



Cisco ONS 15530 Hardware Installation Guide

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Preface

This preface describes the audience, new and changed information, organization, and conventions of the *Cisco ONS 15530 Hardware Installation Guide*. It also provides information about how to obtain related documentation and technical assistance.

The information contained in this document pertains to the entire range of hardware supported on the Cisco ONS 15530 platform. As new hardware and Cisco IOS software releases are made available for the Cisco ONS 15530 platform, verification of compatibility becomes extremely important. To ensure that your Cisco IOS software release supports your hardware, see the [New and Changed Information](#) section. Also refer to the “Hardware Supported” section of the latest release notes for the Cisco ONS 15530.

Audience

This guide is intended for experienced network administrators who are responsible for installing and maintaining the Cisco ONS 15530.

New and Changed Information

The table in this section lists and briefly describes the ongoing new and changed hardware features for the Cisco ONS 15530 by Cisco IOS software release. Additionally, it shows the location of the new feature information in this guide.

Feature	Release	Description	Location
4-channel tunable 10-Gbps ITU trunk card	12.2(26)SV	If the 10-Gbps ITU trunk cards are equipped with Universal Transponders (UT1) that have tunable lasers, the cards are programmable to one of the four supported frequencies belonging to one of the following bands: A, B, C, D, E, F, G, or H.	“10-Gbps ITU Tunable Trunk Cards” section on page 1-42
8-port multi-service muxponder	12.2(25)SV	The 8-port multi-service muxponder transports a mix of different protocols between sites in a metro DWDM network. The protocols that can be aggregated and transported range from high-speed services to low-speed services.	“8-Port Multi-Service Muxponders” section on page 1-33 “Installing SFPs into Aggregation Cards and Muxponders” section on page 2-18 “Installing SFP with Mini SMB Coax Connectors” section on page 2-18 “Connecting the 8-Port Multi-Service Muxponder” section on page 3-23 “8-Port Multi-Service Muxponder Specifications” section on page A-12 “SFP Specifications” section on page A-16
4-port 1-Gbps/2-Gbps FC aggregation card	12.2(23)SV	The Cisco ONS 15530 supports a 4-port 1-Gbps/2-Gbps FC aggregation card for Fibre Channel(FC), FICON, or ISC traffic.	“4-Port 1-Gbps/2-Gbps FC Aggregation Cards” section on page 1-27 “Connecting the 4-Port 1-Gbps/2-Gbps FC Aggregation Card” section on page 3-20 “4-Port 1-Gbps/2-Gbps FC Aggregation Card” section on page A-9
Variable rate SFP optics	12.1(12c)EV3	Variable rate SFP optics are available for the ESCON aggregation card and the 8-port FC/GE aggregation card.	“ESCON Aggregation Cards” section on page 1-25 “8-Port FC/GE Aggregation Cards” section on page 1-30
8-port FC/GE aggregation card	12.1(12c)EV	The Cisco ONS 15530 supports an 8-port Fibre Channel/Gigabit Ethernet aggregation card for FC and GE traffic.	“8-Port FC/GE Aggregation Cards” section on page 1-30 “Connecting the 8-Port FC/GE Aggregation Card” section on page 3-21

Feature	Release	Description	Location
2.5-Gbps ITU trunk cards	12.1(12c)EV	2.5-Gbps ITU trunk card sends and receives the ITU grid wavelength signal to and from an OADM module.	“2.5-Gbps ITU Trunk Cards” section on page 1-36 “Connecting the 2.5-Gbps ITU Trunk Card” section on page 3-24
Protection switch module	12.1(12c)EV	PSM (protection switch module) provides trunk fiber protection.	“PSMs” section on page 1-15 “Cabling PSMs” section on page 3-15

Organization

This guide describes how to install the Cisco ONS 15530 and is organized as follows:

Chapter	Title	Description
Chapter 1	Cisco ONS 15530 Overview	Describes the Cisco ONS 15530 chassis and its components
Chapter 2	Installing the Cisco ONS 15530	Describes how to install the Cisco ONS 15530 chassis and its components
Chapter 3	Connecting the Cisco ONS 15530	Describes how to install and route the cable connectors in the Cisco ONS 15530
Appendix A	Specifications	Lists the specifications for the Cisco ONS 15530 chassis and components

Conventions

This document uses the following conventions for notes, cautions, and safety warnings.

Convention	Application
boldface	Commands and keywords in body text.
<i>italic</i>	Command input that is supplied by the user.
[]	Keywords or arguments that appear within square brackets are optional.
{ x x x }	A choice of keywords (represented by x) appears in braces separated by vertical bars. The user must select one.
Ctrl	The control key. For example, where Ctrl + D is written, hold down the Control key while pressing the D key.
screen font	Examples of information displayed on the screen.

Convention**Application****boldface screen font**

Examples of information that the user must enter.

< >

Command parameters that must be replaced by module-specific codes.

Notes and Cautions contain important information that you should be aware of.

**Note**

Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the publication.

**Caution**

Means *reader be careful*. You are capable of doing something that might result in equipment damage or loss of data.

Safety warnings appear throughout this publication in procedures that, if performed incorrectly, may harm you. A warning symbol precedes each warning statement.

**Warning**

This warning symbol means *danger*. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. To see translations of the warnings that appear in this publication, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.

Related Documentation

Refer to the following documents for additional information about the Cisco ONS 15530 system:

- [Regulatory Compliance and Safety Information for the Cisco ONS 15500 Series](#)
- [Cisco ONS 15530 Planning Guide](#)
- [Cisco ONS 15530 Cleaning Procedures for Fiber Optic Connections](#)
- [Cisco ONS 15530 Optical Turn-Up and Test Guide](#)
- [Cisco ONS 15530 Configuration Guide](#)
- [Cisco ONS 15530 Command Reference](#)
- [Cisco ONS 15530 TLI Command Reference](#)
- [Cisco ONS 15530 System Alarms and Error Messages](#)
- [Cisco ONS 15530 Troubleshooting Guide](#)
- [Network Management for the Cisco ONS 15530](#)
- [MIB Quick Reference for the Cisco ONS 15500 Series](#)
- [Cisco ONS 15530 Software Upgrade Guide](#)

Obtaining Documentation

Cisco documentation and additional literature are available on Cisco.com. Cisco also provides several ways to obtain technical assistance and other technical resources. These sections explain how to obtain technical information from Cisco Systems.

Cisco.com

You can access the most current Cisco documentation at this URL:

<http://www.cisco.com/univercd/home/home.htm>

You can access the Cisco website at this URL:

<http://www.cisco.com>

You can access international Cisco websites at this URL:

http://www.cisco.com/public/countries_languages.shtml

Documentation DVD

Cisco documentation and additional literature are available in a Documentation DVD package, which may have shipped with your product. The Documentation DVD is updated regularly and may be more current than printed documentation. The Documentation DVD package is available as a single unit.

Registered Cisco.com users (Cisco direct customers) can order a Cisco Documentation DVD (product number DOC-DOCDVD=) from the Ordering tool or Cisco Marketplace.

Cisco Ordering tool:

<http://www.cisco.com/en/US/partner/ordering/>

Cisco Marketplace:

<http://www.cisco.com/go/marketplace/>

Ordering Documentation

You can find instructions for ordering documentation at this URL:

http://www.cisco.com/univercd/cc/td/doc/es_inpk/pdi.htm

You can order Cisco documentation in these ways:

- Registered Cisco.com users (Cisco direct customers) can order Cisco product documentation from the Ordering tool:
<http://www.cisco.com/en/US/partner/ordering/>
- Nonregistered Cisco.com users can order documentation through a local account representative by calling Cisco Systems Corporate Headquarters (California, USA) at 408 526-7208 or, elsewhere in North America, by calling 1 800 553-NETS (6387).

Documentation Feedback

You can send comments about technical documentation to bug-doc@cisco.com.

You can submit comments by using the response card (if present) behind the front cover of your document or by writing to the following address:

Cisco Systems
Attn: Customer Document Ordering
170 West Tasman Drive
San Jose, CA 95134-9883

We appreciate your comments.

Cisco Product Security Overview

Cisco provides a free online Security Vulnerability Policy portal at this URL:

http://www.cisco.com/en/US/products/products_security_vulnerability_policy.html

From this site, you can perform these tasks:

- Report security vulnerabilities in Cisco products.
- Obtain assistance with security incidents that involve Cisco products.
- Register to receive security information from Cisco.

