C H A P T E R 1

Product Overview

The Cisco ONS 15540 ESPx is an optical transport platform that employs DWDM (dense wavelength division multiplexing) technology. With the Cisco ONS 15540 ESPx, users can take advantage of the availability of dark fiber to build a common infrastructure that supports data, SAN (storage area network), and TDM (time-division multiplexing) traffic. The system uses an enhanced chassis with front fiber-optic cable access for optical interconnections between transponders and optical mux/demux modules.

This chapter describes the Cisco ONS 15540 ESPx and includes the following sections:

Note Before you install, operate, or service the system, read the *Regulatory Compliance and Safety Information for the Cisco ONS 15500 Series* for important safety information you should know before working with the system.

Cisco ONS 15540 ESPx Chassis

The Cisco ONS 15540 ESPx is a 12-slot modular vertical chassis. The system uses redundant -48 VDC inputs. A redundant external AC-input power supply is available or DC-input power can be provided directly. Slots 0 and 1 hold the optical mux/demux motherboards, which are populated with optical mux/demux modules. Slots 2 to 5 and 8 to 11 hold the 2.5-Gbps line card motherboards, which

are populated with 2.5-Gbps transponder modules, and 10-Gbps line card motherboards, which are populated with 10-GE transponder modules. Slots 6 to 7 hold the processor cards. (See Figure 1-1.)

The air intake, fan assembly, cable management tray, cross connect drawers, and cable storage drawers are located beneath the modular slots. The system has an electrical backplane for system control.

Figure 1-1 shows a populated Cisco ONS 15540 ESPx shelf with a cable storage drawer and two cross connect drawers.

Figure 1-1   Cisco ONS 15540 ESPx Populated Shelf
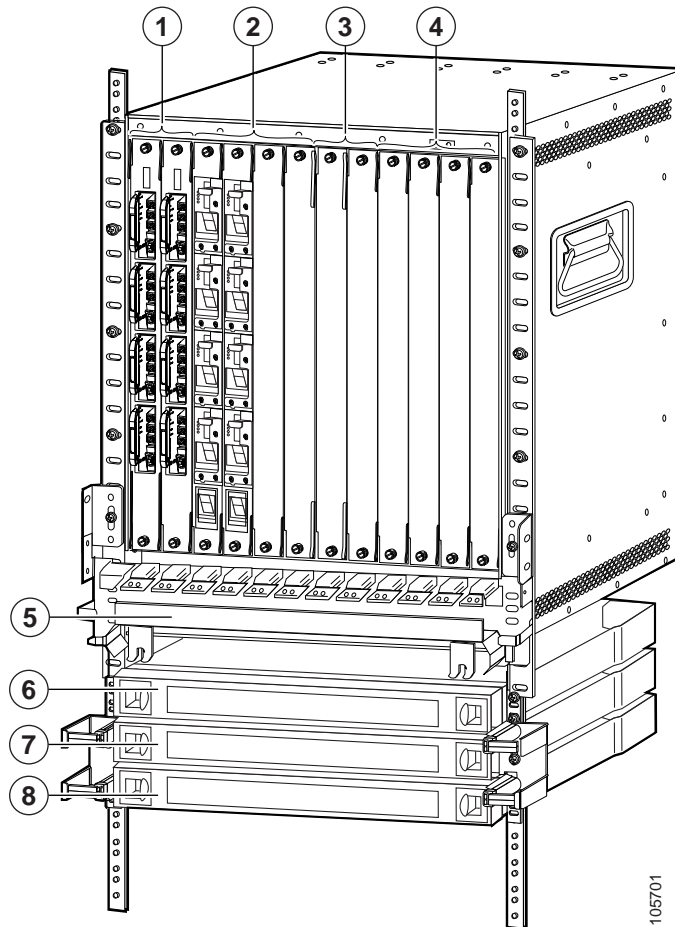
1	Slots 0 and 1 hold the mux/demux motherboards	5	Cable management tray
2	Slots 2 to 5 hold line card motherboards	6	Cable storage drawer
3	Slots 6 and 7 hold the processor cards	7	Cross connect drawer
4	Slots 8 to 11 hold line card motherboards	8	Cross connect drawer

Fan Assembly

The fan assembly is located at the bottom of the chassis and contains eight individual fans and a fan controller board. (See Figure 1-2.) The controller board monitors the status of each fan and reports the status to the processor cards. If a single fan fails, a minor alarm is reported to the processor card. If two or more fans fail, a major alarm is reported to the processor card. To prevent damage to the cards and modules in the shelf when two or more fans fail, you can configure the system to automatically reset or power off the transponder modules. The transponder modules power off if the hardware version of the line card motherboard is 5.1 or later, otherwise the transponder modules reset. Use the **show hardware** command to determine the hardware version of the 2.5-Gbps line card motherboards.

Figure 1-2   Fan Assembly
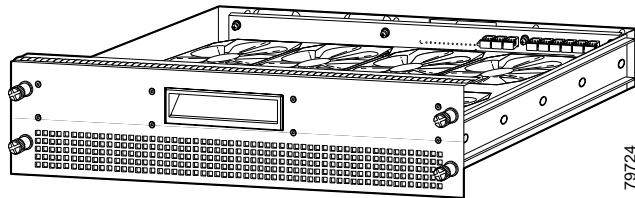
To recover from fan failure shutdown, you must power-cycle the shelf.

Note   Because the system does not know which fans have failed, all of the cards and modules on the shelf are powered down or reset.

Caution   The fan failure shutdown feature disrupts traffic on the shelf when two or more fans fail.

Power Supplies

The optional external power supply is a single-phase, AC-DC, 1050W, -48VDC output power supply that connects to the chassis through terminal blocks. The external power supply is installed in an external power shelf that fits into a standard equipment rack. Up to three external power supplies can be installed in the external power shelf.

See the "Powering Up the Shelf" section on page 2-39 for more information about the power supplies.

