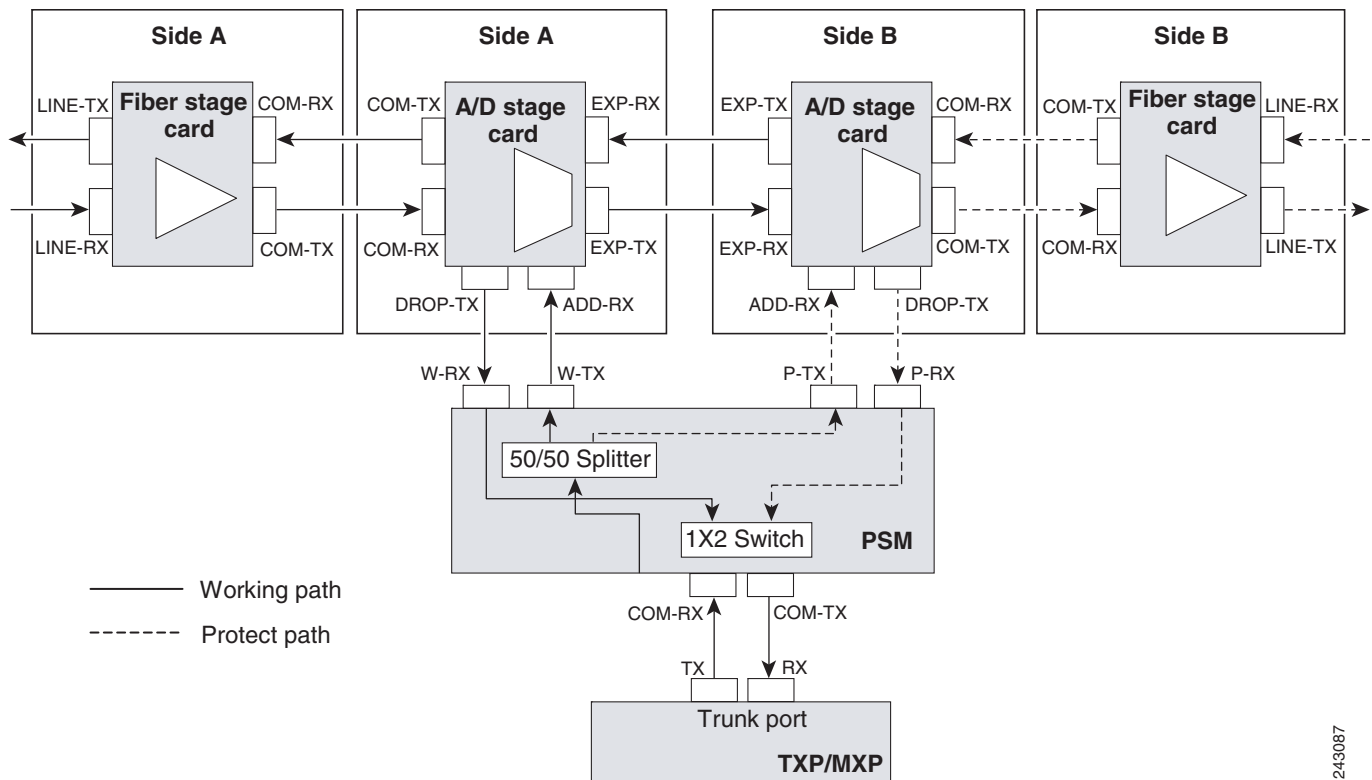
The PSM card supports the following node configurations:

- [10.3.1 Channel Protection](#)
- [10.3.2 Multiplex Section Protection](#)
- [10.3.3 Line Protection](#)

10.3.1 Channel Protection

In channel protection configuration, the PSM card is used in conjunction with a TXP/MXP card. The PSM card in a channel protection configuration can be used in any site apart from a terminal site.

[Figure 10-23](#) shows the DWDM functional view of a PSM card in channel protection configuration.

Figure 10-23 PSM Channel Protection Configuration

In this configuration, the COM-RX and COM-TX ports of the PSM card are connected to the TXP/MXP trunk ports. This configuration is applicable to an n -degree MSTP node, for example, a two-degree ROADM, an n -degree ROADM, or an OADM node. The example block diagram shows a two-degree node with Side A and Side B as the two sides. The Side A and Side B fiber-stage block can be DWDM cards that are used to amplify transmitted or received signal (see the “10.5.1.1 Fiber Stage” section on page 10-29 for the list of cards). The Side A and Side B add/drop stage block can be DWDM cards that can add and drop traffic (see the “10.5.1.2 A/D Stage” section on page 10-31 for the list of cards).

In the transmit direction, the traffic originating from a TXP/MXP trunk port is split by the PSM card on to the W-TX and P-TX ports. The W-TX and P-TX ports are connected to the ADD-RX ports of the add/drop stage cards in Side A and Side B respectively. The add/drop stage cards multiplex traffic on Side A and Side B line ports that become the working and protect paths respectively.

In the receive direction, the W-RX and P-RX ports of the PSM card are connected to the DROP-TX ports of the add/drop stage cards on Side A and Side B respectively. The add/drop stage cards demultiplex traffic received from Side A and Side B line ports that are the working and protect paths respectively. The PSM card selects one of the two input signals on the W-RX and P-RX ports to be transmitted to the COM-RX port of the PSM card.

**Note**

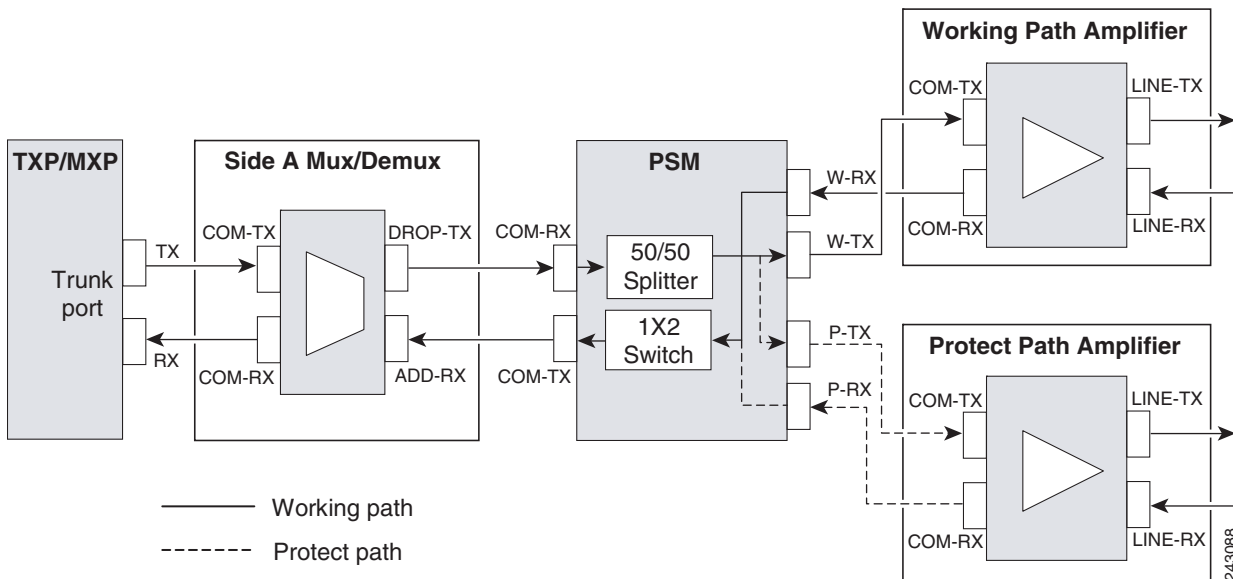
All traffic multiplexed or demultiplexed by the two add/drop stage cards is not protected.

10.3.2 Multiplex Section Protection

The PSM card performs multiplex section protection when connected between a multiplexer/demultiplexer card in a terminal site. The multiplexer/demultiplexer stage can be built using WSS and DMX or 40MUX and 40DMX cards. The terminal sites can be 50/100 GHz band. The number of supported channels can therefore be 32/40 or 72/80.

Figure 10-24 shows the block diagram of a PSM card in multiplex section protection configuration.

Figure 10-24 PSM Multiplex Section Protection Configuration



In the transmit direction, the traffic originating from a TXP trunk port is multiplexed by the Side A multiplexer. The PSM card splits traffic on to the W-TX and P-TX ports, which are independently amplified by two separated booster amplifiers.

In the receive direction, the signal on the line ports is preamplified by two separate preamplifiers and the PSM card selects one of the two input signals on the W-RX and P-RX ports to be transmitted to the COM-RX port of the PSM card. The received signal is then demultiplexed to a TXP card.

The presence of a booster amplifier is not mandatory. However, if a DCN extension is used, the W-TX and P-TX ports of the PSM card can be connected directly to the line. The presence of a preamplifier is also not mandatory.



Note

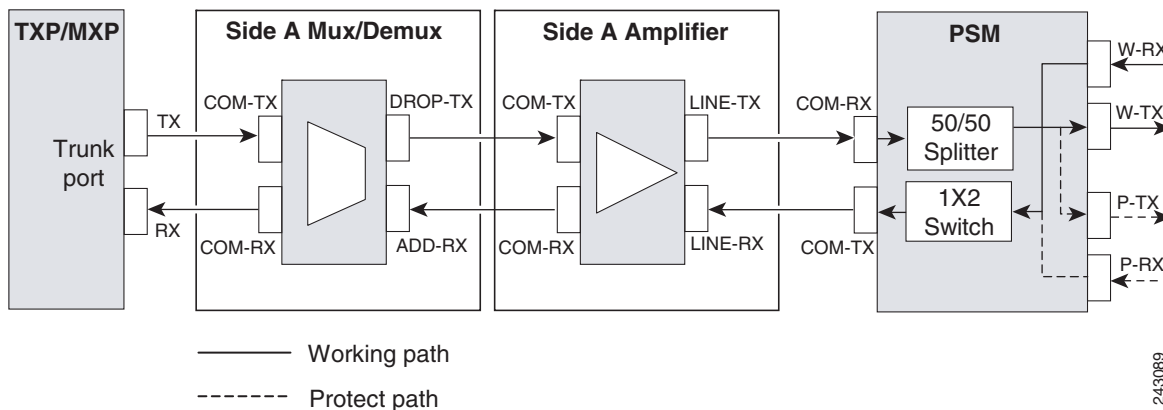
The PSM card cannot be used with Raman amplification in a line protection or section protection configuration.

10.3.3 Line Protection

In a line protection configuration, the working and protect ports of the PSM card are connected directly to the external line. This configuration is applicable to any MSTP node that is configured as a terminal site. The multiplexer/demultiplexer stage can be built using WSS and DMX or 40MUX and 40DMX cards. The terminal sites can be 50/100 GHz band. The number of supported channels can therefore be 32/40 or 72/80.

Figure 10-25 shows the block diagram of a PSM card in line protection configuration.

Figure 10-25 PSM Line Protection Configuration



In the transmit direction, the traffic originating from a transponder trunk port is multiplexed by the Side A multiplexer and amplified by a booster amplifier. The Line-TX port of the amplifier is connected to the COM-RX port of the PSM card. The PSM card splits traffic received on the COM-RX port on to the W-TX and P-TX ports, which form the working and protect paths.

In the receive direction, the PSM card selects one of the two input signals on the W-RX and P-RX ports to be transmitted to the COM-RX port of the PSM card. The received signal is then preamplified and demultiplexed to the TXP card.

The presence of a booster amplifier is not mandatory. However, if a DCN extension is used, the COM-RX port of the PSM card is connected to the multiplex section. The presence of a preamplifier is also not mandatory; the COM-TX port of the PSM card can be connected to the demultiplexer.



Note

The PSM card cannot be used with Raman amplification in a line protection or section protection configuration.

10.4 Multishelf Node

An ONS 15454 node provisioned as a multishelf node can manage up to 12 subtending shelves as a single entity.

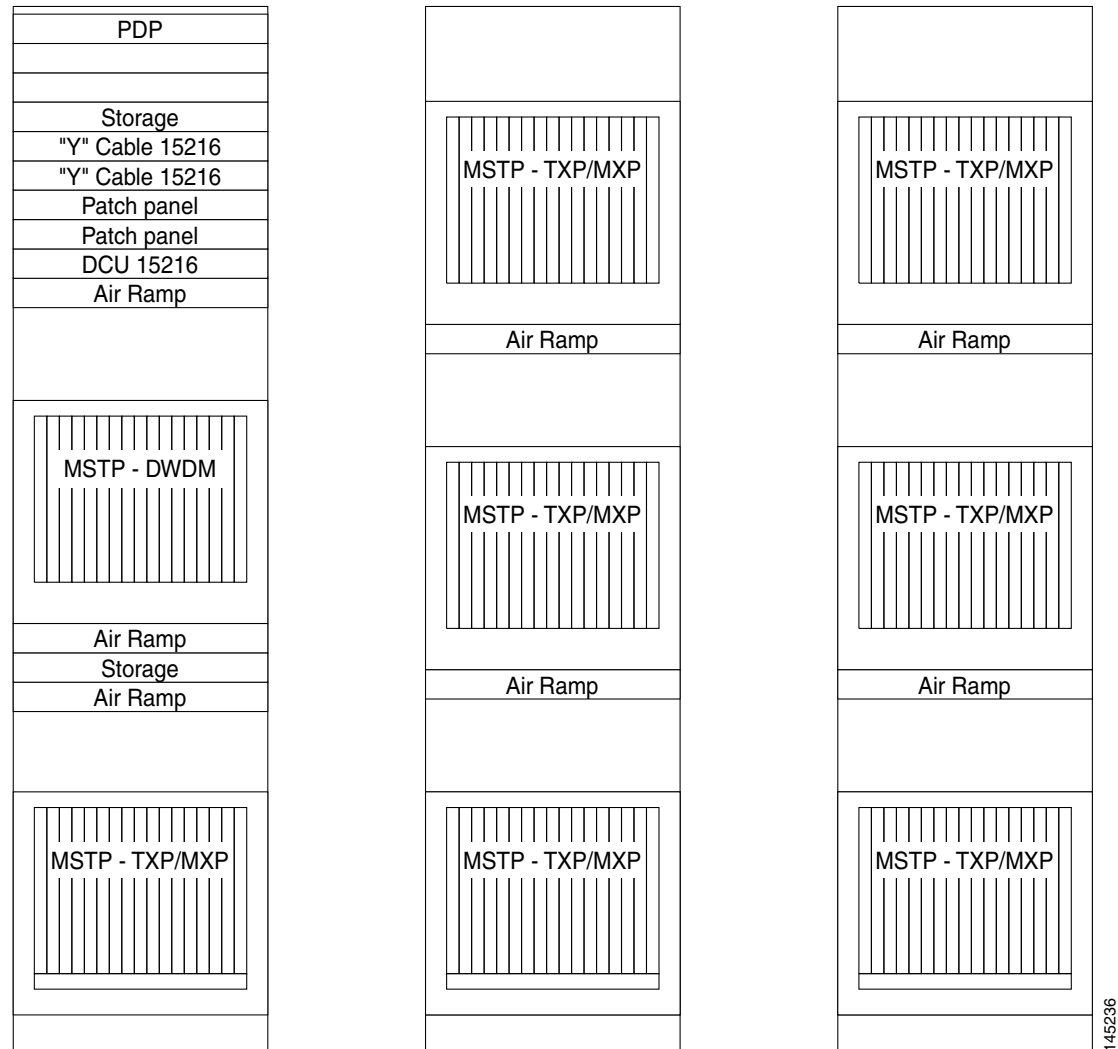


Note

The reason for extending the number of subtending shelves from eight to 12 is to accommodate and manage the new optical and DWDM cards that operate in the even band frequency grid.

The node controller is the main shelf; its TCC2/TCC2P cards run multishelf functions. Each subtending shelf must be equipped with TCC2/TCC2P cards, which run the shelf functions. For internal data exchange between the node controller shelf and subtending shelves, the node controller shelf must be equipped with redundant MS-ISC-100T cards or, as an alternative, the Catalyst 2950 switch. Cisco recommends using the MS-ISC-100T cards. If using the Catalyst 2950, it is installed on one of multishelf racks. All subtending shelves must be located in the same site at a maximum distance of 100 meters or 328 feet from the Ethernet switches used to support the communication LAN. [Figure 10-26](#) shows an example of a multishelf node configuration.

Figure 10-26 Multishelf Node Configuration



A multishelf node has a single public IP address for all client interfaces (Cisco Transport Controller [CTC], Transaction Language One [TL1], Simple Network Management Protocol [SNMP], and HTTP); a client can only connect to the node controller shelf, not to the subtending shelves. The user interface and subtending shelves are connected to a patch panel using straight-through (CAT-5) LAN cables.

The node controller shelf has the following functions:

- IP packet routing and network topology discovery occur at the node controller level.

- Open Shortest Path First (OSPF) is centralized on the node controller shelf.

The subtending shelves have the following functions:

- Overhead circuits are not routed within a multishelf node but are managed at the subtending controller shelf only. To use overhead bytes, the AIC-I must be installed on the subtending shelf where it is terminated.
- Each subtending shelf will act as a single shelf node that can use as timing source line, TCC/TCC2P clock, or building integrated timing supply (BITS) source lines.

10.4.1 Multishelf Node Layout

Multishelf configurations are configured by Cisco TransportPlanner and are automatically discovered by the CTC software. In a typical multishelf installation, all optical units are equipped on the node controller shelf and TXP/MXP cards are equipped in the aggregated subtended shelves. In addition, all empty slots in the node controller shelf can be equipped with TXP/MXP cards. In a DWDM mesh network, up to eight optical sides can be configured with client and optical cards installed in different shelves to support mesh and ring-protected signal output.



Note

When a DWDM ring or network has to be managed through a Telcordia operations support system (OSS), every node in the network must be set up as multi-shelf. OLA sites and nodes with one shelf must be set up as "multi-shelf stand-alone" to avoid the use of LAN switches.

10.4.2 DCC/GCC/OSC Terminations

A multishelf node provides the same communication channels as a single-shelf node:

- OSC links terminate on OSCM/OSC-CSM cards. Two links are required between each ONS 15454 node. An OSC link between two nodes cannot be substituted by an equivalent generic communications channel/data communications channel (GCC/DCC) link terminated on the same pair of nodes. OSC links are mandatory and they can be used to connect a node to a gateway network element (GNE).
- GCC/DCC links terminate on TXP/MXP cards.

The maximum number of DCC/GCC/OSC terminations that are supported in a multishelf node is 48.

10.5 Optical Sides

From a topological point of view, all DWDM units equipped in an MSTP node belongs to a side. A side can be identified by a letter (A, B, C, D, E, F, G, or H), or by the ports (called as side line ports, see [10.5.2 Side line ports, page 10-32](#)) that are physically connected to the spans. An MSTP node can be connected to a maximum of 8 different spans. Each side identifies one of the span the MSTP node is connected to.

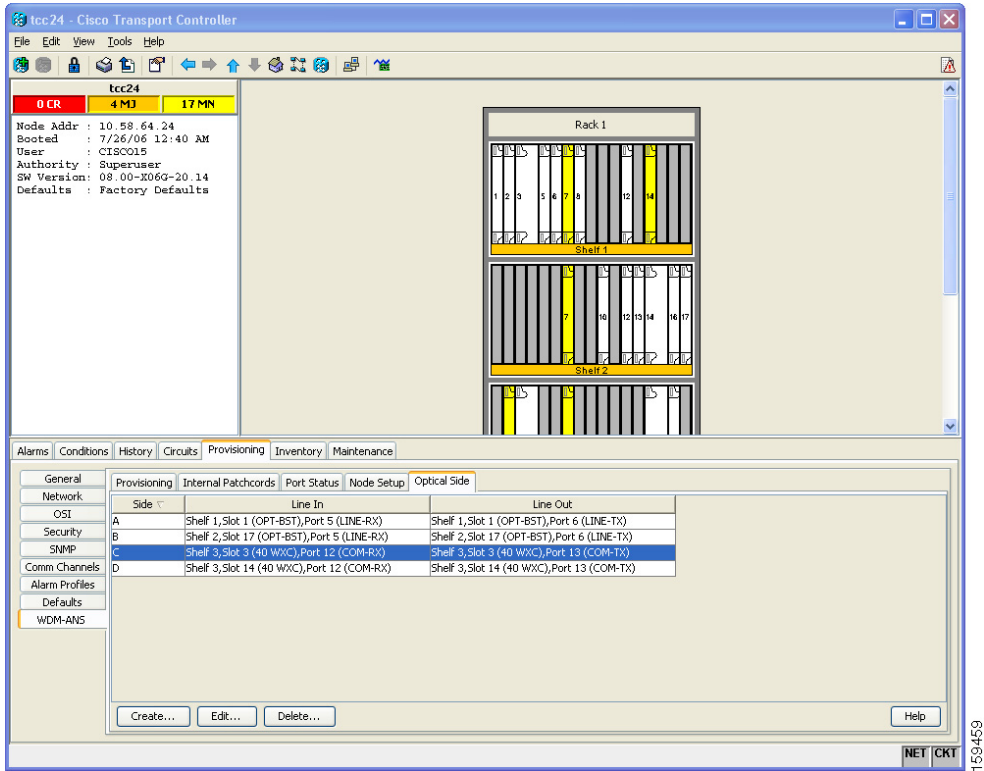


Note

Side A and Side B replace "west" and "east" when referring to the two sides of the ONS 15454 shelf. Side A refers to Slots 1 through 6 (formerly "west"), and Side B refers to Slots 12 through 17 (formerly "east"). The line direction port parameter, East-to-West and West-to-East, has been removed.