A current list of security advisories and notices for Cisco products is available at this URL:

<http://www.cisco.com/go/psirt>

If you prefer to see advisories and notices as they are updated in real time, you can access a Product Security Incident Response Team Really Simple Syndication (PSIRT RSS) feed from this URL:

http://www.cisco.com/en/US/products/products_psirt_rss_feed.html

Reporting Security Problems in Cisco Products

Cisco is committed to delivering secure products. We test our products internally before we release them, and we strive to correct all vulnerabilities quickly. If you think that you might have identified a vulnerability in a Cisco product, contact PSIRT:

- Emergencies—security-alert@cisco.com
- Nonemergencies—psirt@cisco.com



Tip

We encourage you to use Pretty Good Privacy (PGP) or a compatible product to encrypt any sensitive information that you send to Cisco. PSIRT can work from encrypted information that is compatible with PGP versions 2.x through 8.x.

Never use a revoked or an expired encryption key. The correct public key to use in your correspondence with PSIRT is the one that has the most recent creation date in this public key server list:

<http://pgp.mit.edu:11371/pks/lookup?search=psirt%40cisco.com&op=index&exact=on>

In an emergency, you can also reach PSIRT by telephone:

- 1 877 228-7302
- 1 408 525-6532

Obtaining Technical Assistance

For all customers, partners, resellers, and distributors who hold valid Cisco service contracts, Cisco Technical Support provides 24-hour-a-day, award-winning technical assistance. The Cisco Technical Support Website on Cisco.com features extensive online support resources. In addition, Cisco Technical Assistance Center (TAC) engineers provide telephone support. If you do not hold a valid Cisco service contract, contact your reseller.

Cisco Technical Support Website

The Cisco Technical Support Website provides online documents and tools for troubleshooting and resolving technical issues with Cisco products and technologies. The website is available 24 hours a day, 365 days a year, at this URL:

<http://www.cisco.com/techsupport>

Access to all tools on the Cisco Technical Support Website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a user ID or password, you can register at this URL:

<http://tools.cisco.com/RPF/register/register.do>



Note

Use the Cisco Product Identification (CPI) tool to locate your product serial number before submitting a web or phone request for service. You can access the CPI tool from the Cisco Technical Support Website by clicking the **Tools & Resources** link under Documentation & Tools. Choose **Cisco Product Identification Tool** from the Alphabetical Index drop-down list, or click the **Cisco Product Identification Tool** link under Alerts & RMAs. The CPI tool offers three search options: by product ID or model name; by tree view; or for certain products, by copying and pasting **show** command output. Search results show an illustration of your product with the serial number label location highlighted. Locate the serial number label on your product and record the information before placing a service call.

Submitting a Service Request

Using the online TAC Service Request Tool is the fastest way to open S3 and S4 service requests. (S3 and S4 service requests are those in which your network is minimally impaired or for which you require product information.) After you describe your situation, the TAC Service Request Tool provides recommended solutions. If your issue is not resolved using the recommended resources, your service request is assigned to a Cisco TAC engineer. The TAC Service Request Tool is located at this URL:

<http://www.cisco.com/techsupport/servicerequest>

For S1 or S2 service requests or if you do not have Internet access, contact the Cisco TAC by telephone. (S1 or S2 service requests are those in which your production network is down or severely degraded.) Cisco TAC engineers are assigned immediately to S1 and S2 service requests to help keep your business operations running smoothly.

To open a service request by telephone, use one of the following numbers:

Asia-Pacific: +61 2 8446 7411 (Australia: 1 800 805 227)

EMEA: +32 2 704 55 55

USA: 1 800 553-2447

For a complete list of Cisco TAC contacts, go to this URL:

<http://www.cisco.com/techsupport/contacts>

Definitions of Service Request Severity

To ensure that all service requests are reported in a standard format, Cisco has established severity definitions.

Severity 1 (S1)—Your network is “down,” or there is a critical impact to your business operations. You and Cisco will commit all necessary resources around the clock to resolve the situation.

Severity 2 (S2)—Operation of an existing network is severely degraded, or significant aspects of your business operation are negatively affected by inadequate performance of Cisco products. You and Cisco will commit full-time resources during normal business hours to resolve the situation.

Severity 3 (S3)—Operational performance of your network is impaired, but most business operations remain functional. You and Cisco will commit resources during normal business hours to restore service to satisfactory levels.

Severity 4 (S4)—You require information or assistance with Cisco product capabilities, installation, or configuration. There is little or no effect on your business operations.

Obtaining Additional Publications and Information

Information about Cisco products, technologies, and network solutions is available from various online and printed sources.

- Cisco Marketplace provides a variety of Cisco books, reference guides, and logo merchandise. Visit Cisco Marketplace, the company store, at this URL:

<http://www.cisco.com/go/marketplace/>

- *Cisco Press* publishes a wide range of general networking, training and certification titles. Both new and experienced users will benefit from these publications. For current Cisco Press titles and other information, go to Cisco Press at this URL:

<http://www.ciscopress.com>

- *Packet* magazine is the Cisco Systems technical user magazine for maximizing Internet and networking investments. Each quarter, Packet delivers coverage of the latest industry trends, technology breakthroughs, and Cisco products and solutions, as well as network deployment and troubleshooting tips, configuration examples, customer case studies, certification and training information, and links to scores of in-depth online resources. You can access Packet magazine at this URL:

<http://www.cisco.com/packet>

- *iQ Magazine* is the quarterly publication from Cisco Systems designed to help growing companies learn how they can use technology to increase revenue, streamline their business, and expand services. The publication identifies the challenges facing these companies and the technologies to help solve them, using real-world case studies and business strategies to help readers make sound technology investment decisions. You can access iQ Magazine at this URL:

<http://www.cisco.com/go/iqmagazine>

- *Internet Protocol Journal* is a quarterly journal published by Cisco Systems for engineering professionals involved in designing, developing, and operating public and private internets and intranets. You can access the Internet Protocol Journal at this URL:

<http://www.cisco.com/ipj>

- World-class networking training is available from Cisco. You can view current offerings at this URL:

<http://www.cisco.com/en/US/learning/index.html>



Cisco ONS 15530 Overview

The Cisco ONS 15530 is a modular and scalable optical switching and aggregation platform designed to supplement the Cisco ONS 15540 ESP. With the Cisco ONS 15530, users can take advantage of the availability of dark fiber to build a common infrastructure that supports data, storage area network (SAN), and time-division multiplexing (TDM) traffic. For more information about DWDM technology and applications, refer to the *Introduction to DWDM Technology* publication and the *Cisco ONS 15530 Planning Guide*.

The Cisco ONS 15530 is designed to meet or exceed stringent ISP (Internet service provider) requirements for product availability and reliability.



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.

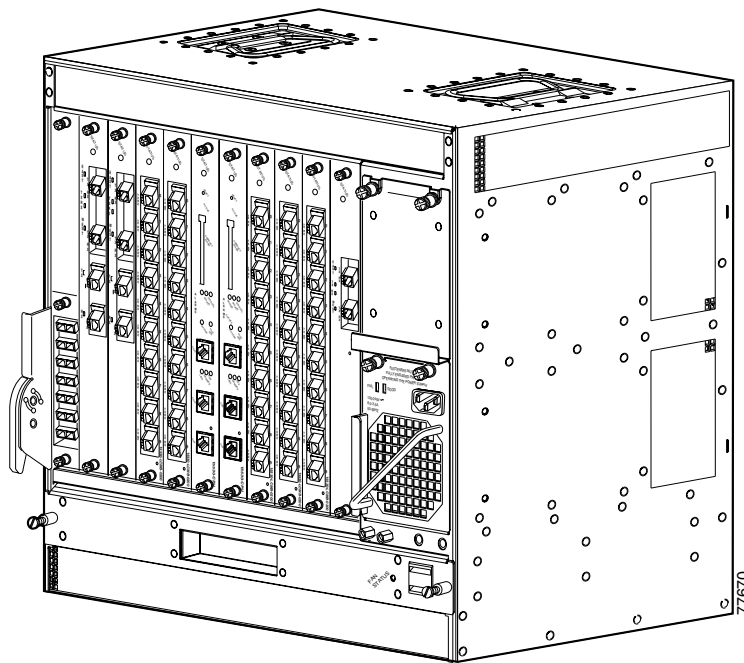
This chapter includes the following sections:

- [Cisco ONS 15530 Chassis, page 1-2](#)
- [Cisco ONS 15530 Components, page 1-10](#)

Cisco ONS 15530 Chassis

The Cisco ONS 15530 is available in two configurations. Both have two vertically stacked half-height slots specifically for the optical OADM (optical add/drop multiplexing) modules, and 10 vertically oriented slots that hold the CPU switch modules, line cards, and 2.5-G transponder trunk line cards. Slot 0 holds two half height optical OADM modules. Slots 1 through 4 and slots 7 through 10 hold the line cards and transponder cards. Slots 5 and 6 hold the CPU switch modules. Power supplies are located on the right side of the chassis next to slot 10. Air inlet and fan tray assembly are located beneath the slots. Cable management is located beneath the slots. The system has an electrical backplane for system control. All optical connections are located on the front of the cards. [Figure 1-1](#) shows a fully populated chassis.