Backplane

The Cisco ONS 15540 ESPx uses an electrical backplane. The power connectors on the modules connect to the electrical backplane allowing line card motherboards to draw up to 100W of power. Optical connections between transponder modules on the client side and the mux/demux modules on the trunk side are made in the front.

The alarm signals from the processor card are sent to the alarm card attached to the bottom of the backplane. They connect to the central office alarm through connectors on the backplane.

Alarm Cards

The alarm card has relays and terminal blocks to interface the chassis to the Telco Central Office alarm equipment. It is a separate card that mounts to the back of the chassis and connects to the backplane.

There are six relays on the alarm card. They are audible and visible with three levels for each type:

- critical
- major
- minor

Each relay has two form C contacts. One is used to connect to the terminal block and the outside. The other is used to provide feedback on the state of the relay.

A processor card energizes the relays by driving 3.3 volts to them. Only the primary processor card drives the relays, however, each processor card can tell if the relay is energized by sensing that the feedback line is grounded through the second contact.

Table 1-1 lists the specifications for the alarm cards on the Cisco ONS 15540 ESPx.

Table 1-1   Alarm Card Specifications

Connector	Type	Level	Pin	Contact	Notes
P1	Visible	Minor	1	C[1]	Each type and level of alarm is signaled by a contact closure of C to NO and an open from C to NC.
			2	NC[2]	
			3	NO[3]	
		Major	4	C	Voltage at contacts is limited to 48 VDC.
			5	NC	
			6	NO	Switched current / load is limited to 1 A resistive.
		Critical	7	C	
			8	NC	Alarms are signaled when the chassis is unpowered.
			9	NO	
P2	Audible	Minor	1	C	
			2	NC	
			3	NO	
		Major	4	C	
			5	NC	
			6	NO	
		Critical	7	C	
			8	NC	
			9	NO	

1. C = center

2. NC = normally closed

3. NO = normally open

Cisco ONS 15540 ESPx Components

The following hardware components can be installed in the
Cisco ONS 15540 ESPx:

- Processor Cards, page 1-7
- Mux/Demux Motherboards and Mux/Demux Modules, page 1-14
- PSMs, page 1-17
- Line Card Motherboards, page 1-19
- Transponder Modules, page 1-21
- Cable Management Tray, page 1-29
- Cross Connect Drawers, page 1-30
- Cable Storage Drawer, page 1-30
- Blank Panels, page 1-31

Note   To ensure that your hardware is supported by your release of Cisco IOS software, see the "New and Changed Information" section on page xii. Also refer to the "Hardware Supported" section of the latest release notes for the Cisco ONS 15540 ESPx.

Processor Cards

Slots 6 and 7 of the Cisco ONS 15540 ESPx chassis hold processor cards. The processor cards support redundancy and online insertion and removal. In a redundant system, the processor cards monitor each other using the Ethernet backplane and signals. The processor card monitors the fan assembly operation and airflow temperature. (See Figure 1-3.) During a fan failure or an out-of-temperature range condition, the processor card activates an alarm. See Table 2-2 on page 2-34 for fan assembly status.

Figure 1-3   Processor Card
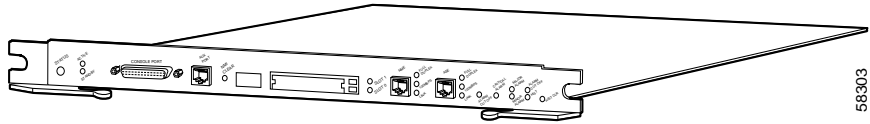
Processor cards manage communication functions for the system. The cards monitor all modules in the chassis and determine the state of the system. Each module determines its state from feedback at various system monitoring points. The processor generates clocking to all the modules and some additional components in the system.

Processor Card LEDs

Table 1-2 lists the LEDs on the processor card faceplate, their default conditions, and what the conditions indicate. Figure 1-4 and Figure 1-5 show the processor card LEDs.

Table 1-2   Processor Card LEDs

LED	Status	Description
STATUS	Red	A board resets or initially powers on.
	Orange	System initialization.
	Green	Full initialization and operational.
ACTIVE	Green	This board is the primary processor and is running IOS software.
STANDBY	Green	This board is the secondary processor.
SLOT 0	Green	Flash PC Card is present.
SLOT 1	Green	Flash PC Card is present.
NME[1]		
FULL DUPLEX	Green	Full duplex is running.
	Off	Half duplex is running.
100MBPS	Green	Operating at 100 Mbps.
	Off	Operating at 10 Mbps.

Table 1-2   Processor Card LEDs (continued)

LED	Status	Description
LINK	Green	Link is up.
	Off	Link is down.
ASE[2]		
FULL DUPLEX	Green	Full duplex is running.
	Off	Half duplex is running.
100MBPS	Green	Operating at 100Mbps.
	Off	Operating at 10Mbps.
LINK	Green	Link is up.
	Off	Link is down.
CRITICAL ALARM	Yellow	A critical alarm condition exists.
MAJOR ALARM	Yellow	A major alarm condition exists.
MINOR ALARM	Yellow	A minor alarm condition exists.
ALARM CUT OFF	Yellow	A major or minor alarm condition exists and the cutoff button has been pushed. Turns off by software when the original alarm clears or any new alarm occurs. See Table 1-5.
HIST	Yellow	A major or minor alarm occurred. Clears if the History Clear button is pushed and no alarm exists. See Table 1-5.

