



Cards Specifications

This chapter contains specific information about cards for dense wavelength division multiplexing (DWDM) applications in the Cisco ONS 15454.



Note

The terms "Unidirectional Path Switched Ring" and "UPSR" may appear in Cisco literature. These terms do not refer to using Cisco ONS 15xxx products in a unidirectional path switched ring configuration. Rather, these terms, as well as "Path Protected Mesh Network" and "PPMN," refer generally to Cisco's path protection feature, which may be used in any topological network configuration. Cisco does not recommend using its path protection feature in any particular topological network configuration.

The following topics are covered in this chapter:

- [2.1 Card Overview, page 2-1](#)
- [2.2 Card Specifications, page 2-12](#)

2.1 Card Overview

Redundant TCC2 and TCC2P cards are required to operate the Cisco ONS 15454. If you are using an ETSI (SDH) shelf assembly, the MIC-A/P and MIC-C/T/P front mount electrical connections (FMECs) are also required. The optional AIC-I card provides external alarms and controls (environmental alarms).

Each DWDM card is marked with a symbol that corresponds to a slot (or slots) on the ONS 15454 shelf assembly. These cards can only be installed into slots displaying the same symbols.

ONS 15454 DWDM cards are grouped into the following categories:

- Optical service channel (OSC) cards provide bidirectional channels that connect all the ONS 15454 DWDM nodes and transport general-purpose information without affecting the client traffic. ONS 15454 OSC cards include the Optical Service Channel Module (OSCM) and the Optical Service Channel and Combiner/Separator Module (OSC-CSM).
- Optical erbium-doped fiber amplifier (EDFA) cards are used in amplified DWDM nodes, including hub nodes, amplified OADM nodes, and line amplified nodes. Optical amplifier cards include the Optical Preamplifier (OPT-PRE) and Optical Booster (OPT-BST).
- Dispersion compensation units (DCUs) are installed in the ONS 15454 dispersion compensation shelf when optical preamplifier cards are installed in the DWDM node. Each DCU module can compensate a maximum of 65 km of single-mode fiber (SMF-28) span. DCUs can be cascaded to extend the compensation to 130 km.

- Multiplexer and demultiplexer cards multiplex and demultiplex DWDM optical channels. The cards consist of three main modules: an optical plug-in, a microprocessor, and a DC/DC converter. ONS 15454 multiplexer and demultiplexer cards include the 32-Channel Multiplexer (32MUX-O), the 32-Channel Demultiplexer (32DMX-O), the single-slot 32-Channel Demultiplexer (32DMX), and the 4-Channel Multiplexer/Demultiplexer (4MD-xx.x).
- Optical Add/Drop Multiplexer (OADM) cards are mainly divided into three groups: band OADM cards, channel OADM cards, and wavelength selective switch (WSS) cards. Band OADM cards add and drop one or four bands of adjacent channels; they include the 4-Band OADM (AD-4B-xx.x) and the 1-Band OADM (AD-1B-xx.x). Channel OADM cards add and drop one, two, or four adjacent channels; they include the 4-Channel OADM (AD-4C-xx.x), the 2-Channel OADM (AD-2C-xx.x) and the 1-Channel OADM (AD-1C-xx.x). The 32-Channel Wavelength Selective Switch (32WSS) card is used with the 32DMX to implement reconfigurable OADM (ROADM) functionality. These cards consist of three main modules: an optical plug-in, a microprocessor, and a DC/DC converter.

Table 2-1 to Table 2-4 show the band IDs and the add/drop channel IDs for the 4MD-xx.x, AD-2C-xx.x, AD-4C-xx.x, and AD-4B-xx.x cards.

Table 2-1 4MD-xx.x Channel Sets

Band IDs	Add/Drop Channel IDs	Add/Drop Wavelengths (nm)
Band 30.3 (A)	30.3, 31.2, 31.9, 32.6	1530.33, 1531.12, 1531.90, 1532.68
Band 34.2 (B)	34.2, 35.0, 35.8, 36.6	1534.25, 1535.04, 1535.82, 1536.61
Band 38.1 (C)	38.1, 38.9, 39.7, 40.5	1538.19, 1538.98, 1539.77, 1540.56
Band 42.1 (D)	42.1, 42.9, 43.7, 44.5	1542.14, 1542.94, 1543.73, 1544.53
Band 46.1 (E)	46.1, 46.9, 47.7, 48.5	1546.12, 1546.92, 1547.72, 1548.51
Band 50.1 (F)	50.1, 50.9, 51.7, 52.5	1550.12, 1550.92, 1551.72, 1552.52
Band 54.1 (G)	54.1, 54.9, 55.7, 56.5	1554.13, 1554.94, 1555.75, 1556.55
Band 58.1 (H)	58.1, 58.9, 59.7, 60.6	1558.17, 1558.98, 1559.79, 1560.61

Table 2-2 AD-2C-xx.x Channel Pairs

Band IDs	Add/Drop Channel IDs	Add/Drop Wavelengths (nm)
Band 30.3 (A)	30.3, 31.2 and 31.9, 32.6	1530.33, 1531.12 and 1531.90, 1532.68
Band 34.2 (B)	34.2, 35.0, and 35.8, 36.6	1534.25, 1535.04 and 1535.82, 1536.61
Band 38.1 (C)	38.1, 38.9 and 39.7, 40.5	1538.19, 1538.98 and 1539.77, 1540.56

Table 2-2 AD-2C-xx.x Channel Pairs (continued)

Band IDs	Add/Drop Channel IDs	Add/Drop Wavelengths (nm)
Band 42.1 (D)	42.1, 42.9 and 43.7, 44.5	1542.14, 1542.94 and 1543.73, 1544.53
Band 46.1 (E)	46.1, 46.9 and 47.7, 48.5	1546.12, 1546.92 and 1547.72, 1548.51
Band 50.1 (F)	50.1, 50.9 and 51.7, 52.5	1550.12, 1550.92 and 1551.72, 1552.52
Band 54.1 (G)	54.1, 54.9 and 55.7, 56.5	1554.13, 1554.94 and 1555.75, 1556.55
Band 58.1 (H)	58.1, 58.9 and 59.7, 60.6	1558.17, 1558.98 and 1559.79, 1560.61

Table 2-3 AD-4C-xx.x Channel Sets

Band IDs	Add/Drop Channel IDs	Add/Drop Wavelengths (nm)
Band 30.3 (A)	30.3, 31.2, 31.9, 32.6	1530.33, 1531.12, 1531.90, 1532.68
Band 34.2 (B)	34.2, 35.0, 35.8, 36.6	1534.25, 1535.04, 1535.82, 1536.61
Band 38.1 (C)	38.1, 38.9, 39.7, 40.5	1538.19, 1538.98, 1539.77, 1540.56
Band 42.1 (D)	42.1, 42.9, 43.7, 44.5	1542.14, 1542.94, 1543.73, 1544.53
Band 46.1 (E)	46.1, 46.9, 47.7, 48.5	1546.12, 1546.92, 1547.72, 1548.51
Band 50.1 (F)	50.1, 50.9, 51.7, 52.5	1550.12, 1550.92, 1551.72, 1552.52
Band 54.1 (G)	54.1, 54.9, 55.7, 56.5	1554.13, 1554.94, 1555.75, 1556.55
Band 58.1 (H)	58.1, 58.9, 59.7, 60.6	1558.17, 1558.98, 1559.79, 1560.61

Table 2-4 AD-4B-xx.x Channel Sets

Band IDs	Add/Drop Channel IDs	Add/Drop Wavelengths (nm)
Band 30.3 (A)	B30.3	1530.33
Band 34.2 (B)	B34.2	1534.25
Band 38.1 (C)	B38.1	1538.19
Band 42.1 (D)	B42.1	1542.14
Band 46.1 (E)	B46.1	1546.12
Band 50.1 (F)	B50.1	1550.12

Table 2-4 AD-4B-xx.x Channel Sets

Band IDs	Add/Drop Channel IDs	Add/Drop Wavelengths (nm)
Band 54.1 (G)	B54.1	1554.13
Band 58.1 (H)	B58.1	1558.17

- Transponder (TXP) and muxponder (MXP) cards convert the “gray” optical client interface signals into trunk signals that operate in the “colored” DWDM wavelength range. Transponding or muxponding is the process of converting the signals between the client and trunk wavelengths.

A muxponder generally handles several client signals. It aggregates, or multiplexes, lower-rate client signals together and sends them out over a higher-rate trunk port. Likewise, a muxponder demultiplexes optical signals coming in on a trunk and sends the signals out to individual client ports. A transponder converts a single client signal to a single trunk signal and converts a single incoming trunk signal to a single client signal.

All of the TXP and MXP cards perform optical-to-electrical-to-optical (OEO) conversion. As a result, they are not optically transparent cards. OEO conversion is necessary because the cards must operate on the signals passing through the cards.

However, the termination mode for all TXPs and MXPs can be configured as transparent (termination is performed at the electrical level). In a transparent termination, neither the Line nor the Section overhead is terminated. The cards can also be configured so that Line overhead, Section overhead, or both Line and Section overhead can be terminated.

**Note**

When configured in the transparent termination mode, the MXP_2.5G_10G card does not terminate some bytes by design.

Table 2-5 describes the Cisco ONS 15454 DWDM cards. Client-facing gray optical signals generally operate at shorter wavelengths, whereas DWDM colored optical signals are in the longer wavelength range (for example, 1490 nm = violet; 1510 nm = blue; 1530 nm = green; 1550 nm = yellow; 1570 nm = orange; 1590 nm = red; 1610 nm = brown). Some of the newer client-facing SFPs, however, operate in the colored region.

Table 2-5 Cisco ONS 15454 DWDM Cards

Card	Part Number	Description
Optical Service Channel Cards		
OSCM	15454-OSCM=	<p>The OSCM card has one set of optical ports and one Ethernet port located on the faceplate. The card operates in Slots 8 and 10.</p> <p>An OSC is a bidirectional channel connecting all the nodes in a ring. The channel transports OSC overhead that is used to manage ONS 15454 DWDM networks. The OSC uses the 1510 nm wavelength and does not affect client traffic. The primary purpose of this channel is to carry clock synchronization and orderwire channel communications for the DWDM network. It also provides transparent links between each node in the network. The OSC is an OC-3 formatted signal.</p> <p>The OSCM is used in amplified nodes that include the OPT-BST booster amplifier. The OPT-BST includes the required OSC wavelength combiner and separator component. The OSCM cannot be used in nodes where you use OC-N cards, electrical cards, or cross-connect cards. The OSCM uses Slots 8 and 10 when the ONS 15454 is configured in a DWDM network.</p>
OSC-CSM	15454-OSC-CSM=	<p>The OSC-CSM card has three sets of optical ports and one Ethernet port located on the faceplate. The card operates in Slots 1 to 6 and 12 to 17.</p> <p>The OSC-CSM is identical to the OSCM, but also contains a combiner and separator module in addition to the OSC module.</p> <p>The OSC-CSM is used in unamplified nodes. This means that the booster amplifier with the OSC wavelength combiner and separator is not required for OSC-CSM operation. The OSC-CSM can be installed in Slots 1 to 6 and 12 to 17 when the ONS 15454 is configured in a DWDM network.</p>
Optical Amplifiers		
OPT-PRE	15454-OPT-PRE=	<p>The OPT-PRE card is designed to support 64 channels at 50 GHz channel spacing. The OPT-PRE is a C-band DWDM, two-stage EDFA with mid-amplifier loss (MAL) for allocation to a DCU. To control the gain tilt, the OPT-PRE is equipped with a built-in variable optical attenuator (VOA). The VOA can also be used to pad the DCU to a reference value. You can install the OPT-PRE in Slots 1 to 6 and 12 to 17 when the ONS 15454 is configured in a DWDM network.</p>
OPT-BST	15454-OPT-BST=	<p>The OPT-BST card is designed to support up to 64 channels at 50 GHz channel spacing. The OPT-BST is a C-band DWDM EDFA with OSC add-and-drop capability. When an ONS 15454 DWDM has an OPT-BST installed, it is only necessary to have the OSCM to process the OSC. The card has a maximum output power of 17 dBm. To control the gain tilt, the OPT-BST is equipped with a built-in VOA. You can install the OPT-BST in Slots 1 to 6 and 12 to 17 when the ONS 15454 is configured in a DWDM network.</p>

Table 2-5 Cisco ONS 15454 DWDM Cards (continued)

Card	Part Number	Description
OPT-BST-E	15454-OPT-BST-E=	The OPT-BST-E card is designed to support up to 64 channels at 50 GHz channel spacing. It is a C-band DWDM EDFA with OSC add-and-drop capability. Its maximum output power is 21 dBm. To control the gain tilt, the OPT-BST-E is equipped with a built-in VOA. You can install the OPT-BST-E in Slots 1 to 6 and 12 to 17 when the ONS 15454 is configured in a DWDM network.
OPT-BST-L	15454-OPT-BST-L=	The OPT-BST-L card is designed to support up to 64 channels at 50 GHz channel spacing. It is an L-band DWDM EDFA with OSC add-and-drop capability. Its maximum output power is 17 dBm. To control the gain tilt, the OPT-BST-L is equipped with a built-in VOA. You can install the OPT-BST-L in Slots 1 to 6 and 12 to 17 when the ONS 15454 is configured in a DWDM network.
OPT-AMP-L	15454-OPT-AMP-L=	The OPT-AMP-L card is designed to support 64 channels at 50 GHz channel spacing. The OPT-AMP-L is a L-band DWDM, two-stage EDFA with MAL for allocation to a DCU. Its maximum output power is 20 dBm. To control the gain tilt, the OPT-AMP-L is equipped with a built-in VOA. The VOA can also be used to pad the DCU to a reference value. OPT-AMP-L is a double-slot card. You can install the OPT-AMP-L in Slots 1-2, 3-4, 5-6, or in Slots 12-13, 14-15, or 16-17.
Multiplexer and Demultiplexer Cards		
32MUX-O	15454-32MUX-O=	The 32MUX-O card multiplexes 32 100 GHz-spaced channels identified in the channel plan. The 32MUX-O card takes up two slots in an ONS 15454 DWDM and can be installed in Slots 1 to 5 and 12 to 16.
32DMX-O	15454-32DMX-O=	The 32DMX-O card demultiplexes 32 100-GHz-spaced channels identified in the channel plan. The 32DMX-O takes up two slots in an ONS 15454 DWDM and can be installed in Slots 1 to 5 and 12 to 16.
32DMX	15454-32DMX=	The 32DMX card is a single-slot optical demultiplexer. The card receives an aggregate optical signal on its COM RX port and demultiplexes it into to 32 100-GHz-spaced channels. The 32DMX card can be installed in Slots 1 to 6 and in Slots 12 to 17.
32DMX-L	15454-32DMX-L=	The 32DMX-L card is a single-slot optical L-band demultiplexer. The card receives an aggregate optical signal on its COM RX port and demultiplexes it into to 32 100 GHz-spaced channels. The 32DMX card can be installed in Slots 1 to 6 and in Slots 12 to 17.
4MD-xx.x	15454-4MD-xx.x=	The 4MD-xx.x card multiplexes and demultiplexes four 100 GHz-spaced channels identified in the channel plan. The 4MD-xx.x card is designed to be used with band OADMs (both AD-1B-xx.x and AD-4B-xx.x). There are eight versions of this card that correspond with the eight subbands specified in Table 2-1 on page 2-2 . The 4MD-xx.x can be installed in Slots 1 to 6 and 12 to 17 when the ONS 15454 is configured in a DWDM network.
Optical Add/Drop Multiplexer Cards		

Table 2-5 Cisco ONS 15454 DWDM Cards (continued)