Figure 1-1 Cisco ONS 15530 Shelf

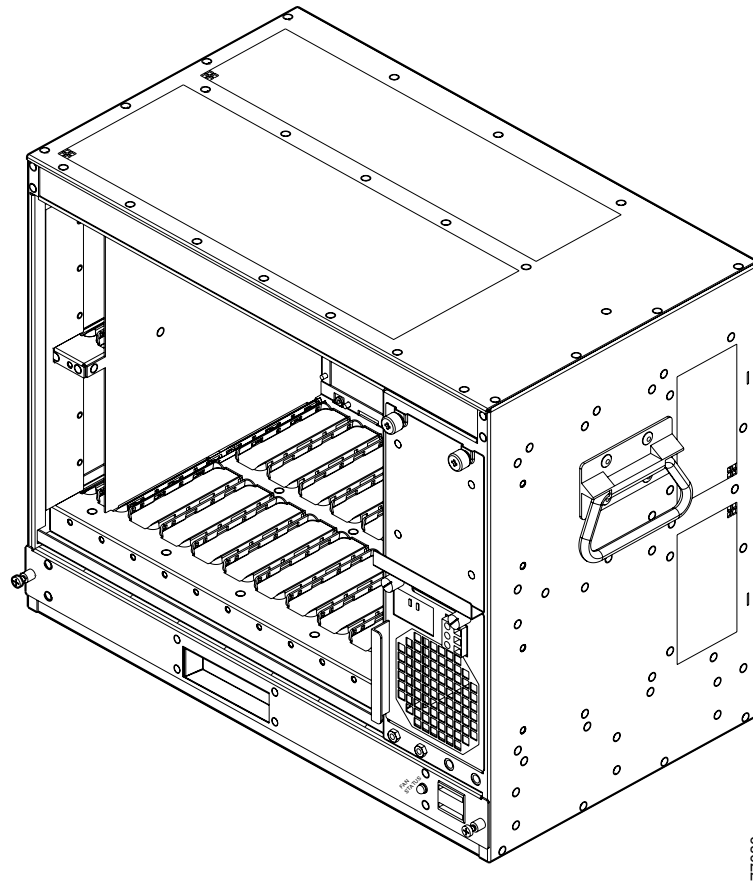


The chassis configurations differ in how cooling air is routed through the chassis and where the lifting handles are placed.

Cisco ONS 15530-CHAS-E Chassis

The dimensions of the Cisco ONS 15530 CHAS-E chassis are 14.4 x 17.3 x 10.1 inches (H x W x D). See [Figure 1-2](#). Handles for lifting the chassis are located on the sides.

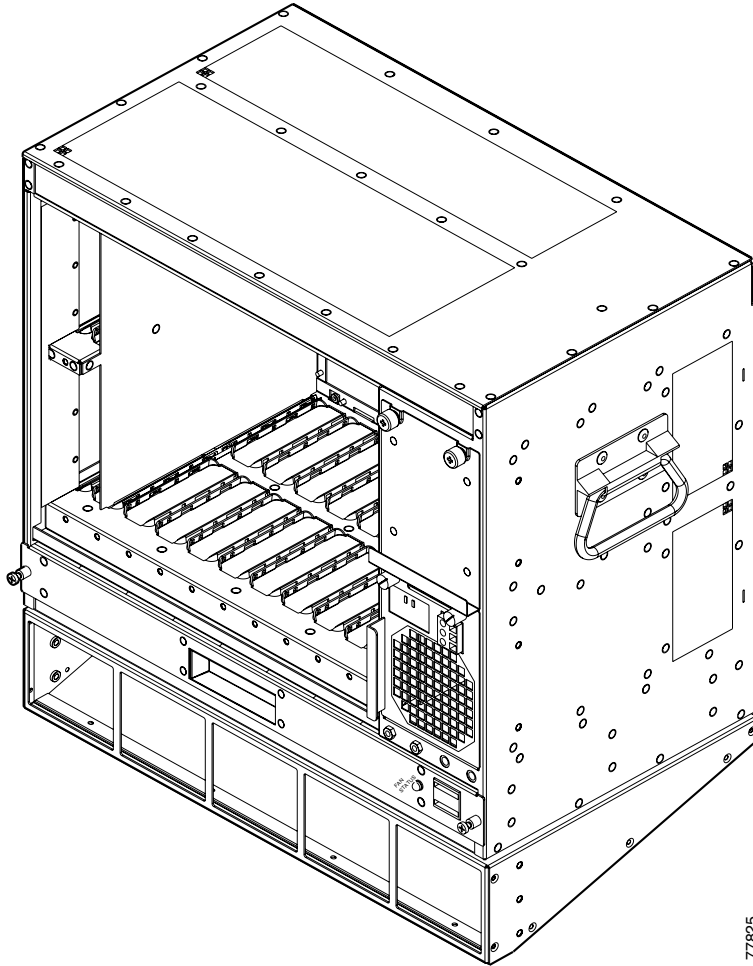
Figure 1-2 Cisco ONS 15530 CHAS-E Chassis



The fan assembly draws in cooling air through the air ramp baffle (see [Figure 1-3](#)) on the bottom of the chassis, pushing the air across the internal components and out the exhaust baffles on the top of the chassis.

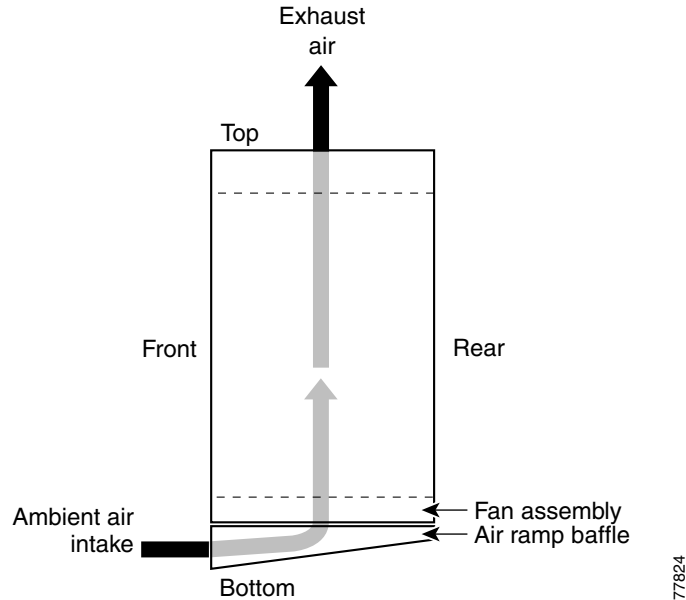
The air ramp baffle for the Cisco ONS 15530 CHAS-E chassis redirects the cooling air intake as shown in [Figure 1-4](#). The air ramp baffle must be installed when installing the Cisco ONS 15530 CHAS-E type chassis.

Figure 1-3 Cisco ONS 15530 CHAS-E (with Air Ramp Baffle)



77825

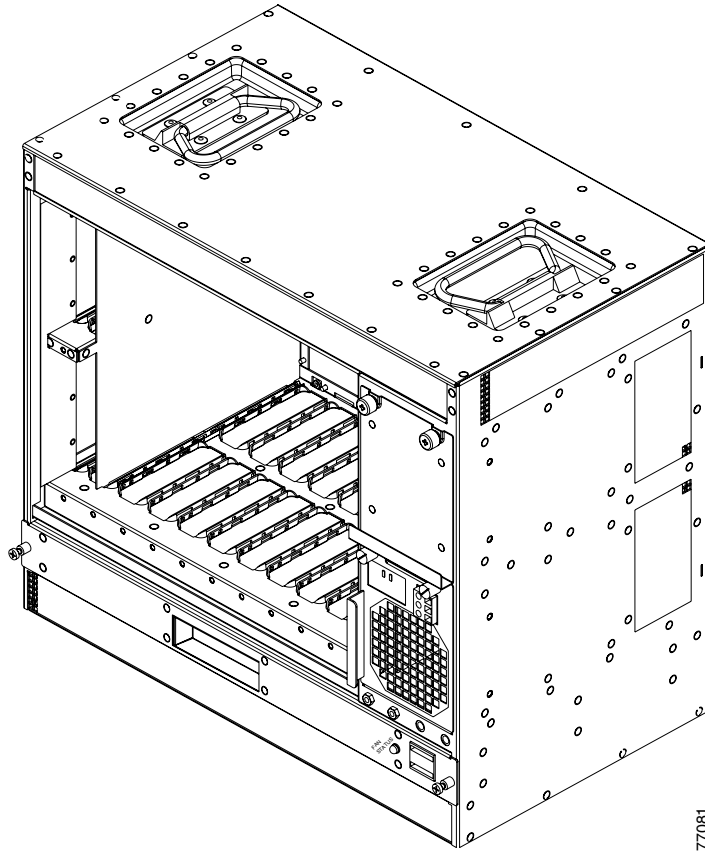
Figure 1-4 Cisco ONS 15530 CHAS-E Chassis Airflow (with Air Ramp Baffle Installed)