1. NME = network management Ethernet

2. ASE = aggregation shelf Ethernet

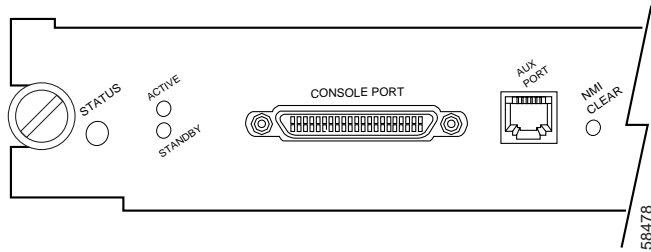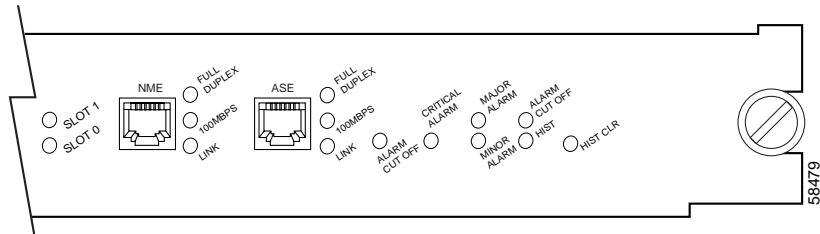*Figure 1-4   Processor Card LEDs (Left Side)*

Figure 1-5   Processor Card LEDs (Right Side)

![Note icon]

Note   The ASE port on the processor card cannot be used as a management port. Do not make any connections to this port.

Management Ports

The console port is a female data communications equipment (DCE), DB-25 receptacle used for connection to a console terminal or modem. Table 1-3 lists the console port pinouts.

Table 1-3   Console Port Pinouts DB-25 DCE

Pin Number	Console		
	Direction	Circuit	Function
1	N/A	gnd	Ground
2	Input	rxd	N/A

Table 1-3   Console Port Pinouts DB-25 DCE (continued)

Pin Number	Console		
3	Output	txd	N/A
4	N/A	RTS	Tied together
5	N/A	CTS	Tied together
6	Output	DCD	N/A
7	N/A	gnd	Ground
8	Output	DCD	N/A
11	N/A	rsvd	N/A
13	N/A	gnd	Ground
19	N/A	rsvd (y cable)	N/A
20	Input	DTR	N/A

The auxiliary port is a female RJ-45 receptacle used for connection to a modem. A three inch RJ-45 cable ships with the processor card for use with the auxiliary port. This cable is necessary for proper use of the auxiliary port. Attach this cable to the auxiliary port before attaching your own cables to the auxiliary port using the proper coupler. See Table 1-4 for the auxiliary port pinouts on the processor card.

Table 1-4   Auxiliary Port Pinouts for the Cisco ONS 15540 ESPx

Pin Number	Direction	Circuit	Function
1	Output	DSR	Data set ready
2	Input	DCD	Data carrier detect
3	Input	DTR	Data terminal ready
4	S/gnd	N/A	Signal ground
5	Output	TXD	Transmit data
6	Input	RXD	Receive data
7	Output	CTS	Clear to send

Table 1-4   Auxiliary Port Pinouts for the Cisco ONS 15540 ESPx

Pin Number	Direction	Circuit	Function
8	Input	RTS	Request to send
9	P/gnd	N/A	Protective ground

Alarms

The processor generates three alarm signals: critical, major, and minor. (See Table 1-5.) These signals generate visual and audible alarm signals to the backplane, where they are connected to two DB-9 connectors that can be connected to a central telco alarm panel. LEDs on the processor card front panel display the status of the critical, major, and minor alarm signals, plus the status of alarm cutoff (ACO) and history conditions.

Push-button switches on the front panel provide for the alarm cutoff and history clear functions. (See Table 1-5.)

Table 1-5   Alarm Cutoff and History Clear Buttons

LED	Location	Description
ALARM CUT OFF	Recessed push-button switch	When pushed, software turns off all external alarm relay control bits until the next new alarm condition.
HISTORY CLR	Recessed push-button switch	When pushed, software turns off the HIST LED if there are no major or minor alarm conditions.

Note To clear the switch alarms, use a thin tool (such as a small screwdriver) to press and release the button.

Flash SIMM

The processor card Flash SIMM is a 16 MB, 80-pin SIMM that contains a compressed Cisco IOS image that is loaded and executed automatically by ROMMON upon powerup.

Flash PC Card Slots

The processor card has two Flash PC Card slots that are accessible from the front panel. Either slot can be a memory or an I/O device.

The Flash PC Cards are typically used to copy system images and save standard configurations. Flash PC Cards are a type of Flash memory that provide expanded file storage for your system. Flash PC Cards, unlike the onboard Flash SIMM (bootflash), are not required for the operation of the system.

Note Not all cards that are commercially available are supported. Only cards requiring 3.3V or 5V power are supported. No 12 VDC power supply is available to the Flash PC Card slots.

Table 1-6 lists the Flash PC Card slot LEDs on the processor faceplate and what the conditions indicate.

Table 1-6   Flash PC Card Slot LEDs

LED	Status	Description
SLOT 0	Green	Flash PC Card slot 0 is being accessed.
SLOT 1	Green	Flash PC Card slot 1 is being accessed.

NMI Clear

A recessed push button, labeled NMI CLR, is accessible through the faceplate to clear an NMI (nonmaskable interrupt).

Note To activate the switch, use a thin tool (such as a small screwdriver) to press and release the button.

NME Interface

The NME (network management Ethernet) interface supports 10-Mbps or 100-Mbps UTP (unshielded twisted pair) ports. This RJ-45 interface supports full-duplex or half-duplex connections.

The NME port on the processor card is a management port that allows multiple simultaneous Telnet or SNMP network management sessions. The Ethernet port on the processor card does not route or bridge traffic to other Ethernet ports on the Cisco ONS 15540 ESPx. This Ethernet port is a management port only and cannot be configured as a routing port.

Table 1-7 describes the LEDs used to confirm and troubleshoot the operation of the NME interface. The LEDs on the processor faceplate indicate the status of the NME interface.

Table 1-7   NME LEDs

LED	Status	Description
FULL DUPLEX	Green	Interface is operating in full duplex mode.
100MBPS	Green	Interface is operating at 100Mbps.
LINK	Green	NME interface is receiving the link integrity signal.