Card	Part Number	Description
AD-1C-xx.x	15454-AD-1C-xx.x=	The AD-1C-xx.x card passively adds or drops one of the 32 channels utilized within the 100 GHz-spacing of the DWDM card. There are thirty-two versions of this card, each designed only for use with one wavelength. Each wavelength version of the card has a different part number. The AD-1C-xx.x can be installed in Slots 1 to 6 and 12 to 17 when the ONS 15454 is configured in a DWDM network.
AD-2C-xx.x	15454-AD-2C-xx.x=	The AD-2C-xx.x card passively adds or drops two adjacent 100-GHz channels within the same band. There are sixteen versions of this card, each designed for use with one pair of wavelengths. The card bidirectionally adds and drops in two different sections on the same card to manage signal flow in both directions. Each version of the card has a different part number. The AD-2C-xx.x cards are provisioned for the channel pairs in Table 2-2 on page 2-2 . In this table, channel IDs are provided instead of wavelengths. The AD-2C-xx.x can be installed in Slots 1 to 6 and 12 to 17 when the ONS 15454 is configured in a DWDM network.
AD-4C-xx.x	15454-AD-4C-xx.x=	The AD-4C-xx.x card passively adds or drops all four 100 GHz-spaced channels within the same band. There are eight versions of this card, each designed for use with one band of wavelengths. The card bidirectionally adds and drops two different sections on the same card to manage signal flow in both directions. Each version of this card has a different part number. The AD-4C-xx.x cards are provisioned for the channel pairs in Table 2-3 on page 2-3 . In this table, channel IDs are given rather than wavelengths. The AD-4C-xx.x can be installed in Slots 1 to 6 and 12 to 17 when the ONS 15454 is configured in a DWDM network.
AD-1B-xx.x	15454-AD-1B-xx=	The AD-1B-xx.x card passively adds or drops a single band of four adjacent 100 GHz-spaced channels. There are eight versions of this card with eight different part numbers, each version designed for use with one band of wavelengths. The card bidirectionally adds and drops in two different sections on the same card to manage signal flow in both directions. This card can be used when there is asymmetric adding and dropping on each side (east or west) of the node; a band can be added or dropped on one side but not on the other. The AD-1B-xx.x can be installed in Slots 1 to 6 and 12 to 17 when the ONS 15454 is configured in a DWDM network.
AD-4B-xx.x	15454-AD-4B-xx=	The AD-4B-xx.x card passively adds or drops four bands of four adjacent 100 GHz-spaced channels. There are two versions of this card with different part numbers, each version designed for use with one set of bands. The card bidirectionally adds and drops in two different sections on the same card to manage signal flow in both directions. This card can be used when there is asymmetric adding and dropping on each side (east or west) of the node; a band can be added or dropped on one side but not on the other. The AD-4B-xx.x cards are provisioned for the channel pairs in Table 2-4 on page 2-3 . In this table, channel IDs are given rather than wavelengths. The AD-4B-xx.x can be installed in Slots 1 to 6 and 12 to 17 when the ONS 15454 is configured in a DWDM network.

Table 2-5 Cisco ONS 15454 DWDM Cards (continued)

Card	Part Number	Description
32WSS	15454-32WSS=	The 32WSS card has seven sets of ports located on the faceplate. The card takes up two slots and operates in Slots 1-2, 3-4, 5-6, 12-13, 14-15, or 16-17. The 32WSS card performs channel add/drop processing within the ONS 15454 DWDM node. The 32WSS card works in conjunction with the 32DMX card to implement ROADM functionality. Equipped with ROADM functionality, the ONS 15454 DWDM can be configured to add or drop individual optical channels using Cisco Transport Controller (CTC), Cisco MetroPlanner, and Cisco Transport Manager (CTM). A ROADM network element utilizes two 32WSS cards (two slots each) and two 32DMX cards (one slot each), for a total of six slots in the chassis.
32WSS-L	—	The 32WSS-L card has seven sets of ports located on the faceplate. The card takes up two slots and operates in Slots 1-2, 3-4, 5-6, 12-13, 14-15, or 16-17. The 32WSS-L card performs channel add/drop processing in the L band. The 32WSS-L card works in conjunction with the 32DMX-L card to implement ROADM functionality. Equipped with ROADM functionality, the ONS 15454 DWDM can be configured to add and drop or pass through each individual optical channel.
MMU	—	The MMU card supports multiring and mesh upgrades for ROADM nodes in both the C band and the L band. Mesh/multiring upgrade is the capability to optically bypass a given wavelength from one section of the network or ring to another one without requiring 3R regeneration. In each node, you need to install two MMU cards, one on the east side and one on the west side. The MMU card has six sets of ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.
Transponder and Muxponder Cards		
TXP_MR_10G	15454-10T-L1-xx.x=	<p>The 10 Gbps Transponder-100 GHz-Tunable xx.xx-xx.xx card (TXP_MR_10G) has two sets of ports located on the faceplate and can be in Slots 1 to 6 and 12 to 17. It processes one 10-Gbps signal (client side) into one 10-Gbps, 100-GHz DWDM signal (trunk side). It provides one 10-Gbps port per card that can be provisioned for an STM64/OC-192 short reach (1310 nm) signal, compliant with ITU-T G.707, ITU-T G.709, ITU-T G.691, and Telcordia GR-253-CORE, or to 10GE-BASE-LR, compliant with IEEE 802.3. Each version of this card has a different part number.</p> <p>The TXP_MR_10G card is tunable over two neighboring wavelengths in the 1550 nm, ITU 100 GHz range. It is available in sixteen different versions, covering thirty-two different wavelengths in the 1550 nm range.</p>

Table 2-5 Cisco ONS 15454 DWDM Cards (continued)

Card	Part Number	Description
TXP_MR_10E	15454-10E-L1-xx.x=	<p>The 10 Gbps Transponder-100 GHz-Tunable xx.xx-xx.xx (TXP_MR_10E) card has two sets of ports located on the faceplate and can be installed in Slots 1 to 6 and Slots 12 to 17. It is a multirate transponder for the ONS 15454 platform. It processes one 10-Gbps signal (client side) into one 10-Gbps, 100-GHz DWDM signal (trunk side) that is tunable on four wavelength channels (ITU-T 100-GHz grid). Each version of this card has a different part number.</p> <p>You can provision this card in a linear configuration, bidirectional line switched ring (BLSR), a path protection, or a hub. The card can be used in the middle of BLSR or 1+1 spans when the card is configured for transparent termination mode.</p> <p>The TXP_MR_10E port features a 1550-nm laser for the trunk port and an ONS-XC-10G-S1 XFP module for the client port and contains two transmit and receive connector pairs (labeled) on the card faceplate.</p> <p>The TXP_MR_10E card is tunable over four wavelengths in the 1550 nm ITU 100 GHz range. They are available in eight versions, covering thirty-two different wavelengths in the 1550 nm range.</p>
TXP_MR_10E-C	15454-10E-L1-C=	This transponder has the same features as the TXP_MR_10E card, but its trunk interface can be tuned over the entire C band.
TXP_MR_10E-L	15454-10E-L1-L=	This transponder has the same features as the TXP_MR_10E card, but its trunk interface can be tuned over the entire L band.
TXP_MR_2.5G	15454-MR-L1-xx.x=	<p>The 2.5 Gbps Multirate Transponder-100 GHz-Tunable xx.xx-xx.xx (TXP_MR_2.5G) card has two sets of ports located on the faceplate and can be installed in Slots 1 to 6 and Slots 12 to 17. It processes one 8 Mbps to 2.488 Gbps signal (client side) into one 8 Mbps to 2.5 Gbps, 100-GHz DWDM signal (trunk side). It provides one long-reach STM-16/OC-48 port per card, compliant with ITU-T G.707, ITU-T G.709, ITU-T G.957, and Telcordia GR-253-CORE. Each version of this card has a different part number.</p> <p>The TXP_MR_2.5G card is tunable over four wavelengths in the 1550 nm ITU 100-GHz range. The card is available in eight versions, covering thirty-two different wavelengths in the 1550 nm range. The TXP_MR_2.5G card supports 2R (reshape and regenerate) and 3R (retune, reshape and regenerate) modes of operation where the client signal is mapped into a ITU-T G.709 frame.</p>

Table 2-5 Cisco ONS 15454 DWDM Cards (continued)

Card	Part Number	Description
TXPP_MR_2.5G	15454-MRP-L1-xx.x=	<p>The 2.5 Gbps Multirate Transponder-Protected-100 GHz-Tunable xx.xxxx. xx (TXPP_MR_2.5G) card has three sets of ports located on the faceplate and can be installed in Slots 1 to 6 and Slots 12 to 17. It processes one 8 Mbps to 2.488 Gbps signal (client side) into two 8 Mbps to 2.5 Gbps, 100-GHz DWDM signals (trunk side). It provides two long-reach STM-16/OC-48 ports per card, compliant with ITU-T G.707, ITU-T G.957, and Telcordia GR-253-CORE. Each version of this card has a different part number.</p> <p>The TXPP_MR_2.5G card is tunable over four wavelengths in the 1550 nm ITU 100-GHz range. The card is available in eight versions, covering thirty-two different wavelengths in the 1550 nm range. The TXPP_MR_2.5G card support 2R and 3R modes of operation where the client signal is mapped into a ITU-T G.709 frame.</p>
MXP_2.5G_10G	15454-10M-L1-xx.x=	<p>The 2.5 Gbps-10 Gbps Muxponder-100 GHz-Tunable xx.xx-xx.xx (MXP_2.5G_10G) card has 9 sets of ports located on the faceplate and can be installed in Slots 1 to 6 and Slots 12 to 17. It multiplexes/demultiplexes four 2.5-Gbps signals (client side) into one 10-Gbps, 100-GHz DWDM signal (trunk side). It provides one extended long-range STM-64/OC-192 port per card on the trunk side (compliant with ITU-T G.707, ITU-T G.709, ITU-T G.957, and Telcordia GR-253-CORE) and four intermediate- or short-range OC-48/STM-16 ports per card on the client side. The port operates at 9.95328 Gbps over unamplified distances up to 80 km (50 miles) with different types of fiber such as C-SMF or dispersion compensated fiber limited by loss and/or dispersion. The port can also operate at 10.70923 Gbps in ITU-T G.709 Digital Wrapper/FEC mode. Each version of this card has a different part number.</p> <p>Client ports on the MXP_2.5G_10G card are also interoperable with OC-1 (STS-1) fiber-optic signals defined in Telcordia GR-253-CORE. An OC-1 signal is the equivalent of one DS-3 channel transmitted across optical fiber. OC-1 is primarily used for trunk interfaces to phone switches in the United States.</p> <p>The MXP_2.5G_10G card is tunable over two neighboring wavelengths in the 1550 nm, ITU 100-GHz range. It is available in sixteen different versions, covering thirty-two different wavelengths in the 1550 nm range.</p>
MXPP_2.5G_10G	15454-	

Table 2-5 Cisco ONS 15454 DWDM Cards (continued)

Card	Part Number	Description
MXP_2.5G_10E	15454-10ME-xx.x=	<p>The 2.5 Gbps-10 Gbps Muxponder-100 GHz-Tunable xx.xx-xx.xx (MXP_2.5G_10E) card has nine sets of ports located on the faceplate and can be installed in Slots 1 through 6 and 12 through 17. It is a DWDM muxponder for the ONS 15454 platform that supports full optical transparency on the client side. The card multiplexes four 2.5 Gbps client signals (4 x OC48/STM-16 SFP) into a single 10-Gbps DWDM optical signal on the trunk side. The MXP_2.5G_10E card provides wavelength transmission service for the four incoming 2.5 Gbps client interfaces. It passes all SONET overhead bytes transparently. Each version of this card has a different part number.</p> <p>The MXP_2.5G_10E works with Optical Transparent Network (OTN) devices defined in ITU-T G.709. The card supports Optical Data Channel Unit 1 (ODU1) to Optical Channel Transport Unit (OTU2) multiplexing, an industry standard method for asynchronously mapping a SONET/SDH payload into a digitally wrapped envelope.</p> <p>The MXP_2.5G_10E card is tunable over four neighboring wavelengths in the 1550 nm, ITU 100-GHz range. It is available in eight different versions, covering thirty-two different wavelengths in the 1550 nm range. It is not compatible with the MXP_2.5G_10G card, which does not supports full optical transparency. The faceplate designation of the card is “4x2.5G 10E MXP.”</p>
MXP_2.5G_10E-C	15454-10ME-C=	This muxponder has the same features as the MXP_2.5G_10E card, but its trunk interface can be tuned over the entire C band.
MXP_2.5G_10E-L	15454-10ME-L=	This muxponder has the same features as the MXP_2.5G_10E card, but its trunk interface can be tuned over the entire L band.
MXP_MR_2.5G	15454-Datamux2.5GDM	The MXP_MR_2.5G card has nine sets of ports located on the faceplate. The MXP_MR_2.5G card aggregates a mix and match of client Storage Area Network (SAN) service client inputs (GE, FICON, Fibre Channel, and ESCON) into one 2.5 Gbps STM-16/OC-48 DWDM signal on the trunk side. It provides one long-reach STM-16/OC-48 port per card and is compliant with Telcordia GR-253-CORE.
MXPP_MR_2.5G	15454-Datamux2.5GDMP	The MXPP_MR_2.5G card has ten sets of ports located on the faceplate. The 2.5-Gbps Multirate Muxponder-Protected-100 GHz-Tunable 15xx.xx-15yy.yy (MXPP_MR_2.5G) card aggregates various client SAN service client inputs (GE, FICON, Fibre Channel, and ESCON) into one 2.5 Gbps STM-16/OC-48 DWDM signal on the trunk side. It provides two long-reach STM-16/OC-48 ports per card and is compliant with ITU-T G.957 and Telcordia GR-253-CORE.

Table 2-5 Cisco ONS 15454 DWDM Cards (continued)

Card	Part Number	Description
MXP_MR_10DME_C	15454-10DME-C=	<p>The MXP_MR_10DME_C and MXP_MR_10DME_L cards aggregate a mix of client SAN service client inputs (GE, FICON, and Fibre Channel) into one 10-Gbps STM-64/OC-192 DWDM signal on the trunk side. It provides one long-reach STM-64/OC-192 port per card and is compliant with Telcordia GR-253-CORE and ITU-T G.957. They pass all SONET/SDH overhead bytes transparently.</p> <p>The ITU-T G.709 compliant digital wrapper function formats the DWDM wavelength so that it can be used to set up generic communications channels (GCCs) for data communications, enable forward error correction (FEC), or facilitate performance monitoring (PM). The cards work with the OTN devices defined in ITU-T G.709. The cards support ODU1 to OTU2 multiplexing, an industry standard method for asynchronously mapping a SONET/SDH payload into a digitally wrapped envelope. You can install MXP_MR_10DME_C and MXP_MR_10DME_L cards in Slots 1 to 6 and 12 to 17.</p> <p>The MXP_MR_10DME_C card features a tunable 1550-nm C-band laser on the trunk port. The laser is tunable across 82 wavelengths on the ITU grid with 50-GHz spacing between wavelengths. The MXP_MR_10DME_L features a tunable 1580-nm L-band laser on the trunk port. The laser is tunable across 80 wavelengths on the ITU grid, also with 50-GHz spacing. Each card features four 1310-nm lasers on the client ports and contains five transmit and receive connector pairs (labeled) on the card faceplate. The cards use dual LC connectors on the trunk side and use SFP modules on the client side for optical cable termination. The SFP pluggable modules are SR or IR and support an LC fiber connector.</p>
MXP_MR_10DME_L	15454-10DME-L=	

2.2 Card Specifications

Refer to the “Card Reference” chapter in the *Cisco ONS 15454 DWDM Reference Manual* for a detailed description of each card.