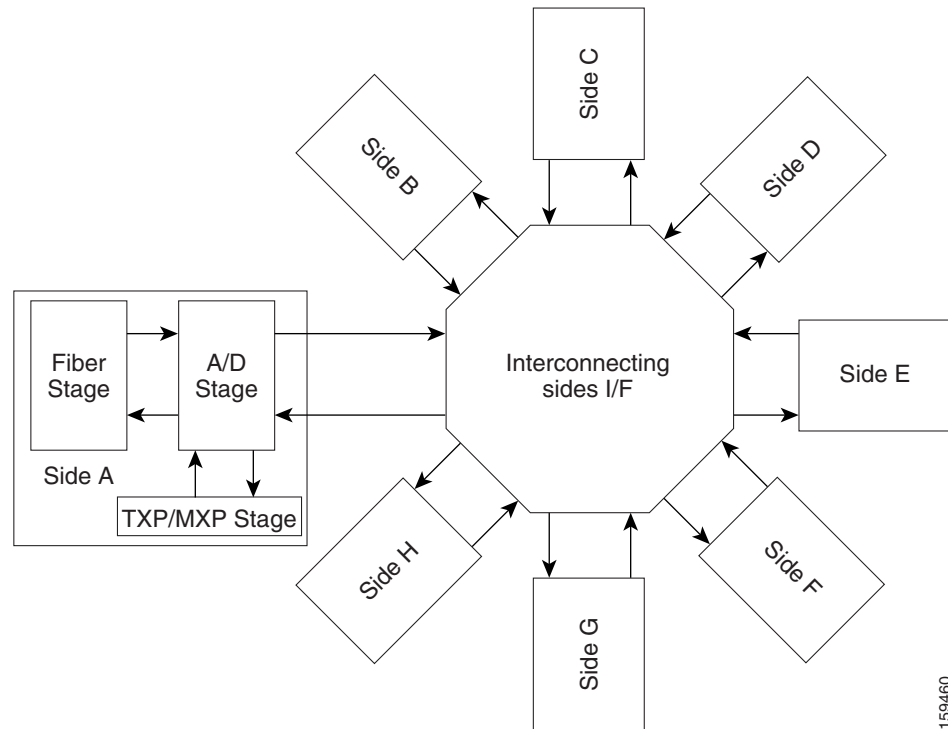
Sides are viewed and managed from the Provisioning > WDM-ANS > Optical Sides tab in CTC, shown in [Figure 10-27](#).

Figure 10-27 Optical Side Tab



10.5.1 Optical Side Stages

All MSTP nodes can be modelled according to [Figure 10-28](#).

Figure 10-28 Interconnecting Sides Conceptual View

According to [Figure 10-28](#), each MSTP node side includes DWDM units that can be conceptually divided into three stages.

- Fiber stage—The set of DWDM cards with ports that directly or indirectly face the span.
- A/D stage—The add/drop stage.
- TXP/MXP stage—The virtual grouping of all TXP or MXP cards with signals multiplexed or demultiplexed to and from the physical fiber stage.

10.5.1.1 Fiber Stage

The fiber stage includes DWDM cards that are used to amplify transmitted or received signal and cards that are used to add optical supervision channel. The fiber stage cards are:

- Booster amplifier cards that directly connect to the span, such as:
 - OPT-BST
 - OPT-BST-E
 - OPT-BST-L
 - OPT-AMP-C, when provisioned in OPT-LINE (booster amplifier) mode
 - OPT-AMP-L, when provisioned in OPT-LINE (booster amplifier) mode
 - OPT-AMP-17-C, when provisioned in OPT-LINE (booster amplifier) mode
- Preamplifier cards, such as:
 - OPT-PRE
 - OPT-AMP-C, when provisioned in OPT-PRE (preamplifier) mode

- OPT-AMP-L, when provisioned in OPT-PRE (preamplifier) mode
- OPT-AMP-17-C, when provisioned in OPT-PRE (preamplifier) mode
- OSC cards, such as:
 - OSCM
 - OSC-CSM
- OPT-RAMP-C card

Table 10-1 shows the commonly deployed fiber stage layouts supported by DWDM mesh nodes. In the table, OPT-BST includes the OPT-BST, OPT-BST-E, and OPT-BST-L cards. OPT-AMP includes the OPT-AMP-L and OPT-AMP-17-C cards configured in either OPT-PRE or OPT-LINE mode.

**Note**

In the table, L and C suffix is not reported because C-band and L-band amplifiers cannot be mixed in the same layout.

Table 10-1 **Supported Fiber Stage Configurations**

Layout	Cards	Configurations
A	OPT-BST <-> OPT-PRE/OPT-AMP (OPT-PRE mode)	• OPT-BST OSC ports connected to OSCM OSC ports or OSC-CSM LINE ports • OPT-BST LINE ports connected to the span • OPT-BST COM-TX ports connected to OPT-AMP (OPT-PRE mode) or OPT-PRE COM-RX ports • OPT-AMP (OPT-PRE mode) or OPT-PRE LINE-TX or COM-TX ports connected to the next stage (for example, a 40-WSS-C/40-WSS-CE COM-RX port in a ROADM node) • OPT-BST COM-RX ports connected to the next stage (for example, a 40-WSS-C/40-WSS-CE COM-TX port in a ROADM node)
B	OPT-AMP (OPT-BST mode) <-> OPT-PRE/OPT-AMP (OPT-PRE mode)	• OPT-AMP (BST) OSC ports connected to OSCM OSC ports or OSC-CSM LINE ports • OPT-AMP (BST) LINE ports connected to the span • OPT-AMP (BST) COM-TX ports connected to OPT-AMP (PRE)/OPT-PRE COM-RX ports • OPT-AMP (PRE)/OPT-PRE LINE-TX/COM-TX port connected to the next stage (for example, a 40-WSS-C/40-WSS-CE COM-RX port in a ROADM node) • OPT-AMP (BST) COM-RX port connected to the next stage (for example, a 40-WSS-C/40-WSS-CE COM-TX port in a ROADM node)

Table 10-1 Supported Fiber Stage Configurations (continued)

Layout	Cards	Configurations
C	OSC-CSM <-> OPT-PRE/OPT-AMP(OPT-PRE mode)	• OSC-CSM LINE ports connected to the span • OSC-CSM COM-TX ports connected to OPT-AMP COM-RX ports • OPT-AMP(PRE)/OPT-PRE LINE-TX/COM-TX port connected to the next stage (for example, 40-WSS-C/40-WSS-CE COM-RX ports in ROADM) • OSC-CSM COM-RX port connected to the next stage (for example, a 40-WSS-C/40-WSS-CE COM-TX port in a ROADM node)
D	OPT-BST	• OPT-BST OSC ports connected to OSCM OSC ports or OSC-CSM LINE ports • OPT-BST LINE ports connected to the span • OPT-BST COM ports connected to the next stage (for example, a 40-WSS-C/40-WSS-CE COM port in a ROADM node)
E	OPT-AMP (OPT-BST mode)	• OPT-AMP OSC ports connected to OSCM OSC ports or OSC-CSM LINE ports • OPT-AMP LINE ports connected to the span • OPT-AMP COM ports connected to the next stage (for example, a 40-WSS-C/40-WSS-CE COM port in a ROADM node)
F	OSC-CSM	• OSC-CSM LINE ports connected to the span • OSC-CSM COM ports connected to the next stage (for example, a 40-WSS-C/40-WSS-CE COM port in a ROADM node)

10.5.1.2 A/D Stage

The A/D stage includes DWDM cards that can add and drop traffic. The A/D stage is divided into three node types:

- Mesh nodes—ONS 15454 nodes configured in multishelf mode can connect to eight different sides. For more detail on mesh node, see [10.6 Configuring Mesh DWDM Networks, page 10-37](#).
- Legacy—Half of a ROADM node or an OADM node with cascaded AD-xB-xx-x or AD-xC-xx.x cards
- Non-A/D—A line node or a side that does not have A/D capability is included in the A/D stage

Stages are built by active cards and patchcords. However, the interconnecting sides are completed by the mesh patch panels (four-degree patch panel or eight-degree patch panel) in mesh nodes, or by patchcords connected to EXP-RX/EXP-TX ports in legacy nodes.

10.5.2 Side line ports

Side line ports are ports that are physically connected to the spans. Side line ports can be:

- All ports terminating the fiber stage and physically labeled as LINE, such as ports on the following cards:
 - Booster amplifier (OPT-BST, OPT-BST-E, or OPT-BST-L cards, and the OPT-AMP-C, OPT-AMP-L, or OPT-AMP-17-C cards when provisioned in OPT-LINE mode)
 - OSC-CSM
 - OPT-RAMP-C
- All ports that can be physically connected to the external span using DCN terminations, such as:
 - Booster amplifier LINE-RX and LINE-TX ports
 - OSC-CSM LINE-RX and LINE-TX ports
 - 40-WXC-C COM-RX and COM-TX ports
 - MMU EXP-A-RX and EXP-A-TX ports
- All ports that can be physically connected to the external span using DCN terminations in a line node, such as:
 - Preamplifier (OPT-PRE card and the OPT-AMP-C, OPT-AMP-L, or OPT-AMP-17-C cards when provisioned in OPT-PRE mode) COM-RX and COM-TX ports
 - Booster amplifier COM-TX port
 - OSC-CSM COM-TX port
- All ports that can be physically connected to the external span using DCN terminations in a 40-channel MUX/DMX terminal node, such as:
 - 40-MUX-C COM-TX port
 - 40-DMX-C COM-RX port
- All ports that can be physically connected to the external span when PSM cards implement line protection:
 - PSM W-TX and W-RX ports
 - PSM P-TX and P-RX ports



Note PSM card will support two sides A(w) and A(p).

10.5.3 Optical Side Configurations

You can use the following Side IDs depending on the type of node layout:

- In legacy nodes (that is, a node with no provisioned or installed 40-WXC-C cards), the permissible Side IDs are A and B only.
- In four-degree mesh nodes with four or less 40-WXC-C cards installed, the permissible Side IDs are A, B, C, and D.
- In eight-degree mesh nodes, with eight or less 40-WXC-C cards installed, the allowed Side IDs are A, B, C, D, E, F, G, and H.

Side IDs are assigned automatically by the system when you create default internal patchcords in CTC or when you import the CTP XML configuration file into CTC. You can create a side manually using CTC or TL1 if the following conditions are met:

- You use a permissible side identifier, A through H.
- The shelf contains a TX and an RX side line port (see “[10.5.2 Side line ports](#)” section on [page 10-32](#)).
- The side line ports are not connected to an internal patchcord.

**Note**

Cisco does not recommend that you manually create or modify ONS 15454 sides.

The following tables show examples of how Side IDs are automatically assigned by the system for common DWDM layouts.

[Table 10-2](#) shows a standard ROADM shelf with Sides A and B provisioned. The shelf is connected to seven shelves containing TXP, MXP, ADM-10G, GE_XP, 10GE_XP, GE_XPE, and 10GE_XPE cards.

Table 10-2 Multishelf ROADM Layout Example

Shelf	Slots 1–6	Side	Slots 12–17	Side
1	WSS+DMX	A	WSS+DMX	B
2	TXP/MXP	—	TXP/MXP	—
3	TXP/MXP	—	TXP/MXP	—
4	TXP/MXP	—	TXP/MXP	—
5	TXP/MXP	—	TXP/MXP	—
6	TXP/MXP	—	TXP/MXP	—
7	TXP/MXP	—	TXP/MXP	—
8	TXP/MXP	—	TXP/MXP	—

[Table 10-3](#) shows a protected ROADM shelf. In this example, Side A and B are Slots 1 through 6 in Shelves 1 and 2. 40-WSS-C/40-WSS-CE/40-DMX-C or 40-WSS-CE/40-DMX-CE cards are installed in Sides A and B. Slots 12 through 17 in Shelves 1 and 2 contain TXP, MXP, ADM-10G, GE_XP, 10GE_XP, GE_XPE, or 10GE_XPE cards.

Table 10-3 Multishelf Protected ROADM Layout Example

Shelf	Slots 1–6	Side	Slots 12–17	Side
1	WSS+DMX	A	TXP/MXP	—
2	WSS+DMX	B	TXP/MXP	—
3	TXP/MXP	n/a	TXP/MXP	—
4	TXP/MXP	n/a	TXP/MXP	—
5	TXP/MXP	n/a	TXP/MXP	—
6	TXP/MXP	n/a	TXP/MXP	—
7	TXP/MXP	n/a	TXP/MXP	—
8	TXP/MXP	n/a	TXP/MXP	—

Table 10-4 shows a four-degree mesh node. Side A is Shelf 1, Slots 1 through 6. Side B and C are Shelf 2, Slots 1 through 6 and 12 through 17, and Side D is Shelf 3, Slots 1 through 6. 40-WXC-C cards in line termination mode are installed in Sides A through D.

Table 10-4 Multishelf Four-Degree Mesh Node Layout Example

Shelf	Slots 1–6	Side	Slots 12–17	Side
1	WXC Line Termination	A	TXP/MXP	—
2	WXC Line Termination	B	WXC Line Termination	C
3	WXC Line Termination	D	TXP/MXP	—
4	TXP/MXP	n/a	TXP/MXP	—
5	TXP/MXP	n/a	TXP/MXP	—
6	TXP/MXP	n/a	TXP/MXP	—
7	TXP/MXP	n/a	TXP/MXP	—
8	TXP/MXP	n/a	TXP/MXP	—

Table 10-5 shows a protected four-degree mesh node example. In the example, Sides A through D are assigned to Slots 1 through 6 in Shelves 1 through 4.

Table 10-5 Multishelf Four-Degree Protected Mesh Node Layout Example

Shelf	Slots 1–6	Side	Slots 12–17	Side
1	WXC Line Termination	A	TXP/MXP	—
2	WXC Line Termination	B	TXP/MXP	—
3	WXC Line Termination	C	TXP/MXP	—
4	WXC Line Termination	D	TXP/MXP	—
5	TXP/MXP	—	TXP/MXP	—
6	TXP/MXP	—	TXP/MXP	—
7	TXP/MXP	—	TXP/MXP	—
8	TXP/MXP	—	TXP/MXP	—

Table 10-6 shows a protected four-degree mesh node example. In the example, Sides A through D are assigned to Slots 1 through 4 in Shelves 1 through 4, and TXP, MXP, ADM-10G, GE_XP, 10GE_XP, GE_XPE, or 10GE_XPE cards are installed in Shelves 1 through 4, Slots 12-17, and Shelves 5 through 8, Slots 1 through 6 and 12 through 17.

Table 10-6 Multishelf Four-Degree Protected Mesh Node Layout Example

Shelf	Slots 1–6	Side	Slots 12–17	Side
1	WXC Line Termination	A	TXP/MXP	—
2	WXC Line Termination	B	TXP/MXP	—
3	WXC Line Termination	C	TXP/MXP	—
4	WXC Line Termination	D	TXP/MXP	—
5	TXP/MXP	—	TXP/MXP	—
6	TXP/MXP	—	TXP/MXP	—
7	TXP/MXP	—	TXP/MXP	—
8	TXP/MXP	—	TXP/MXP	—

Table 10-7 shows a four-degree mesh node provisioned as an upgrade. In the example, Sides A through D are assigned to Slots 1 through 4, and 12 through 17 in Shelves 1 and 2. 40-WXC-C cards in XC termination mode are installed in Sides A and B, and 40-WXC-C cards in line termination mode are installed in Sides C and D.

Table 10-7 Multishelf Four-Degree Mesh Node Upgrade Layout Example

Shelf	Slots 1–6	Side	Slots 12–17	Side
1	WXC XC Termination	A	WXC XC Termination	B
2	WXC Line Termination	C	WXC Line Termination	D
3	TXP/MXP	—	TXP/MXP	—
4	TXP/MXP	—	TXP/MXP	—
5	TXP/MXP	—	TXP/MXP	—
6	TXP/MXP	—	TXP/MXP	—
7	TXP/MXP	—	TXP/MXP	—
8	TXP/MXP	—	TXP/MXP	—

Table 10-8 shows an eight-degree mesh node. In the example, Sides A through H are assigned to Slots 1 through 6 in Shelf 1, Slots 1 through 6 and 12 through 17 in Shelves 2 through 4, and Slots 1 through 6 in Shelf 5. 40-WXC-C cards in line termination mode are installed in Sides A through H.

Table 10-8 Multishelf Eight-Degree Mesh Node Layout Example

Shelf	Slots 1–6	Side	Slots 12–17	Side
1	WXC Line Termination	A	TXP/MXP	—
2	WXC Line Termination	B	WXC Line Termination	C
3	WXC Line Termination	D	WXC Line Termination	E
4	WXC Line Termination	F	WXC Line Termination	G
5	WXC Line Termination	H	TXP/MXP	—
6	TXP/MXP	—	TXP/MXP	—
7	TXP/MXP	—	TXP/MXP	—
8	TXP/MXP	—	TXP/MXP	—

Table 10-9 shows another eight-degree mesh node. In the example, Sides A through H are assigned to Slots 1 through 6 in all shelves (Shelves 1 through 8). 40-WXC-C cards in line termination mode are installed in Sides A through H.

Table 10-9 Multishelf Four-Degree Mesh Node Upgrade Layout Example

Shelf	Slots 1–6	Side	Slots 12–17	Side
1	WXC Line Termination	A	TXP/MXP	—
2	WXC Line Termination	B	TXP/MXP	—
3	WXC Line Termination	C	TXP/MXP	—
4	WXC Line Termination	D	TXP/MXP	—
5	WXC Line Termination	E	TXP/MXP	—
6	WXC Line Termination	F	TXP/MXP	—
7	WXC Line Termination	G	TXP/MXP	—
8	WXC Line Termination	H	TXP/MXP	—

Table 10-10 shows a four-degree mesh node with a user-defined side. Because the software assigns sides consecutively, and because the mesh node is four-degrees, the side assigned to Shelf 5, Slots 1 through 6 is “Unknown.”

Table 10-10 Multishelf Four-Degree Mesh Node User-Defined Layout Example

Shelf	Slots 1–6	Side	Slots 12–17	Side
1	WXC Line Termination	A	TXP/MXP	—
2	TXP/MXP	—	WXC Line Termination	C ¹
3	WXC Line Termination	D	TXP/MXP	—
4	TXP/MXP	—	TXP/MXP	—
5	WXC Line Termination	U ²	TXP/MXP	—
6	TXP/MXP	—	TXP/MXP	—
7	TXP/MXP	—	TXP/MXP	—
8	TXP/MXP	—	TXP/MXP	—

1. User-defined
2. Unknown

10.6 Configuring Mesh DWDM Networks

ONS 15454 shelves can be configured in mesh DWDM networks using the 40-WXC-C wavelength cross-connect cards, multishelf provisioning, and the 40-channel patch panel, four-degree patch panel, and eight-degree patch panels. ONS 15454 DWDM mesh configurations can be up to four degrees (four optical directions) when the four-degree patch panel patch panel is installed, and up to eight degrees (eight optical directions) when the eight-degree patch panel is installed. Two mesh node types are available, the line termination mesh node and the cross-connect (XC) termination mesh node.

10.6.1 Line Termination Mesh Node

The line termination mesh node is installed in native Software Release 9.0 mesh networks. Line termination mesh nodes can support between one and eight line terminations. Each line direction requires the following cards: 40-WXC-C, 40-MUX-C, 40-DMX-C or 40-DMX-CE, a preamplifier and a booster. Within this configuration, the following substitutions can be used:

- The 40-MUX-C cards can be replaced with 40-WSS-C/40-WSS-CE cards.
- The OPT-BST cards can be replaced with OPT-AMP-17-C (in OPT-BST mode) and/or OPT-BST-E cards.
- The OPT-PRE can be replaced with an OPT-AMP-17-C (in OPT-LINE mode) card.

Each side of the line termination mesh node is connected as follows:

- The 40-WXC-C COM-RX port is connected to the preamplifier output port.
- The 40-WXC-C COM-TX port is connected to the booster amplifier COM-RX port.
- The 40-WXC-C DROP TX port is connected to the 40-DMX-C or 40-DMX-CE COM-RX port.
- The 40-WXC-C ADD-RX port is connected to the 40-MUX-C COM-TX port.

- The 40-WXC-C EXP-TX port is connected to the mesh patch panel.
- The 40-WXC-C EXP-RX port is connected to the mesh patch panel.

Figure 10-29 shows one shelf from a line termination node. (Examples of line termination nodes in four-degree and eight-degree mesh networks are shown in Figure 10-36 on page 10-45 and Figure 10-37 on page 10-46.)

Figure 10-29 Line Termination Mesh Node Shelf

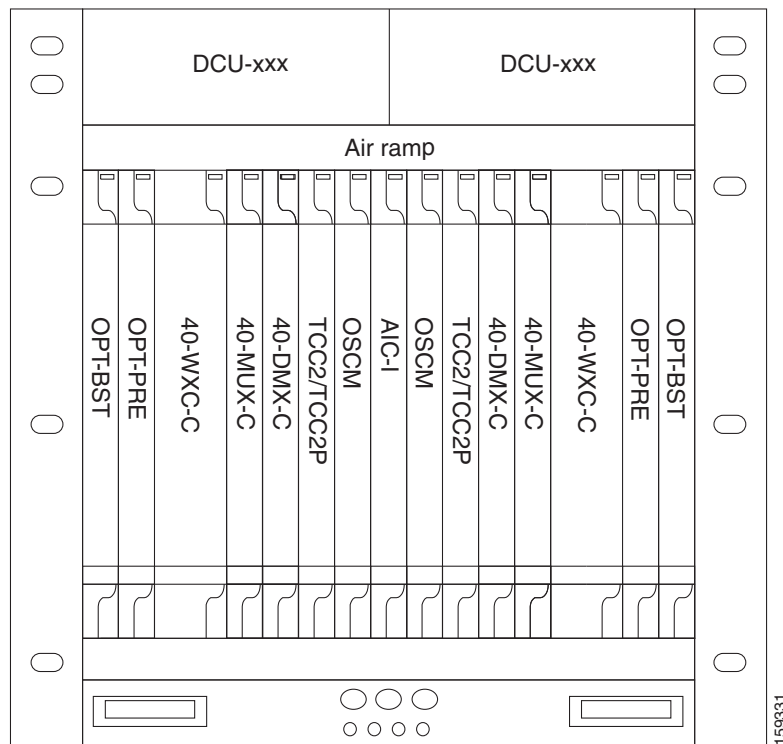


Figure 10-30 shows a functional block diagram of one line termination side using 40-WXC-C and 40-MUX-C cards.