Mux/Demux Motherboards and Mux/Demux Modules

The optical mux/demux motherboards occupy slots 0 and 1 of the Cisco ONS 15540 ESPx chassis. The chassis uses one optical mux/demux motherboard for unprotected operation or two per system for protected operation. The chassis supports the following mux/demux motherboards:

• Cisco ONS 15540 ESPx mux/demux motherboard with OSC

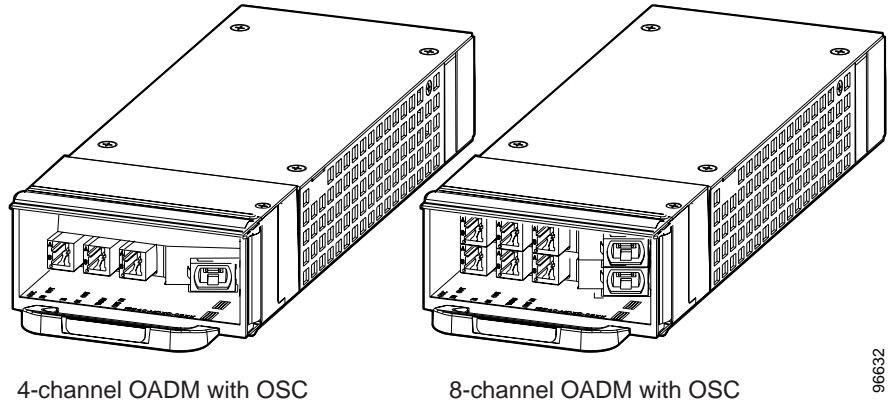• Cisco ONS 15540 ESPx mux/demux motherboard without OSC

Each Cisco ONS 15540 ESPx mux/demux motherboard can accept up to four 4-channel or 8-channel mux/demux modules or one 32-channel mux/demux module. The modular mux/demux motherboards are available with or without OSC (optical supervisory channel) and can be populated according to user needs.

There are three types of mux/demux modules available:

• 4 channels

• 8 channels

• 32 channels

Up to four 4-channel or 8-channel optical add/drop mux/demux modules can be installed in a mux/demux motherboard. Each module can multiplex and demultiplex a band of 4 or 8 channels, for a maximum of 32 channels. Channels not filtered are passed on to the next mux/demux module. (See Figure 1-6.)

Figure 1-6   4- and 8-Channel OADM Modules with OSC

4-channel OADM with OSC   8-channel OADM with OSC

One 32-channel terminal mux/demux module can be installed in slot 0 or 1 of the Cisco ONS 15540 ESPx chassis. The 32-channel terminal mux/demux module is equipped with OSC, input/output, and monitoring ports that use MU connectors. The remaining 8 ports that connect to the transponder modules use MTP connectors. The OSC is a dedicated, full duplex communication ITU-T DWDM channel for in-band management traffic. The input/output ports are trunk connections used to connect to the external fiber trunks. Monitoring ports use a one percent tap coupler (20 dB) for both the mux and demux sides and also allow you to non-obtrusively connect an OSA (optical spectrum analyzer) to monitor the incoming or outgoing DWDM signals.(See Figure 1-7.)

Figure 1-7   32-Channel Terminal Mux/Demux Module
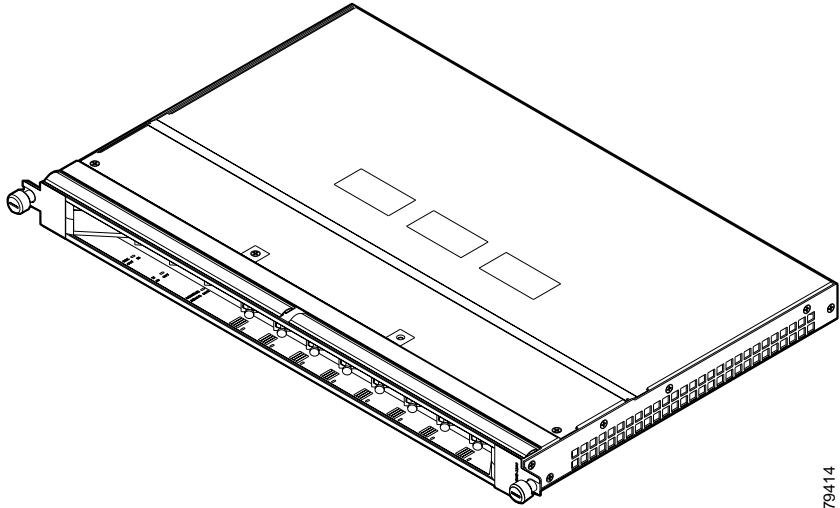
Mux/Demux Motherboard LEDs

Table 1-8 lists the LEDs on the mux/demux motherboard with OSC faceplate, their default conditions, and what the conditions indicate.

Note   Mux/demux motherboards without OSC have no LEDs.

Table 1-8   Mux/Demux Motherboard with OSC LEDs

LED	Status	Description
STATUS	Blinking green	The motherboard has a good system clock from the primary processor and is out of the reset state.
	Orange	System clock is not present.
	Solid green	Software initialization is successful.
	Off	Board failure.

Table 1-8   Mux/Demux Motherboard with OSC LEDs (continued)

LED	Status	Description
TX	Solid green	OSC is present and the optical laser output is enabled.
	Off	OSC is not present and the optical laser output is disabled.
RX	Solid green	OSC is present and the optical data stream is received.
	Off	OSC is not present and the optical data stream is not received.

|			
1	Channel 1 IN OUT ports	5	Channel 3 IN OUT ports
2	Channel 1 LED	6	Channel 3 LED
3	Channel 2 IN OUT ports	7	Channel 4 IN OUT ports
4	Channel 2 LED	8	Channel 4 LED

PSMs

The PSM (protection switch module) provides trunk fiber protection for Cisco ONS 15540 ESPx systems configured in point-to-point topologies. The PSM sends the DWDM signal from the mux/demux modules to both the west and east directions. It receives both the west and east signals and sends one to the mux/demux module. When a trunk fiber cut occurs on the active path, the PSM switches the received signal to the standby path. The PSM can protect up to 32 data channels and the OSC.