Cisco ONS 15530 CHAS-N Chassis

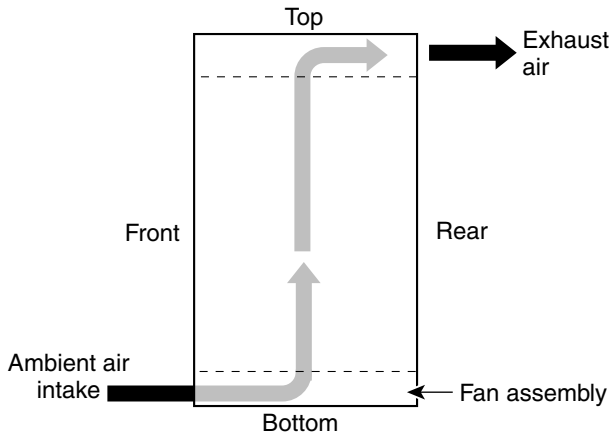
The dimensions of the Cisco ONS 15530 CHAS-N chassis are 14.4 x 15.7 x 10.1 inches (H x W x D). (See [Figure 1-5](#).) Handles for lifting the chassis are located on the top. The fan assembly draws in cooling air through the intake baffles on the front of the chassis, below the fan assembly, pushing the air over the internal components and out the exhaust on the top rear and sides of the chassis (see [Figure 1-6](#)).

Figure 1-5 Cisco ONS 15530 CHAS-N Chassis



77081

Figure 1-6 Cisco ONS 15530 CHAS-N Chassis Airflow

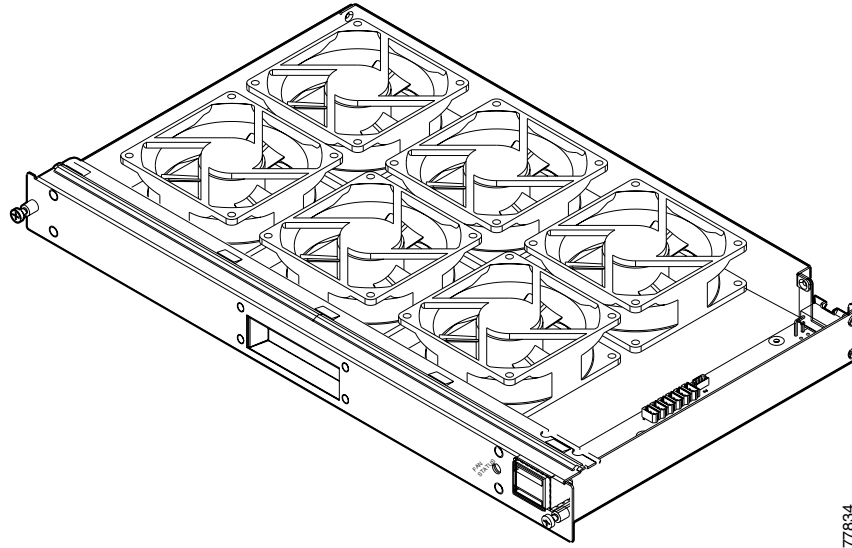


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Fan Assembly

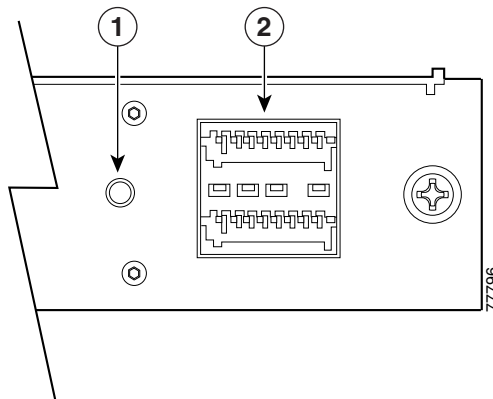
The Cisco ONS 15530 fan assembly is located at the bottom of the chassis. The assembly contains six individual fans and a fan controller board (see [Figure 1-7](#)).

Figure 1-7 Fan Assembly



The controller board monitors the status of each fan and reports the status to the CPU switch modules. If a single fan fails, a minor alarm is reported to the CPU and the fan assembly LED changes from green to yellow (see [Figure 1-8](#)). If two or more fans fail, a major alarm is reported to the CPU and the fan LED changes to red.

Figure 1-8 Fan Assembly LED



1	Fan assembly LED	2	Alarm connector
----------	------------------	----------	-----------------

Table 1-1 lists the fan assembly LED status describing the alarm reports for the fan assembly. The fan assembly is hot-swappable.

Table 1-1 Fan Assembly Status

Fan Failure	LED	Status
None	Green	Normal
One	Yellow	Minor
Two or more	Red	Major

Audible and Visible Alarms

The Cisco ONS 15530 provides audible and visible alarm status to the Telco central office alarm equipment through hardware located on the fan assembly (see Figure 1-8). Software determines the alarm condition and sets the appropriate relays for critical, major, or minor alarms. Table 1-2 lists the terminal block pinouts.

Table 1-2 Terminal Block Pinouts

Connector	Alarm Type	Level	Pin	Contact	Notes
P1	Visible	Critical	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. Voltage at contacts is limited to 48 VDC. Switched current / load is limited to 1-A resistive. Alarms are signaled when the chassis is unpowered.
			2	NC ²	
			3	NO ³	
		Major	4	C	
			5	NC	
			6	NO	
		Minor	7	C	
			8	NC	
			9	NO	
P2	Audible	Critical	1	C	
			2	NC	
			3	NO	
		Major	4	C	
			5	NC	
			6	NO	
		Minor	7	C	
			8	NC	
			9	NO	

1. C = center
2. NC = normally closed
3. NO = normally open

Power Supplies

The Cisco ONS 15530 chassis supports redundant 120–240 VAC (see [Figure 1-9](#)) or –48 VDC (see [Figure 1-10](#)) power. The power supplies are located at the right of the chassis, next to the card slots (see [Figure 1-1](#)). Up to two power supplies can be installed for redundancy.

Figure 1-9 120–240 VAC Power Supply

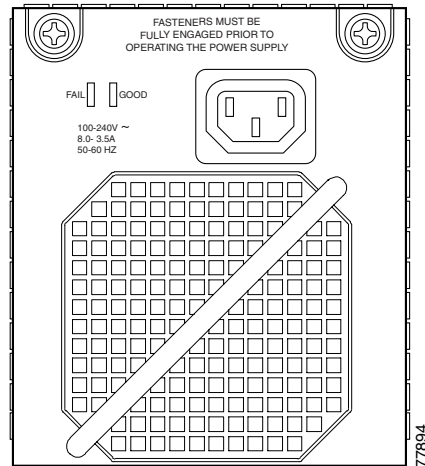
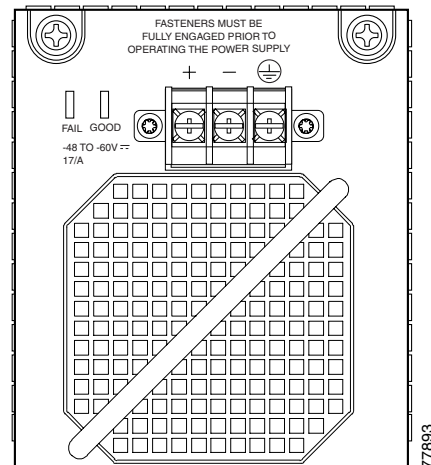


Figure 1-10 –48 VDC Power Supply



See the “[Powering Up the Shelf](#)” section on page 2-31 for more information about the power supplies.