Figure 10-30 Line Termination Mesh Node Side—40-MUX-C Cards

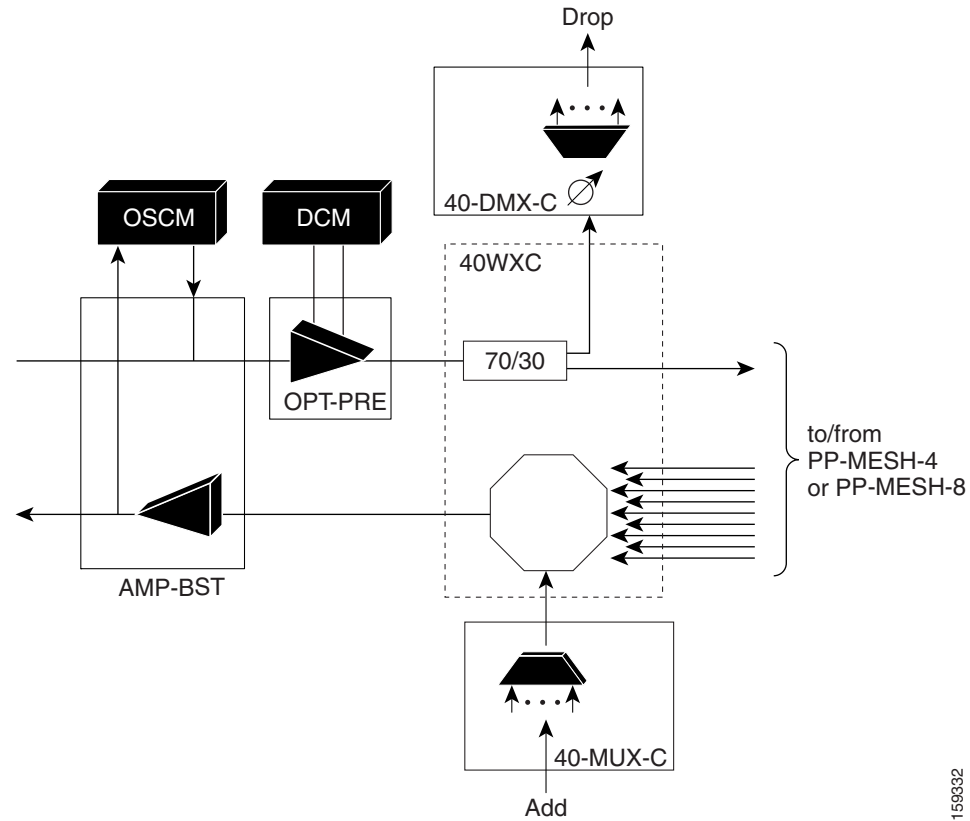
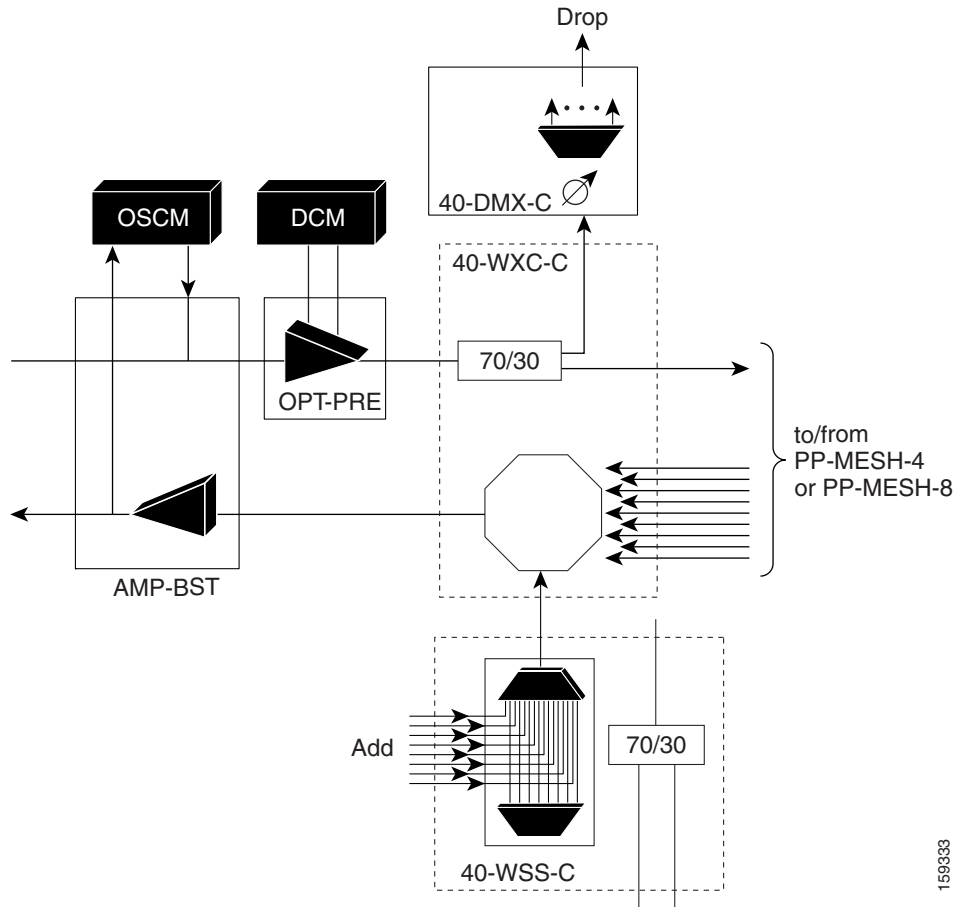


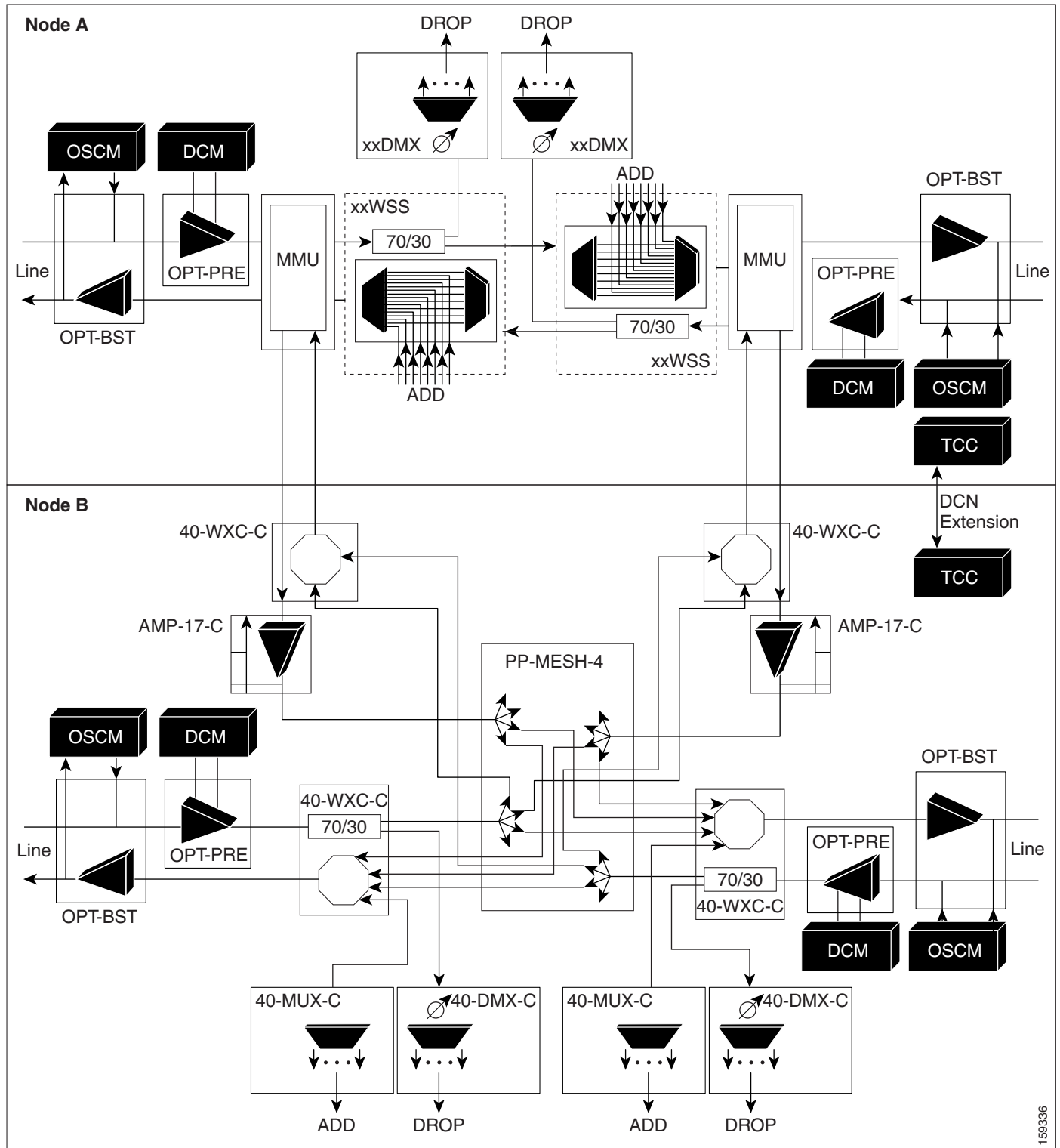
Figure 10-31 shows a functional block diagram line termination side using 40-WXC-C and 40-WSS-C cards.

Figure 10-31 Line Termination Mesh Node Side—40-WSS-C Cards

159333

Figure 10-32 shows a functional block diagram of a node that interconnects a ROADM with MMU cards with two native line termination mesh sides.

Figure 10-32 Line Termination Mesh Nodes—ROADM With MMU Cards



159336

10.6.2 XC Termination Mesh Node

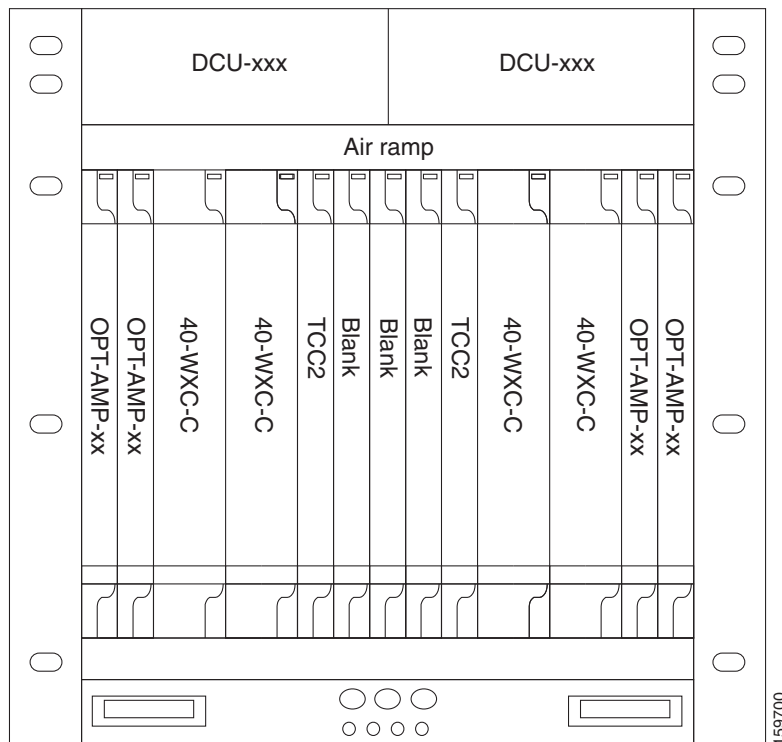
The XC termination mesh node, shown in [Figure 10-33](#), is the second mesh node type. It is used to upgrade a non-mesh node to a mesh node or to interconnect two non-mesh nodes. The XC termination mesh nodes contain the following cards:

- 40-WXC-C cards
- OPT-AMP-17-C cards configured in OPT-PRE mode

The XC termination mesh node is connected as follows:

- The 40-WXC-C COM-RX port is connected to the MMU EXP-A-TX port.
- The 40-WXC-C COM-TX port is connected to the MMU EXP-A-RX port.
- 40-WXC-C EXP-TX port is connected to the OPT-AMP-17-C COM-RX port.
- 40-WXC-C EXP-RX port is connected to the OPT-AMP-17-C COM-TX port.
- The 40-WXC-C EXP-TX port is connected to the mesh patch panel.
- The 40-WXC-C EXP-RX port is connected to the mesh patch panel.

Figure 10-33 XC Termination Mesh Node Shelf

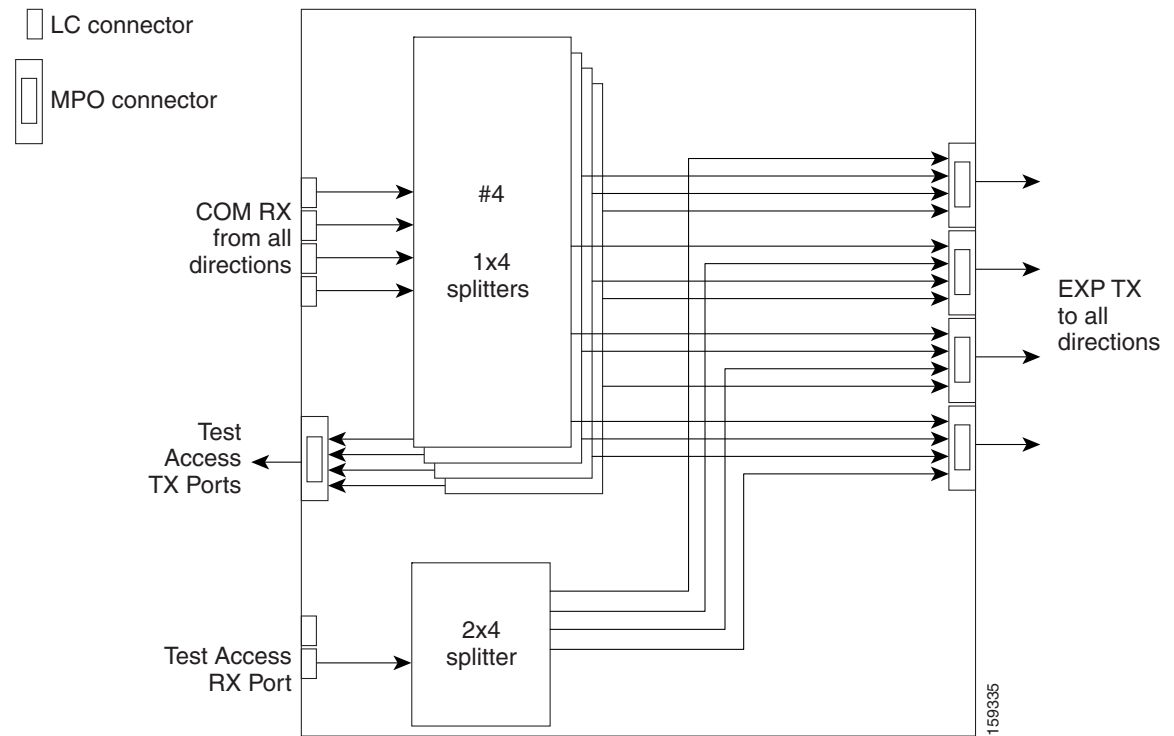


10.6.3 Mesh Patch Panels and Shelf Layouts

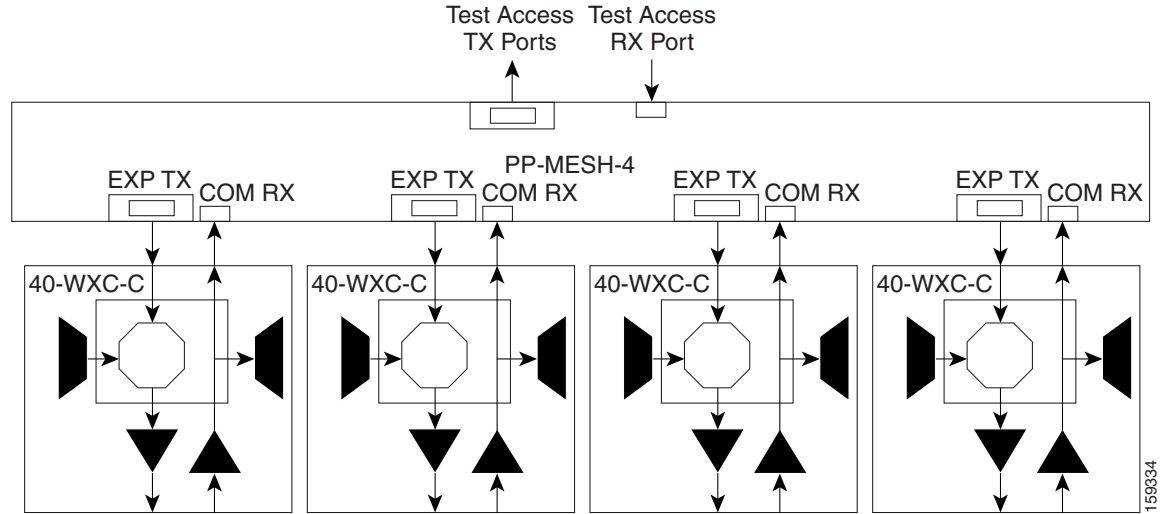
ONS 15454 mesh topologies require the installation of a four-degree patch panel (PP-MESH-4) or eight-degree patch panel (PP-MESH-8). If the four-degree patch panel is installed, mesh topologies of up to four degrees can be created. If the eight-degree patch panel patch panel is installed, mesh

topologies of up to eight degrees can be created. The four-degree patch panel contains four 1x4 optical splitters, and the eight-degree patch panel contains eight 1x8 splitters. Each mesh patch panel contains a 2x8 splitter that is used for the test access transmit and receive ports. [Figure 10-34](#) shows a block diagram for the four-degree patch panel.

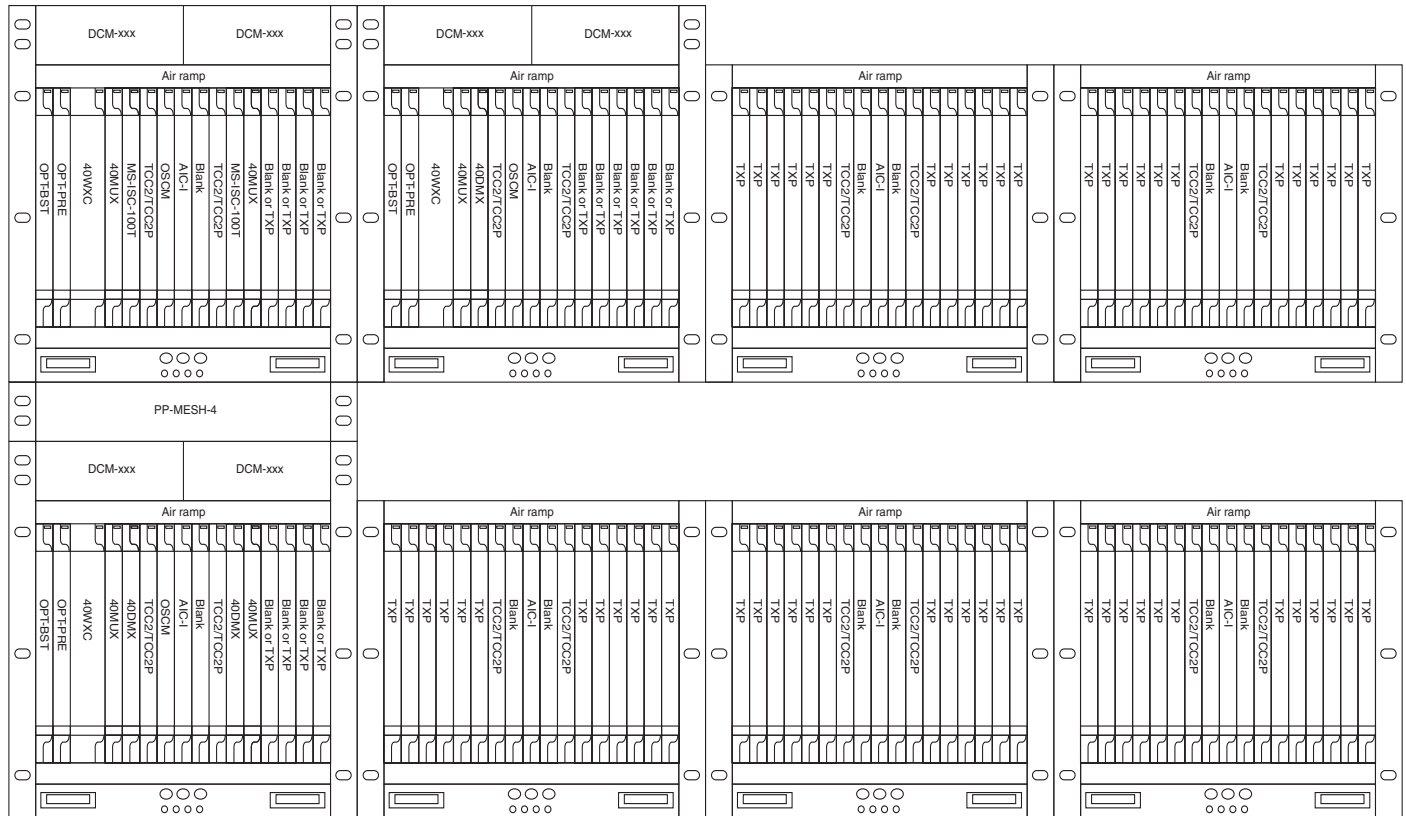
Figure 10-34 Four-Degree Patch Panel Block Diagram



At the mesh patch panel, the signal is split into four signals (if four-degree patch panel is used) or eight signals (if an eight-degree patch panel is used). [Figure 10-35](#) shows the signal flow at the four-degree patch panel. 40-WXC-C cards connect to the four-degree patch panel at the EXP TX and COM RX ports.