2.2.1 Common Control Cards

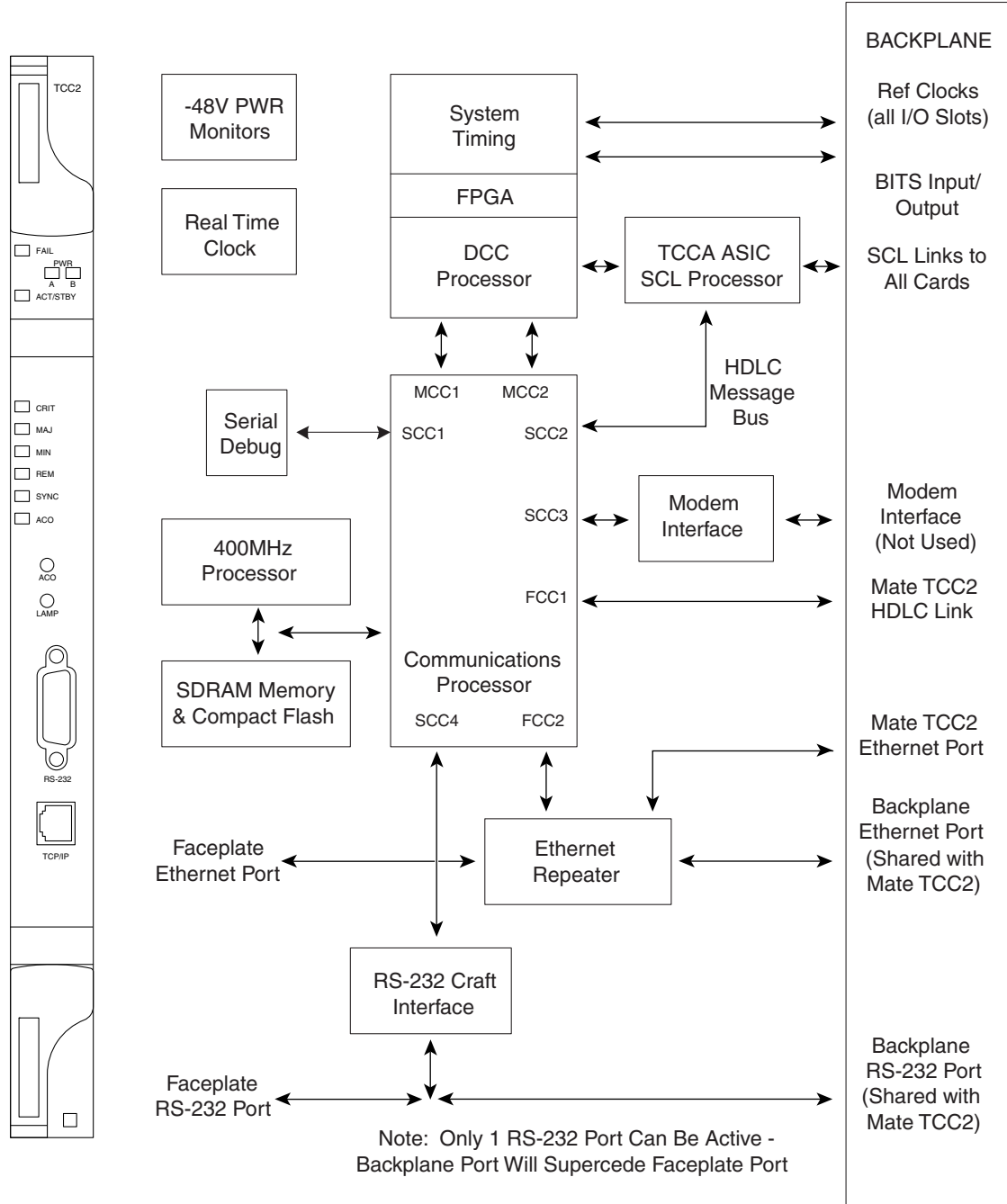
This section describes the common control cards (TCC2, TCC2P, AIC-I, and MS-ISC-100T).

2.2.1.1 TCC2 Card

The Advanced Timing, Communications, and Control (TCC2) card performs system initialization, provisioning, alarm reporting, maintenance, diagnostics, IP address detection/resolution, SONET section overhead (SOH) data communications channel/generic communications channel (DCC/GCC) termination, optical service channel (OSC) DWDM data communications network (DCN) termination, and system fault detection for the ONS 15454. The TCC2 also ensures that the system maintains Stratum 3 (Telcordia GR-253-CORE) timing requirements. It monitors the supply voltage of the system.

Figure 2-1 shows the faceplate and block diagram for the TCC2.

Figure 2-1 TCC2 Block Diagram and Faceplate



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The TCC2 card terminates up to 32 DCCs. The TCC2 hardware is prepared for up to 84 DCCs, which will be available in a future software release.

The node database, IP address, and system software are stored in TCC2 nonvolatile memory, which allows quick recovery in the event of a power or card failure.

The TCC2 performs all system-timing functions for each ONS 15454. The TCC2 monitors the recovered clocks from each traffic card and two building integrated timing supply (BITS) ports for frequency accuracy. The TCC2 selects a recovered clock, a BITS, or an internal Stratum 3 reference as the system-timing reference. You can provision any of the clock inputs as primary or secondary timing sources. A slow-reference tracking loop allows the TCC2 to synchronize with the recovered clock, which provides holdover if the reference is lost.

The TCC2 monitors both supply voltage inputs on the shelf. An alarm is generated if one of the supply voltage inputs has a voltage out of the specified range.

Install TCC2 cards in Slots 7 and 11 for redundancy. If the active TCC2 fails, traffic switches to the protect TCC2.

The TCC2 card has two built-in interface ports for accessing the system: an RJ-45 10BaseT LAN interface and an EIA/TIA-232 ASCII interface for local craft access. It also has a 10BaseT LAN port for user interfaces via the backplane.

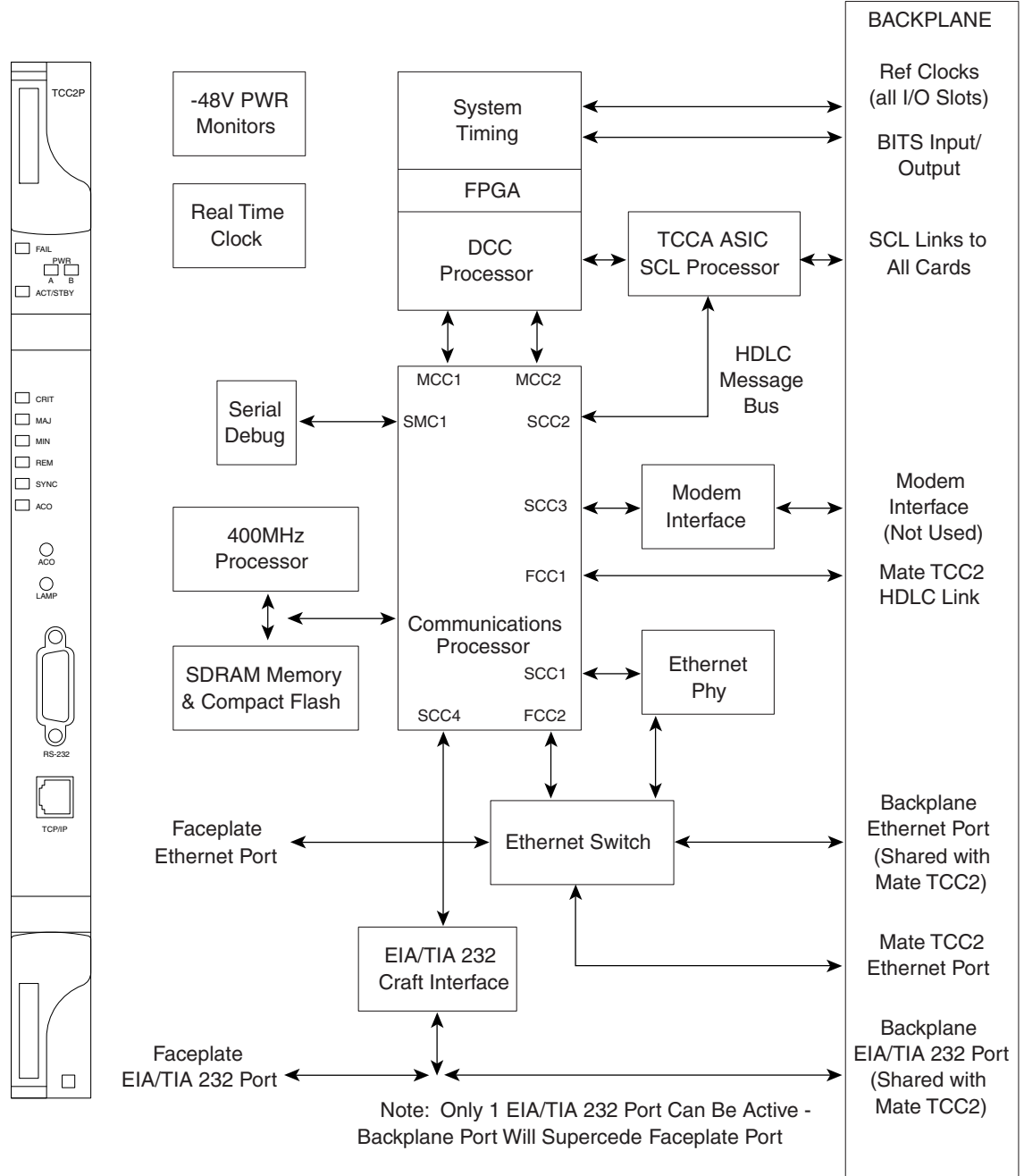
2.2.1.2 TCC2P Card

The Advanced Timing, Communications, and Control Plus (TCC2P) card is an enhanced version of the TCC2 card. The primary enhancements are Ethernet security features and 64K composite clock BITS timing.

The TCC2P card performs system initialization, provisioning, alarm reporting, maintenance, diagnostics, IP address detection/resolution, SONET SOH DCC/GCC termination, and system fault detection for the ONS 15454. The TCC2P also ensures that the system maintains Stratum 3 (Telcordia GR-253-CORE) timing requirements. It monitors the supply voltage of the system.

[Figure 2-2](#) shows the faceplate and block diagram for the TCC2P card.

Figure 2-2 TCC2P Block Diagram and Faceplate



The TCC2P card supports multichannel, high-level data link control (HDLC) processing for the DCC. Up to 84 DCCs can be routed over the TCC2P card and up to 84 section DCCs can be terminated at the TCC2P card (subject to the available optical digital communication channels). The TCC2P selects and processes 84 DCCs to facilitate remote system management interfaces.

The TCC2P card also originates and terminates a cell bus carried over the module. The cell bus supports links between any two cards in the node, which is essential for peer-to-peer communication. Peer-to-peer communication accelerates protection switching for redundant cards.

The node database, IP address, and system software are stored in TCC2P card nonvolatile memory, which allows quick recovery in the event of a power or card failure.

The TCC2P card performs all system-timing functions for each ONS 15454. The TCC2P card monitors the recovered clocks from each traffic card and two BITS ports for frequency accuracy. The TCC2P card selects a recovered clock, a BITS, or an internal Stratum 3 reference as the system-timing reference. You can provision any of the clock inputs as primary or secondary timing sources. A slow-reference tracking loop allows the TCC2P card to synchronize with the recovered clock, which provides holdover if the reference is lost.

The TCC2P card supports 64/8K composite clock and 6.312 MHz timing output. The TCC2P card monitors both supply voltage inputs on the shelf. An alarm is generated if one of the supply voltage inputs has a voltage out of the specified range.

Install TCC2P cards in Slots 7 and 11 for redundancy. If the active TCC2P card fails, traffic switches to the protect TCC2P card. All TCC2P card protection switches conform to protection switching standards when the bit error rate (BER) counts are not in excess of $1 * 10 \text{ exp} - 3$ and completion time is less than 50 ms.

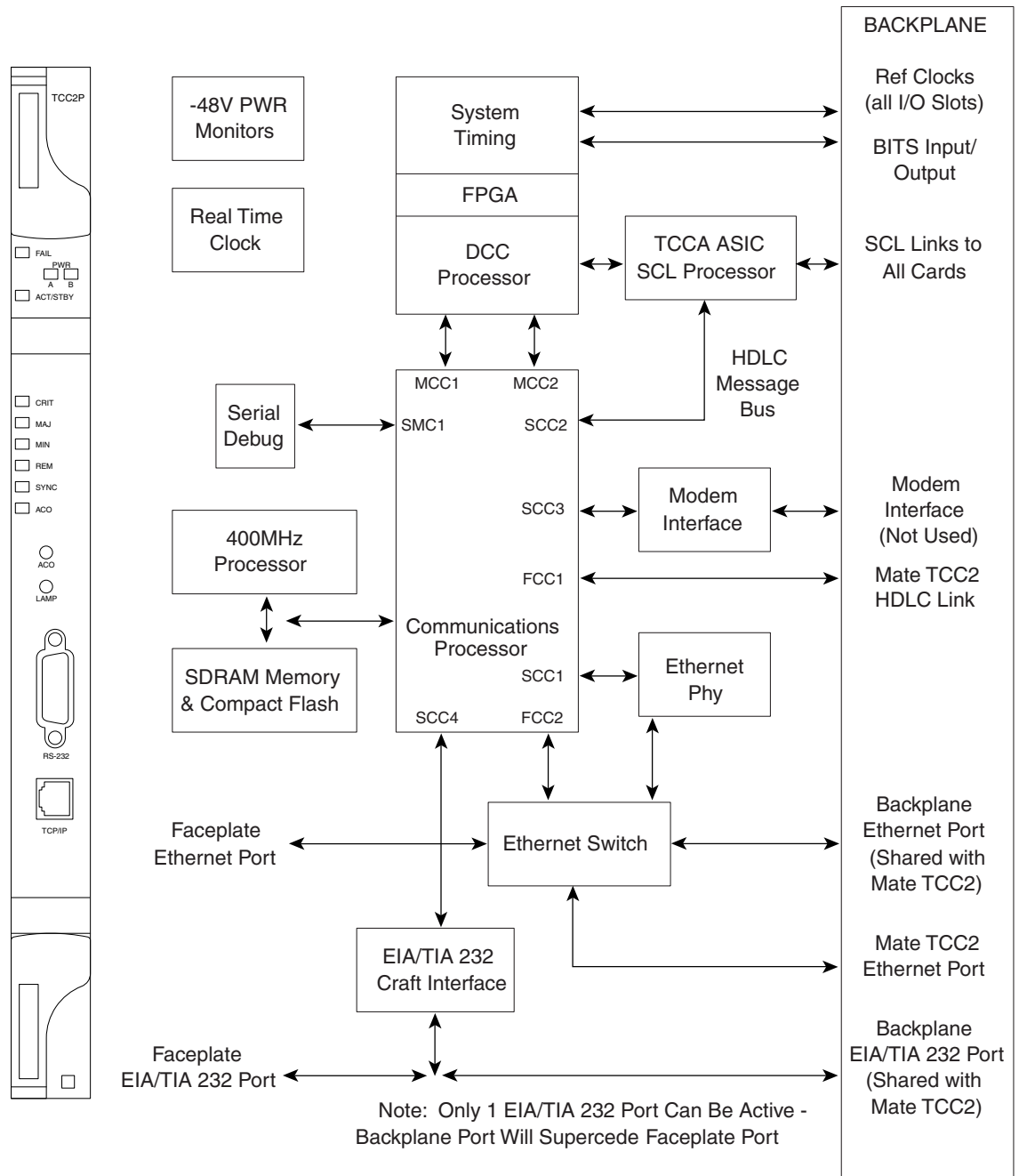
The TCC2P card has two built-in Ethernet interface ports for accessing the system: one built-in RJ-45 port on the front faceplate for on-site craft access and a second port on the backplane. The rear Ethernet interface is for permanent LAN access and all remote access via TCP/IP as well as for Operations Support System (OSS) access. The front and rear Ethernet interfaces can be provisioned with different IP addresses using CTC.