The PSM also has an optical monitor port for testing the west and east receive signals. This port samples 10 percent of these signals, which can be monitored with an optical power meter.

One PSM can be installed in any slot of a mux/demux motherboard on the Cisco ONS 15540 ESPx chassis.

The PSM has the same dimensions as the OADM channels used in the Cisco ONS 15540 ESPx. The front panel has four dual MU connectors, and the module internally consists of two boards interconnected through a board-to-board right angle connector. One board (called the generic optics module) contains the optics and sensitive analog circuitry, and the other board contains the logic and system interface board. (See Figure 1-8.)

Figure 1-8   Protection Switch Module
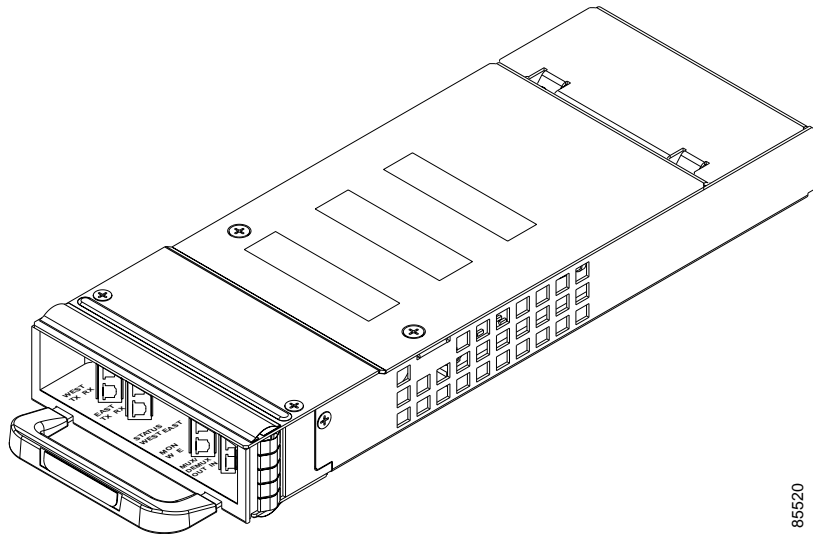
PSM LEDs

Table 1-9 lists the LEDs on the PSM, their default conditions, and what the conditions indicate

Table 1-9   PSM LEDs

LED	Status	Description
STATUS	Solid green	Software initialization is successful.
	Off	Board failure.

Line Card Motherboards

The Cisco ONS 15540 ESPx supports 2.5-Gbps line card motherboards and 10-Gbps line card motherboards. You can install up to eight hot-swappable line card motherboards in slots 2 to 5 and 8 to 11 of the chassis.

Each 2.5-Gbps line card motherboard can hold four 2.5-Gbps transponder modules. All modules are hot-pluggable, allowing in-service upgrades and replacement. Figure 1-9 shows the 2.5-Gbps line card motherboard without inserts installed.

Figure 1-9   2.5-Gbps Line Card Motherboard
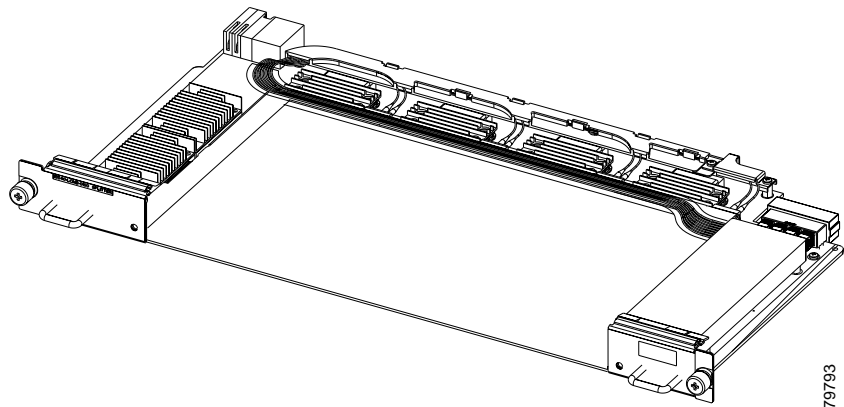
The 10-Gbps line card motherboard holds two 10-GE transponder modules. (See Figure 1-10.)

Figure 1-10   10-Gbps Line Card Motherboard
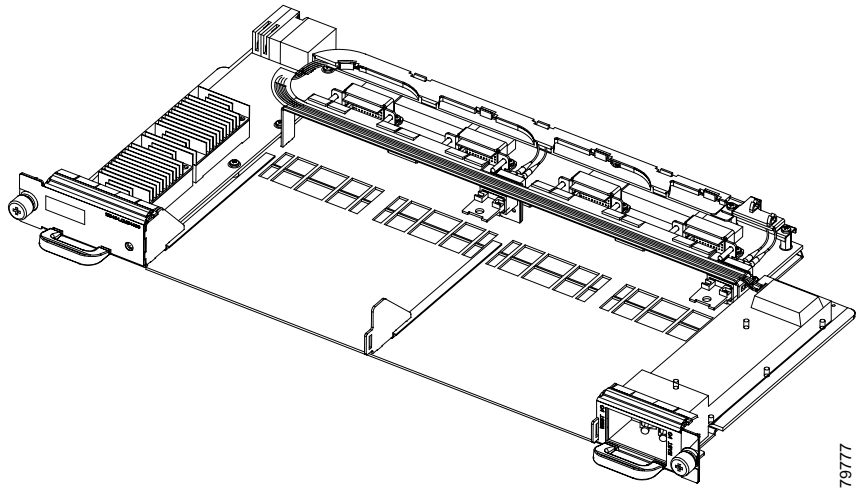
Line Card Motherboard LEDs

Table 1-10 lists the LEDs on the 2.5-Gbps line card motherboard faceplate, their default conditions, and what the conditions indicate.