Figure 10-35 Four-Degree Patch Panel Signal Flow

The mesh patch panels interconnect 40-WXC-C cards to create mesh networks, including four-degree and eight-degree mesh topologies. In addition, shelves with 40-WXC-C cards can be configured with mesh patch panels to create multiring, MMU-based mesh nodes. 40-WXC-C cards can be installed in ROADMs with MMU cards to upgrade a two-degree MMU-based ROADM node into four-degree or eight-degree mesh nodes. [Figure 10-36](#) shows the ROADM node with MMU cards configuration after it has been upgraded into a four-degree mesh topology.

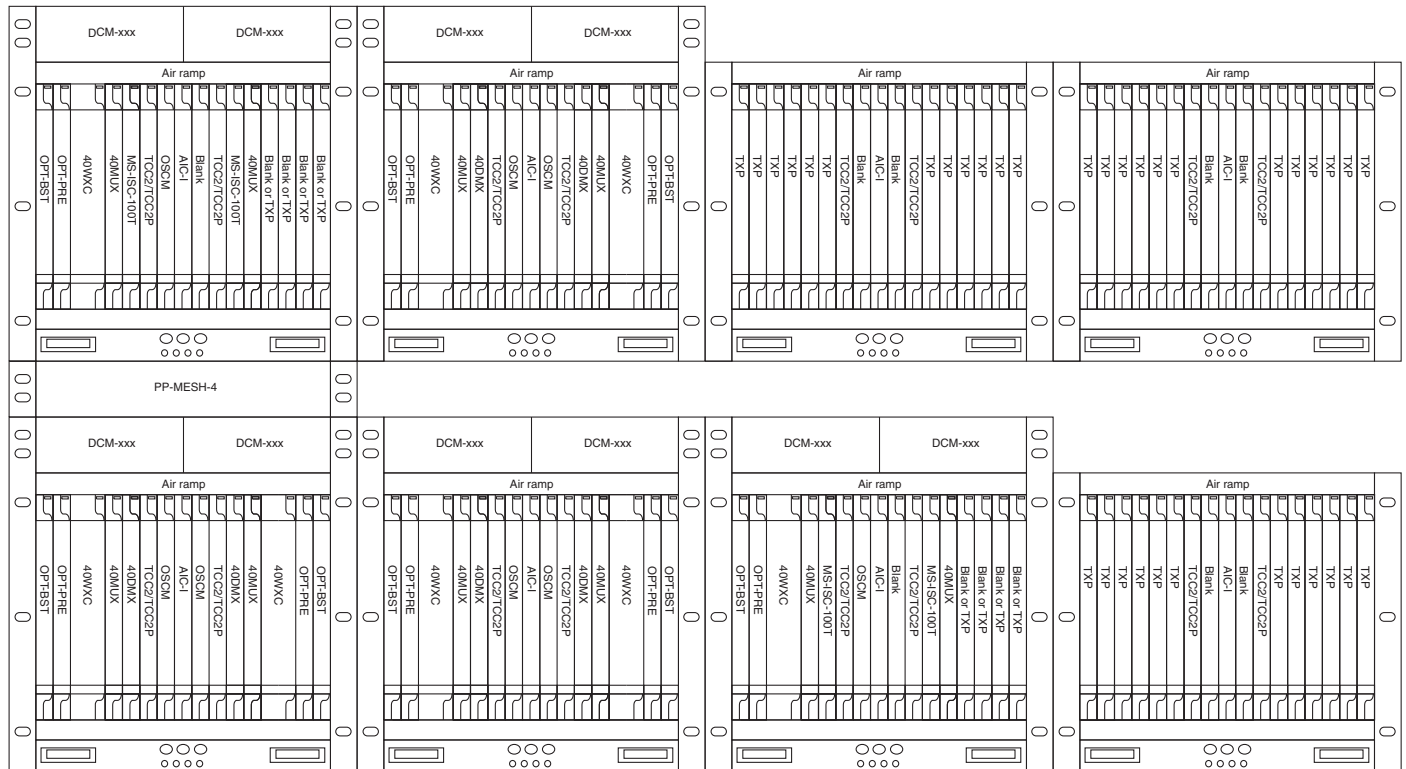
Figure 10-36 Layout for ROADM Node with MMU Cards and Four-Degree Mesh Topology

159337

The following figures show different mesh configurations at the shelf level. [Figure 10-37](#) shows a basic four-degree mesh node layout based on the shelf configuration shown in [Figure 10-29](#) on page 10-38.

0 0 0 0 0 0 0 0 0 0	Air ramp										0 0 0 0 0 0 0 0 0 0
	TXP										
	TXP										
	TXP										
	TXP										
	TXP										
	TXP										
	TC02/TC02P										
	Blank										
	AIC-I										
0 0 0 0 0 0 0 0 0 0	DCM-xxx										0 0 0 0 0 0 0 0 0 0
	Blank or TXP										
	Blank or TXP										
	Blank or TXP										
	Blank or TXP										
	40MUX										
	MS-ISC-100T										
	TC02/TC02P										
	Blank										
	AIC-I										
0 0 0 0 0 0 0 0 0 0	DCM-xxx										0 0 0 0 0 0 0 0 0 0
	Blank or TXP										
	Blank or TXP										
	Blank or TXP										
	Blank or TXP										
	40MUX										
	MS-ISC-100T										
	TC02/TC02P										
	Blank										
	AIC-I										
0 0 0 0 0 0 0 0 0 0	DCM-xxx										0 0 0 0 0 0 0 0 0 0
	Blank or TXP										
	Blank or TXP										
	Blank or TXP										
	Blank or TXP										
	40MUX										
	MS-ISC-100T										
	TC02/TC02P										
	Blank										
	AIC-I										
0 0 0 0 0 0 0 0 0 0	DCM-xxx										0 0 0 0 0 0 0 0 0 0
	Blank or TXP										
	Blank or TXP										
	Blank or TXP										
	Blank or TXP										
	40MUX										
	MS-										

Figure 10-38 shows a protected four-degree mesh node layout based on the shelf configuration shown in Figure 10-29 on page 10-38.

Figure 10-38 Four-Degree Protected Line Termination Mesh Node Layout

159339

10.6.4 Using a Mesh Node for Local Add/Drop Channel Management

Normally, a multidegree mesh node uses four or eight 40-WXC-C cards and a four- or eight-degree patch panel. Each of the 40-WXC-C cards uses a 40-MUX-C card to add wavelengths going to the span and a 40-DMX-C or 40-DMX-CE card to drop wavelengths coming in from the span. The 40-MUX-C and 40-DMX-C or 40-DMX-CE cards connect to their respective TXP or MXP cards. In this new local add/drop channel management configuration, at least one of the directions of a multidegree node can be used to manage local add/drop traffic. The advantage of this configuration is to consolidate all of the TXP, MXP, 40-MUX-C, and 40-DMX-C or 40-DMX-CE cards where they are needed for adding or dropping wavelengths locally. [Figure 10-39](#) shows an example of how to set up a local add/drop configuration.

By setting up network elements (NE) as shown in the figure, it is possible to connect the transmit ports of TXP or MXP cards to a 40-MUX-C card and then connect the output of the 40-MUX-C card to an OPT-BST card, which then connects to a preferred 40-WXC-C card in an NE that has been set up as a four-degree or eight-degree mesh node. Through software configuration, the wavelengths entering the preferred 40-WXC-C card can be selectively sent out through a multidegree patch panel and the other 40-WXC-C cards in that NE in any desired outbound direction. In the inbound direction, any of the wavelengths entering the NE through the 40-WXC-C cards and multidegree patch panel can be selectively routed to the preferred 40-WXC-C card facing the NE containing an OPT-PRE card and a

40-DMX-C or 40-DMX-CE card. These wavelengths are then sent along to the corresponding TXP/MXP receive port. The NEs are in separate shelves with separate IP addresses and communicate through DCN extensions.

The advantage of this configuration is that all of the transponder cards, 40-MUX-C cards, and 40-DMX-C or 40-DMX-CE cards can be located in a single NE, which then communicates with a second mesh NE containing only 40-WXC-C cards and a multidegree patch panel. Normally, each 40-WXC-C card in the multidegree node would have its own 40-MUX-C and 40-DMX-C or 40-DMX-CE card and corresponding TXP/MXP cards. Using this new configuration, the extra 40-MUX-C cards, 40-DMX-C or 40-DMX-CE cards, and corresponding TXP and MXP cards are eliminated. You now also have a dedicated NE from which you can send and receive wavelengths to and from any desired direction in the multidegree node. In addition, the wavelengths and the direction in which they leave the node are reconfigurable through software and require no manual recabling.

An example of using a mesh node for local add/drop channel management is shown in [Figure 10-39](#).

Figure 10-39 *Local Add/Drop Management Using Two Network Elements*

10.7 DWDM Node Cabling

DWDM node cabling is specified by the Cisco TransportPlanner Internal Connections table. The following sections provide examples of the cabling that you will typically install for common DWDM node types.

**Note**

The cabling illustrations shown in the following sections are examples. Always install fiber-optic cables based on the Cisco TransportPlanner Internal Connections table for your site.

10.7.1 OSC Link Termination Fiber-Optic Cabling

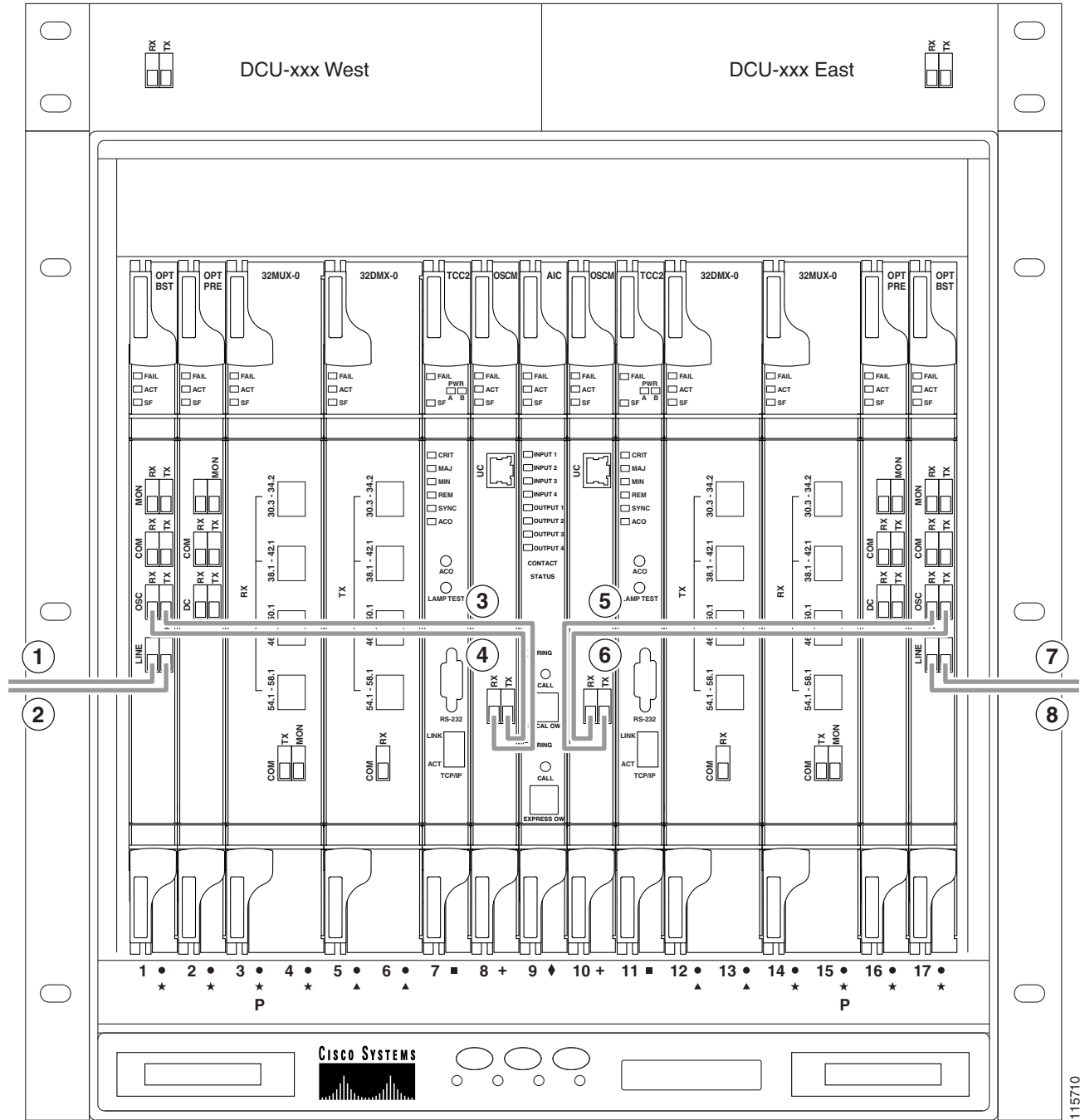
OSC link termination cabling include the following characteristics:

- The OPT-BST and OSC-CSM cards are the only cards that directly interface with the line (span) fiber.
- The OSCM card only carries optical service channels, not DWDM channels.
- The OSCM and OSC-CSM cards cannot both be installed on the same side of the shelf (Side B or Side A). You can have different cards on each side, for example an OSCM card on Side A and an OSC-CSM card on Side B.
- When an OPT-BST card and an OSC-CSM card are both used on the same side of the node, the OPT-BST card combines the supervision channel with the DWDM channels and the OSC-CSM card acts as an OSCM card; it does not carry DWDM traffic.
- If an OPT-BST and an OSCM card are installed on Side B, the Side B OPT-BST OSC RX port is connected to the Side B OSCM TX port, and the Side B OPT-BST OSC TX port is connected to the Side B OSCM RX port.
- If an OPT-BST and an OSC-CSM card are installed on Side B, the Side B OPT-BST OSC RX port is connected to the Side B OSC-CSM LINE TX port, and the Side B OPT-BST OSC TX port is connected to the Side B OSC-CSM LINE RX port.
- If an OPT-BST and an OSCM card are installed on Side A, The Side A OPT-BST OSC TX port is connected to the Side A OSCM RX port, and the Side A OPT-BST OSC RX port is connected to the Side A OSCM TX port.
- If an OPT-BST and an OSC-CSM card are installed on Side A, the Side A OPT-BST OSC TX port is connected to the Side A OSC-CSM LINE RX port, and the Side A OPT-BST OSC RX port is connected to the Side A OSC-CSM LINE TX port.

Figure 10-40 shows an example of OSC fibering for a hub node with OSCM cards installed.

10.7.1 OSC Link Termination Fiber-Optic Cabling

Figure 10-40 Fiberizing OSC Terminations—Hub Node with OSCM Cards



115710

1 Side A OPT-BST LINE RX to Side B OPT-BST or OSC-CSM LINE TX on adjacent node	5 Side B OSCM TX to Side B OPT-BST OSC RX
--	---

2	Side A OPT-BST LINE TX to Side B OPT-BST or OSC-CSM LINE RX on adjacent node	6	Side B OSCM RX to Side B OPT-BST OSC TX
3	Side A OPT-BST OSC TX to Side A OSCM RX	7	Side B OPT-BST LINE TX to Side A OPT-BST or OSC-CSM LINE RX on adjacent node
4	Side A OPT-BST OSC RX to Side A OSCM TX	8	Side B OPT-BST LINE RX to Side A OPT-BST or OSC-CSM LINE TX on adjacent node

10.7.2 Hub Node Fiber-Optic Cabling

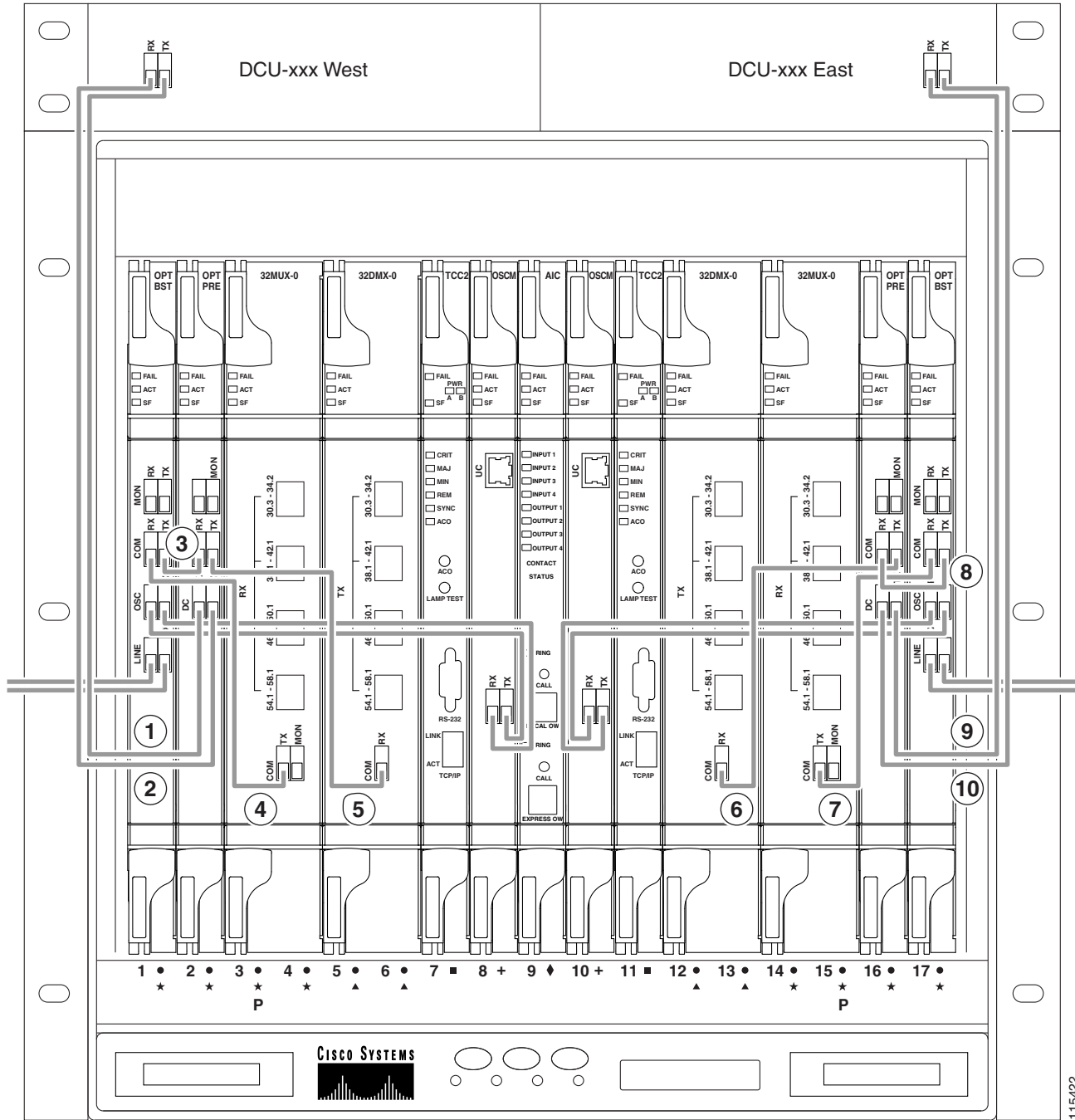
The following rules generally apply to hub node cabling:

- The Side A OPT-BST or OSC-CSM card common (COM) TX port is connected to the Side A OPT-PRE COM RX port or the Side A 32DMX-O/40-DMX-C/40-DMX-CE COM RX port.
- The Side A OPT-PRE COM TX port is connected to the Side A 32DMX-O/40-DMX-C/40-DMX-CE COM RX port.
- The Side A 32MUX-O/32WSS/32WSS-L COM TX port is connected to the Side A OPT-BST or Side A OSC-CSM COM RX port.
- The Side B 32MUX-O/32WSS/32WSS-L COM TX port is connected to the Side B OPT-BST or Side B OSC-CSM COM RX port.
- The Side B OPT-BST or Side B OSC-CSM COM TX port is connected to the Side B OPT-PRE COM RX port or the Side B 32DMX-O/32DMX COM RX port.
- The Side B OPT-PRE COM TX port is connected to the Side B 32DMX-O/32DMX COM RX port.

Figure 10-41 shows an example of a hub node with cabling. In the example, OSCM cards are installed. If OSC-CSM cards are installed, they are usually installed in Slots 1 and 17.

10.7.2 Hub Node Fiber-Optic Cabling

Figure 10-41 Fiberling a Hub Node



115422

1	Side A DCU TX to Side A OPT-PRE DC RX ¹	6	Side B 32DMX-O COM RX to Side B OPT-PRE COM TX
2	Side A DCU RX to Side A OPT-PRE DC TX ¹	7	Side B 32MUX-O COM TX to Side B OPT-BST COM RX

3	Side A OPT-BST COM TX to Side A OPT-PRE COM RX	8	Side B OPT-PRE COM RX to Side B OPT-BST COM TX
4	Side A OPT-BST COM RX to Side A 32MUX-O COM TX	9	Side B DCU TX to Side B OPT-PRE DC RX ¹
5	Side A OPT-PRE COM TX to Side A 32DMX-O COM RX	10	Side B DCU RX to Side B OPT-PRE DC TX ¹

1. If a DCU is not installed, a 4-dB attenuator loop, +/- 1 dB must be installed between the OPT-PRE DC ports.

10.7.3 Terminal Node Fiber-Optic Cabling

The following rules generally apply to terminal node cabling:

- A terminal site has only one side (as compared to a hub node, which has two sides). The terminal side can be either Side B or Side A.
- The terminal side OPT-BST or OSC-CSM card COM TX port is connected to the terminal side OPT-PRE COM RX port or the 32DMX-O/40-DMX-C/40-DMX-CE COM RX port.
- The terminal side OPT-PRE COM TX port is connected to the terminal side 32DMX-O/40-DMX-C/40-DMX-CE COM RX port.
- The terminal side 32MUX-O/40-MUX-C COM TX port is connected to the terminal side OPT-BST or OSC-CSM COM RX port.