Two EIA/TIA-232 serial ports, one on the faceplate and a second on the backplane, allow for craft interface in TL1 mode.

2.2.1.3 MS-ISC-100T Card

The MS-ISC-100T Ethernet LAN card (see [Figure 2-3](#)), which is a 12-port NEBS3 Ethernet Switch running Cisco IOS. The MS-ISC-100T card must be equipped in an NC shelf; the preferred slots are 6 and 12. MS-ISC-100T Cisco IOS configuration is part of the software package and is automatically loaded to the card at start-up. This configuration can be modified using the Cisco IOS command-line interface (CLI) only. The CLI is disabled by default, but it can be enabled from the Cisco Transport Controller (CTC) interface. All MS-ISC-100T ports are turned on by default. Using the CLI, you can turn off ports that are not used.

Figure 2-3 MS-ISC-100T Faceplate and Block Diagram



The MS-ISC-100T separates internal and external traffic using a VLAN.

A Cisco IOS configuration file assigns a specific role to each of MS-ISC-100T ports that are shown on the card faceplates. They are as follows:

- DCN Port: Connected to external supervision
- SSC Port: Connected to a TCC2/TCC2P equipped in a subtended shelf
- NC Port: Connected to a TCC2/TCC2P equipped in an NC shelf

- PROT: Connected to the other MS-ISC-100T ports

The TCC is connected to the MS LAN by its front panel port. The back panel Ethernet port is disabled and cannot be used in the MS node.

2.2.2 Optical Service Channel Cards

The Optical Service Channel (OSC) is a bidirectional channel that connects all the nodes in a DWDM ring that transports general-purpose information without affecting client traffic. In its primary application, this channel carries data sub-channels for telemetry (supervisory) services for an optical system, provides orderwire applications, and provides transparent links between each node of the network for user-defined or proprietary functions.

The ONS 15454 has two OSC cards, the OSCM and the OSC-CSM.

Table 2-6 shows the optical specifications for the OSCM card.

Table 2-6 OSCM Card Optical Specifications

Parameter	Condition	Min	Max	Unit
OSC bandwidth at -0.5 dB	OSCRX -> TX – OSCTX	1500	1520	nm
Insertion loss	OSCRX -> TX – OSCTX	—	1.4	dB
OSC band chromatic dispersion	OSCRX -> TX – OSCTX	-10	+10	ps/nm
Polarization Mode Dispersion (PMD)	OSCRX -> TX – OSCTX	—	0.1	ps
Polarization Dependent Loss (PDL)	OSCRX -> TX – OSCTX	0-10dB	0.45	dB
Optical power setting accuracy	—	-0.5	+0.5	dB
Optical attenuation VOAosc power set resolution (granularity)	—	—	0.1	dB
Optical power stability	—	-0.2	+0.2	dB
Optical power setting time	—	—	200	ms
VOAosc dynamic range	—	30	—	dB
VOAosc off state	AVS state	39	—	dB
Directivity	—	40	—	dB
Return loss	—	40	—	dB

Table 2-7 shows the optical specifications for the OSC-CSM card.

Table 2-7 OSC-CSM Card Optical Specifications

Parameter	Condition	Min	Max	Unit
OSC (-0.5 dB bandwidth)	LINE _{RX} – OSC _{TX} OSC _{RX} – LINE _{TX}	1500	1520	nm
Channels (-0,5 dB bandwidth)	LINE _{RX} – COM _{TX} COM _{RX} – LINE _{TX}	1529	1605	nm

Table 2-7 OSC-CSM Card Optical Specifications (continued)

Parameter	Condition	Min	Max	Unit	
Insertion loss	LINE _{RX} – OSC _{TX}	0.5	1.4	dB	
	LINE _{RX} – COM _{TX}	0.4	1.2	dB	
	OSC _{RX} – LINE _{TX}	1.2	2.2	dB	
	COM _{RX} – LINE _{TX}	1.2	2.2	dB	
OSC crosstalk	LINE _{RX} – OSC _{TX}	30	—	dB	
	OSC _{RX} – LINE _{TX}	—	—	—	
Isolation	LINE _{RX} – COM _{TX}	–15	—	dB	
	COM _{RX} – LINE _{TX}	—	—	—	
OSC band chromatic dispersion	LINE _{RX} – OSC _{TX}	–20	+20	ps/nm	
	OSC _{RX} – LINE _{TX}	—	—	—	
Channel band chromatic dispersion	LINE _{RX} – COM _{TX}	–20	+20	ps/nm	
	COM _{RX} – LINE _{TX}	—	—	—	
PMD	Each optical path	—	0.1	ps	
PDL	LINE _{RX} – COM _{TX}	—	0.2	dB	
	LINE _{RX} – OSC _{TX}	—	—	—	
	COM _{RX} – LINE _{TX}	—	—	—	
	OSC _{RX} – LINE _{TX}	—	0.5	—	
Optical power setting accuracy	VOA in closed loop	–0.5	+0.5	dB	
Optical power setting time	VOA in closed loop	—	200	ms	
VOAosc dynamic range	—	30	—	dB	
VOAosc off state	AVS state	39	—	dB	
Switch input lambda range	COM _{RX} – LINE _{TX}	1528	1605	nm	
Switch open condition attenuation	COM _{RX} – LINE _{TX}	>40	—	dB	
Switching time	Closed/Open	COM _{RX} – LINE _{TX}	—	5	ms
	Open/Closed	—	—	20	—
Directivity	—	40	—	dB	
Return loss	—	40	—	dB	

2.2.3 Optical Add and Drop Cards

This section describes the internal parameter and performance information for the 32WSS, 32WSS-L, 32DMX, 32DMX-L, 32DMX-O, 32DMX-L, AD-1B-xx.x, AD-4B-xx.x, AD-1C-xx.x, AD-2C-xx.x, AD-4C-xx.x, and MMU cards.

2.2.3.1 32WSS Card

Table 2-8 defines internal parameter and performance details for the 32WSS card.

Table 2-8 32WSS Card Parameters and Performance

Parameter	Condition	Min	Typical	Max	Unit
Channel grid					
-0.5 dB bandwidth	EXP RX => COM TX	+/-115			pm
-0.5 dB bandwidth	Add 1, 32 => COM TX	+/-135			
Insertion loss	EXP RX => COM TX	—	—	11.3	dB
	COM RX => EXP TX	—	—	1.5	
	Add 1, 32 => COM TX	—	—	7.6	
	COM RX => DROP TX	6	—	8.5	
Adjacent crosstalk	Add 1, 32	23	—	—	dB
Multipath interference	EXP RX => COM TX	45	—	—	
Nonadjacent crosstalk	Add 1, 32	30	—	—	
PDL	EXP RX => COM TX	—	—	0.9	dB
	COM RX => EXP TX	—	—	0.1	
	Add 1, 32 => COM TX	—	—	0.5	
	COM RX => DROP TX	—	—	0.1	
In-band chromatic dispersion	All paths	-20	—	+20	ps/nm
Group delay ripple	All paths	-10	—	+10	ps
In-band PMD	All paths	—	—	0.5	ps
Optical power/VOA attenuation setting resolution	—	—	—	0.1	dB
Optical power setting accuracy	—	-0.5	—	+ 0.5	dB
Optical power setting precision	—	-0.1	—	+ 0.1	dB
Optical power/VOA attenuation settling time	—	—	—	200	ms
Optical switch state settling time	—	—	—	5	ms
	—	—	—	5	
VOA dynamic range	EXP RX => COM TX	20	—	—	dB
	Add 1, 32 => COM TX	25	—	—	
Channel shutoff attenuation (AVS)	EXP RX => COM TX	40	—	—	dB
	Add 1, 32 => COM TX		—	—	
	EXP RX => COM TX	40	—	—	
	Add 1, 32 => COM TX		—	—	
Optical port isolation	EXP RX => COM TX	32	—	—	dB
	Add 1, 32 => COM TX	42	45	—	

Table 2-8 32WSS Card Parameters and Performance (continued)

Parameter	Condition	Min	Typical	Max	Unit
Directivity	Add 1,32 <=> Add 1,32	40	—	—	dB
	Add 1, 32 <=> EXP RX				
Return loss	—	40	—	—	dB
Maximum optical input power	—	300	—	—	mW
Maximum AWG startup time	—	—	—	10	min.

2.2.3.2 32WSS-L Card

The 32WSS-L card is capable of operating bidirectionally over the L band of the optical spectrum (wavelengths from 1577 nm to 1605 nm).

In one line direction, the EXP-RX port receives the aggregate optical signal. The first arrayed wavelength grating (AWG) opens the spectrum and each wavelength goes through a 1x2 optical switch, where the same wavelength can be added from its ADD port. A dedicated per-channel VOA allows per-channel power regulation. The second AWG multiplexes all the wavelengths and the aggregate signal goes through the COM-TX output port.

In the other line direction, the aggregate optical signal comes in from the COM-RX port. An 80/20 splitter (80 Express/20 Drop) sends the optical signals on two output ports, the DROP-TX port for demultiplexing and dropping wavelengths, and the EXP-TX port for the next stage.

Each input and output port is equipped with either a real or a virtual photodiode. All VOAs for the 32 channels and switches are software-controlled for remote reconfiguration. [Table 2-9](#) defines all optical internal parameters and performances details.

Table 2-9 32WSS-L Card Parameters and Performance

Parameter	Condition	Min	Typical	Max	Unit
-0.5 dB bandwidth	EXP RX => COM TX	+/-91	±116	—	pm
-0.5 dB bandwidth	Add 1, 32 => COM TX	+/-135	±161	—	
Insertion loss	EXP RX => COM TX	—	9.7	11.3	dB
	COM RX => EXP TX	—	1.4	1.6	
	Add 1, 32 => COM TX	—	6.2	8.0	
	COM RX => DROP TX	6	8	8.5	
Adjacent crosstalk	Add 1, 32	23	30	—	dB
Multi path interference	EXP RX => COM TX	41	49	—	
Nonadjacent crosstalk	Add 1, 32	30	42	—	
PDL	EXP RX => COM TX	—	0.5	0.9	dB
	COM RX => EXP TX	—	0.5	0.9	
	Add 1, 32 => COM TX	—	0.7	1.5	
	COM RX => DROP TX	—	0.7	1.3	

Table 2-9 32WSS-L Card Parameters and Performance (continued)

Parameter	Condition	Min	Typical	Max	Unit
In-band chromatic dispersion	All paths	-20	—	+20	ps/nm
Group delay ripple	All paths	-10	—	+10	ps
In-band PMD	All paths	—	—	1	ps
Optical power/VOA attenuation setting resolution	—	—	—	0.1	dB
Optical power setting accuracy	—	-0.7	0.1	+ 0.7	dB
Optical power setting precision	—	-0.4	0.1	+ 0.4	dB
Optical power/VOA attenuation settling time	—	—	—	200	ms
Optical switch state settling time	—	—	—	5	ms
	—	—	—	5	
VOA dynamic range	EXP RX => COM TX	20	25	—	dB
	Add 1, 32 => COM TX	25	25	—	
Channel shutoff attenuation (AVS)	EXP RX => COM TX	28	45	—	dB
	Add 1, 32 => COM TX			—	
	EXP RX => COM TX	39	50	—	
	Add 1, 32 => COM TX			—	
Optical port isolation	EXP RX => COM TX	27	33	—	dB
	Add 1, 32 => COM TX	36	50	—	
Directivity	Add 1,32 <=> Add 1,32	40	—	—	dB
	Add 1, 32 <=> EXP RX				
Return loss	—	40	—	—	dB
Maximum optical input power	—	300	—	—	mW
Maximum AWG startup time	—	—	—	10	min.

The 32WSS-L card supports OChSPRing protection. This implies that the optical plug-in module needs to perform a switch fast enough to allow a total unit switching time of less than 10 ms.

The 32WSS-L is a double-slot card that has three LEDs on its front panel.

2.2.3.3 32DMX Card

Table 2-10 defines the 32DMX card optical parameters and the maximum insertion loss allowed.

Table 2-10 32DMX Card Optical Parameters and Insertion Loss

Parameter	Condition	Min	Typical	Max	Unit
-1 dB Bandwidth	COM RX => TX 1, 32 (OUT)	+/-110	—	—	pm
-3 dB Bandwidth		+/-200	—	—	
Insertion Loss	COM RX => TX 1, 32	—	—	5.5	dB
Adjacent Crosstalk	COM RX => TX 1, 32	26	—	—	dB
Nonadjacent Crosstalk		34	—	—	
Total Crosstalk		20	—	—	
PDL	COM RX => TX 1, 32	—	—	0.5	dB
In Band Chromatic Dispersion	All paths	-20	—	+20	ps/nm
Group Delay Ripple	All paths	-10	—	+10	ps
In Band PMD	All paths	—	—	0.5	ps
VOA attenuation Setting Resolution	—	—	—	0.1	dB
VOA Attenuation Setting Accuracy	Attenuation range 0 – 10 dB	-0.5	—	+ 0.5	dB
VOA Attenuation Setting Precision	Attenuation range 0 – 10 dB	-0.1	—	+ 0.1	dB
Power Monitoring Indication Response Time Internal Cycle	All PDs (both real and virtual)	—	—	20	ms
Optical Power/VOA Attenuation Settling time	—	—	—	200	ms
VOA shut-off Attenuation (AVS)	COM RX => TX 1, 32	40	—	—	dB
Directivity	—	40	—	—	dB
Return Loss	—	40	—	—	dB
Maximum Optical input power	—	300	—	—	mW
Maximum AWG Start-up time	—	—	—	10	min.

2.2.3.4 32DMX-L Card

The 32DMX-L is a unidirectional unit that operates over the L band of the optical spectrum in wavelengths from 1577 nm to 1605 nm. The 32DMX-L card receives the aggregate optical signal through the COM-RX port and demultiplexes all 32 wavelengths onto its output ports. Every port has a photodiode for optical power monitoring. The common path is equipped with a common VOA for optical power regulation.

The single VOA on the common path is the main difference between the 32DMX-L card and the 32DMX-O card, which has 32 VOAs, one for each output port. The 32DMX-L cannot provide power regulation for each individual channel.

When output ports are connected to the client equipment, an external bulk attenuator might be required to match the receive (Rx) window of the interface. [Table 2-11](#) defines the internal optical parameters.

Table 2-11 32DMX-L Card Optical Parameters

Parameter	Condition	Min	Typical	Max	Unit
-1 dB bandwidth	COM RX => TX 1, 32 (OUT)	+/-100	—	—	pm
-3 dB bandwidth		+/-200	—	—	
Insertion loss	COM RX => TX 1, 32	—	—	5.8	dB
Adjacent crosstalk	COM RX => TX 1, 32	25	—	—	dB
Nonadjacent crosstalk		34	—	—	
Total crosstalk		20	—	—	
PDL	COM RX => TX 1, 32	—	—	0.5	dB
In-band chromatic dispersion	All paths	-20	—	+20	ps/nm
Group delay ripple	All paths	-10	—	+10	ps
In-band PMD	All paths	—	—	0.5	ps
VOA attenuation setting resolution	—	—	—	0.1	dB
VOA attenuation setting accuracy	Attenuation range 0 – 10 dB	- 0.7	—	+ 0.7	dB
VOA attenuation setting precision	Attenuation range 0 – 10 dB	-0.1	—	+ 0.1	dB
Power monitoring indication response time internal cycle	All PDs (both real and virtual)	—	—	20	ms
Optical power/VOA attenuation settling time	—	—	—	200	ms
VOA shutoff attenuation (AVS)	COM RX => TX 1, 32	40	—	—	dB
Directivity	—	40	—	—	dB
Return loss	—	40	—	—	dB
Maximum optical input power	—	300	—	—	mW
Maximum AWG startup time	—	—	—	10	min.