Table 1-10   2.5-Gbps Line Card Motherboard LEDs

LED	Status	Description
STATUS	Blinking green	Motherboard has a good system clock from the primary processor and is out of the reset state.
	Solid green	Software initialization is successful.
	Orange	System clock is not present. Board is unavailable.
	Off	Board failure.

Table 1-11 lists the LEDs for the 10-Gbps line card motherboard.

Table 1-11   10-Gbps Line Card Motherboard LEDs

LED	Status	Description
STATUS	Blinking green	Motherboard has a good system clock from the primary processor and is out of the reset state.
	Solid green	Software initialization is successful.
	Orange	System clock is not present. Board is unavailable.
	Off	Board failure.

Transponder Modules

In the transponder module, the client signal is converted to an ITU-compliant wavelength, which is cross-connected over the optical backplane to the mux/demux modules. You can populate the line card motherboard subcard slots with as few or as many transponder modules as required (up to 32) to support the desired number of client signals or data channels.

The Cisco ONS 15540 ESPx supports four types of interface transponder modules:

- SM (single-mode) transponder modules
- MM (multimode) transponder modules
- Type 2 extended range transponder modules with SFP optics
- 10-GE transponder modules

SM Transponder Modules

SM transponder modules have fixed, non-pluggable transceivers for the single client interface. SM transponder modules accept SM client signals on the 1310-nm wavelength through an SC connector and support client signal clock rates ranging from 16 Mbps to 2.5 Gbps.
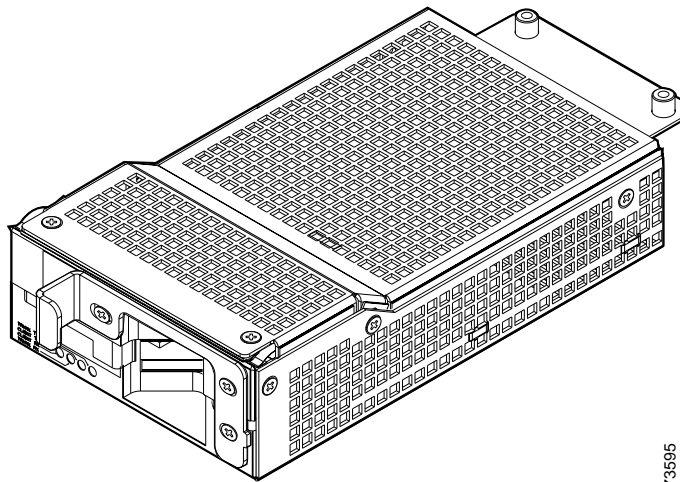
MM Transponder Modules

MM transponder modules have fixed, non-pluggable transceivers for the single client interface. MM transponder modules accept both SM client signals and MM client signals on the 1310-nm wavelength through an SC connector and support client signal clock rates ranging from 16 Mbps to 622 Mbps.

Type 2 Extended Range Transponder Modules with SFP Optics

The Type 2 extended range transponder modules with selectable SFP optics support different protocol rates. (See Figure 1-11.)

Figure 1-11   Type 2 Extended Range Transponder Module

Fixed rate SFP optics modules support specific protocols. Table 1-12 lists the features for the fixed rate SFP optics supported by the Type 2 extended range transponder modules.

✎
Note   Only use Cisco-certified SFP optics for the Type 2 extended range transponders.

Table 1-12   Fixed Rate SFP Optics Features

Model Number	Supported Protocols	Fiber Type	Wavelength	Connector Type
15500-XVRA-01A2	ESCON, OC-3/ STM-1 SR	MM 50/125 m MM 62.5/125 m	1310 nm	MT-RJ
15500-XVRA-02C1	Gigabit Ethernet[1], Fibre Channel (1 Gbps)[2], ISC-1 (1-Gbps)	MM 50/125 m MM 62.5/125 m	850 nm	LC
15500-XVRA-02C2	Fibre Channel (2 Gbps)[3], ISC-3 (1-Gbps and 2-Gbps)	MM 50/125 m MM 62.5/125 m	850 nm	LC
15500-XVRA-03B1	Gigabit Ethernet[4], Fibre Channel (1 Gbps)[5], ISC-3 (2-Gbps)	SM 9/125 m	1310 nm	LC
15500-XVRA-03B2	Fibre Channel (2 Gbps)	SM 9/125 m	1310 nm	LC
15500-XVRA-06B1	OC-12/STM-4 SR[6]	SM 9/125 m	1310 nm	LC
15500-XVRA-07B1	OC-48/STM-16 SR	SM 9/125 m	1310 nm	LC

1. 1000BASE-SX

2. FC-0-100-M5-SN-S and FC-0-100-M6-SN-S standards

3. FC-0-200-M5-SN-S and FC-0-200-M6-SN-S standards

4. 1000BASE-LX

5. FC-0-100-SM-LC-S standard

6. SR = short range

Variable rate SFP optics modules support a range of clock rates. Table 1-13 list the characteristics for the variable rate SFP optics supported by the Type 2 extended range transponder.

*Table 1-13   Variable Rate SFP Optics Features*

Model Number	Clock Rate Range	Fiber Type	Wavelength	Connector Type
15500-XVRA-10A1	Low-band 8 Mbps to 200 Mbps	MM 50/125 m MM 62.5/125 m	1310 nm	LC
15500-XVRA-10B1	Low-band 8 Mbps to 200 Mbps	SM 9/125 m	1310 nm	LC
15500-XVRA-11A1	Mid-band 200 Mbps to 622 Mbps	MM 62.5/125 m	1310 nm	LC
15500-XVRA-11B1	Mid-band 200 Mbps to 1.25 Gbps, ISC-1	SM 9/125 m	1310 nm	LC
15500-XVRA-12B1	High-band 1.062 Gbps to 2.488 Gbps, ISC-1, ISC-3	SM 9/125 m	1310 nm	LC

Figure 1-12 shows the two types of SFP optics that the Type 2 extended range transponders support. The figure may not match your SFP exactly but it should be a close variation of the SFP.