10.7.4 Line Amplifier Node Fiber-Optic Cabling

The following rules generally apply to line amplifier node cabling:

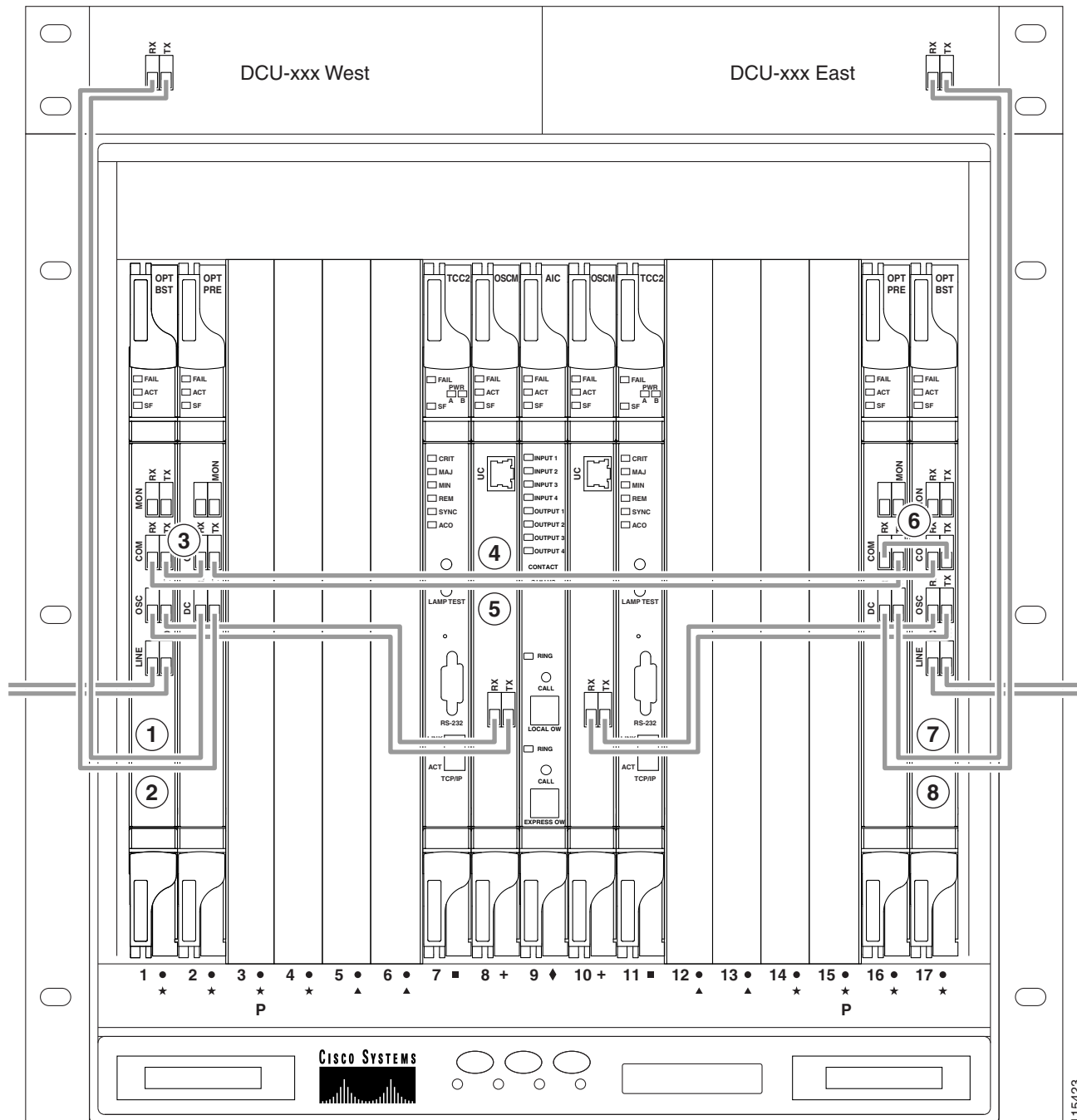
- The line amplifier node layout allows all combinations of OPT-PRE and OPT-BST cards and allows you to use asymmetrical card choices in Side A-to-Side B and Side B-to-Side A configurations. For a given line direction, you can configure the four following possibilities:
 - Only preamplification (OPT-PRE)
 - Only booster amplification (OPT-BST)
 - Both preamplification and booster amplification (where a line amplifier node has amplification in at least one direction)
 - Neither preamplification nor booster amplification
- If a Side A OPT-PRE card is installed:
 - The Side A OSC-CSM or OPT-BST COM TX is connected to the Side A OPT-PRE COM RX port.
 - The Side A OPT-PRE COM TX port is connected to the Side B OSC-CSM or OPT-BST COM RX port.
- If a Side A OPT-PRE card is not installed, the Side A OSC-CSM or OPT-BST COM TX port is connected to the Side B OSC-CSM or OPT-BST COM RX port.
- If an Side B OPT-PRE card is installed:
 - The Side B OSC-CSM or OPT-BST COM TX port is connected to the Side B OPT-PRE COM RX port.

10.7.4 Line Amplifier Node Fiber-Optic Cabling

- The Side B OPT-PRE COM TX port is connected to the Side A OSC-CSM or OPT-BST COM RX port.
- If an Side B OPT-PRE card is not installed, the Side B OSC-CSM or OPT-BST COM TX port is connected to the Side A OSC-CSM or OPT-BST COM RX port.

Figure 10-42 shows an example of a line amplifier node with cabling.

Figure 10-42 *Fibering a Line Amplifier Node*



1	Side A DCU TX to Side A OPT-PRE DC RX ¹	5	Side A OPT-BST COM RX to Side B OPT-PRE COM TX
2	Side A DCU RX to Side A OPT-PRE DC TX ¹	6	Side A OPT-BST COM RX to Side B OPT-PRE COM TX
3	Side A OPT-BST COM TX to Side A OPT-PRE COM RX	7	Side B DCU TX to Side B OPT-PRE DC RX ¹
4	Side A OPT-PRE COM TX to Side B OPT-BST COM RX	8	Side B DCU RX to Side B OPT-PRE DC TX ¹

1. If a DCU is not installed, a 4-dB attenuator loop, +/- 1 dB, must be installed between the OPT-PRE DC ports.

10.7.5 OSC Regeneration Node Fiber-Optic Cabling

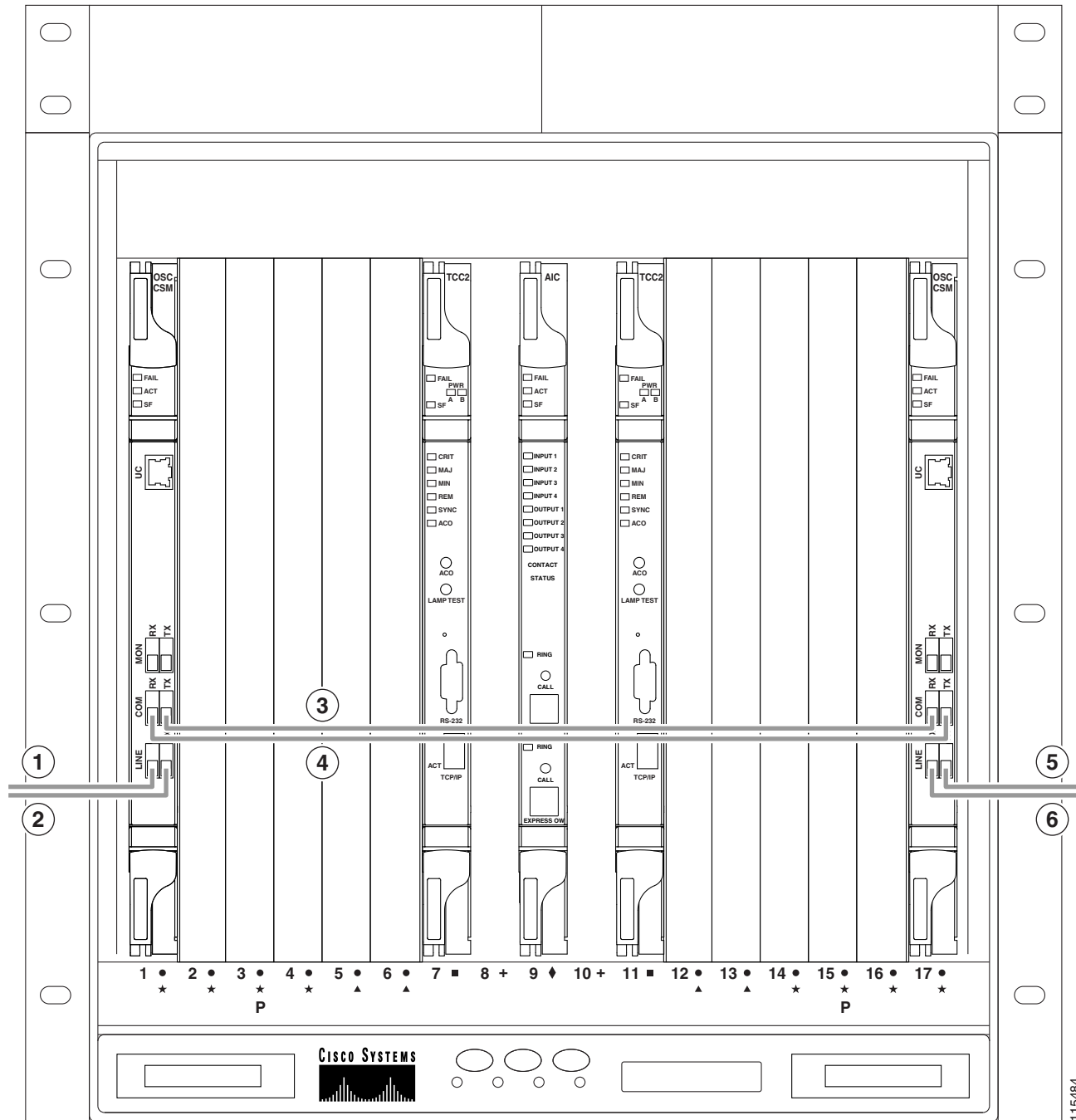
The following rules generally apply to OSC regeneration node cabling:

- The Side A OSC-CSM COM TX port connects to the Side B OSC-CSM COM RX port.
- The Side A OSC-CSM COM RX port connects to the Side B OSC-CSM COM TX port.
- Slots 2 through 5 and 12 through 16 can be used for TXP and MXP cards.

[Figure 10-43](#) shows an example of an OSC regeneration node with cabling.

10.7.5 OSC Regeneration Node Fiber-Optic Cabling

Figure 10-43 Fiberling an OSC Regeneration Node



115484

1	Side A OSC-CSM LINE RX to Side B OSC-CSM or OPT-BST LINE TX on adjacent node	4	Side A OSC-CSM COM RX to Side B OSC-CSM COM TX
2	Side A OSC-CSM LINE TX to Side B OSC-CSM or OPT-BST LINE RX on adjacent node	5	Side B OSC-CSM LINE RX to Side A OSC-CSM or OPT-BST LINE TX on adjacent node
3	Side A OSC-CSM COM TX to Side B OSC-CSM COM RX	6	Side B OSC-CSM LINE TX to Side A OSC-CSM or OPT-BST LINE RX on adjacent node

10.7.6 Amplified or Passive OADM Node Fiber-Optic Cabling

The two sides of the OADM node do not need to be symmetrical. On each side, Cisco TransportPlanner can create one of the following four configurations:

- OPT-BST and OPT-PRE
- OSC-CSM and OPT-PRE
- Only OSC-CSM
- Only OPT-BST



Note

Amplified OADM nodes contain OPT-PRE cards and/or OPT-BST cards. Passive OADM nodes do not. Both contain add/drop channel or band cards.

The following rules generally apply for OADM node express path cabled connections:

- TX ports should only be connected to RX ports.
- EXP ports are connected only to COM ports in between AD-xC-xx.x or AD-xB-xx.x cards that all belong to Side B (that is, they are daisy-chained).
- EXP ports are connected only to COM ports in between AD-xC-xx.x or AD-xB-xx.x cards that all belong to Side A (that is, they are daisy-chained).
- The EXP port of the last AD-xC-xx.x or AD-xB-xx.x card on Side A is connected to the EXP port of the first AD-xC-xx.x or AD-xB-xx.x card on Side B.
- The OPT-BST COM RX port is connected to the nearest (in slot position) AD-xC-xx.x or AD-xB-xx.x COM TX port.
- The OPT-PRE COM TX port is connected to the nearest (in slot position) AD-xC-xx.x or AD-xB-xx.x COM RX port.
- If OADM cards are located in adjacent slots, the TCC2/TCC2P card assumes that they are connected in a daisy-chain between the EXP ports and COM ports as noted previously.
- The first Side A AD-xC-xx.x or AD-xB-xx.x card COM RX port is connected to the Side A OPT-PRE or OSC-CSM COM TX port.
- The first Side A AD-xC-xx.x or AD-xB-xx.x card COM TX port is connected to the Side A OPT-BST or OSC-CSM COM RX port.
- The first Side B AD-xC-xx.x or AD-xB-xx.x card COM RX port is connected to the Side B OPT-PRE or OSC-CSM COM TX port.

- The first Side B AD-xC-xx.x or AD-xB-xx.x card COM TX port is connected to the Side B OPT-BST or OSC-CSM RX port.
- If a Side A OPT-PRE is present, the Side A OPT-BST or OSC-CSM COM TX port is connected to the Side A OPT-PRE COM RX port.
- If an Side B OPT-PRE is present, the Side B OPT-BST or OSC-CSM COM TX port is connected to the Side B OPT-PRE COM RX port.

The following rules generally apply for OADM node add/drop path cabled connections:

- AD-xB-xx.x add/drop (RX or TX) ports are only connected to the following ports:
 - 4MD-xx.x COM TX or 4MD-xx.x COM RX ports
 - Another AD-xB-xx.x add/drop port (a pass-through configuration)
- An AD-xB-xx.x add/drop band port is only connected to a 4MD-xx.x card belonging to the same band.
- For each specific AD-xB-xx.x card, the add and drop ports for that band card are connected to the COM TX and COM RX ports of the same 4MD-xx.x card.
- The AD-xB-xx.x and 4MD-xx.x cards are located in the same side (the connected ports all have the same line direction).

The following rules generally apply for OADM node pass-through path cabled connections:

- Pass-through connections are only established between add and drop ports on the same band or channel and in the same line direction.
- AD-xC-xx.x or AD-xB-xx.x add/drop ports must be connected to other AD-xC-xx.x or AD-xB-xx.x add/drop ports (as pass-through configurations).
- Add (RX) ports must be connected to drop (TX) ports.
- 4MD-xx.x client input/output ports must be connected to other 4MD-xx.x client input/output ports.
- A Side A AD-xB-xx.x drop (TX) port is connected to the corresponding Side A 4MD-xx.x COM RX port.
- A Side A AD-xB-xx.x add (RX) port is connected to the corresponding Side A 4MD-xx.x COM TX port.
- An Side B AD-xB-xx.x drop (TX) port is connected to the corresponding Side B 4MD-xx.x COM RX port.
- An Side B AD-xB-xx.x add (RX) port is connected to the corresponding Side B 4MD-xx.x COM TX port.

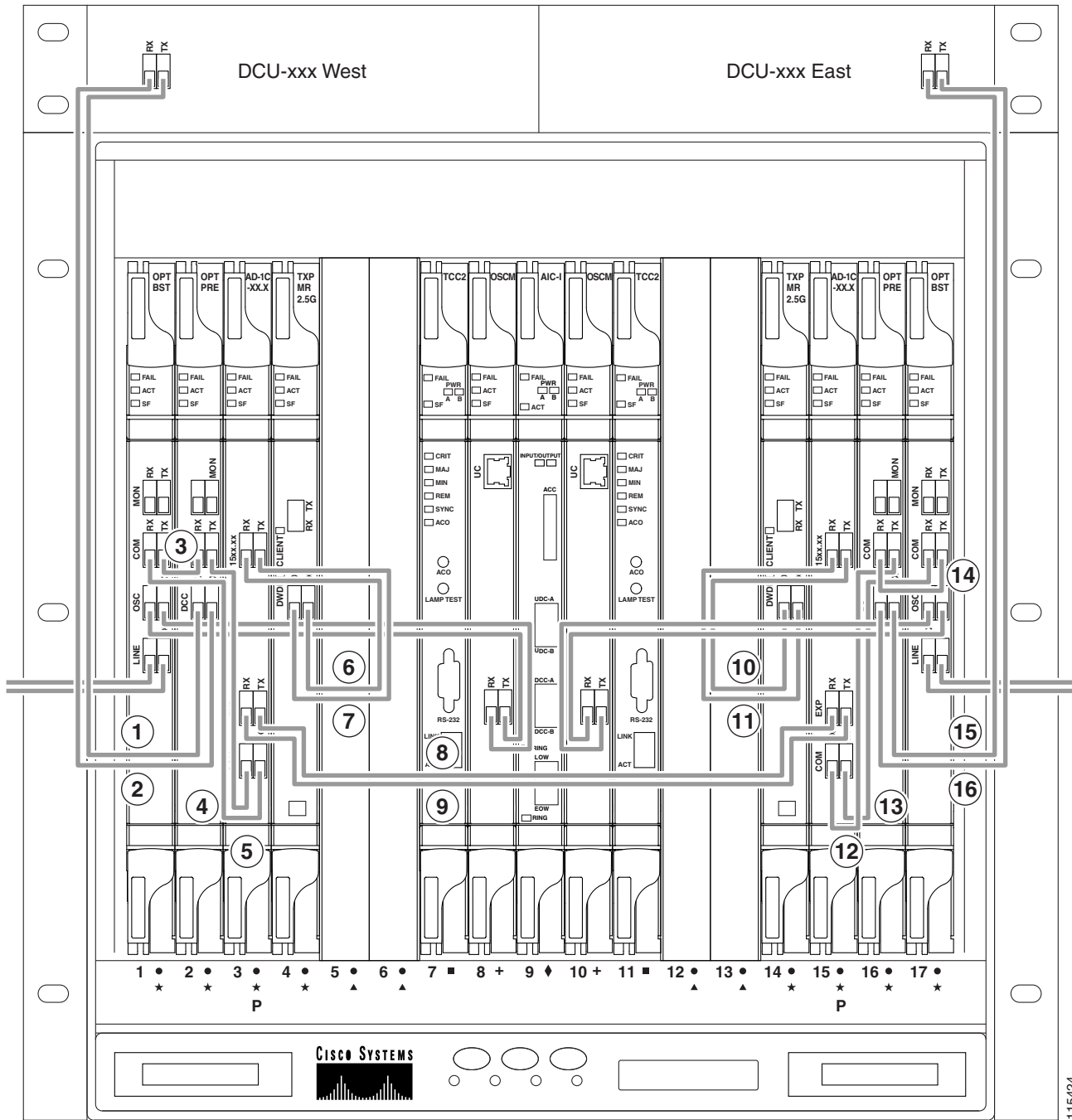
Figure 10-44 shows an example of an amplified OADM node with AD-1C-xx.x cards installed.



Note

Figure 10-44 is an example. Always install fiber-optic cables based on the Cisco TransportPlanner Internal Connections table for your site.