2.2.3.5 32MUX-O Card

[Table 2-12](#) defines the optical parameters for the 32MUX-O card.

Table 2-12 32MUX-O Card Optical Parameters

Parameter	Min	Typical	Max	Unit
-1 dB bandwidth	160	—	300	pm
In-band ripple	—	—	0.5	dB
Insertion loss	4	—	8.5	dB
Insertion loss disuniformity	—	—	1.5	dB
Adjacent crosstalk	23	—	—	dB
Nonadjacent crosstalk	30	—	—	dB
Total crosstalk	20	—	—	dB
PDL	—	—	1.5	dB
In-band chromatic dispersion	-20	—	+20	ps/nm
In-band PMD	—	—	0.5	ps
Optical power/VOA attenuation setting resolution	—	—	0.1	dB
Optical power setting accuracy	-0.5	—	+0.5	dB
VOA attenuation setting accuracy	-0.1	—	+0.1	dB
Power monitoring indication response time	—	—	20	ms
Optical power/VOA attenuation settling time	—	—	200	ms
Optical rise and fall time	—	—	200	ms
Optical over and undershoot	-1.5	—	+1.5	dB
VOA dynamic range	25	—	—	dB
VOA shutoff attenuation (AVS) with unit powered off	20	—	—	dB
VOA shutoff attenuation (AVS) with unit powered on	40	—	—	dB
Directivity	40	—	—	dB
Return loss	40	—	—	dB
Optical monitor tap splitting ratio on monitor port	19	—	21	dB
Maximum optical input power	300	—	—	mW
Maximum AWG startup time	—	—	10	min.

2.2.3.6 32DMX-O Card

Table 2-13 defines the optical parameters for the 32DMX-O card.

Table 2-13 32DMX-O Card Optical Parameters

Parameter	Min	Typical	Max	Unit
-1 dB bandwidth	160	—	300	pm
In-band ripple	—	—	0.5	dB
Insertion loss	4	—	8.5	dB
Insertion loss disuniformity	—	—	1.5	dB
Adjacent crosstalk	23	—	—	dB
Nonadjacent crosstalk	30	—	—	dB
Total crosstalk	20	—	—	dB
PDL	—	—	1.5	dB
In-band chromatic dispersion	-20	—	+20	ps/nm
In-band PMD	—	—	0.5	ps
Optical power/VOA attenuation setting resolution	—	—	0.1	dB
Optical power setting accuracy	-0.5	—	+0.5	dB
VOA attenuation setting accuracy	-0.1	—	+0.1	dB
Power monitoring indication response time	—	—	20	ms
Optical power/VOA attenuation settling time	—	—	200	ms
Optical rise and fall time	—	—	200	ms
Optical over and undershoot	-1.5	—	+1.5	dB
VOA dynamic range	25	—	—	dB
VOA shutoff attenuation (AVS) with unit Powered Off	20	—	—	dB
VOA shutoff attenuation (AVS) with unit powered on	40	—	—	dB
Directivity	40	—	—	dB
Return loss	40	—	—	dB
Optical monitor tap splitting ratio on monitor port	19	—	21	dB
Maximum optical input power	300	—	—	mW
Maximum AWG startup time	—	—	10	min.

2.2.3.7 4MD-xx.x Card

Table 2-14 defines optical parameters for the 4MD-xx.xx card.

Table 2-14 4MD-xx.x Card Optical Parameters

Optical Parameters	Value
Maximum insertion loss demultiplex section	3.2 dB
Maximum insertion loss multiplex section	3.6 dB at VOA min attenuation
Adjacent crosstalk	25 dB
Nonadjacent crosstalk	38 dB
VOA dynamic range	30 dB

2.2.3.8 C-Band OADM Filter Cards

Table 2-15 to Table 2-19 define optical parameters for the AD-1B-xx.x, AD-4B-xx.x, AD-1C-xx.x, AD-2C-xx.x, and AD-4C-xx.x cards.

Table 2-15 AD-1B-xx.x Card Optical Parameters

Optical Parameters	Value
Maximum insertion loss drop section	3 dB at VOA minimum attenuation
Maximum insertion loss add section	2.2 dB
Maximum insertion loss express section (Exp RX – COM TX)	1.6 dB
Maximum insertion loss express section (COM RX – Exp TX)	2.8 dB at VOA minimum attenuation
In-band ripple	0.3 dB
Out-of-band ripple (COM RX – Exp TX)	0.5 dB at VOA minimum attenuation
Out-of-band ripple (Exp RX – COM TX)	0.3 dB
Left/Right adjacent crosstalk	25 dB
First channel nonadjacent crosstalk	30 dB
Nonadjacent crosstalk	35 dB
Left/Right isolation drop path	-26 dB
Left/Right isolation add path	-13 dB

Table 2-16 AD-4B-xx.x Card Optical Parameters

Optical Parameters	Value
Maximum insertion loss drop section	4.5 dB at VOA minimum attenuation
Maximum insertion loss add section	3.5 dB
Maximum insertion loss express section (Exp RX – COM TX)	3 dB
Maximum insertion loss express section (COM RX – Exp TX)	4.8 dB at VOA minimum attenuation
In-Band Ripple	0.3 dB

Table 2-16 AD-4B-xx.x Card Optical Parameters (continued)

Optical Parameters	Value
In-band ripple	0.5 dB at VOA minimum attenuation
Out-of-band ripple (COM RX – Exp TX)	0.3 dB
Left/Right adjacent crosstalk	25 dB
First channel nonadjacent crosstalk	30 dB
Nonadjacent crosstalk	35 dB
Left/Right isolation drop path	–26 dB
Left/Right isolation add path	–13 dB

Table 2-17 AD-C-xx.x Card Optical Parameters

Optical Parameters	Value
Maximum insertion loss drop section	2 dB
Maximum insertion loss add section	2.6 dB at VOA minimum attenuation
Maximum insertion loss express section (Exp RX – COM TX)	1.1 dB
Maximum insertion loss express section (COM RX – Exp TX)	2.2 dB at VOA minimum attenuation
Adjacent crosstalk	25 dB
Nonadjacent crosstalk	35 dB
Isolation left/right	–14 dB
VOA dynamic range	30 dB

Table 2-18 AD-2C-xx.x Card Optical Parameters

Optical Parameters	Value
Maximum insertion loss drop section	2.4 dB
Maximum insertion loss add section	3.1 dB at VOA minimum attenuation
Maximum insertion loss express section (Exp RX – COM TX)	1.5 dB
Maximum insertion loss express section (COM RX – Exp TX)	2.7 dB at VOA minimum attenuation
Adjacent crosstalk	25 dB
Nonadjacent crosstalk	35 dB
Isolation left/right	–14 dB
VOA dynamic range	30 dB

Table 2-19 AD-4C-xx.x Card Optical Parameters

Optical Parameters	Value
Maximum insertion loss drop section	5.4 dB
Maximum insertion loss add section	4.9 dB at VOA min attenuation
Maximum insertion loss express section (Exp RX – COM TX)	1.2 dB
Maximum insertion loss express section (COM RX – Exp TX)	2.5 dB at VOA min attenuation
Adjacent crosstalk	25 dB
Nonadjacent crosstalk	38 dB
Isolation (COM RX – Exp TX)	-26 dB
Isolation (Exp RX – COM TX)	-13 dB
VOA dynamic range	30 dB

2.2.3.9 MMU Card

The MMU is a single-slot bidirectional card that operates over both the C-band and L-band optical spectrums. The MMU has six LC-PC-II optical connectors on its front panel. Table 2-20 shows the MMU specifications.

Table 2-20 MMU Card Optical Specifications

Parameter	Condition	Notes	Min	Typical	Max	Unit
Operating bandwidth	All paths	All SOP, including	1500 – 1605	—	—	nm
Insertion loss	EXP RX => COM TX	WDL and within whole operating temperature range, connectors included	—	—	7.0	dB
	EXP A RX => COM TX		—	—	2.3	
	COM RX => EXP TX		—	—	0.8	
	COM RX => EXP A TX		—	—	14.8	
Wavelength dependent losses	C band only		—	—	0.3	dB
	L band only		—	—	0.3	
	C + L band		—	—	0.5	
PDL	C band only	—	—	—	0.2	dB
	L band only	—	—	—	0.2	
	C + L band	—	—	—	0.3	
Chromatic dispersion	All paths	—	-20	—	+20	ps/nm
PMD	All paths	—	—	—	0.1	ps

Table 2-20 MMU Card Optical Specifications (continued)

Parameter	Condition	Notes	Min	Typical	Max	Unit
Optical power reading resolution	All PDs (both real and virtual)	—	—	—	0.1	dB
Optical power reading precision		—	- 0.1	—	0.1	dB
Directivity	EXP RX => EXP A RX	All SOP, including WDL and within whole operating temperature range	40	—	—	dB
	EXP RX => EXP B RX					
	EXP A RX => EXP B RX					
Return loss	—	—	40	—	—	dB
Maximum optical input power	—	Maximum power handling	500	—	—	mW

2.2.4 Optical Amplifiers

The optical amplifier cards can be installed in Slots 1 through 6 and 12 through 17.

These cards contain three main modules:

- Optical plug-in module
- Microprocessor module (uP8260)
- DC/DC converter

The optical plug-in module has a built-in microcontroller for managing functionalities such as the optical power, laser current, and temperature control loops.

The microprocessor module (uP8260) manages the communication between the optical amplifier card and the TCC2/TCC2P card, and provides all the Operation, Administration, Maintenance, and Provisioning (OAM&P) functions (including controls and alarms). The DC/DC converter provides the power supply voltages for the cards.

The Cisco ONS 15454 has five optical amplifier cards:

- C-Band Preamplifier (OPT-PRE)
- C-Band Booster (OPT-BST)
- C-Band Booster Enhanced (OPT-BST-E)
- L-Band Amplifier (OPT-AMP-L)
- L-Band Booster (OPT-BST-L)

2.2.4.1 OPT-PRE Card

Table 2-21 provides the internal parameters and performance information for the OPT-PRE preamplifier card.

Table 2-21 OPT-PRE Card Standard Power and Gain Range

Parameter	Comment	Min	Typical	Max	Unit
Total input signal power range	Full channel load; see Figure 2-4 for a detailed Pin-Pout power mask	-4	—	12	dBm
	Single channel; see Figure 2-4 for a detailed Pin-Pout power mask	-22	—	-6	dBm
Maximum output signal power	Full channel load	17.0	—	17.5	dBm
	Single channel	-1.0	—	-0.5	dBm
Mid-stage loss range	—	3	—	9	dB
Maximum total mid-stage output power	—	—	—	15	dBm
Maximum per-channel mid-stage output power	At 32 channels	—	—	0	dBm
Maximum optical amplifier signal gain	With tilt controlled at 0 dB	—	—	21	dB
Standard gain range	With tilt controlled at 0 dB	5	—	21	dB

Figure 2-4 shows a graphical representation of a standard range power mask for OPT-PRE card.

Figure 2-4 OPT-PRE Standard Range Power Mask

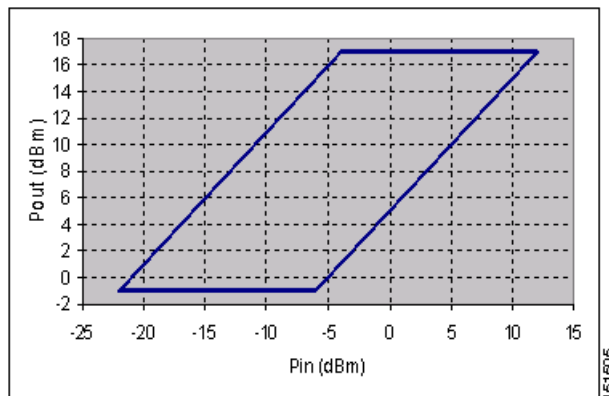


Table 2-22 indicates the extended power and gain range for OPT-PRE card.

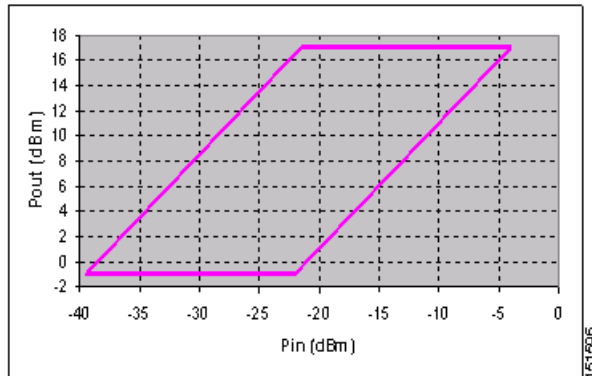
Table 2-22 OPT-PRE Extended Power and Gain Range

Parameter	Comment	Min	Typical	Max	Unit
Total input signal power range	Full channel load See Figure 2-5 for detailed P_{in} - P_{out} power mask	-21.5		-4	dBm
	Single channel See Figure 2-5 for detailed P_{in} - P_{out} power mask	-39.5		-22	dBm
Maximum output signal power	Full channel load	17.0	—	17.5	dBm
	Single channel	-1.0	—	-0.5	dBm
Extended gain range ¹	See Figure 2-5 Uncontrolled Tilt	21		38.5	dB

1. In the DWDM system, the amplifier will be used in Constant Gain mode for Gain \leq 28 dB; in the region 28dB < Gain \leq 38.5 dB, the operational mode will be Constant Output Power mode.

Figure 2-5 shows a graphical representation of an extended range power mask for an OPT-PRE card.

Figure 2-5 OPT-PRE Card Extended Range Power Mask



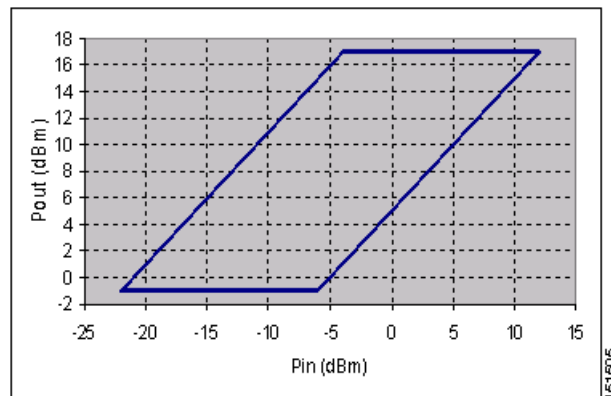
2.2.4.2 OPT-BST and OPT-BST-E Cards

Table 2-23 and Table 2-24 define all optical internal parameters and performance information for the OPT-BST and OPT-BST-E booster amplifier cards.

Table 2-23 OPT-BST Card Power and Gain Specification

Parameter	Comment	Min	Typical	Max	Unit
Total input signal power range	Full channel load; see Figure 2-6 for detailed Pin-Pout power mask	-3	—	12	dBm
	Single channel; see Figure 2-6 for detailed Pin-Pout power mask	-21	—	-6	dBm
Maximum output signal power	Full channel load	17.0	—	17.5	dBm
	Single channel	-1.0	—	-0.5	dBm
Maximum optical amplifier signal gain	With tilt controlled at 0 dB	—	—	20	dB
Gain range	Figure 44	5	—	20	dB
Gain tilt error at target gain tilt = 0 dB	—	—	—	0.5	dB

[Figure 2-6](#) shows a graphical representation of the power mask for the OPT-BST card.