Backplane

The Cisco ONS 15530 backplane implements all board-to-board signal interconnects and provides power distribution within the chassis. Connections are present for two power supplies and the fan assembly. The backplane contains a total of 12 slots; two half-height slots for the OADM modules, two full height slots for the CPU switch modules, and eight full height slots for line cards and transponder cards.

Cable Storage Drawer

The cable storage drawer is mounted directly below the fan assembly. It provides storage for the excess cable length. Sliding radius limiters move to release the excess fiber cable slack when the drawer is pulled out, allowing the user to raise the fiber routing tray and access the fan assembly.

Version Identification Labels

The version identifier on a 4-port 1-Gbps/2-Gbps FC aggregation card is located on the inside of the card. We recommend that you record the version ID in a safe place before installing the card. You can also use the **show hardware** and **show inventory** commands to verify the version ID of the card.

Cisco ONS 15530 Components

The following hardware components can be installed in the Cisco ONS 15530:

- [CPU Switch Modules, page 1-11](#)
- [OSC Modules and Carrier Motherboards, page 1-14](#)
- [PSMs, page 1-15](#)
- [Transponder Line Cards, page 1-17](#)
- [OADM Modules, page 1-20](#)
- [Wide-Band Variable Optical Attenuator and Per-Band Optical Equalizer Modules, page 1-21](#)
- [ESCON Aggregation Cards, page 1-25](#)
- [4-Port 1-Gbps/2-Gbps FC Aggregation Cards, page 1-27](#)
- [8-Port FC/GE Aggregation Cards, page 1-30](#)
- [8-Port Multi-Service Muxponders, page 1-33](#)
- [2.5-Gbps ITU Trunk Cards, page 1-36](#)
- [10-Gbps ITU Trunk Cards, page 1-39](#)
- [10-Gbps ITU Tunable Trunk Cards, page 1-42](#)
- [10-Gbps Uplink Cards, page 1-45](#)

**Note**

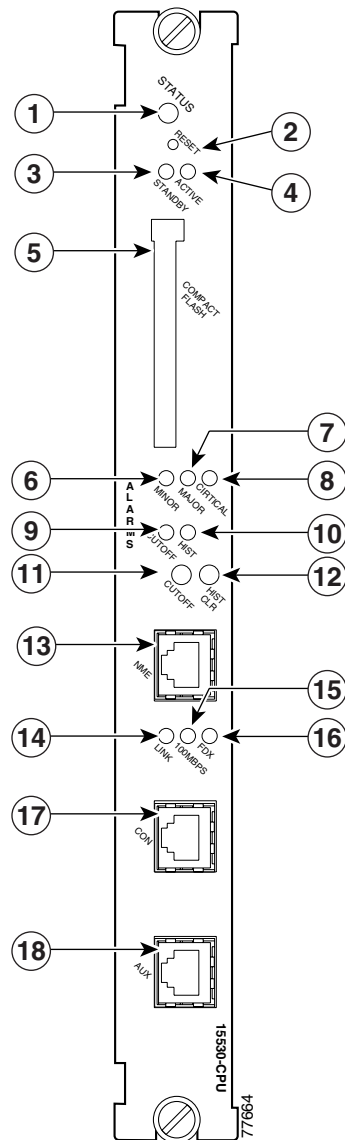
To ensure that your release of Cisco IOS software supports your hardware, see the [“New and Changed Information” section on page vii](#). Also refer to the “Hardware Supported” section of the latest release notes for the Cisco ONS 15530.

CPU Switch Modules

The Cisco ONS 15530 supports two CPU switch modules for redundancy, one in active mode and the other in hot-standby mode. CPU switch modules are installed in slot 5 and slot 6. Each CPU switch module has a processor, a switch fabric, a clock, an Ethernet switch for communication between processors and with the LRC (line card redundancy controller) on the OADM modules and line cards, and an SRC (switch card redundancy controller). The active processor controls the system. All LRCs in the system use the system clock and synchronization signals from the active processor. Interfaces on the CPU switch modules permit access by 10/100 Ethernet, console terminal, or modem connections.

Figure 1-11 shows the front panel of the CPU switch module.

Figure 1-11 Cisco ONS 15530 CPU Switch Module



1	Card status LED	7	Major alarm LED	13	NME port
2	Reset button	8	Critical alarm LED	14	Link LED
3	Standby LED	9	Cutoff LED	15	100 Mbps LED
4	Active LED	10	HIST LED	16	Full-duplex LED
5	CompactFlash card slot	11	Cutoff LED	17	Console port
6	Minor alarm LED	12	HIST CLR LED	18	Auxiliary port

CPU Switch Module Ports, LEDs, and Switches

Table 1-3 lists the LEDs on the CPU switch module faceplate with a description of the status indication.

Table 1-3 CPU Switch Module LEDs

LED	Status	Description
STATUS	Green	IOS is loaded and running.
	Yellow	Card is in the process of booting.
ACTIVE	Green	Module is the primary CPU switch module, otherwise the LED is off.
STANDBY	Green	Module is in standby mode, otherwise the LED is off.
ALARM LEDs		
CRITICAL	Red	A system wide critical alarm exists.
MAJOR	Yellow	A system wide major alarm exists.
MINOR	Yellow	A system wide minor alarm exists.
HIST	Yellow	A system wide major or minor alarm has occurred.
HIST CLR	Yellow	A system wide major or minor alarm has occurred.
CUTOFF	Red	A major or minor alarm exists and the cutoff button has been pushed.
FDX	Green	Module is running full-duplex.
	Off	Module is running half-duplex.
100MBPS	Green	Module is running at 100 Mbps.
	Off	Module is running at 10 Mbps.
LINK	Green	Link is up.
	Off	Link is down.

Connector Ports

The front panel on the CPU switch module contains three ports with RJ-45 connectors (see Figure 1-11):

- Network Management Ethernet port (NME)—This Ethernet port connects the CPU switch module to a 10/100BASE-T network management LAN.
- Console port (CON)—This asynchronous EIA/TIA-232 serial port connects a terminal to the CPU switch module for local administrative access.
- Auxiliary port (AUX)—This asynchronous EIA/TIA-232 serial port connects a modem to the CPU switch module for remote administrative access.

The RJ-45 connectors on the front panel of the CPU switch module have an extra EMI shield and the signals going to them are filtered.

Table 1-4 shows the pinouts of the console and auxiliary ports.

Table 1-4 Console and Auxiliary Port RJ-45 Pinout

Pin No.	Console			Auxiliary		
	Direction	Function		Direction	Function	
1	Output	RTS	Request To Send	Output	RTS	Request To Send
2	Output	DTR	Data terminal ready	Output	DTR	Data terminal ready
3	Output	TxD	Transmit data	Output	TxD	Transmit data
4	N/A	GND	Ground	N/A	GND	Ground
5	N/A	GND	Ground	N/A	GND	Ground
6	Input	RxD	Receive data	Input	RxD	Receive data
7	Input	DSR	Data set ready	Input	CD	Carrier Detect
8	Input	CTS	Clear To Send	Input	CTS	Clear To Send

CompactFlash Card Slot

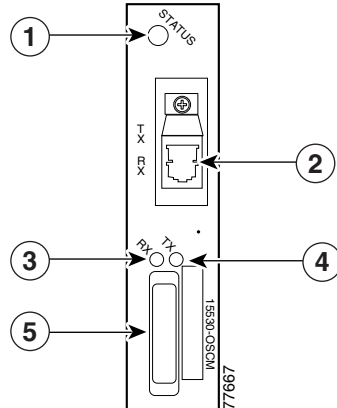
A CompactFlash card slot (see [Figure 1-11](#)) can store the Cisco IOS image or a system configuration file on a CompactFlash memory card. The system can also boot from the software stored on the CompactFlash memory card.

OSC Modules and Carrier Motherboards

The OSC (optical supervisory channel) module supports an optional out-of-band management channel for communicating between systems on the network. Using a 33rd wavelength (channel 0), the OSC allows control and management traffic to be carried without requiring a separate Ethernet connection to each Cisco ONS 15530 in the network. Up to two OSC modules can be installed in the carrier motherboard, one module for the west direction and one for the east direction.

The OSC always terminates on a neighboring node. By contrast, data channels may or may not be terminated on a given node, depending on whether the channels on the OADM modules are treated as either express (pass-through) or add/drop channels.

[Figure 1-12](#) shows the front panel of the OSC module.

Figure 1-12 OSC Module

1	Card status LED	4	Transmit LED
2	OADM port	5	Card handle
3	Receive LED		

OSC Module LEDs

Table 1-5 lists the LEDs on the OSC module faceplate, their default conditions, and what the conditions indicate.