Figure 10-44 Fiberizing an Amplified OADM Node



115424

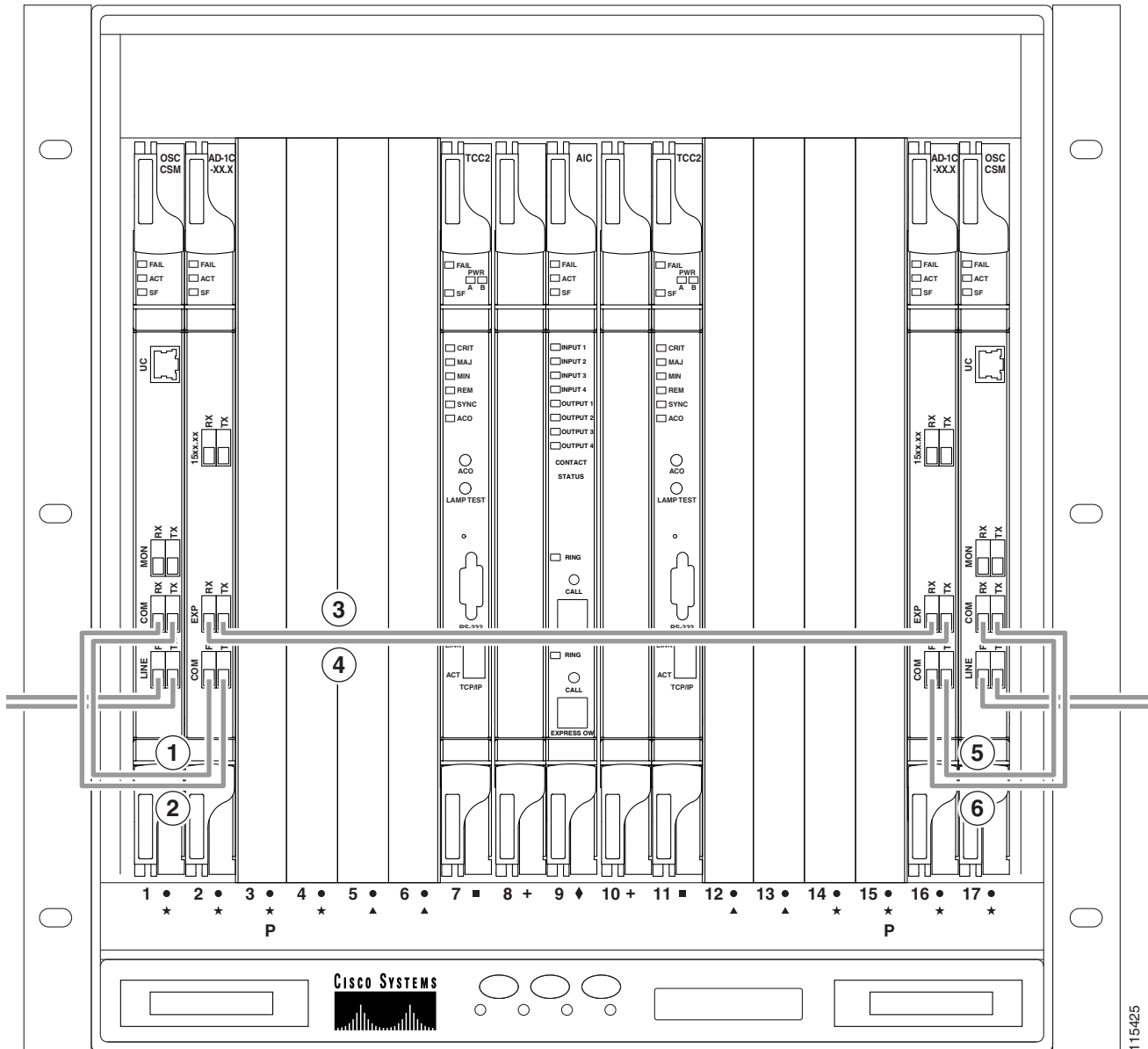
1	Side A DCU TX to Side A OPT-PRE DC RX ¹	9	Side A AD-1C-xx.x EXP RX to Side B AD-1C-xx.x EXP TX
2	Side A DCU RX to Side A OPT-PRE DC TX ¹	10	Side B TXP_MR_2.5G DWDM RX to Side B AD-1C-xx.x (15xx.xx) TX
3	Side A OPT-BST COM TX to Side A OPT-PRE COM RX	11	Side B TXP_MR_2.5G DWDM TX to Side B AD-1C-xx.x (15xx.xx) RX

10.7.6 Amplified or Passive OADM Node Fiber-Optic Cabling

4	Side A OPT-BST COM RX to Side A AD-1C-xx.x COM TX	12	Side B AD-1C-xx.x COM RX to OPT-PRE COM TX
5	Side A OPT-PRE COM TX to Side A AD-1C-xx.x COM RX	13	Side B AD-1C-xx.x COM TX to OPT-BST COM RX
6	Side A AD-1C-xx.x (15xx.xx) RX to Side A TXP_MR_2.5G DWDM TX	14	Side B OPT-PRE COM RX to Side B OPT-BST COM TX
7	Side A AD-1C-xx.x (15xx.xx) TX to Side A TXP_MR_2.5G DWDM RX	15	Side B DCU TX to Side B OPT-PRE DC RX ¹
8	Side A AD-1C-xx.x EXP TX to Side B AD-1C-xx.x EXP RX	16	Side B DCU RX to Side B OPT-PRE DC TX ¹

1. If a DCU is not installed, a 4-dB attenuator loop, +/- 1 dB, must be installed between the OPT-PRE DC ports.

Figure 10-45 shows an example of a passive OADM node with two AD-1C-xx.x cards installed.

Figure 10-45 *Fibering a Passive OADM Node*

115/425

1	Side A OSC-CSM COM TX to Side A AD-1C-xx.x COM RX	4	Side A OSC-CSM EXP RX to Side B AD-1C-xx.x EXP TX
2	Side A OSC-CSM COM RX to Side A AD-1C-xx.x COM TX	5	Side B AD-1C-xx.x COM TX to Side B OSC-CSM COM RX
3	Side A OSC-CSM EXP TX to Side B AD-1C-xx.x EXP RX	6	Side B AD-1C-xx.x COM RX to Side B OSC-CSM COM TX

10.7.7 ROADM Node Fiber-Optic Cabling

The following rules generally apply to ROADM node cabling:

- The Side A OPT-BST or OSC-CSM COM TX port is connected to the Side A OPT-PRE COM RX port.
- The Side A OPT-PRE COM TX port is connected to the Side A 32WSS COM RX port.
- The Side A OPT-BST or OSC-CSM COM RX port is connected to the Side A 32WSS COM TX port.
- The Side A OPT-BST (if installed) OSC TX port is connected to the Side A OSCM RX port.
- The Side A OPT-BST (if installed) OSC RX port is connected to the Side A OSCM TX port.
- The Side A 32WSS EXP TX port is connected to the Side B 32WSS EXP RX port.
- The Side A 32WSS EXP RX port is connected to the Side B 32WSS EXP TX port.
- The Side A 32WSS DROP TX port is connected to the Side A 32DMX COM RX port.
- The Side A 40-WSS-C/40-WSS-CE DROP TX port is connected to the Side A 40-DMX-C or 40-DMX-CE COM RX port.
- The Side B OPT-BST or OSC-CSM COM TX port is connected to the Side B OPT-PRE COM RX port.
- The Side B OPT-PRE COM TX port is connected to the Side B 32WSS COM RX port.
- The Side B OPT-BST or OSC-CSM COM RX port is connected to the Side B 32WSS COM TX port.
- The Side B OPT-BST (if installed) OSC TX port is connected to the Side B OSCM RX port.
- The Side B OPT-BST (if installed) OSC RX port is connected to the Side B OSCM TX port.
- The Side B 32WSS DROP TX port is connected to the Side B 32DMX COM RX port.
- The Side B 40-WSS-C/40-WSS-CE DROP TX port is connected to the Side B 40-DMX-C or 40-DMX-CE COM RX port.

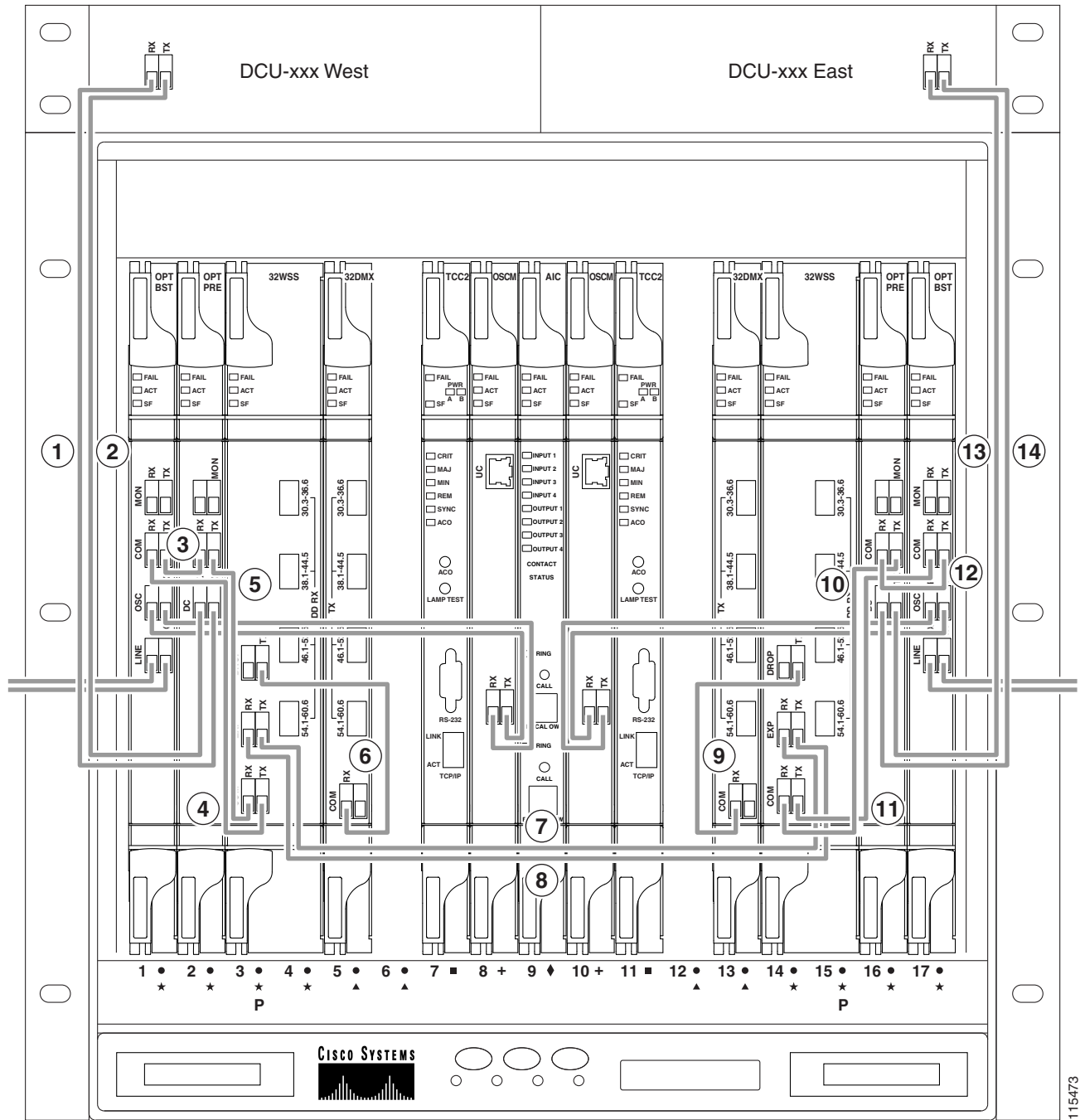
Figure 10-46 shows an example of an amplified ROADM node with cabling.



Note

Figure 10-46 is an example. Always install fiber-optic cables based on the Cisco TransportPlanner Internal Connections table for your site.

Figure 10-46 Fiberizing a ROADM Node



115473

1	Side A DCU TX to Side A OPT-PRE DC RX ¹	8	Side A 32WSS EXP RX to Side B 32WSS EXP TX
2	Side A DCU RX to Side A OPT-PRE DC TX ¹	9	Side B 32DMX COM RX to Side B 32WSS DROP TX
3	Side A OPT-BST COM TX to Side A OPT-PRE COM RX	10	Side B 32WSS COM RX to Side B OPT-PRE COM TX

4	Side A 32WSS COM TX to Side A OPT-BST COM RX	11	Side B 32WSS COM TX to Side B OPT-BST COM RX
5	Side A 32WSS COM RX to Side A OPT-PRE COM TX	12	Side B OPT-BST COM TX to Side B OPT-PRE COM RX
6	Side A 32DMX COM RX to Side A 32WSS DROP TX	13	Side B DCU RX to Side B OPT-PRE DC TX ¹
7	Side A 32WSS EXP TX to Side B 32WSS EXP RX	14	Side B DCU TX to Side B OPT-PRE DC RX ¹

1. If a DCU is not installed, a 4-dB attenuator loop, +/-1 dB must be installed between the OPT-PRE DC ports.

10.8 Automatic Node Setup

Automatic node setup (ANS) is a TCC2/TCC2P function that adjusts values of the variable optical attenuators (VOAs) on the DWDM channel paths to equalize the per-channel power at the amplifier input. This power equalization means that at launch, all channels have the same amplifier power, independent from the input signal on the client interface and independent from the path crossed by the signal inside the node. This equalization is needed for two reasons:

- Every path introduces a different penalty on the signal that crosses it.
- Client interfaces add their signal to the ONS 15454 DWDM ring with different power levels.

To support ANS, integrated VOAs and photodiodes are provided in the following cards:

- AD-xB-xx.x card express and drop paths
- AD-xC-xx.x card express and add paths
- 4MD-xx.x card add paths
- 32MUX-O card add paths
- 32WSS/40-WSS-C/40-WSS-CE/40-WXC-C add and pass through paths
- 32DMX-O card drop paths
- 32DMX, 40-DMX-C, 40-DMX-CE card input port
- 40-MUX-C card output port
- PSM card input and output ports (both working and protect path)

Optical power is equalized by regulating the VOAs. Based on the expected per-channel power, ANS automatically calculates the VOA values by:

- Reconstructing the different channels paths.
- Retrieving the path insertion loss (stored in each DWDM transmission element).

VOAs operate in one of three working modes:

- **Automatic VOA Shutdown**—In this mode, the VOA is set at maximum attenuation value. Automatic VOA shutdown mode is set when the channel is not provisioned to ensure system reliability in the event that power is accidentally inserted.
- **Constant Attenuation Value**—In this mode, the VOA is regulated to a constant attenuation independent from the value of the input signal. Constant attenuation value mode is set on VOAs associated to aggregated paths.
- **Constant Power Value**—In this mode, the VOA values are automatically regulated to keep a constant output power when changes occur to the input power signal. This working condition is set on VOAs associated to a single channel path.

ANS calculates the following VOA provisioning parameters:

- Target attenuation
- Target power

To allow you to modify ANS values based on your DWDM network requirements, provisioning parameters are divided into two contributions:

- Reference Contribution—(Display only) This value is set by ANS.
- Calibration Contribution—This value can be set by the user.

To complete the equalization, ANS requires the following information:

- The order in which DWDM cards are connected together on the express paths.
- The number of channels that are add or dropped.
- The number of channels and/or bands that are configured as passthrough.

ANS assumes that every DWDM port is associated to one on the node side. The port-to-side association is based on node layout deriving from provisioned (or automatically calculated) internal patchcords.

From CTC or TL1 you can:

- Calculate the default connections on the NE.
- Retrieve the list of existing connections.
- Retrieve the list of free ports.
- Create new connections or modify existing ones.
- Launch ANS.

After you launch ANS, one of the following statuses is provided for each ANS parameter:

- Success - Changed—The parameter setpoint was recalculated successfully.
- Success - Unchanged—The parameter setpoint did not need recalculation.
- Unchanged - Port in IS state—ANS could not modify the setpoint because the ports in an IS state.
- Not Applicable—The parameter setpoint does not apply to this node type.
- Fail - Out of Range—The calculated setpoint is outside the expected range.
- Fail - Missing Input Parameter—The parameter could not be calculated because the required provisioning data is unknown or not available.

Optical patchcords are passive devices that are modeled by the two termination points, each with an assigned slot and port. If user-provisioned optical patchcords exist, ANS checks that the new connection is feasible (according to internal connection rules) and returns a denied message if the user connection violates one of the rules. ANS requires the expected wavelength to be provisioned. When provisioning the expected wavelength, the following rules apply:

- The card name is generically characterized by the card family, and not the particular wavelengths supported (for example, AD-2C-xx.x for all two-channel OADMs).
- At the provisioning layer, you can provision a generic card for a specific slot using CTC or TL1.
- Wavelength assignment is done at the port level.
- An equipment mismatch alarm is raised when a mismatch between the identified and provisioned value occurs. The default value for the provisioned attribute is AUTO.

ONS 15454 ANS parameters set the values required for the node to operate successfully.

Cisco TransportPlanner calculates the ANS parameters based on the requirements for a planned network. Cisco TransportPlanner exports the parameters to an ASCII, NE Update file. The NE Update file can

then be imported by CTC to automatically provision the node for the network. All ANS parameters can be viewed and manually modified from the node view Provisioning > WDM-ANS > Provisioning tab, shown in Figure 10-47.

Figure 10-47 WDM-ANS Provisioning

The screenshot displays the WDM-ANS Provisioning tab in the CTC interface. The left pane shows a tree view (Selector) with the following structure:

- tc21 (ROADM)
 - Network Type
 - Side A
 - Rx
 - Amplifier
 - Tilt
 - Ch Power
 - Working Mode
 - Power
 - Add&Drop - Drop Power
 - Add&Drop - Input Power
 - Threshold
 - Amplifier In Power Fail Th
 - OSC LOS Threshold
 - Channel LOS Threshold
 - Min Expected Span Loss
 - Max Expected Span Loss
 - Tx
 - Amplifier
 - Tilt
 - Ch Power
 - Working Mode
 - Power
 - Add&Drop - Output Power
 - Threshold
 - Fiber Stage Input Threshold
 - Side B
 - Rx
 - Amplifier
 - Tilt
 - Ch Power
 - Working Mode
 - Power
 - Add&Drop - Drop Power

The right pane shows a table of parameters for the selected node. The table has the following columns: Parameter, Value, Origin, and Note. The parameters are listed for Side A and Side B, including Network Type, Amplifier, Power, Threshold, and Fiber Stage Input Threshold. The Origin column indicates whether the value is a default or imported from a CTP XML file.

Parameter	Value	Origin	Note
Network Type	Metro-Core	DEFAULT	
Side A.Rx.Amplifier.Tilt	0.0 (dB)	DEFAULT	
Side A.Rx.Amplifier.Ch Power	2.0 (dBm)	DEFAULT	
Side A.Rx.Amplifier.Working Mode	Control Gain	DEFAULT	
Side A.Rx.Power.Add&Drop - Drop Power	-14.0 (dBm)	DEFAULT	
Side A.Rx.Power.Add&Drop - Input Power	-14.0 (dBm)	DEFAULT	
Side A.Rx.Threshold.Amplifier In Power Fail Th	9.0 (dBm)	DEFAULT	
Side A.Rx.Threshold.OSC LOS Threshold	-40.0 (dBm)	DEFAULT	
Side A.Rx.Threshold.Channel LOS Threshold	-30.0 (dBm)	DEFAULT	
Side A.Rx.Min Expected Span Loss	0.0 (dB)	DEFAULT	
Side A.Rx.Max Expected Span Loss	60.0 (dB)	DEFAULT	
Side A.Tx.Amplifier.Tilt	0.0 (dB)	DEFAULT	
Side A.Tx.Amplifier.Ch Power	2.0 (dBm)	DEFAULT	
Side A.Tx.Amplifier.Working Mode	Control Gain	DEFAULT	
Side A.Tx.Power.Add&Drop - Output Power	-14.0 (dBm)	DEFAULT	
Side A.Tx.Threshold.Fiber Stage Input Thre...	9.0 (dBm)	DEFAULT	
Side B.Rx.Amplifier.Tilt	0.0 (dB)	DEFAULT	
Side B.Rx.Amplifier.Ch Power	2.0 (dBm)	DEFAULT	
Side B.Rx.Amplifier.Working Mode	Control Gain	DEFAULT	
Side B.Rx.Power.Add&Drop - Drop Power	-14.0 (dBm)	DEFAULT	
Side B.Rx.Power.Add&Drop - Input Power	-14.0 (dBm)	DEFAULT	
Side B.Rx.Threshold.Amplifier In Power Fail Th	9.0 (dBm)	DEFAULT	
Side B.Rx.Threshold.OSC LOS Threshold	-40.0 (dBm)	DEFAULT	
Side B.Rx.Threshold.Channel LOS Threshold	-30.0 (dBm)	DEFAULT	
Side B.Rx.Min Expected Span Loss	0.0 (dB)	DEFAULT	
Side B.Rx.Max Expected Span Loss	60.0 (dB)	DEFAULT	
Side B.Tx.Amplifier.Tilt	0.0 (dB)	DEFAULT	
Side B.Tx.Amplifier.Ch Power	2.0 (dBm)	DEFAULT	
Side B.Tx.Amplifier.Working Mode	Control Gain	DEFAULT	
Side B.Tx.Power.Add&Drop - Output Power	-14.0 (dBm)	DEFAULT	
Side B.Tx.Threshold.Fiber Stage Input Thre...	9.0 (dBm)	DEFAULT	

Retrieved: September 8, 2001 20:50:07 PM, PDT from node

The Provisioning > WDM-ANS > Provisioning tab presents the following information:

- **Selector**—Presents the ANS parameters in a tree view. Clicking the + or – expands or collapses individual tree elements. Clicking a tree element displays the element parameters in the table on the right. For example, clicking the node name at the top displays all the node ANS parameters. Clicking Rx > Amplifier displays the amplifier receive parameters only.
- **Parameter**—displays the parameter name.
- **Value**—Displays the parameter value. Values can be modified manually, although manual modification of ANS parameters is not recommended. If ANS could not calculate a parameter, “Unknown” is displayed in the Value column.
- **Origin**—Indicates how the parameter was calculated:
 - **Default**—The value is the default setting provided with the node.
 - **Imported**—The value was set by importing the CTP XML file.

- Provisioned—The value was manually provisioned.
- Automatic—The value is automatically calculated by the system using the Installation without MP or the Raman provisioning wizard. For more information on how to provision using a wizard, see the “DLP-G468 Configure the OPT-RAMP-C Card” task in the *Cisco ONS 15454 DWDM Procedure Guide*.
- Note—Displays information for parameters that could not be calculated, that is, parameters with Unknown appearing in the Value column.

Table 10-11 shows the following information displayed for ANS parameters on the Provisioning > WDM-ANS > Provisioning tab.

- Side—The optical side, which can be A (Slots 1 through 6) or B (Slots 12 through 17) for DWDM nodes in non-mesh DWDM networks, or A, B, C, D, E, F, G, or H for nodes in DWDM mesh networks.
- Rx/Tx—Indicates whether the parameter is transmit or receive.
- Category—The parameter category as displayed in the ANS parameter tree.
- Min—Minimum value in decibels.
- Max—Maximum value in decibels.
- Def—Default value in decibels. Other defaults include MC (metro core), CG (control gain), U (unknown).
- Optical Type—Parameter optical type: T (Terminal), FC (flexible channel count terminal), O (OADM), H (hub), L (line amplifier), R (ROADM), or U (unknown).