Figure 2-6 OPT-BST Card Power Mask

[Table 2-24](#) defines the power and gain specifications for the OPT-BST-E card.

Table 2-24 OPT-BST-E Card Power and Gain Specifications

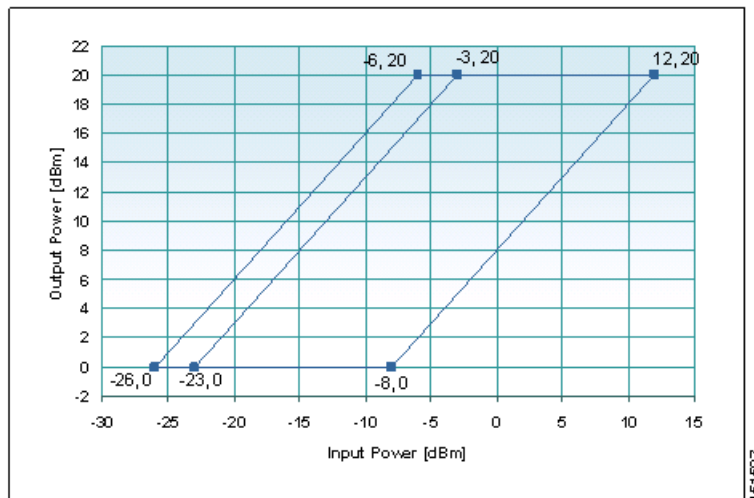
Parameter	Comment	Min	Typical	Max	Unit
Total input signal power range	Full channel load	-26	—	12	dBm
Maximum output signal power	Full channel load	20	—	20.5	dBm
Operative output power range	—	2	—	20	dBm

Table 2-24 OPT-BST-E Card Power and Gain Specifications (continued)

Parameter	Comment	Min	Typical	Max	Unit
Maximum optical amplifier signal gain	With tilt controlled at 0 dB	—	—	23	dB
Gain range	—	8	—	23	dB
Extended gain range	Gain range with tilt uncontrolled	23	—	26	dB
Gain tilt error at target gain tilt = 0 dB	—	—	—	+/- 0.5	dB

Figure 2-7 shows a graphical representation of standard extended gain range for the OPT-BST-E card.

Figure 2-7 OPT-BST-E Card Standard and Extended Gain Range



2.2.4.3 OPT-BST-L Card

The OPT-BST-L card is an L-band DWDM EDFA with OSC add/drop capability that can operate up to 64 optical transmission channels at 50-GHz channel spacing over the L band of the optical spectrum (wavelengths from 1570 nm to 1605 nm). To control gain tilt, the card is equipped with a built-in VOA managed by the card microprocessor. The OPT-BST-L provides the following features:

- True variable gain
- Fixed gain mode (with programmable tilt)
- Fast transient suppression
- Nondistorting low frequency transfer function
- Settable maximum output power
- Fixed output power mode (mode used during provisioning)
- Constant drive current mode (test mode)
- Amplified spontaneous emission (ASE) compensation in fixed gain mode

- Full monitoring and alarm handling capability with settable thresholds
- Supported optical safety functionality by signal loss detection and alarm, fast power down control, and reduced maximum output power in safe power mode

The OPT-BST-L card implements the following optical safety functions:

- Optical Safety Remote Interlock (OSRI)
- Automatic Laser Shutdown (ALS)

The OSRI function provides hardware and software capability for shutting down or reducing the output optical power to a safer level, whereas the ALS function provides a safety mechanism (automatic power reduction [APR]) for fiber cuts.

Table 2-25 defines all power and gain specifications for OPT-BST-L card:

Table 2-25 OPT-BST-L Card Power and Gain Specifications

Parameter	Comment	Min	Typical	Max	Unit
Operative input power range	Full channel load	-10	—	9	dBm
	Single channel	-37	—	-18	dBm
Maximum total output power	FW or HW limited	—	—	17.5	dBm
Signal output power range	Full channel load	—	—	17	dBm
	Single channel	-10	—	—	dBm
Standard gain range	Controllable gain tilt	8	—	20	dB
Extended gain range	Gain tilt uncontrolled	20	—	27	dB

Figure 2-8 shows the standard and extended gain range for the OPT-BST-L card. Red lines indicate the total measurement range accomplished by the photodiodes.

Figure 2-8 OPT-BST-L Card Standard and Extended Gain Range

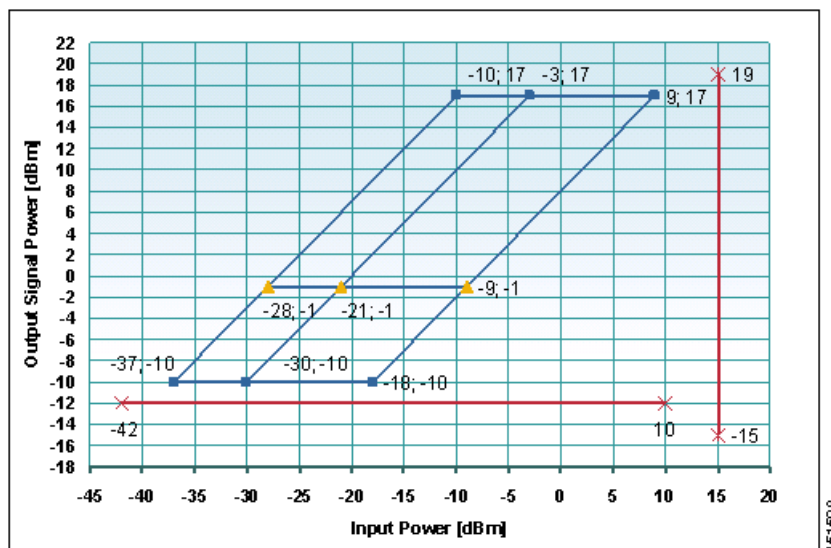
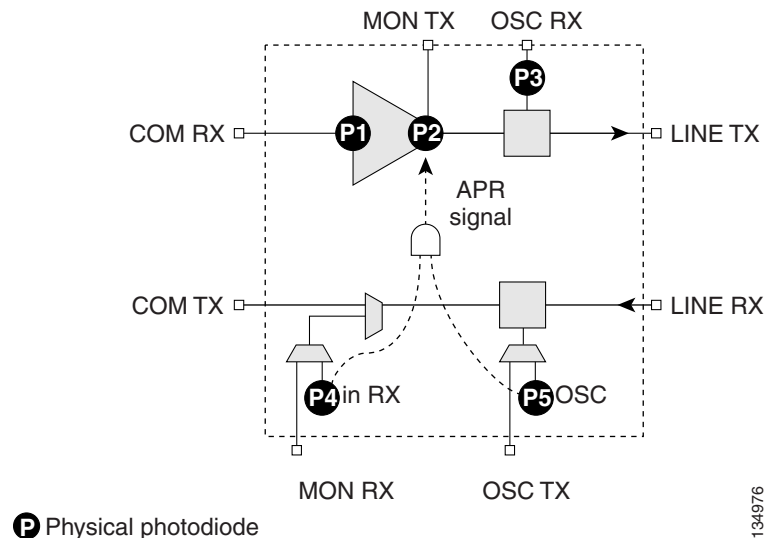


Figure 2-9 shows the internal functional structure for the OPT-BST-L card.

Figure 2-9 OPT-BST-L Card Functional Block Diagram



Optical loss (in dB) caused by the OPT-BST-L monitor ports is printed on the card faceplate. The OPT-BST-L is a single-slot bidirectional card with three LEDs and eight LC-PC-II optical connectors on the card faceplate.

2.2.4.4 OPT-AMP-L Card

The OPT-AMP-L preamplifier card can operate up to 64 optical transmission channels with 50-GHz channel spacing over the L-band optical spectrum (wavelengths from 1570 nm to 1605 nm). The OPT-AMP-L is an L-band DWDM optical amplifier module consisting of a two-stage EDFA with a MAL section for allocation of DCU and with the capability to add/drop the OSC. The OPT-AMP-L preamplifier is software configurable as a preamplifier or as a booster amplifier.

To control gain tilt, the card is equipped with a built-in VOA managed by the card's microprocessor. The VOA can also be used to pad the DCU to a reference value.

The OPT-AMP-L card provides the following features:

- True variable gain
- Fast transient suppression
- Nondistorting low frequency transfer function
- Settable maximum output power
- Fixed Output Power mode (mode used during provisioning)
- Constant drive current mode (test mode)
- MAL support for a fiber-based DCU
- ASE compensation in Fixed Gain mode
- Full monitoring and alarm handling capability with settable thresholds
- Supported optical safety functionality by means of signal loss detection and alarm, fast power down control and reduced maximum output power in safe power mode

The OPT-AMP-L card implements the following optical safety functions:

- OSRI
- ALS

The OSRI function provides hardware and software capability for shutting down optical power or reducing it to a safe level, whereas the ALS function provides an APR safety mechanism for fiber cuts.

Table 2-26 defines the standard and extended gain ranges for the OPT-AMP-L card.

Table 2-26 OPT-AMP-L Card Standard and Extended Gain Range

Parameter	Comment	Min	Typ	Max	Unit
Operative input power range	Full channel load	-15	—	8	dBm
	Single channel	-40	—	-17	dBm
Maximum total output power	FW or HW limited	—	—	21	dBm
Signal output power range	Full channel load	—	—	20	dBm
	Single channel	-5	—	—	dBm
Standard gain range	With full MSL range. Output gain tilt = 0 dB for: 0 dB MSL 12 dB	12	—	24	dB
Extended gain range	With full MSL range. Output gain tilt = 0 dB for: 0 dB MSL (36 - G) [dB]	24	—	35	dB

Figure 2-10 shows a graphical representation of standard and extended gain range for the OPT-AMP-L card.

Figure 2-10 OPT-AMP-L Card Standard and Extended Gain Range

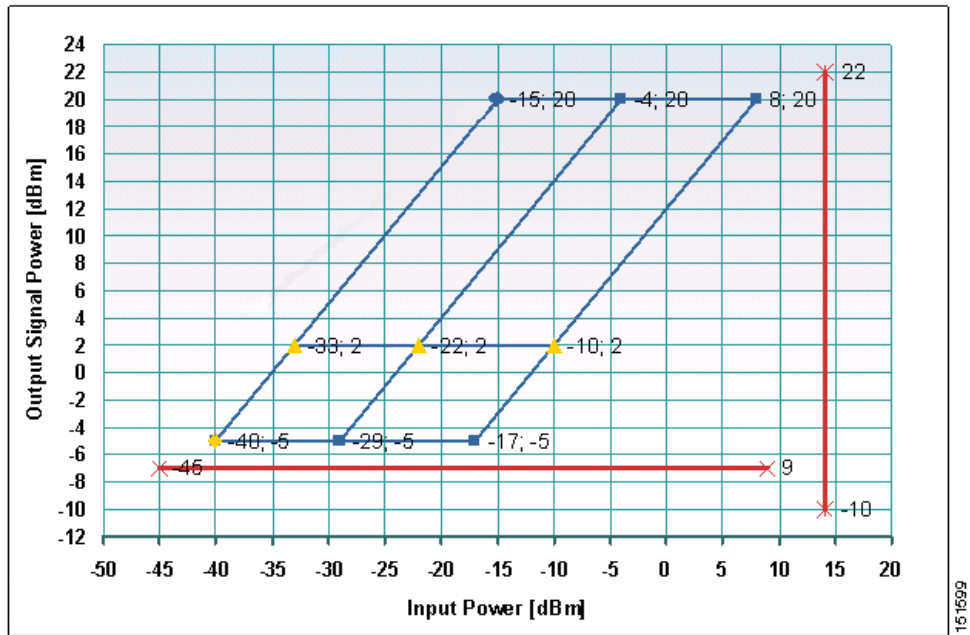
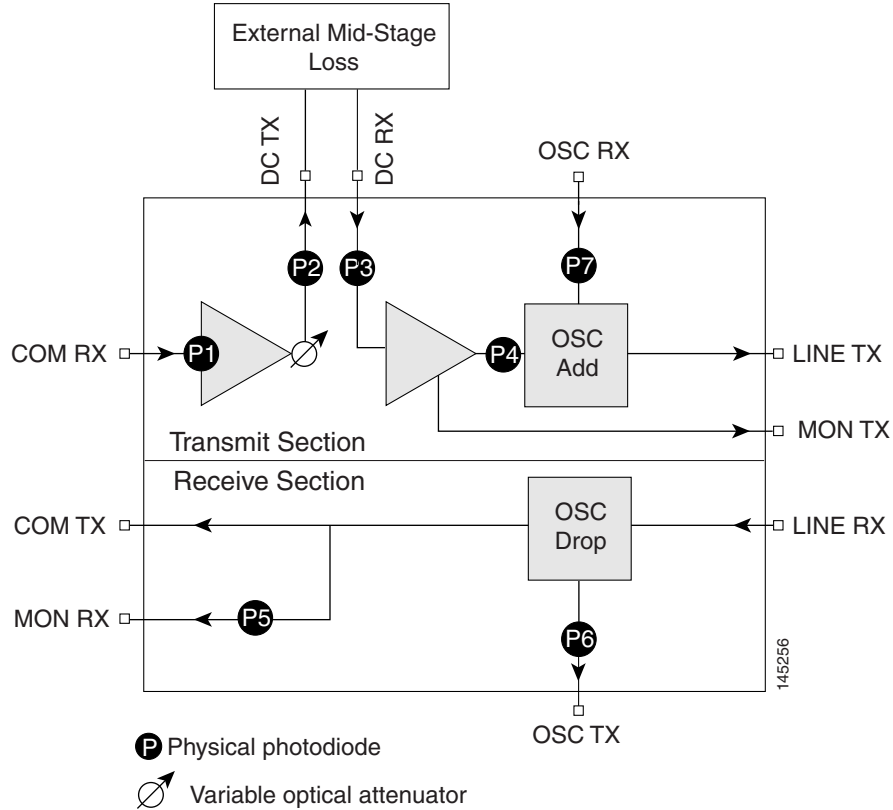


Figure 2-11 shows the internal functional structure of the OPT-AMP-L card.

Figure 2-11 OPT-AMP-L Card Functional Block Diagram



The card faceplate shows the optical loss (in dB) of the monitor ports provided by the OPT-AMP-L card. The OPT-AMP-L is a double-slot card with three LEDs on the faceplate.

2.2.5 Dispersion Compensation Units

Dispersion compensation units (DCUs) are installed in the ONS 15454 dispersion compensation shelf when optical preamplifier (OPT-PRE or OPT-AMP-L) cards are installed in the DWDM node.

Table 2-27 lists the DCUs used with the ONS 15454 DWDM configuration.