Note   Only use Cisco-certified SFP optics for the Type 2 extended range transponders.

Figure 1-12   Type 2 Extended Range Transponder Module SFP Optics

MT-RJ connector   LC connector
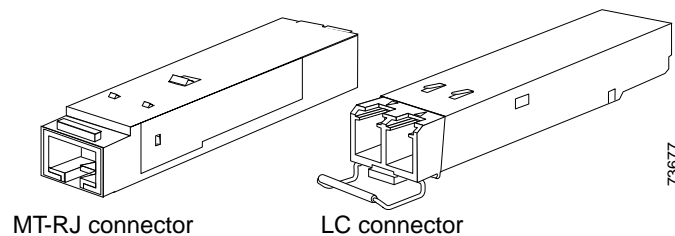
For information on how to install the SFP optics onto the transponder module, see the "Installing the Type 2 Extended Range Transponder Modules with SFP Optics" section on page 2-25.
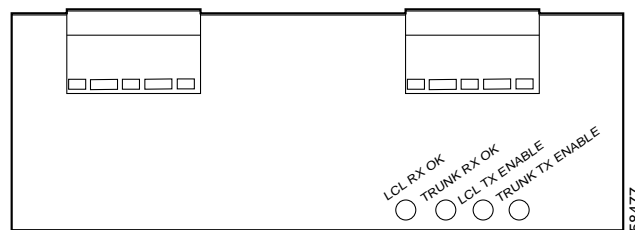
Transponder Module LEDs

Table 1-14 lists the LEDs on the transponder module faceplate, their default conditions, and what the conditions indicate. (See Figure 1-13.)

Table 1-14   SM and MM Transponder Module LEDs

| LED	Status	Description
LCL RX OK	Green	Data is received on the client side.
TRUNK RX OK	Green	Data is received on the trunk side.
LCL TX ENABLE	Green	Client side transmit laser is enabled.
TRUNK TX ENABLE	Green	Trunk side transmit laser is enabled.

Figure 1-13   SM and MM Transponder Module LEDs

Table 1-15 lists the LEDs for the Type 2 extended range transponder module. Figure 1-14 shows the LEDs.

Table 1-15   Type 2 Extended Range Transponder Module LEDs

LED	Status	Description
CLIENT RX	Green	Data is received on the client side.
TRUNK RX	Green	Data is received on the trunk side.
CLIENT TX	Green	Client side transmit laser is enabled.
TRUNK TX	Green	Trunk side transmit laser is enabled.

Figure 1-14   Type 2 Extended Range Transponder Module LEDs
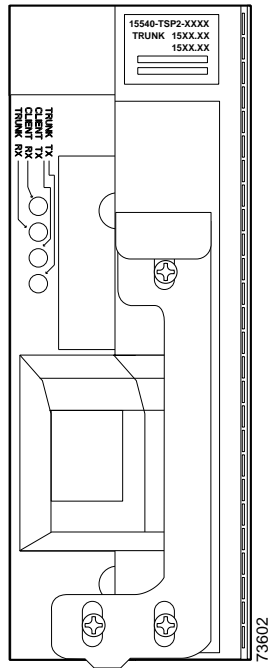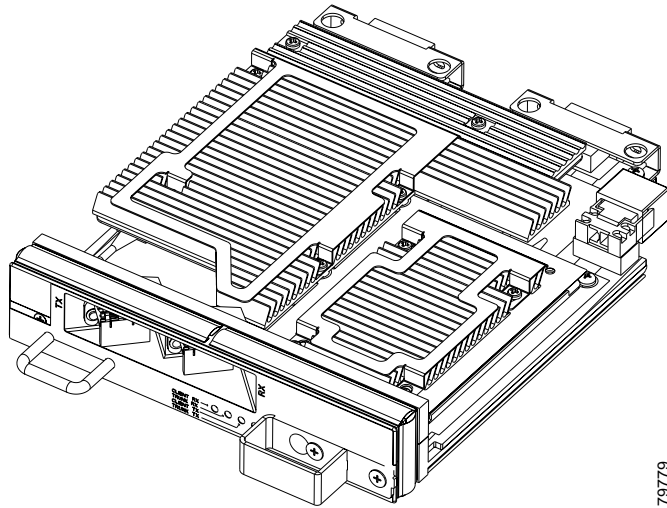

10-GE Transponder Module

The 10-GE transponder module is double the size of the 2.5-Gbps transponder module and requires a special 10-Gbps line card motherboard. You can install up to two 10-GE transponder modules in a 10-Gbps line card motherboard. Each transponder supports one client side and one trunk side interface. The client side is a short-reach 1310-nm interface and the trunk side interface is an ITU grid compliant 15xx-nm long-reach interface. The transmitter supports a 1260-nm to 1355-nm wavelength range. The 10-GE transponder module is available in 32 versions, one for each of the 32 ITU channels it supports.

The 10-GE transponder module is not protocol independent; it supports the 802.ae specification for 10GBASE-LR interfaces. (See Figure 1-15.)
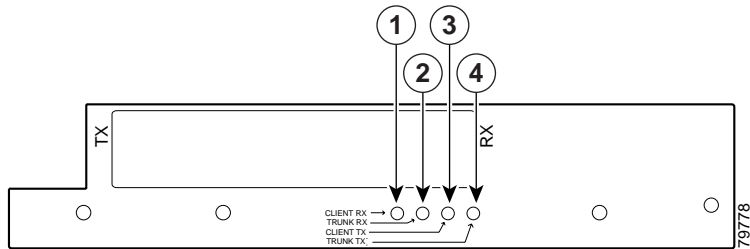
Figure 1-15   10-GE Transponder Module

10-GE Transponder Module LEDs

Figure 1-16 shows the LEDs on the 10-GE transponder module.