Table 10-11 Provisioning > ANS-WDM > Provisioning Tab Parameters

Side	Rx/Tx	Category	Parameters	Min	Max	Def	Optical Types
i^1	—	Network Type	Network Type	—	—	MC	U, T, FC, O, H, L, R
	Rx	Amplifier	Side i .Rx.Amplifier.Tilt	0	30	0	T, FC, O, H, L, R
			Side i .Rx.Amplifier.Gain	0	30	0	T, FC, O, H, L, R
			Side i .Rx.Amplifier.Ch Power	–10	17	2	T, FC, O, H, L, R
			Side i .Rx.Amplifier.Working Mode	—	—	CG	T, FC, O, H, L, R
	Power	Power	Side i Rx.Power.Far End	–50	30	U	T, FC, O, H, L, R
			Side i Rx.Power.Add&Drop - Input Power	–50	30	14	T, FC, O, H, R
			Side i .Rx.Power.Add&Drop - Drop Power	–50	30	14	T, FC, O, H, R
			Side i .Rx.Power.Band n .Drop Power (where $n = 1-8$)	–50	30	14	FC, O
			Side i .Rx.Power.Channel n .Drop Power Side B (where $n = 1-32^2$ or $1-40^3$)	–50	30	14	T, H, R

Table 10-11 Provisioning > ANS-WDM > Provisioning Tab Parameters (continued)

Side	Rx/Tx	Category	Parameters	Min	Max	Def	Optical Types
	Rx	Raman	Side <i>i</i> .Rx.Raman.Expected Raman Gain	0	12	0	T, O, L, R
			Side <i>i</i> .Rx.Raman.Expected Raman EDFA Per Channel Power	-50	30	2	T, O, L, R
			Side <i>i</i> .Rx.Raman.Expected Raman Stage Output Power	-50	30	-14	T, O, L, R
			Side <i>i</i> .Rx.Raman.Raman Ratio	0.0	100.0	0	T, O, L, R
			Side <i>i</i> .Rx.Raman.Raman Power	100	450	200	T, O, L, R
		Thresholds	Side <i>i</i> .Rx.Threshold. LOS Threshold	-50	30	U	T, FC, O, H, L, R
			Side <i>i</i> .Rx.Threshold.Channel LOS Threshold	-50	30	U	T, FC, O, H, L, R
			Side <i>i</i> Rx Amplifier In Power Fail Th	-50	30		
		—	Side <i>i</i> Rx Working and Protect Combined Power	-50	30	-14	T
	Tx	Amplifier	Side <i>i</i> .Tx.Amplifier.Tilt	0	30	0	T, FC, O, H, L, R
			Side <i>i</i> .Tx.Amplifier.Gain	0	30	0	T, FC, O, H, L, R
			Side <i>i</i> .Tx.Amplifier.Ch Power	-10	17	2	T, FC, O, H, L, R
			Side <i>i</i> .Tx.Amplifier.Working Mode	—	—	CG	T, FC, O, H, L, R
		Power	Side <i>i</i> .Tx.Power.Add&Drop - Output Power	-50	30	14	T, FC, O, H, R
			Side <i>i</i> .Tx.Power.Add&Drop - By-Pass Power	-50	30	14	H
		Threshold	Side <i>i</i> .Tx.Threshold.Fiber Stage Input Threshold	-50	30	U	
<i>i</i> ⁴ (w)	Rx	—	Side <i>i</i> .W.Rx.Max Expected Span Loss ⁵	0	60	60	T, FC, O, H, L, R
			Side <i>i</i> .W.Rx.Min Expected Span Loss	0	60	60	T, FC, O, H, L, R
<i>i</i> ⁶ (p)	Rx	—	Side <i>i</i> .P.Rx.Max Expected Span Loss	0	60	60	T, FC, O, H, L, R
			Side <i>i</i> .P.Rx.Min Expected Span Loss	0	60	60	T, FC, O, H, L, R

- Where *i* = A, B, C, D, E, F, G, H
- If 32-channel cards are installed
- If 40-channel cards are installed
- Working side, displayed only if you have provisioned a PSM card in line protection configuration
- Protected side, displayed only if you have provisioned a PSM card in line protection configuration
- If working and protected sides are not present, the Max Expected Span Loss and Min Expected Span Loss parameters are displayed without the W and P prefix.

10.8.1 Raman Setup and Tuning

Raman amplification occurs in the optical fiber and the consequent Raman gain depends on the characteristics of the span (attenuator presence, fiber type, junctions, etc.). Since 2 Raman pumps at 2 different wavelengths are used to stimulate the Raman effect, not only is the total signal power calculation significant, but the right mix of power to ensure gain flatness is crucial. These setpoints of the total Raman power and Raman ratio can be configured on the OPT-RAMP-C card in three ways:

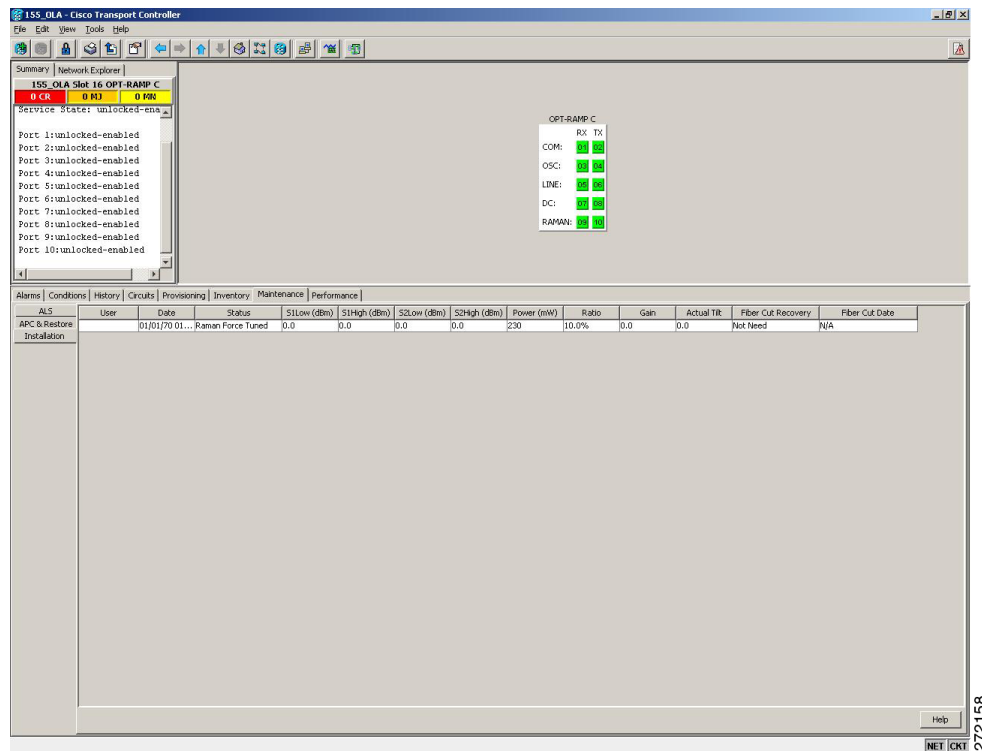
- Raman installation wizard
- CTP XML file
- CTC/TL1 interface

For information on how to configure the setpoints on the OPT-RAMP-C card, see the *Cisco ONS DWDM Procedure Guide*.

Raman amplification on OPT-RAMP-C cards depends on the optical fiber installed. Therefore, Raman total power and Raman ratio values calculated using the Raman installation wizard via CTC is more accurate than the values provisioned by loading the CTP XML file. For this reason, the value provisioned using the wizard cannot be overridden by the CTP XML file. However, the values provisioned by the wizard or the CTP XML file can be overridden by manually provisioning the parameters.

Once the Raman installation is completed, a report of the status of Raman configuration on a node in the OPT-RAMP-C card can be viewed in the Maintenance > Installation tab when you are in card view. See [Figure 10-48](#).

Figure 10-48 View Raman Configuration Status



The Installation tab displays the following fields:

- User—Name of user who performed the Raman pump configuration.
- Date—Date when the Raman pump configuration was performed.
- Status
 - Tuned—Installation wizard configured the Raman pump successfully.
 - Not Tuned—Raman configuration on the span is not present, or a fiber cut has occurred but the link is not restored.
 - Fiber Cut Restore—A fiber cut restoration procedure was successfully performed and shows the data.
 - Raman Force Tuned—The Raman gain values were forcibly applied and shows the data.
- S1Low (dBm)—See [Table 10-12](#).

10.8.1 Raman Setup and Tuning

- S1High (dBm)—See [Table 10-12](#).
- S2Low (dBm)—See [Table 10-12](#).
- S2High (dBm)—See [Table 10-12](#).
- Power (mW)—Total Raman power setpoints.
- Ratio—Raman pump ratio setpoint.
- Gain—Expected Raman gain as calculated by the wizard.
- Actual Tilt—Expected Raman tilt as calculated by the wizard.
- Fiber Cut Recovery—Fiber cut has occurred, but restoration of the fiber cut link is pending.
- Fiber Cut Date—Date when the fiber cut happened.

The Raman pump is equipped with two different Raman pumps transmitting powers (P1 and P2) at two different wavelengths $\lambda 1$ and $\lambda 2$. During installation, the two pumps alternatively turn ON and OFF at two different power values. $\lambda 1$ and $\lambda 2$ signals are used as probes at the end of spans to measure Raman gain efficiency of the two Raman pumps separately.

The example in [Figure 10-49 on page 10-70](#) shows the Raman gain on an OPT-RAMP-C card in Node B that was measured by setting the wavelength and power measurements as follows:

$\lambda 1$ =1530.33 nm signal probe at Node A

$\lambda 2$ =1560.61 nm signal probe at Node A

P1 = 1425 nm power at Node B

P2 = 1452 nm power at B

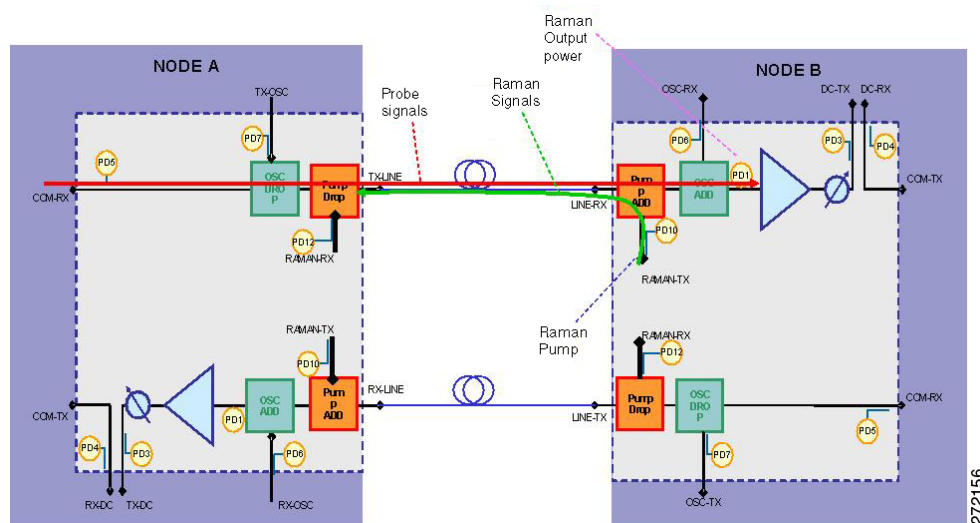
Plow = 100 mW

Phigh = 280 mW

Pmin = 8 mW

Pmax = 450 mW

Figure 10-49 Raman Gain on Node B



The S1low, S1high, S2low, and S2low values in the Maintenance > Installation tab are based on the power values read on the LINE-RX port of Node B.

Table 10-12 Example of Raman Power Measurements

Input	P1	P2	Raman Power at Node B
λ 1=1530.33 nm at Node A	P _{low} = 100 mW	P _{min} = 8 mW	S1 _{low}
	P _{high} = 250 mW	P _{min} = 8 mW	S1 _{high}
λ 2=1560.61 nm at Node A	P _{min} = 8 mW	P _{low} = 100 mW	S2 _{low}
	P _{min} = 8 mW	P _{high} = 250 mW	S2 _{low}

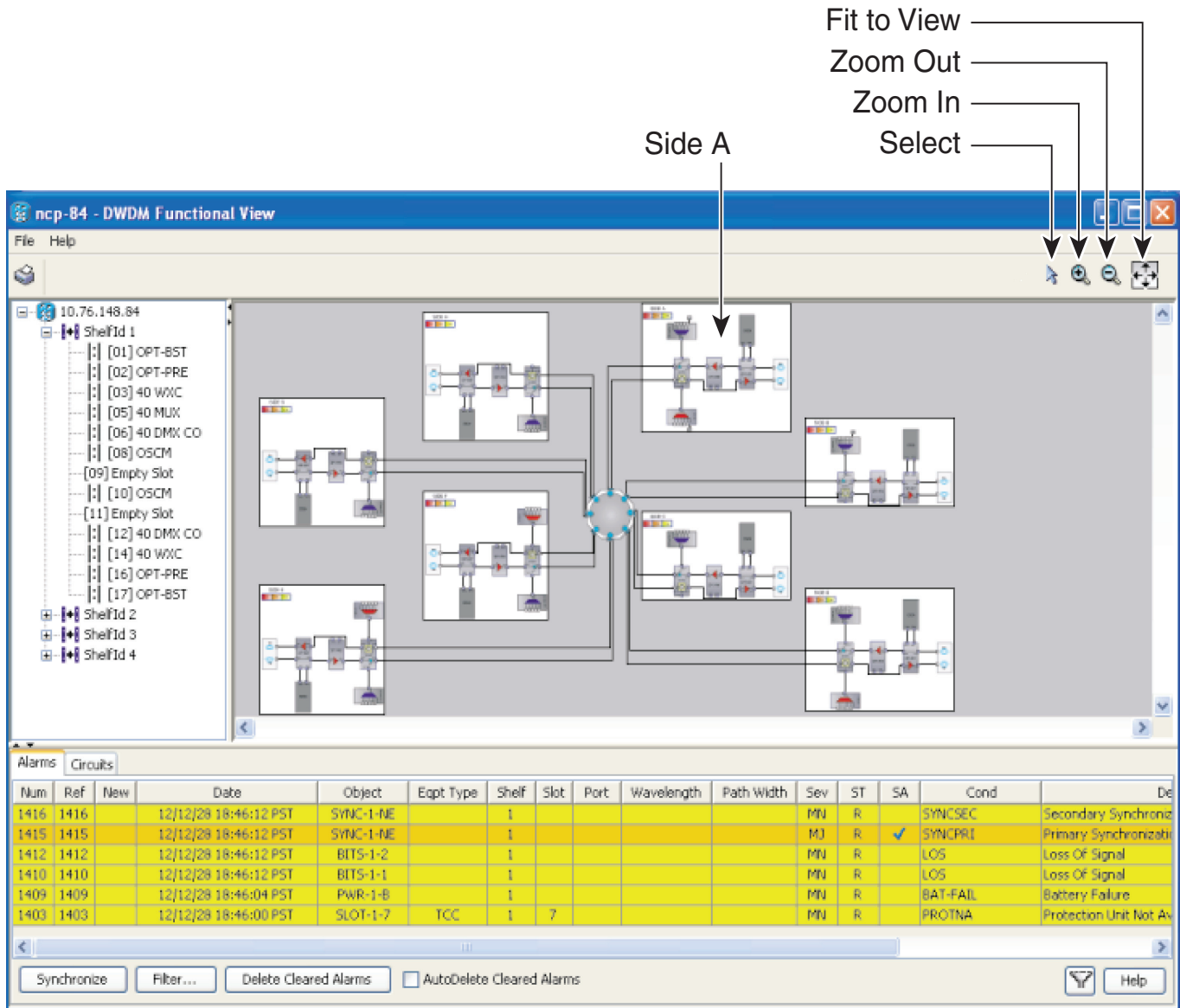
10.9 DWDM Functional View

DWDM functional view offers a graphical view of the DWDM cards and the internal connections between them in an MSTP node. The functional view also shows cards and connections for multidegree MSTP nodes (up to eight sides). To navigate to the functional view of a DWDM node, use the following navigational path in CTC when you are in node view:

Provisioning > WDM-ANS > Internal Patchcords > Functional View

An example of the functional view for an eight-sided node is shown in [Figure 10-50](#).

Figure 10-50 Functional View for an Eight-Sided Node



240752

10.9.1 Navigating Functional View

The functional view has two main panes. The upper pane contains a tree view of the shelves and a graphical view of the shelf equipment. The lower pane describes alarms and circuits in a tabular format.

The upper pane in Figure 10-50 is divided into a left pane and a right pane. The left pane shows a tree structure view of the shelf or shelves in the MSTP system. You can expand the tree view of a shelf to show the slot usage in that shelf. The right-hand pane is a graphical view of the sides in the shelf. In the case of Figure 10-50, there are eight sides (A through H). Side A is located as shown in the figure. All of the cards in each side are grouped together.

The meanings of the icons in the upper right corner are as follows:

- Select—use this icon to select a graphical element in the graphical view pane.
- Patchcord—Use this icon to create an internal patchcord between cards.



Note

The Patchcord icon is not functional for Software Release 8.5.

- Zoom In/Zoom Out—Use these icons to zoom in or zoom out in the graphical display pane.
- Fit to View—Use this icon to have the graphical view fit the space available on your screen.

The bottom pane can be used to display alarms (using the Alarms tab) or Circuits (using the Circuits tab). Clicking the Alarms tab displays the same information as the Alarms tab in the network, node, or card view. Clicking the Circuits tab displays the same information as the Alarms tab in the network, node, or card view.

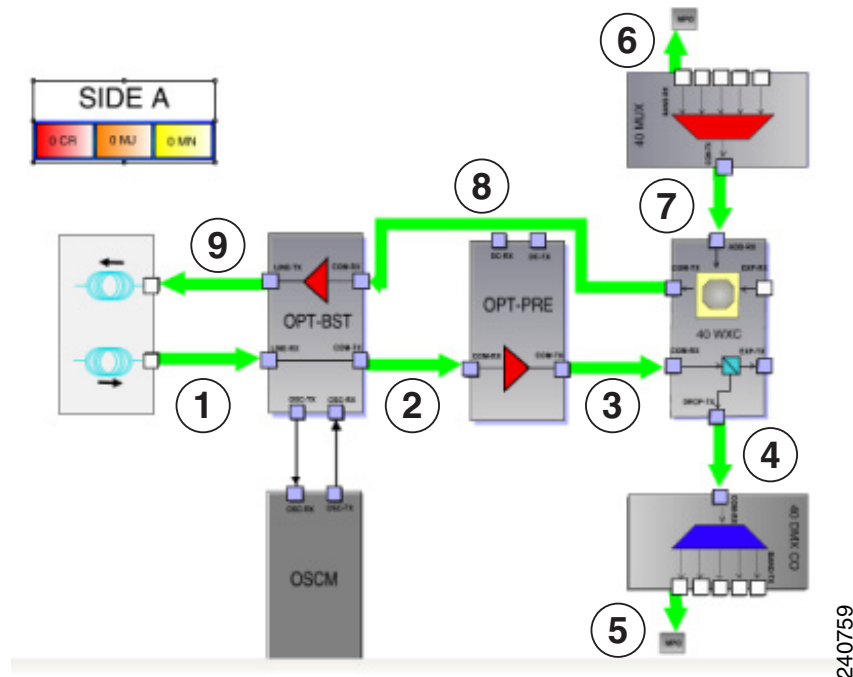
10.9.2 Using the Graphical Display

This section explains how to use the graphical portion of the display to gather information about the cards and ports.

10.9.2.1 Displaying a Side

Double-click a side to show the details of that side. For example, if you double-click Side A in [Figure 10-50](#), the result is as shown in [Figure 10-51](#).

Figure 10-51 Side A Details



The green arrows in the diagram represent the DWDM optical path within the selected side. The optical path in this instance is summarized as follows:

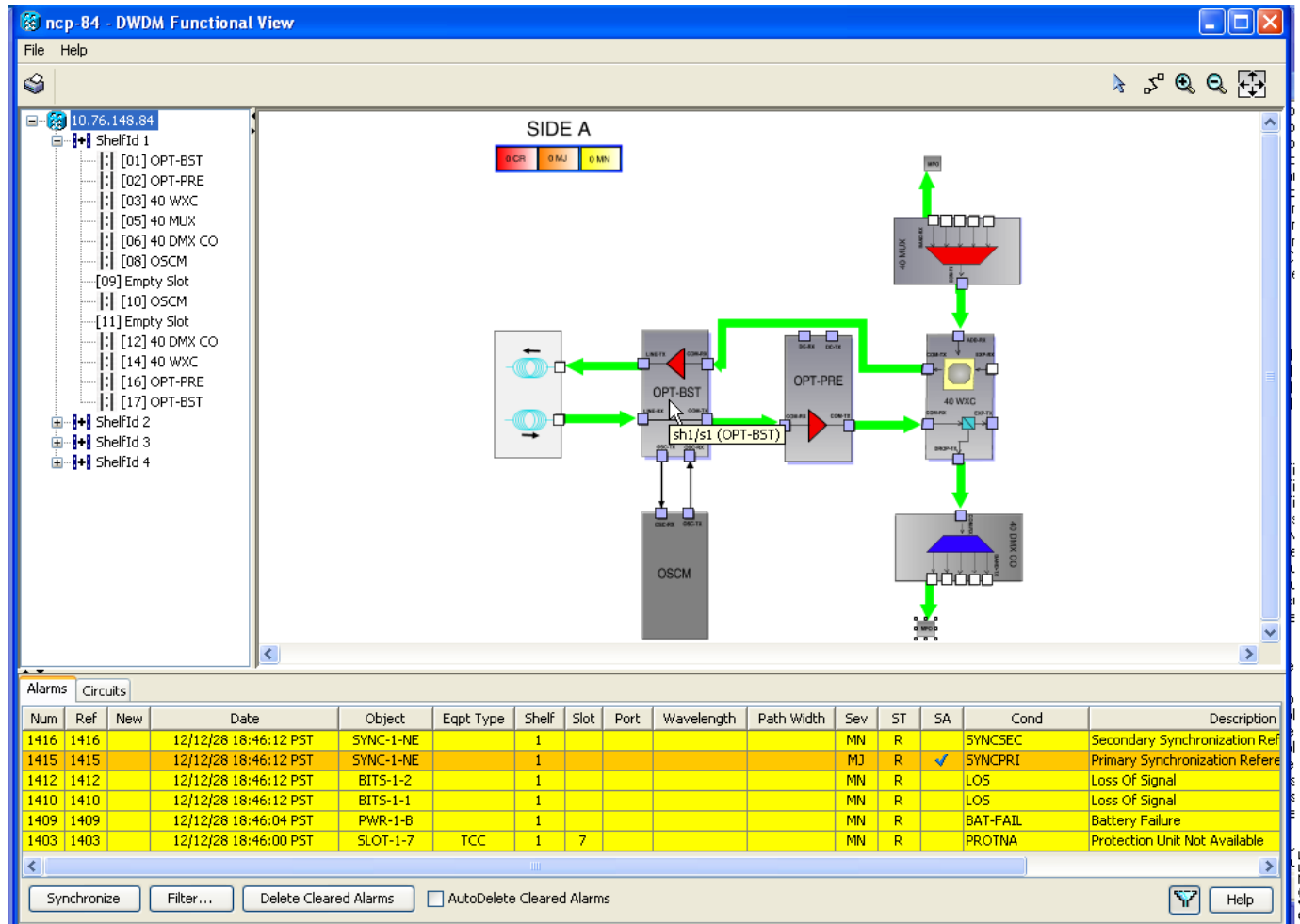
1. The light enters the OPT-BST card LINE-RX port from the optical span.
2. The path continues out of the OPT-BST card COM-TX port to the COM-RX port of the OPT-PRE card.
3. The OPT-PRE card sends the optical signal out of its COM-TX port to the 40-WXC COM-RX input port.
4. The 40-WXC card sends the signal to be locally dropped out of its DROP-TX port to the 40-DMX/40-DMX-CE card COM-RX port.
5. The 40-DMX/40-DMX-CE card sends the dropped signal out on one of its multifiber push on (MPO) connectors to the block labeled MPO. When you expand the MPO block (double-click it or right-click it and select **Down**), you will see a muxponder (MUX) card inside the MPO block. One of the eight optical fibers in the MPO cable is connected to the MUX trunk port.
6. The optical signal from the trunk port of the MXP card inside the MPO block enters the 40-MUX card at one of its five MPO connectors.
7. The 40-MUX card sends the optical signal out of its COM-TX port to the ADD-RX port of the 40-WXC card.
8. The added signal from the MXP gets sent out on the COM-TX port of the 40-WXC card to the COM-RX port of the OPT-BST card.
9. Finally, the OPT-BST card sends the optical signal out onto the span from its LINE-TX port.