Table 2-27 Dispersion Compensation Units by Fiber Type

Fiber	DCU Description	C Band	L Band
SMF-28	SMF C-Band Dispersion Compensation Unit 100ps/nm	15216-DCU-100=	—
	SMF C-Band Dispersion Compensation Unit 350ps/nm	15216-DCU-350=	—
	SMF C-Band Dispersion Compensation Unit 450ps/nm	15216-DCU-450=	—
	SMF C-Band Dispersion Compensation Unit 550ps/nm	15216-DCU-550=	—
	SMF C-Band Dispersion Compensation Unit 750ps/nm	15216-DCU-750=	—
	SMF C-Band Dispersion Compensation Unit 950ps/nm	15216-DCU-950=	—
	SMF C-Band Dispersion Compensation Unit 1150ps/nm	15216-DCU-1150=	—
	SMF L-Band Dispersion Compensation Unit 300ps/nm	—	15216-DCU-L-300=
	SMF L-Band Dispersion Compensation Unit 600ps/nm	—	15216-DCU-L-600=
	SMF L-Band Dispersion Compensation Unit 700ps/nm	—	15216-DCU-L-700=
	SMF L-Band Dispersion Compensation Unit 800ps/nm	—	15216-DCU-L-800=
	SMF L-Band Dispersion Compensation Unit 1000ps/nm	—	15216-DCU-L-1000=
	SMF L-Band Dispersion Compensation Unit 1100ps/nm	—	15216-DCU-L-1100=
E-LEAF	—	15216-DCU-E-200=	—
	—	15216-DCU-E-350=	—
DS	DSF L-Band Dispersion Compensation Unit 100ps/nm	—	15216-DCU-DS-L100=
	DSF L-Band Dispersion Compensation Unit 200ps/nm	—	15216-DCU-DS-L200=
	DSF L-Band Dispersion Compensation Unit 300ps/nm	—	15216-DCU-DS-L300=

Each C-band DCU can compensate a maximum of 65 km of single-mode fiber (SMF-28). DCUs can be cascaded to extend the compensation to 130 km.

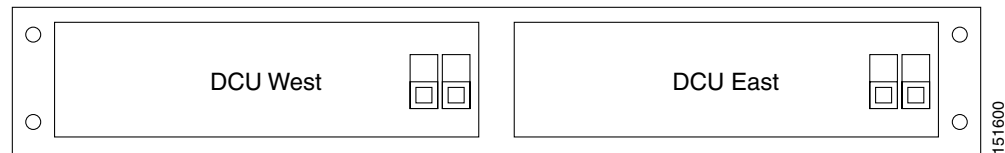
2.2.5.1 DCU Mechanical Specifications

The DCU subrack is designed to comply with all international standards. The DCU shelf is housed in a 1-RU 19" (482.6mm)/23" (584.2mm) rack-mounted shelf [17" (431.8mm) wide, 11" (279.4mm) deep, 1.75" (44.45mm) high] with all front access (fibers, management interfaces when applicable). The depth of the subrack, including cable management, does not exceed the 280 mm requirement.

For a bidirectional DCU, shown in [Figure 2-12](#), the dimensions are 8" (205mm) wide, 9" (230 mm) deep, and 1.5" (38.5 mm) high.

The DCU has one optical adapter on its front panel that can house two LC-PC-II connectors.

Figure 2-12 DCU Front Panel



Refer to the *Cisco ONS 15216 System Dispersion Compensation Unit User Guide* for the Cisco ONS 15216 DCU mechanical specifications.

2.2.5.2 DCU Optical Specifications

[Table 2-28](#) shows the optical specifications for ONS 15454 DCUs.

Table 2-28 Optical Specifications for ONS 15454 DCUs

Units		Specifications				Notes
C Band	L Band	Insertion Loss [dB]	PMD [ps/nm]	PDL [dB]	ORL [dB]	
15216-DCU-100=	—	<2.1	0.3	<0.1	<45	Wavelength range 1525 to 1565n
15216-DCU-350=	—	<3.5	0.55			
15216-DCU-450=	—	<3.5	0.65			
15216-DCU-550=	—	<3.9	0.7			
15216-DCU-750=	—	<5	0.8			
15216-DCU-950=	—	<5.5	0.9			
15216-DCU-1150=	—	<6	1			
15216-DCU-E-200=	—	<5.5	0.9	<0.1	<45	Wavelength range 1529.5 to 1561.6 nm
15216-DCU-E-350=	—	<7.0	1			

Table 2-28 Optical Specifications for ONS 15454 DCUs (continued)

Units		Specifications				Notes
C Band	L Band	Insertion Loss [dB]	PMD [ps/nm]	PDL [dB]	ORL [dB]	
—	15216-DCU-L-300=	<3	0.5	<0.1	<45	Wavelength range 1576 to 1605 nm
—	15216-DCU-L-600=	<4.2	0.6			
—	15216-DCU-L-700=	<4.6	0.6			
—	15216-DCU-L-800=	<5	0.7			
—	15216-DCU-L-1000=	<5.8	0.8			
—	15216-DCU-L-1100=	<6	0.8			
—	15216-DCU-DS-L100=	<3.6	0.5	<0.1	<45	
—	15216-DCU-DS-L200=	<4.4	0.6			
—	15216-DCU-DS-L300=	<5.2	0.7			

2.2.6 Transponder, Muxponder, and Optical Cards

For DWDM system interoperability, the operating center frequency (wavelength) of channels must be the same at the transmitting and receiving ends. Channel selection (center frequency) and channel width determine the number of nonoverlapping channels in the spectrum. Channel width, wavelength, bit rate, fiber type, and fiber length determine the amount of dispersion. Channel separation allows for a frequency deviation of approximately 2 GHz, caused by frequency drifts in the laser, filter, and amplifier devices to avoid interchannel interference.

The ITU-T currently recommends 81 channels in the C band, starting from 1528.77 nm and incrementing in multiples of 50 GHz to 1560.61 nm.

All C-band TXP and MXP cards support a range of wavelengths in increments of 100 GHz, as shown in [Table 2-29](#).

Table 2-29 Supported C-Band Wavelengths for TXP/MXP Cards

Frequency (THz)	Wavelength (nm)	DWDM 10-Gbps TXP/MXP		DWDM 2.5-Gbps TXP/MXP	DWDM 10-Gbps TXP/MXP
		(2 Ch Tunable)	(4 Ch Tunable)	(4 Ch Tunable)	(Full C-Band Tunable)
196	1529.55	—	—	—	15454-10E-L1-C=
195.9	1530.33	15454-10M-L1-30.3=	15454-10E-L1-30.3=	15454-DM-L1-30.3=	15454-10ME-C=
195.8	1531.12	15454-10T-L1-30.3=	15454-10ME-30.3=	15454-DMP-L1-30.3=	15454-10DME-C=
195.7	1531.90	15454-10M-L1-31.9=		15454-MR-L1-30.3=	
195.6	1532.68	15454-10T-L1-31.9=		15454-MRP-L1-30.3=	

Table 2-29 Supported C-Band Wavelengths for TXP/MXP Cards (continued)

Frequency (THz)	Wavelength (nm)	DWDM 10-Gbps TXP/MXP		DWDM 2.5-Gbps TXP/MXP	DWDM 10-Gbps TXP/MXP
		(2 Ch Tunable)	(4 Ch Tunable)	(4 Ch Tunable)	(Full C-Band Tunable)
195.5	1533.47	—	—	—	
194.9	1538.19	15454-10M-L1-38.1=	15454-10E-L1-38.1=	15454-DM-L1-38.1=	
194.8	1538.98	15454-10T-L1-38.1=	15454-10ME-38.1=	15454-DMP-L1-38.1=	
194.7	1539.77	15454-10M-L1-39.7=		15454-MR-L1-38.1=	
194.6	1540.56	15454-10T-L1-39.7=		15454-MRP-L1-38.1=	
194.5	1541.35	—	—	—	
194.4	1542.14	15454-10M-L1-42.1=	15454-10E-L1-42.1=	15454-DM-L1-42.1=	
194.3	1542.94	15454-10T-L1-42.1=	15454-10ME-42.1=	15454-DMP-L1-42.1=	
194.2	1543.73	15454-10M-L1-43.7=		15454-MR-L1-42.1=	
194.1	1544.53	15454-10T-L1-43.7=		15454-MRP-L1-42.1=	
194	1545.32	—	—	—	
193.9	1546.12	15454-10M-L1-46.1=	15454-10E-L1-46.1=	15454-DM-L1-46.1=	
193.8	1546.92	15454-10T-L1-46.1=	15454-10ME-46.1=	15454-DMP-L1-46.1=	
193.7	1547.72	15454-10M-L1-47.7=		15454-MR-L1-46.1=	
193.6	1548.51	15454-10T-L1-47.7=		15454-MRP-L1-46.1=	
193.5	1549.32	—	—	—	

Table 2-29 Supported C-Band Wavelengths for TXP/MXP Cards (continued)

Frequency (THz)	Wavelength (nm)	DWDM 10-Gbps TXP/MXP		DWDM 2.5-Gbps TXP/MXP	DWDM 10-Gbps TXP/MXP
		(2 Ch Tunable)	(4 Ch Tunable)	(4 Ch Tunable)	(Full C-Band Tunable)
193.4	1550.12	15454-10M-L1-50 .1=	15454-10E-L1-50. 1=	15454-DM-L1-50. 1=	
193.3	1550.92	15454-10T-L1-50. 1=	15454-10ME-50.1 =	15454-DMP-L1-5 0.1=	
193.2	1551.72	15454-10M-L1-50 .1=		15454-MR-L1-50. 1=	
193.1	1552.52	15454-10T-L1-50. 1=		15454-MRP-L1-50 .1=	
193	1553.33	—	—	—	
192.9	1554.13	15454-10M-L1-54 .1=	15454-10E-L1-54. 1=	15454-DM-L1-54. 1=	
192.8	1554.94	15454-10T-L1-54. 1=	15454-10ME-54.1 =	15454-DMP-L1-5 4.1=	
192.7	1555.75	15454-10M-L1-55 .7=		15454-MR-L1-54. 1=	
192.6	1556.55	15454-10T-L1-55. 7=		15454-MRP-L1-54 .1=	
192.5	1557.36	—	—	—	
192.4	1558.17	15454-10M-L1-58 .1=	15454-10E-L1-58. 1=	15454-DM-L1-58. 1=	
192.3	1558.98	15454-10T-L1-58. 1=	15454-10ME-58.1 =	15454-DMP-L1-5 8.1=	
192.2	1559.79	15454-10M-L1-59 .7=		15454-MR-L1-58. 1=	
192.1	1560.61	15454-10T-L1-59. 7=		15454-MRP-L1-58 .1=	
192	1561.42	—	—	—	

The TXP and MXP cards support the following L-band range of wavelengths in increments of 100 GHz.

Table 2-30 Supported L-Band Wavelengths for Transponder/Muxponder Cards

Frequency (THz)	Wavelength (nm)	DWDM 10-Gbps TXP/MXP (4 Ch Tunable)	DWDM 10-Gbps TXP/MXP (Full L-Band Tunable)
190.9	1570.42	—	15454-10E-L1-L=
190.8	1571.24	—	15454-10ME-L=
190.7	1572.06	—	15454-10DME -L=
190.6	1572.89	—	
190.5	1573.71	—	
190.4	1574.54	—	
190.3	1575.37	—	
190.2	1576.2	—	
190.1	1577.03	—	
190	1577.86	15454-10E-L1-77.4=	
189.9	1578.69	15454-10ME-77.4=	
189.8	1579.52		
189.7	1580.35		
189.6	1581.18	15454-10E-L1-80.7=	
189.5	1582.02	15454-10ME-80.7=	
189.4	1582.85		
189.3	1583.69		
189.2	1584.53	15454-10E-L1-84.1=	
189.1	1585.36	15454-10ME-84.1=	
189	1586.20		
188.9	1587.04		

Table 2-30 Supported L-Band Wavelengths for Transponder/Muxponder Cards (continued)

Frequency (THz)	Wavelength (nm)	DWDM 10-Gbps TXP/MXP (4 Ch Tunable)	DWDM 10-Gbps TXP/MXP (Full L-Band Tunable)
188.8	1587.88	15454-10E-L1-87.4=	
188.7	1588.73	15454-10ME-87.4=	
188.6	1589.57		
188.5	1590.41		
188.4	1591.26	15454-10E-L1-90.8=	
188.3	1592.10	15454-10ME-90.8=	
188.2	1592.95		
188.1	1593.79		
188	1594.64	—	
187.9	1595.49	—	
187.8	1596.34	—	
187.7	1597.19	—	
187.6	1598.04	—	
187.5	1598.89	—	
187.4	1599.75	—	
187.3	1600.6	—	
187.2	1601.46	—	
187.1	1602.31	—	
187	1603.17	—	
186.9	1604.03	—	
186.8	1604.88	—	
186.7	1605.74	—	

2.2.6.1 OC48 ITU-T Optics

The Cisco ONS 15454 supports a range of wavelengths in increments of 100 GHz and 200 GHz with its OC48 ITU-T optics, as shown in [Table 2-31](#).

Table 2-31 OC48 ITU-T Channels Available for the ONS 15454

C-Band Spectrum		
15454 OC48 ELR 100 GHz ITU-T Cards	Channel (nm)	Frequency (THz)
X	1528.77	196.1
X	1529.55	196
X	1530.33	195.9
X	1531.12	195.8
X	1531.90	195.7

Table 2-31 OC48 ITU-T Channels Available for the ONS 15454 (continued)

C-Band Spectrum		
15454 OC48 ELR 100 GHz ITU-T Cards	Channel (nm)	Frequency (THz)
X	1532.68	195.6
X	1533.47	195.5
X	1534.28	195.4
X	1535.04	195.3
X	1535.82	195.2
X	1536.61	195.1
X	1538.19	194.9
X	1538.98	194.8
X	1539.77	194.7
X	1540.56	194.6
X	1541.35	194.5
X	1542.14	194.4
X	1542.94	194.3
X	1543.73	194.2
X	1544.53	194.1
X	1546.12	193.9
X	1546.92	193.8
X	1547.72	193.7
X	1548.51	193.6
X	1549.32	193.5
X	1550.12	193.4
X	1550.92	193.3
X	1551.72	193.2
X	1552.52	193.1
X	1554.13	192.9
X	1554.94	192.8
X	1555.75	192.7
X	1556.55	192.6
X	1557.36	192.5
X	1558.17	192.4
X	1558.98	192.3
X	1559.79	192.2
X	1560.61	192.1

The ONS 15454 OC48 ITU-T cards provide you with 37 separate ITU-T channels to choose from. These wavelengths conform to ITU-T 100-GHz and 200-GHz channel spacing, enabling compatibility with most DWDM systems. Integrating the ONS 15454 OC48 ITU-T cards with third-party DWDM products enables you to design a low-cost, scalable DWDM system with full add/drop capabilities.

2.2.6.2 OC192 ITU-T Optics

Table 2-32 lists the OC192 ITU-T channels available for the ONS 15454.

Table 2-32 OC192 ITU-T Channels Available for the ONS 15454

C-Band Spectrum		
15454 OC192 LR 100 GHz ITU-T Cards ¹	Channel (nm)	Frequency (THz)
—	1530.33	195.9
—	1531.12	195.8
—	1531.90	195.7
—	1532.68	195.6
X	1534.25	195.4
X	1535.04	195.3
X	1535.82	195.2
X	1536.61	195.1
X	1538.19	194.9
X	1538.98	194.8
X	1539.77	194.7
X	1540.56	194.6
X	1542.14	194.4
X	1542.94	194.3
X	1543.73	194.2
X	1544.53	194.1
X	1546.12	193.9
X	1546.92	193.8
X	1547.72	193.7
X	1548.51	193.6
X	1550.12	193.4
X	1550.92	193.3
X	1551.72	193.2
X	1552.52	193.1
X	1554.13	192.9
X	1554.94	192.8
X	1555.75	192.7

Table 2-32 OC192 ITU-T Channels Available for the ONS 15454 (continued)

C-Band Spectrum		
15454 OC192 LR 100 GHz ITU-T Cards ¹	Channel (nm)	Frequency (THz)
X	1556.55	192.6
X	1558.17	192.4
X	1558.98	192.3
X	1559.79	192.2
X	1560.61	192.1

1. These wavelengths are shorter lead-time cards and are recommended for deployment.

The ONS 15454 offers eight OC192 ITU-T cards. Each card provides a long-reach SONET compliant 9.95328 Gbps high-speed interface operating at a 100-GHz spaced, ITU-T compliant wavelength within the 1530 to 1562 nm frequency band. The primary application for the OC192 ITU-T card is for use in ultra high-speed metro interoffice facility (IOF) solutions interconnecting central offices and collocation sites over a DWDM-based transport network.