Table 1-5 OSC Module LEDs

LED	Status	Description
STATUS	Green	OSC module initialization process is complete.
	Yellow	OSC module is in initialization process.
TX	Green	Transmit laser is enabled.
RX	Green	Light reception exists at wave OSC interface.

PSMs

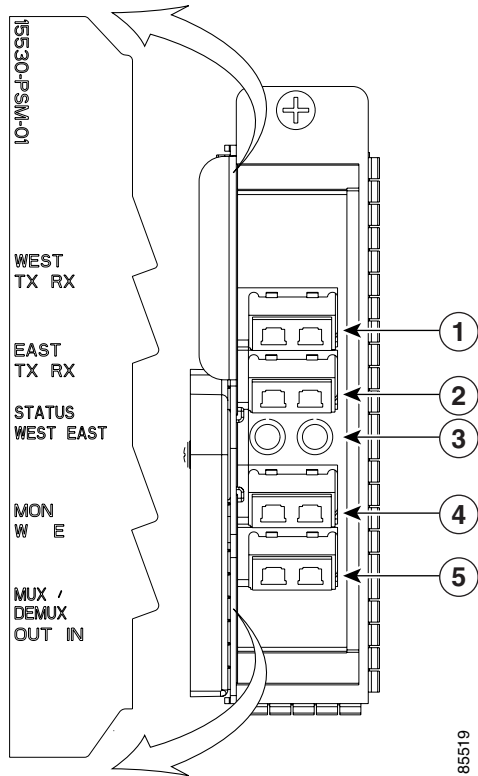
The PSM (protection switch module) provides trunk fiber protection for Cisco ONS 15530 systems configured in point-to-point topologies. The PSM sends the signal from an OADM module, an ITU trunk card, or a transponder line card to both the west and east directions. It receives both the west and east signals and sends to the OADM module, ITU trunk card, or transponder line card. Both nodes in the network topology must have the same shelf configuration. When a trunk fiber cut occurs on the active path, the PSM switches the received signal to the standby path. Because the PSM occupies one of the OADM subslots in the shelf, it protects a maximum of four channels and the OSC in a single shelf configuration.

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

A PSM can be installed in subslots 0/0 and 0/1 of the Cisco ONS 15530 chassis.

The PSM for the Cisco ONS 15530 has a front panel with four MU connector pairs, as shown in Figure 1-13.

Figure 1-13 PSM



1	Rx/Tx West ports	4	East and West optical monitor ports
2	Rx/Tx East ports	5	Common IN/OUT ports
3	East and West status LEDs		

PSM LEDs

Table 1-6 lists the LEDs on the PSM faceplate, their default conditions, and what the conditions indicate.

Table 1-6 PSM LEDs

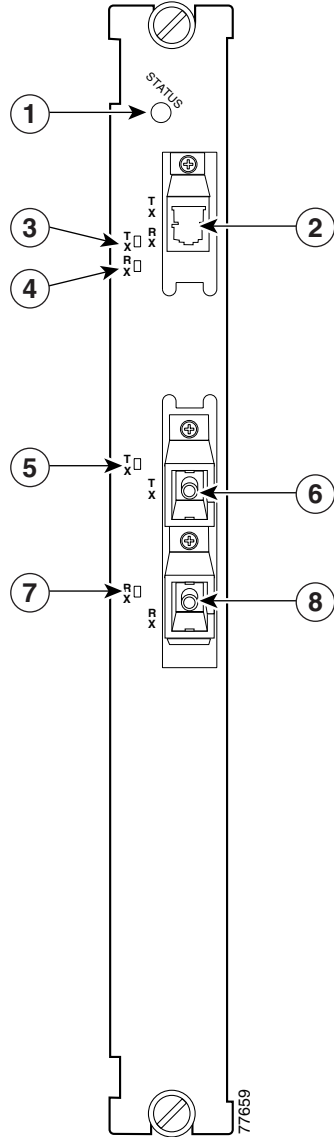
LED	Status	Description
Status	Green	Software initialization is successful.
	Off	Board failure.

Transponder Line Cards

The protocol-transparent and bit-rate transparent transponder line card converts a single client signal into an ITU wavelength, or channel. The transponder line cards have tunable lasers and you can configure the line cards to work in two different wavelengths. The Cisco ONS 15530 holds up to four transponder line cards, one for each wavelength supported by the OADM modules.

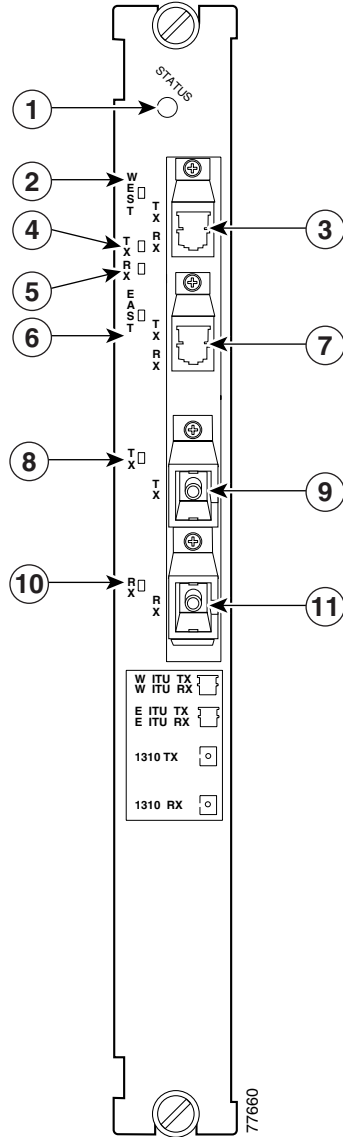
The Cisco ONS 15530 supports four types of single client interface transponder line cards: SM (single mode) unprotected, SM splitter protected, MM (multimode) unprotected, and MM splitter protected. Both types of SM transponder line cards accept SM client signals on the 1310-nm wavelength through an SC connector and support client signal clock rates ranging from 16 Mbps to 2.5 Gbps. Both types of MM transponder line cards accept SM 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 (see [Figure 1-14](#) and [Figure 1-15](#)).

Figure 1-14 Transponder Line Card LEDs (Nonsplitter)



1	Card status LED	5	Client side transmit LED
2	ITU side port	6	Client side transmit port
3	ITU transmit LED	7	Client side receive LED
4	ITU receive LED	8	Client side receive port

Figure 1-15 Transponder Line Card LEDs (Splitter)



1	Card status LED	7	East side ITU port
2	West side ITU LED	8	Client side transmit LED
3	West side ITU port	9	Client side transmit port
4	ITU side transmit LED	10	Client side receive LED
5	ITU side receive LED	11	Client side receive port
6	East side ITU LED		

The transponder line cards are hot swappable, permitting in-service upgrades and replacement. All client signals on the transponders are supported in 3R (reshape, retune, retransmit) mode, regardless of protocol encapsulation type. The client interfaces also support the OFC (open fiber control) safety protocol for Fibre Channel, ISC compatibility mode, and FICON. The client side ports use SC-type connectors.

On the trunk side, the transponder line card output laser power ranges from 5 to 10 dBm and the receive detector has a sensitivity of -32 dBm. The ports on the trunk side use MU-type connectors.

Transponder Line Card LEDs

Table 1-7 lists the LEDs on the transponder line card faceplate, their default conditions, and what the conditions indicate.

Table 1-7 Transponder Line Card LEDs

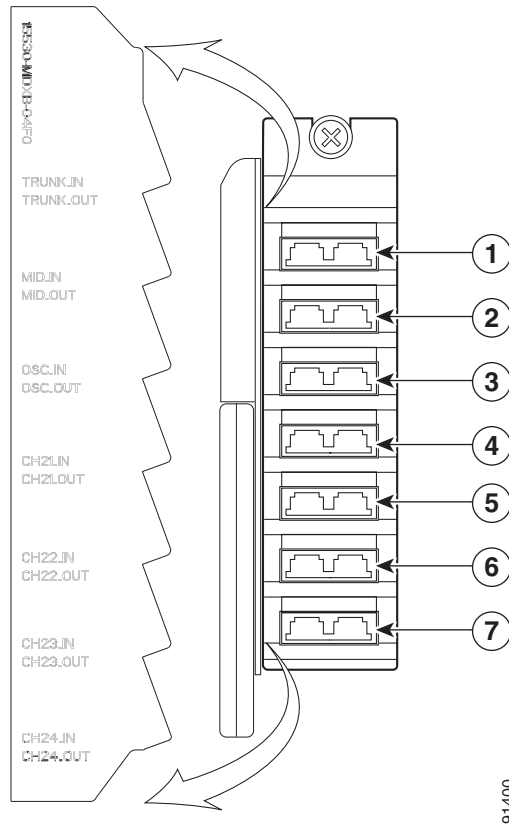
LED	Status	Description
STATUS	Green	Card is properly initialized.
	Blinking green	Good system clock is present and card is out of reset state.
	Yellow	System clock is not present.
EAST ¹	Green	Card is listening to the east side signal.
TX (Trunk port)	Green	Port is up and transmit laser is enabled.
RX (Trunk port)	Green	Light reception exists at the port.
WEST ¹	Green	Card is listening to the west side signal.
TX (Client port)	Green	Port is up and transmit laser is enabled.
RX (Client port)	Green	Light reception exists at the port.