10.9.2.2 Displaying Card Information

In the functional view graphical pane, you can double-click a card to bring up the usual CTC card view.

You can also move the mouse over a card to display information about the card. For example, when the mouse is placed over the OPT-BST card in Side A, the tooltip text displays sh1/s1 (OPT-BST), indicating that the OPT-BST card for Side A is located in Shelf 1, Slot 1. See [Figure 10-52](#).

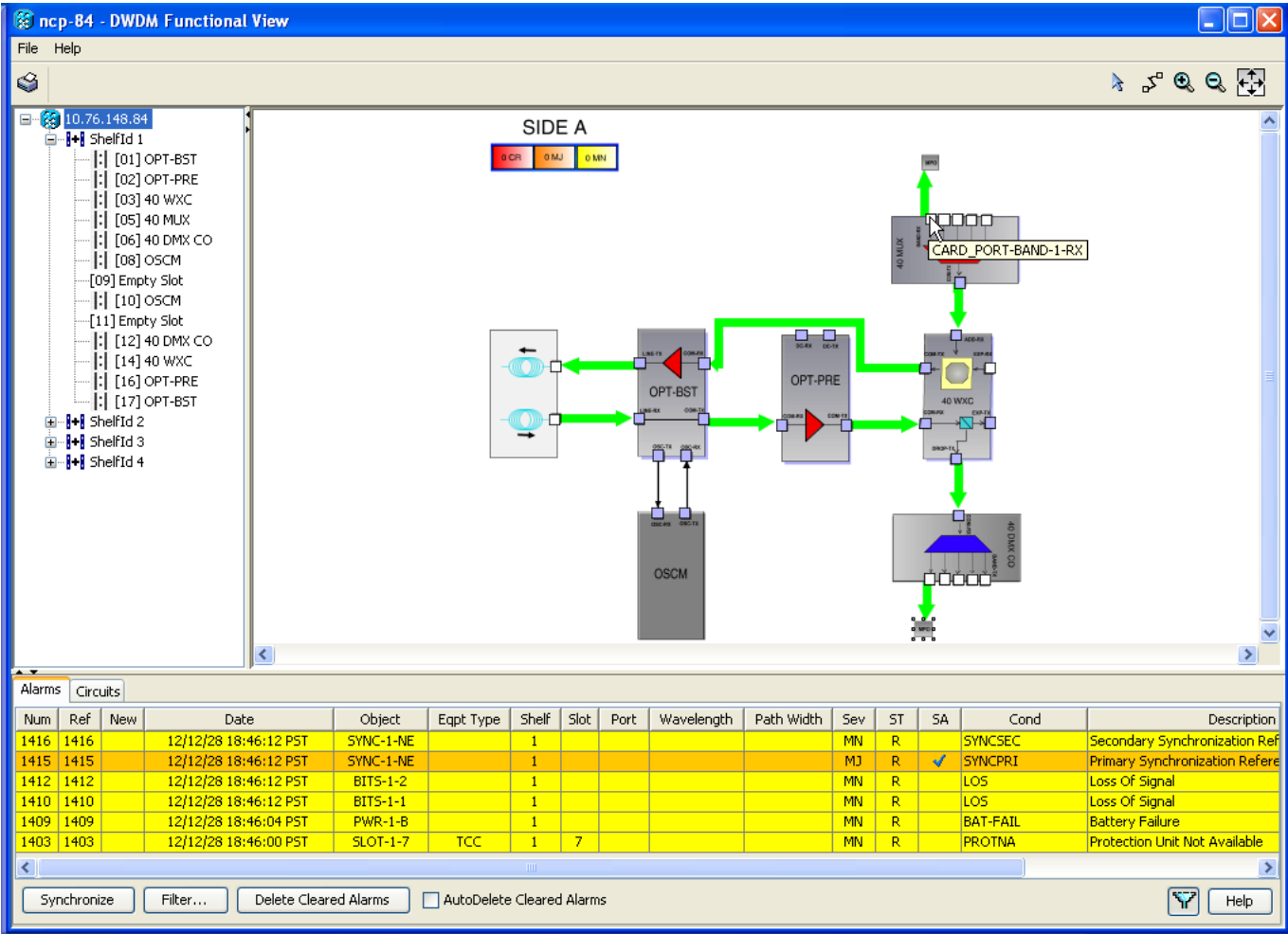
Figure 10-52 Side A OPT-BST Card Shelf and Slot Information



10.9.2.3 Displaying Port Information

Move the mouse over a port on a card to display information about the port. For example, when the mouse is placed over the top left port of the 40-MUX card in Side A, the tooltip text displays CARD_PORT-BAND-1-RX, indicating that the 40-MUX port being pointed to is for the first band of wavelengths (wavelengths 1 to 8) to be added into the optical path at the 40-MUX card. These wavelengths come into the 40-MUX card from a transponder (TXP) or muxponder (MXP) on an MPO connector, which contains eight integrated optical fibers. See [Figure 10-53](#).

Figure 10-53 Side A 40-MUX Port Information

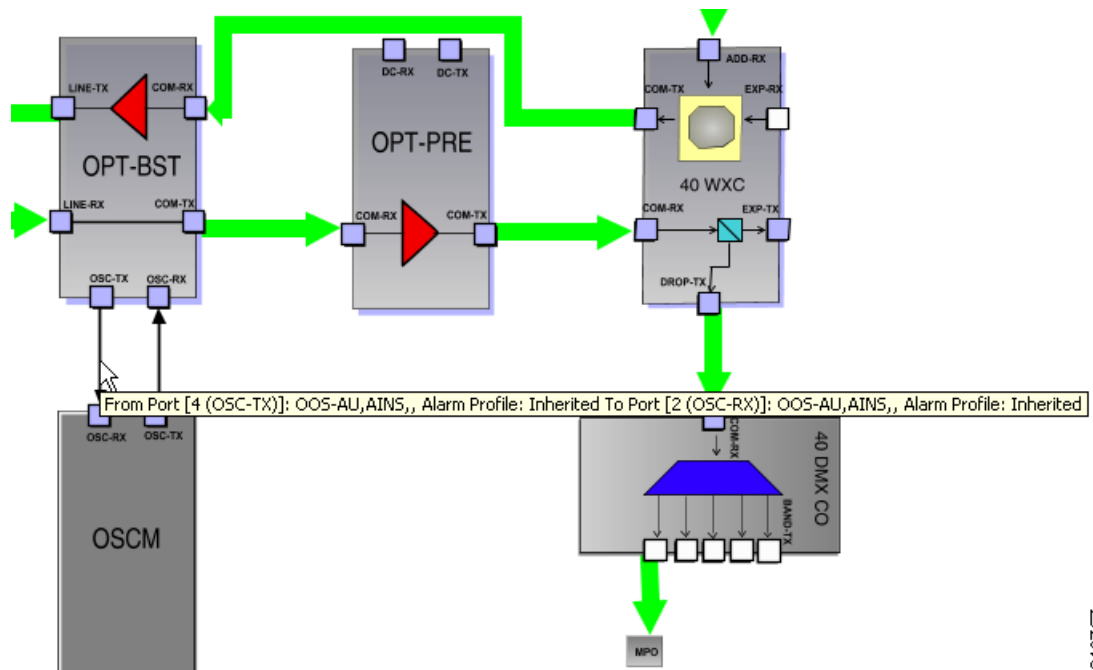


10.9.2.4 Displaying Patchcord Information

Move the mouse over a patchcord to see the state of the output and input port associated with that patchcord. See Figure 10-54.

240756

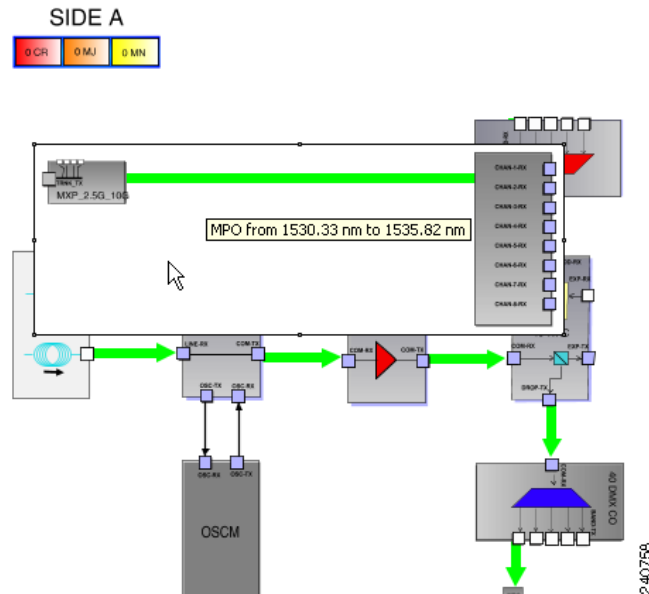
Figure 10-54 Patchcord Input and Output Port State Information



240757

10.9.2.5 Displaying MPO Information

To show the details inside an MPO block, double-click it or right-click it and select **Down**. When the detailed view is visible, right-click inside the MPO block and select **Upper View** to collapse the block. When you move the mouse over the MPO block, the associated wavelengths are displayed as a tool tip (see Figure 10-55).

Figure 10-55 MPO Information

10.9.2.6 Alarm Box Information

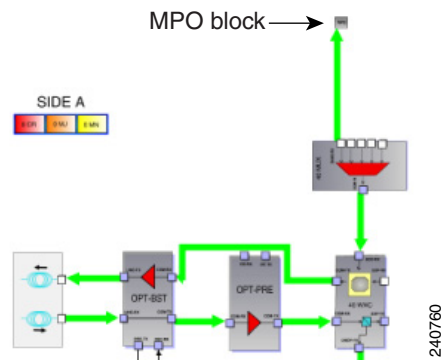
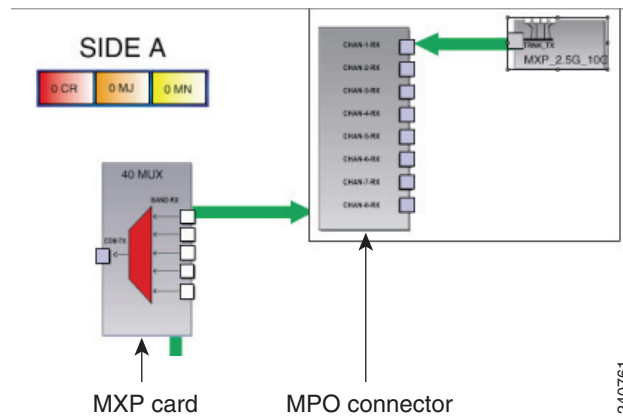
Within the side display, an alarm box is shown that gives the alarm count for the Critical, Major, and Minor alarms that affect that side. This alarm summary is only for the side, and is different from the alarms under the Alarms tab, where all of the alarms for the system are summarized. If an alarm under the Alarms tab appears that has to do with Side A, for example, only the appropriate alarm count in the Alarm box for Side A is incremented. The alarm counts in the Alarm boxes for the other nodes (B through H) are not incremented. In the graphical view of a side, the card icon or port icon changes color to reflect the severity of an alarm associated with the card (red, orange, or yellow). The color of the MPO block reflects the color of highest alarm severity for the elements in the MPO block.

10.9.2.7 Transponder and Muxponder Information

All of the TXP and MXP cards connected with patchcords are grouped together under the MPO icon. In node shown in [Figure 10-50](#), there is an MXP card in Side A that is connected to the 40-MUX card and to the 40-DMX/40-DMX-CE card. The MXP card is connected through the 40-MUX card to the add port on the 40-WXC card and it is also connected through the 40-DMX/40-DMX-CE card to the drop port on the 40-WXC card. To view the connections to the MXP card from the 40-MUX card, double-click the MPO icon. [Figure 10-56](#) shows the MPO icon before double-clicking it and [Figure 10-57](#) shows the result after double-clicking it.


Note

In the case of a protected TXP (TXPP) or MXP (MXPP) card, the card icon has a label indicating the active trunk and the protected trunk.

Figure 10-56 Side A MPO Connection to an MXP Before Double-Clicking**Figure 10-57** Side A MPO Connection to an MXP After Double-Clicking

10.9.2.8 Changing the Views

When you right-click inside of a side view, a shortcut menu allows you to do the following (see [Figure 10-58](#)):

- Fit to View—Fits the side view into the available display space.
- Delete Side—Deletes the selected side.
- Rotate Left—Rotates the side 90 degrees counterclockwise (all connections are maintained).
- Rotate Right—Rotates the side 90 degrees clockwise (all connections are maintained).
- Horizontal Flip—Flips the side horizontally (all connections are maintained).
- Vertical Flip—Flips the side vertically (all connections are maintained).

After you have selected Fit to View for a side, you can right-click in the side view to bring up a new menu with the following selections (see [Figure 10-59](#)):

- Go to Upper View—Returns to the previous view.

- Perform AutoLayout—Optimizes the placement of the cards and the connections between them.

Figure 10-58 Side A View Options

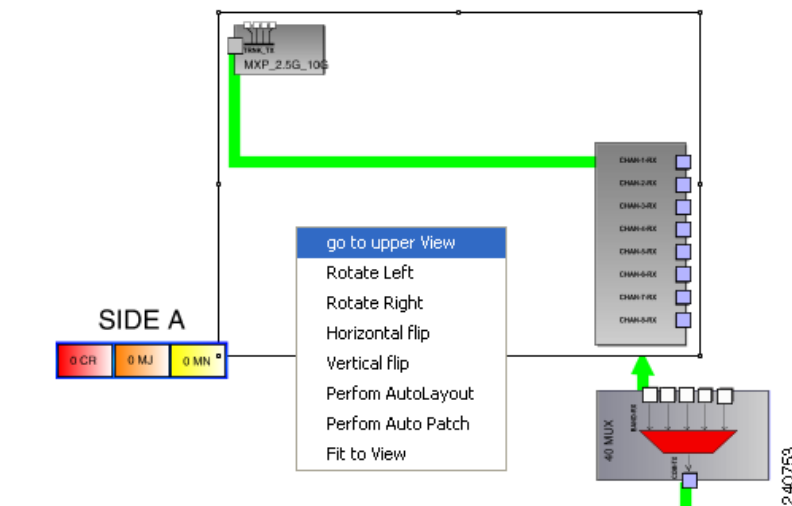
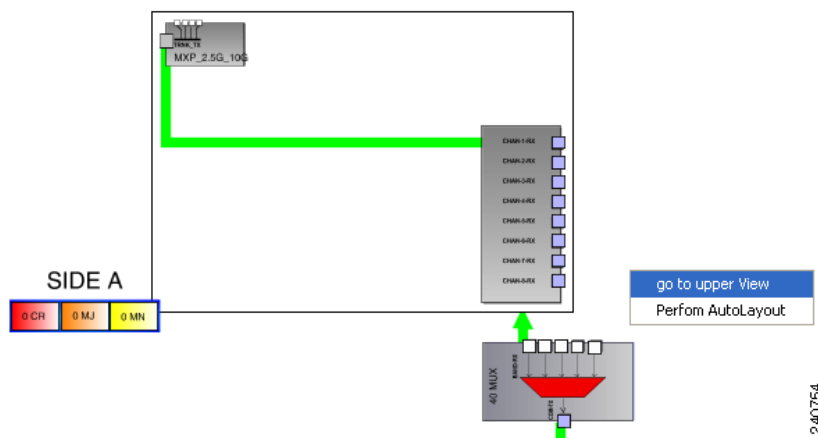


Figure 10-59 Side A View Options (after Selecting Fit to View)



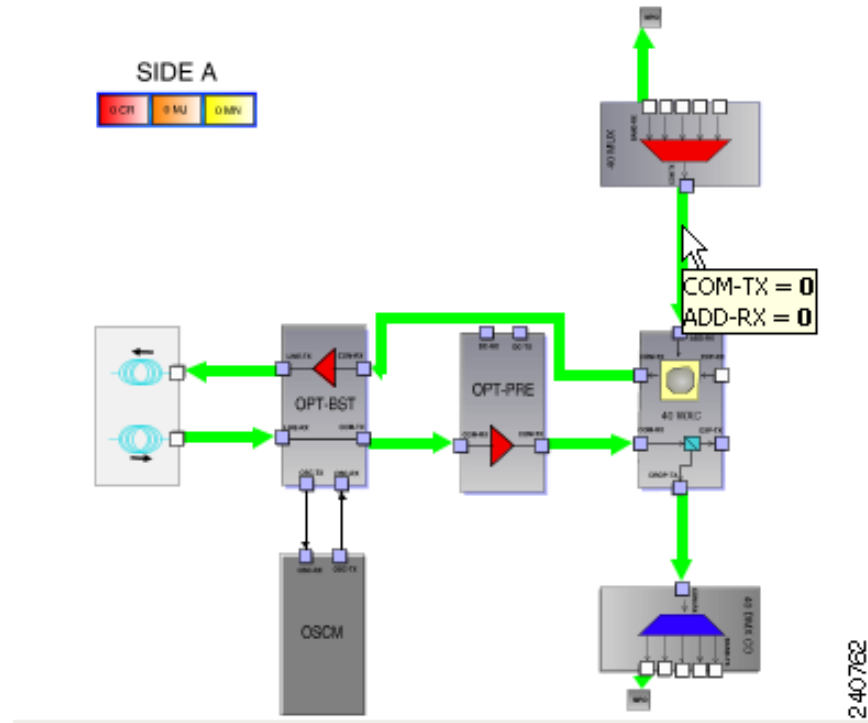
10.9.2.9 Selecting Circuits

When the Circuits tab is selected, the circuits for the functional view are shown. The patchcord lines in the graphical display are normally black in color. A patchcord line becomes green only when you select a circuit associated with the patchcord that carries the selected circuit.

10.9.2.10 Displaying Optical Path Power

To show the optical power present in an optical path, move the mouse over the desired optical path (green line). A tooltip shows the power along the optical path in dBm (see [Figure 10-60](#)).

Figure 10-60 Optical Path Power



10.10 Non-DWDM (TDM) Networks

Non-DWDM (TDM) Networks take synchronous and asynchronous signals and multiplexes them to a single higher bit rate for transmission at a single wavelength over fiber. When the node is configured as a Non-DWDM Network, the supported MSTP cards — amplifiers, transponders, and muxponders, are used in the standalone mode. MSTP applications like Circuit Provisioning, NLAC and APC are not supported in amplified TDM networks. For more information on how to configure a node as a Non-DWDM network, see the “NTP-G320 Configure the Node as a Non-DWDM Network” section in “Turn Up a Node” chapter in the *Cisco ONS 15454 DWDM Procedure Guide*.

When the node is configured as a Not-DWDM network, all the amplifiers are configured by default with the following values:

- Working mode = Control Gain
- Channel Power Ref. = +1dBm.

Booster(LINE) amplifiers enable optical safety when used in Non-DWDM. ALS configuration is set to “Auto Restart” by default. A manual restart request is therefore needed to turn up the bidirectional link, in addition with an appropriated cabling (bi-directional) of LINE TX/RX ports.

In NOT-DWDM mode, you must configure significant optical parameters and thresholds before launching the ANS application. For information on how to configure the amplifier, see the “DLP-G693 Configure the Amplifier” section in “Turn Up a Node” chapter in the *Cisco ONS 15454 DWDM Procedure Guide*. For information on how to configure the PSM behavior, see the “DLP-G694 Configure the PSM” section in “Turn Up a Node” chapter in the *Cisco ONS 15454 DWDM Procedure Guide*.

When the ANS application is launched, amplifier ports move into IS state and Gain Setpoint is automatically calculated by the card, after initial APR cycle. Gain Setpoint must be equal to MAX [Min Gain Setpoint of the card ; (Power Ref-Pinput)]; where Pinput is the optical power value at the ingress port (COM-RX) of the amplification stage.