2.2.6.3 Client Side Interfaces

The TXP and MXP cards utilize small form-factor pluggables (SFPs) and 10-Gigabit SFPs (XFPs) to accommodate various client interface payloads. The SFP and XFP modules are inserted into matching connectors on the front panels of the cards and then connected to the client equipment with fiber-optic cables. [Table 2-33](#) shows the SFP and XFP pluggable client modules available for each client service type.

Table 2-33 Client Services

Program Name	Client Service Type	Client Interface (SFP/XFP)	SFP/XFP Product ID (ANSI)	SFP/XFP Product ID (ETSI)
—	Gigabit Ethernet	1000Base-LX (IEEE 802.3)	15454-SFP-GE+-LX	15454E-SFP-GE+-LX
		1000Base-SX (IEEE 802.3)	15454-SFP-GEFC-SX	15454E-SFP-GEFC-SX
	FibreChannel FICON 1G	100-SM-LC-L	15454-SFP-GE+-LX	15454E-SFP-GE+-LX
		100-M5-SN-I	15454-SFP-GEFC-SX	15454E-SFP-GEFC-SX
		100-M6-SN-I	15454-SFP-GEFC-SX	15454E-SFP-GEFC-SX
	FibreChannel 2G FICON 2G	200-SM-LC-L	15454-SFP-GE+-LX	15454E-SFP-GE+-LX
		200-M5-SN-I	15454-SFP-GEFC-SX	15454E-SFP-GEFC-SX
		200-M6-SN-I	15454-SFP-GEFC-SX	15454E-SFP-GEFC-SX
	OC-3	IR-1 (GR-253-CORE-Table 4-9)	15454-SFP3-1-IR	—
	OC-12	IR-1 (GR-253-CORE-Table 4-10)	15454-SFP12-4-IR	—
OC-48	IR-1 (GR-253-CORE-Table 4-11) SR-1 (GR-253-CORE-Table 4-6)	15454-SFP-OC48-IR ONS-SE-2G-S1	—	
DV-6000	IR-1	15454-SFP-OC48-IR	15454E-SFP-L.16.1	
STM-1	S-1.1 (ITU-T G.957-Table 2)	—	15454E-SFP-L.1.1	
STM-4	S-4.1 (ITU-T G.957-Table 3)	—	15454E-SFP-L.4.1	
—	STM-16	S-16.1 (ITU-T G.957-Table 4) I-16.1 (ITU-T G.957-Table 4)	—	15454E-SFP-L.16.1 ONS-SE-2G-S1
	ISC-COMPAT	100-SM-LC-L	15454-SFP-GE+-LX	15454E-SFP-GE+-LX
	ISC-PEER	100-SM-LC-L	15454-SFP-GE+-LX	15454E-SFP-GE+-LX
	ESCON Sysplex ETR Sysplex CLO	SBCON	15454-SFP-200	15454-SFP-200
	D1 Video SDI	ITU BT-1367	15454-SFP3-1-IR	15454E-SFP-L.1.1
	HDTV	ITU BT-1367	15454-SFP-GE+-LX	15454E-SFP-GE+-LX
	2R Any Rate	—	—	—

Table 2-33 Client Services (continued)

Program Name	Client Service Type	Client Interface (SFP/XFP)	SFP/XFP Product ID (ANSI)	SFP/XFP Product ID (ETSI)
15454-DM-L1- 15454-DMP-L1-	Gigabit Ethernet	1000Base-LX	15454-SFP-GE+-LX	15454E-SFP-GE+-LX
		1000Base-SX	15454-SFP-GEFC-SX	15454E-SFP-GEFC-SX
	FibreChannel FICON 1G	100-SM-LC-L	15454-SFP-GE+-LX	15454E-SFP-GE+-LX
		100-M5-SN-I	15454-SFP-GEFC-SX	15454E-SFP-GEFC-SX
		100-M6-SN-I	15454-SFP-GEFC-SX	15454E-SFP-GEFC-SX
	FibreChannel 2G FICON 2G	200-SM-LC-L	15454-SFP-GE+-LX	15454E-SFP-GE+-LX
200-M5-SN-I		15454-SFP-GEFC-SX	15454E-SFP-GEFC-SX	
200-M6-SN-I		15454-SFP-GEFC-SX	15454E-SFP-GEFC-SX	
15454-10T-L1-	10GE	10GBASE-LR	No SFP	No SFP
	OC-192	SR-1	No SFP	No SFP
	STM-64	I-64.1	No SFP	No SFP
15454-10M-L1-	4xOC-48	IR-1	15454-SFP-OC48-IR	—
		SR-1	ONS-SE-2G-S1	—
	4xSTM-16	S-16.1	—	15454E-SFP-L.16.1
		I.16.1	—	ONS-SE-2G-S1
15454-10E-L1-	10GE	10GBASE-LR	ONS-XC-10G-S1	ONS-XC-10G-S1
	FibreChannel -10G			
	OC-192	SR-1	ONS-XC-10G-S1	—
	STM-64	I-64.1	—	ONS-XC-10G-S1
15454-10ME-	4xOC-48	IR-1	15454-SFP-OC48-IR	—
		SR-1	ONS-SE-2G-S1	—
	4xSTM-16	S-16.1	—	15454E-SFP-L.16.1
		I.16.	—	ONS-SE-2G-S1

For more information on SFPs and XFPs, refer to the “SFP Specifications” and “XFP Specifications” sections in *Cisco ONS 15454 DWDM Reference Manual*.

2.2.7 Y-Cable Module

The two types of Y-cable module are the multimode splitter module and the single-mode splitter module. Both module types have 6 optical LC-LC adapters on the front panel. The adapter position and labeling are depicted in [Figure 2-13](#).

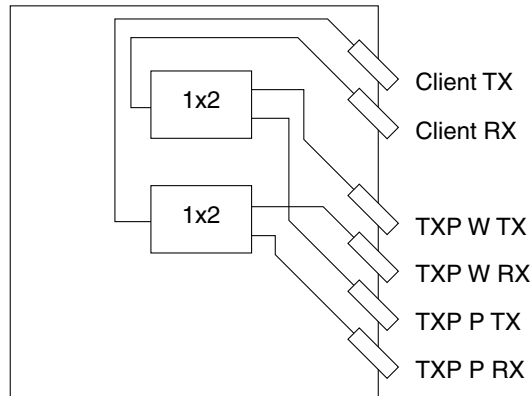
Figure 2-13 Multimode Y-Cable Splitter Module

Table 2-34 shows operating parameters for a multimode Y-cable module.

Table 2-34 Multimode Y-Cable Module Operating Parameters

Parameter	Conditions	Min	Typical	Max	Unit
Wavelength range (WR)	—	770–1260		860–1380	nm
Insertion loss (IL)	In all wavelength ranges (both windows)	—	—	4.4	dB
Insertion loss uniformity	In all wavelength ranges (both windows)	—	—	0.7	dB
PDL	At both ports	—	—	0.1	dB
Optical return loss (RL)	—	40	—	—	dB
Directivity	—	40	—	—	dB
Operating temperature (Top)	—	–5	—	65	°C
Optical power	—	—	—	500	mW

Table 2-35 shows operating parameters for the single-mode Y-cable module.

Table 2-35 Single-Mode Y-Cable Module Operating Parameters

Parameter	Conditions	Min	Typical	Max	Unit
Wavelength range (WR)	—	1260–1430	—	1360–1580	nm
Insertion loss (IL)	In all wavelength ranges (both windows)	—	—	4.1	dB
Insertion loss uniformity	In all wavelength ranges (both windows)	—	—	1.1	dB
PDL	At both ports	—	—	0.1	dB
Optical return loss (RL)	—	50	—	—	dB
Directivity	—	50	—	—	dB
Operating temperature (Top)	—	–5	—	65	°C
Optical power	—	—	—	500	mW

2.2.8 Mechanical Equipment

The following section describes mechanical equipment such as the bay frame, optical shelf, dispersion compensation shelf, Y-cable shelf, fiber storage units, and 32-channel patch-panel units.

2.2.8.1 Bay Frame

DWDM cards use a generic standard bay frame, which is compliant with ANSI Standard Seismic 19-inch and 23-inch Bay Frames (Telcordia GR-63-CORE) and/or ETSI 600 mm x 300 mm (ETS 300-119, ETS 300-019, CEI EN 60917 and IEC 61587).

Floor mounting depends on the frame or cabinet that the customer chooses.

2.2.8.2 Optical Shelf

The shelf assemblies used in the ONS 15454 DWDM system and SONET/SDH systems are the same. The ONS 15454 is simple to engineer and flexible, in order to reduce the equipping rules as much as possible.

The system dimensions for an ONS 15454 ETSI rack are 617 mm(18.17") high x 432 mm (17") wide x 280 mm (11") deep. The dimensions of the ANSI system are 18.1" (461.6 mm) high x 17"(431.8 mm) wide x 12"(305.0 mm) deep. A total of four shelves fit into a standard ANSI rack. A total of three shelves fit into ETSI racks.

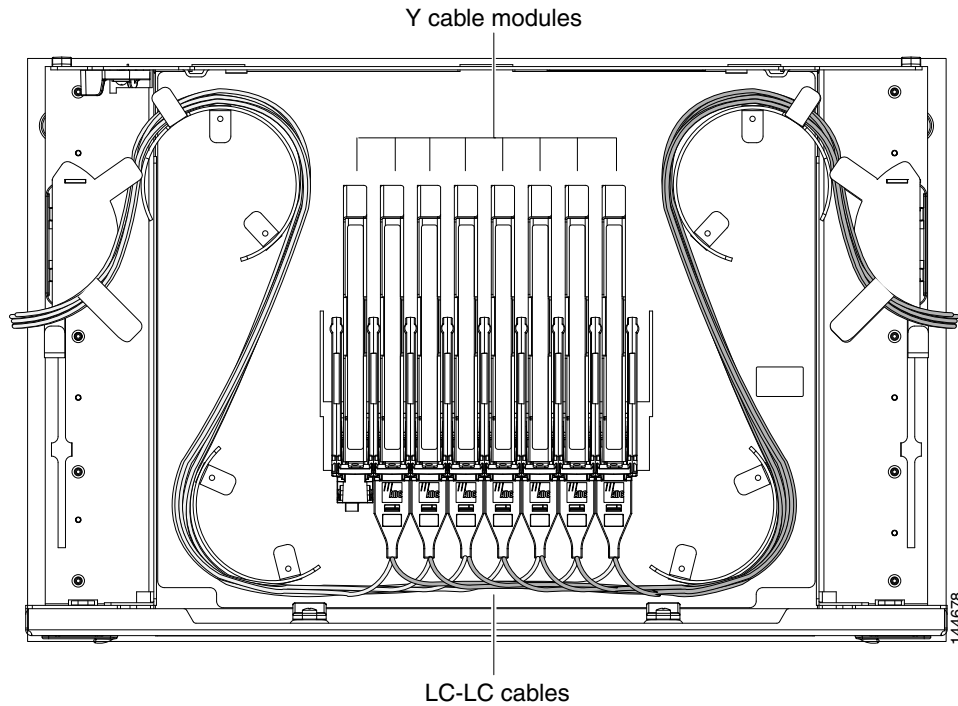
The subrack has 17 card slots, which are numbered from 1 starting at the left. Each slot is labeled with an icon that must match the icon on the plug-in card's faceplate. This enables easy identification of card/slot compatibility. Slots 7 through 11, indicated in white, are dedicated to system operations. These slots are known as common-control card slots. Slots 1 through 6 and 12 through 17, indicated in yellow and blue, are dedicated to traffic cards, such as OSC cards, optical add/drop cards, optical amplifier cards, and transponder/muxponder cards.

2.2.8.3 Dispersion Compensation Shelf

The dispersion compensation shelf is 1 RU in height. Two DCUs (one for each direction) can be housed in the dispersion compensation shelf. The shelf is not powered or cooled because the DCUs are optically passive.

2.2.8.4 Y-Cable Shelf

The Y-cable shelf houses up to eight Y-cable modules and all relevant patchcords. The Y-cable shelf has a height of 2 RU and can be installed in 19"(482.6 mm) ANSI or ETSI racks. See [Figure 2-14](#).

Figure 2-14 Y-Cable Shelf Fiber Routing

2.2.8.5 Fiber Storage

The fiber storage tray has height of 1 RU and can be installed in 19" (482.6 mm) ANSI or ETSI racks. The fiber storage tray manages all incoming and outgoing fibers for a single ONS 15454 shelf. The minimum fiber bend radius is 1.5" (38.1 mm) or 20 times the cable diameter at any point, whichever is greater.

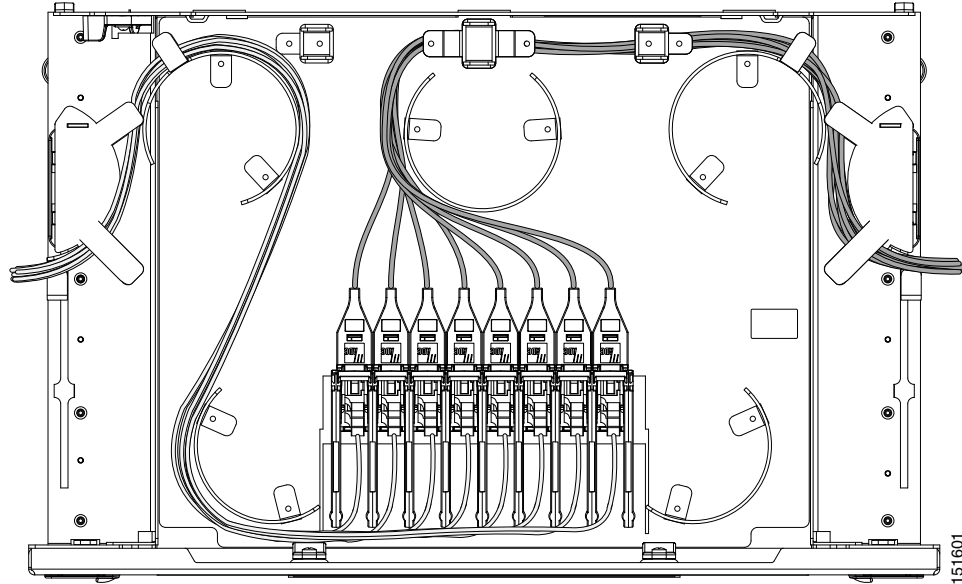
For more information on fiber management, refer to the *Cisco ONS 15454 DWDM Reference Manual*.

2.2.8.6 32 Channel Patch-Panel Trays

The ONS 15454 offers two patch panel trays that can be installed in 19" (482.6 mm) ANSI or ETSI shelves. The regular tray (15454-PP-64-LC) is 1 RU in height, and the deep tray is (PP-64) is 2 RU in height.

The deep patch panel tray (PP-64) manages the 32 channels that interconnect a ROADM node to relevant TXPs.

[Table 2-35](#) shows fiber routing on the deep patch panel tray.

Figure 2-15 32-Channel Patch Panel Shelf Fiber Routing

The PP-64 contains 64 LC-LC adapters and manages up to eight multifiber cables. The minimum fiber bend radius is 1.5" (38.1 mm) or 20 times the cable diameter at any point, whichever is greater.

The PP-64 is used for both C-band and L-band systems. A label on the front panel enables identification of channel wavelength IDs during installation.