1. This LED is only present on transponder line cards with splitter.

OADM Modules

The OADM modules are passive devices that optically multiplex and demultiplex a specific band of four ITU wavelengths. The OADM modules supported by the Cisco ONS 15530 each add and drop a specified band of four channels at a node and pass the other bands through. To support the 32-channel spectrum, there are eight different 4-channel cards (see Figure 1-16).

In the transmit direction, the OADM modules multiplex signals transmitted by the transponder line cards and 10-Gbps ITU trunk cards over optical cross connections and provide the interfaces to connect the multiplexed signal to the DWDM trunk side. In the receive direction, the OADM modules demultiplex the signals from the trunk side before passing them over optical cross connections to the transponder line cards and 10-Gbps ITU trunk cards.

Figure 1-16 OADM Module

1	Trunk IN/OUT ports	5	Data channel IN/OUT ports
2	Thru IN/OUT ports	6	Data channel IN/OUT ports
3	OSC IN/OUT ports ¹	7	Data channel IN/OUT ports
4	Data channel IN/OUT ports		

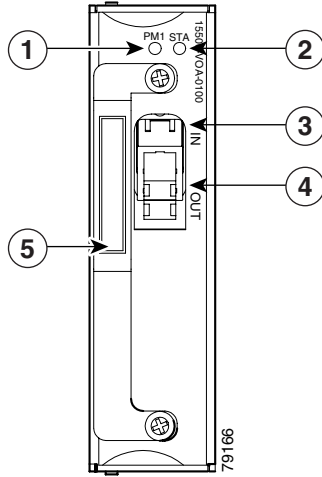
1. Only on OADM modules with OSC. These ports are not used on other modules.

Wide-Band Variable Optical Attenuator and Per-Band Optical Equalizer Modules

The WB-VOA (wide-band variable optical attenuator) and PB-OE (per-band power equalizer) modules are half-width modules that allow the ONS 15530 to extend the internodal and ring circumference distances and number of nodes supported for point-to-point, hub ring, and mesh ring networks by equalizing power levels.

The WB-VOA module and the PB-OE module are available in single and dual band versions. These modules are installed into a carrier mother board. This mother board is installed into and operates on the Cisco ONS 15530 chassis. The carrier mother board can be installed in slots 1 to 4 or 7 to 10. All optical connectors are located on the front panel and the connectors are angled.

[Figure 1-17](#) and [Figure 1-18](#) show the single and dual versions of the WB-VOA module. [Figure 1-19](#) and [Figure 1-20](#) show the single-band and dual-band versions of the PB-OE module.

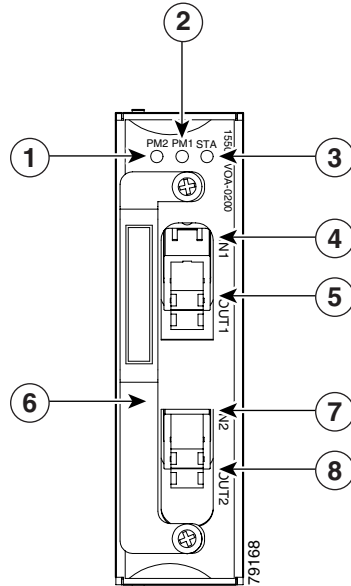
Figure 1-17 Single WB-VOA Module

1	PM1 LED	4	OUT port
2	Card status LED	5	Handle
3	IN port		

Table 1-8 lists the LEDs on the single WB-VOA module faceplate, their default conditions, and what the conditions indicate.

Table 1-8 Single WB-VOA Module LEDs

LED	Status	Description
PM1	Green	Light reception exists at the port.
STA	Green	Card is properly initialized.

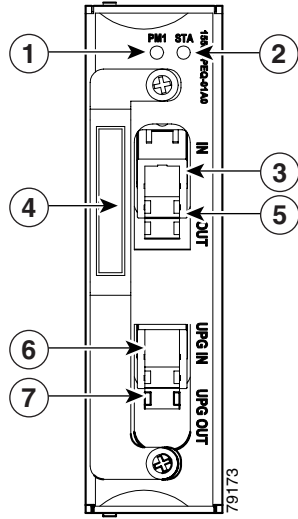
Figure 1-18 Dual WB-VOA Module

1	PM2 LED	5	OUT1 port
2	PM1 LED	6	Handle
3	Card status LED	7	IN2 port
4	IN1 port	8	OUT2 port

Table 1-9 lists the LEDs on the dual WB-VOA module faceplate, their default conditions, and what the conditions indicate.

Table 1-9 Dual WB-VOA Module LEDs

LED	Status	Description
PM2	Green	Light reception exists at the port.
PM1	Green	Light reception exists at the port.
STATUS	Green	Card is properly initialized.

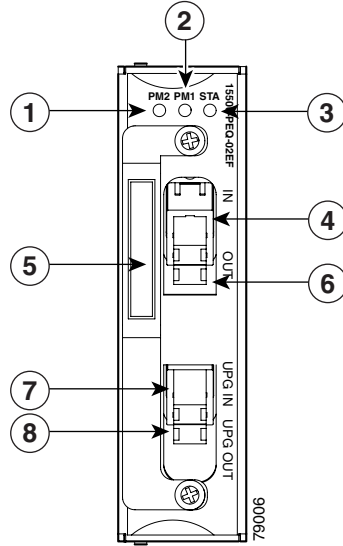
Figure 1-19 Single-Band PB-OE Module

1	PM1 LED	5	OUT port
2	Card status LED	6	UPG IN port
3	IN port	7	UPG OUT port
4	Handle		

[Table 1-10](#) lists the LEDs on the single-band PB-OE module faceplate, their default conditions, and what the conditions indicate.

Table 1-10 Single-Band PB-OE Module

LED	Status	Description
PM1	Green	Light reception exists at the port.
STA	Green	Card is properly initialized.

Figure 1-20 Dual-Band PB-OE Module

1	PM2 LED	5	Handle
2	PM1 LED	6	OUT port
3	Card status LED	7	UPG IN port
4	IN port	8	UPG OUT port

Table 1-11 lists the LEDs on the dual-band PB-OE module faceplate, their default conditions, and what the conditions indicate.

Table 1-11 Dual-Band PB-OE LEDs

LED	Status	Description
PM2	Green	Light reception exists at the port.
PM1	Green	Light reception exists at the port.
STATUS	Green	Card is properly initialized.