Figure 1-16   10-GE Transponder Module LEDs

1	CLIENT RX LED	3	CLIENT TX LED
2	TRUNK RX LED	4	TRUNK TX LED

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Table 1-16 lists the LEDs on the 10-GE transponder module faceplate and what the conditions indicate.

Table 1-16   10-GE Transponder Module LEDs

| LED	Status	Description
CLIENT RX	Off	No frame lock on the PCS 64B66B decoder.
	Green	Frame lock = '1' on PCS 64B66B decoder.
TRUNK RX	Off	No frame lock on the PCS 64B66B decoder.
	Green	Frame lock = '1' on PCS 64B66B decoder.
CLIENT TX	On	Laser is transmitting optical signal.
	Off	Laser is shut and is not transmitting any optical signal.
TRUNK TX	On	Laser is transmitting optical signal.
	Off	Laser is shut and is not transmitting any optical signal.

Cable Management Tray

The cable management tray is a fiber optic cable management guide that is installed over the fan assembly after you rack-mount the chassis. (See Figure 1-17.) The tray attaches to the rack but flips up if the fan assembly should need replacement. Cables are guided through the clips of the cable fanning tray and into and through the inside of the tray to their destination. The cable management tray ships with a cover that can be removed when you are cabling the Cisco ONS ESPx. For installation information for the cable management tray, see the "Mounting the Chassis" section on page 2-3.

Figure 1-17   Cisco ONS 15540 ESPx Cable Management Tray and Cover
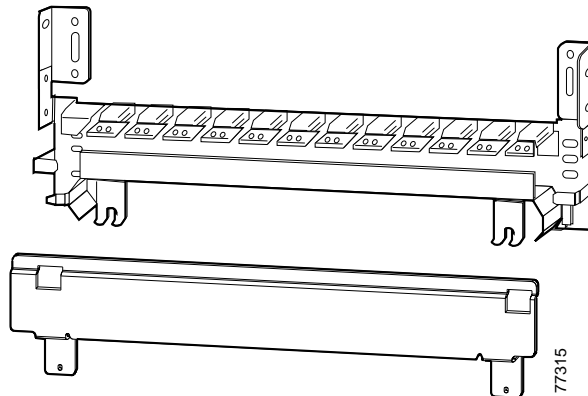
Another cable management guide is available for the processor card cables and is installed on the upper part of the chassis above the line card slots. (See Figure 1-18.)

Figure 1-18   Top Cable Management Guide
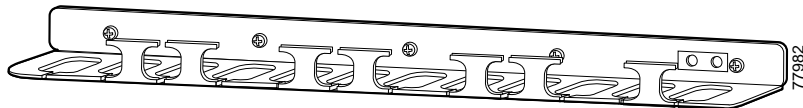
Cross Connect Drawers

The cross connect drawers provide extra flexibility when provisioning channels. The cross connect drawer is a separate unit supporting 8 channels for a total of two channel bands in a protected system. The system is expandable in channels of 8. To cross connect 16 channels, use two cross connect drawers. To cross connect 32 channels, use four cross connect drawers with two cable storage drawers. See Figure 1-1.

Table 1-17 lists the equipment you need if you are using the cross connect drawer in a protected system using line card motherboards with splitter. Table 1-18 lists the equipment needed if you are using the drawer system in an unprotected system using line card motherboards without splitter.

Table 1-17   Equipment Needed for a Protected System

| No. of Channels	No. of Cable Storage Drawers	No. of Cross Connect Drawers
1 to 8	1	1
9 to 16	1	2
17 to 24	2	3
25 to 32	2	4

Table 1-18   Equipment Needed for an Unprotected System

No. of Channels	No. of Cable Storage Drawers	No. of Cross Connect Drawers
1 to 16	1	1
17 to 32	1	2

Cable Storage Drawer

The cable storage drawer should be installed immediately beneath the chassis. (See Figure 1-19.) Cables connect the MTP connectors on the motherboards are routed in, through, and out the other side of the cable storage drawer.

Figure 1-19   Cisco ONS 15540 ESPx Cable Storage Drawer
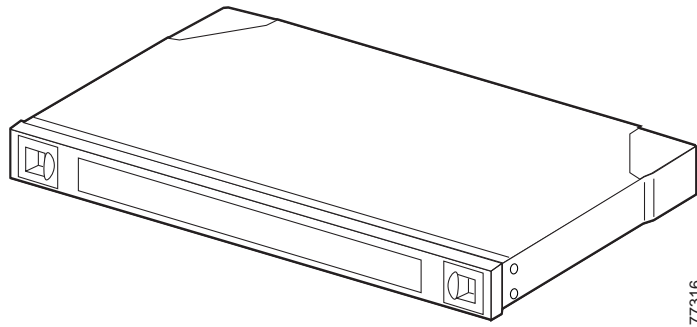
More than one cable storage drawer may be required depending on your configuration needs.

Blank Panels

You can install blank panels in any of the 12 slots of the Cisco ONS 15540 ESPx chassis or in the line card motherboards and mux/demux motherboards. Blank panels have connectors that protect the backplane from dust and particles and are also required for proper airflow in the chassis.

The blank panels are specific to what slot you use them in. They are available as follows:

- Mux/demux motherboard blank panels (slots 0 and 1)

- Line card motherboard blank panels (slots 2 to 5 and 8 to 11)

- 4-channel and 8-channel blank panels (any motherboard installed in slots 0 and 1)

- Transponder module blank panel (any line card motherboard installed in slots 2 to 5 and 8 to 11 without a full complement of transponder modules)