ESCON Aggregation Cards

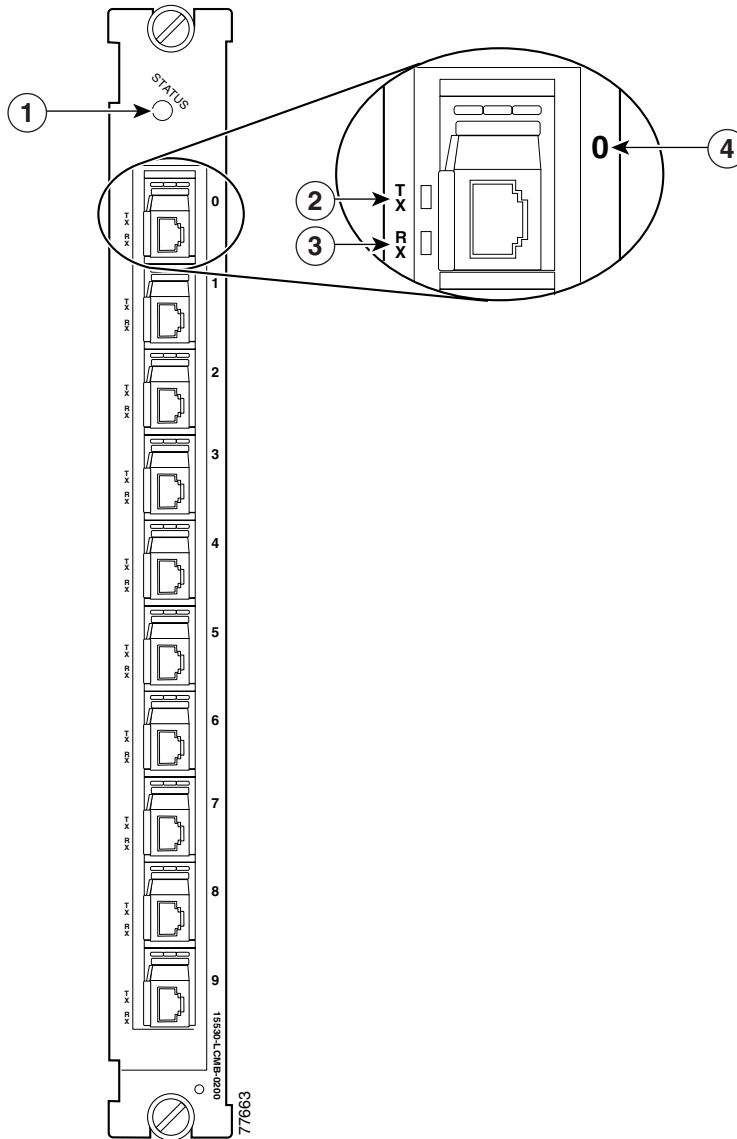
The ESCON aggregation card is a 10-port card for ESCON (Enterprise Systems Connection) traffic. The ESCON card converts the 10 client signals from optical to electrical and then aggregates them into a single 2.5-Gbps signal. This aggregated signal is sent through the backplane and the active switch fabric to either a 10-Gbps ITU trunk card or a 10-Gbps uplink card. The cross connection between the two cards is configured using the CLI (command-line interface). The ESCON aggregation card has a redundant backplane connection.

The ESCON aggregation card uses multimode 62.5/125 μm optical cable with SFPs (small form factor pluggables) and MT-RJ connectors for the client signals. (See Figure 1-21.)

Note

A patch cable to adapt MT-RJ connectors to standard ESCON connectors directly or intermediately to SC-type connectors may be required.

Figure 1-21 ESCON Aggregation Card



1	Card status LED	3	Port receive LED
2	Port transmit LED	4	Port number

This signal is sent through the switch fabric to a 10-Gbps ITU trunk card or a 10-Gbps uplink card. The 10-Gbps ITU trunk card converts the aggregated signal to an ITU-compliant wavelength, or channel. The 10-Gbps uplink card converts the aggregated signal to transmit to another shelf.

Table 1-12 describes the ESCON aggregation card LED status.

Table 1-12 ESCON Aggregation Card LEDs

LED	Status	Description
STATUS	Green	Card is properly initialized.
	Blinking green	Good system clock is present and card is out of reset state.
	Yellow	System clock is not present.
TX	Green	Port is up and transmit laser is enabled.
RX	Green	Light reception exists at the port.

The ESCON aggregation card uses single-mode and multimode SFP optics for the client signals. There are no restrictions on populating the line card with SFPs. For example, you can mix a single-mode SFP optics with a multimode SFP optics on the same ESCON aggregation card. Table 1-13 lists the characteristics for the SFP optics supported by the ESCON aggregation card.

Table 1-13 ESCON Aggregation Card SFP Optics Characteristics

Model Number	Clock Rate Range	Fiber Type	Wavelength	Connector Type
15500-XVRA-01A2	ESCON, OC-3/ STM-1 SR	MM 50/125 μ m MM 62.5/125 μ m	1310 nm	MT-RJ
15500-XVRA-10A1	Low-band 8 Mbps to 200 Mbps	MM 50/125 μ m MM 62.5/125 μ m	1310 nm	LC
15500-XVRA-10B1	Low-band 8 Mbps to 200 Mbps	SM 9/125 μ m	1310 nm	LC
15500-XVRA-11A1	Mid-band 200 Mbps to 622 Mbps	MM 62.5/125 μ m	1310 nm	LC
15500-XVRA-11B1	Mid-band 200 Mbps to 1.25 Gbps	SM 9/125 μ m	1310 nm	LC
15500-XVRA-12B1	High-band 1.062 Gbps to 2.488 Gbps	SM 9/125 μ m	1310 nm	LC



Note

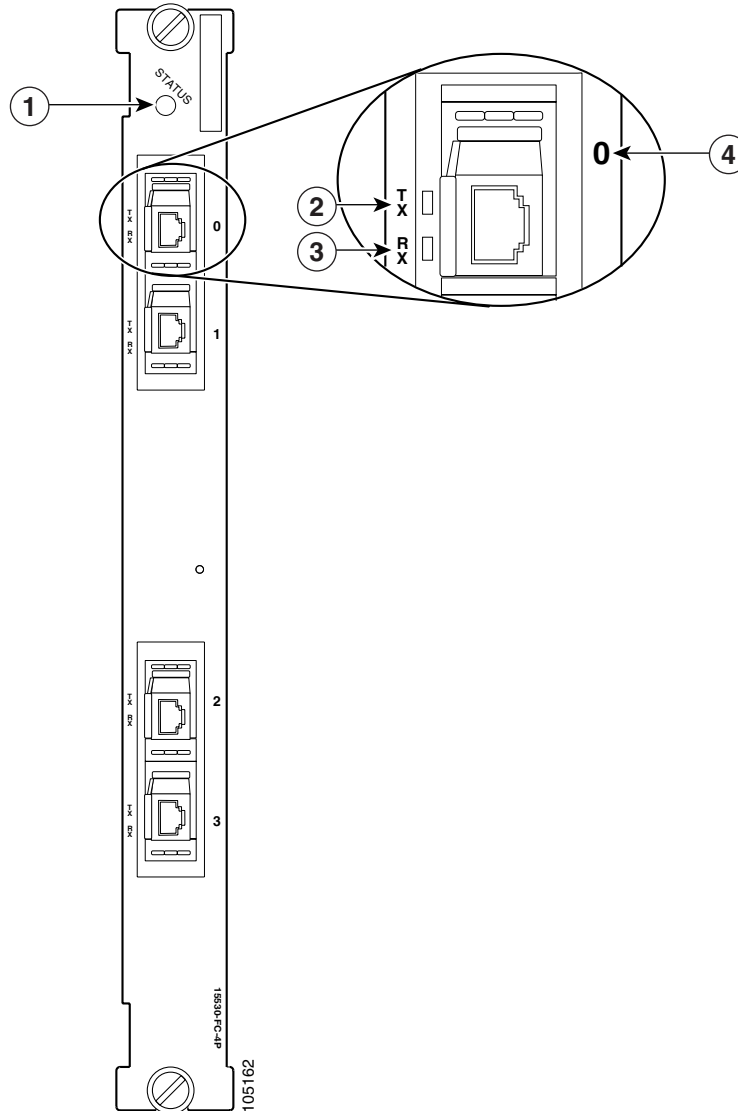
The SFP optics must be purchased separately. Protocol monitoring is the same as for single mode transponder modules and multimode transponder modules.

4-Port 1-Gbps/2-Gbps FC Aggregation Cards

The Cisco ONS 15530 supports a line card for FC (Fibre Channel), FICON, and ISC traffic. The 4-port 1-Gbps/2-Gbps FC aggregation card accepts up to four SFP (small form-factor pluggable) optics for client traffic. Each SFP optic supports either FC, FICON, or ISC, depending on how it is configured in the CLI. The 4-port 1-Gbps/2-Gbps FC aggregation card connects four 2.5-Gbps electric signals, or portgroup interfaces, to the switch fabric. The client port data streams must be mapped to one of these portgroup interfaces, using the CLI. Only two 1-Gbps client interfaces or one 2-Gbps client interface can

be mapped into a single portgroup interface. The signal on the portgroup interfaces connects through the backplane and the switch fabric on the active CPU switch module to a 2.5-Gbps ITU trunk card, a 10-Gbps ITU trunk card, or a 10-Gbps uplink card, where the signal is converted to, and from, an ITU channel. The cross connections between the two cards through the backplane and switch fabrics are configured using the CLI. The 4-port 1-Gbps/2-Gbps FC aggregation card has redundant connections over the backplane to the switch fabric on the active and standby CPU switch modules. (See [Figure 1-22](#)).

Figure 1-22 4-Port 1-Gbps/2-Gbps FC Aggregation Card



1	Status LED	3	Rx LED
2	Tx LED	4	Port number

Table 1-14 lists the LEDs on the 4-port 1-Gbps/2-Gbps FC aggregation card, their default conditions, and what the conditions indicate.

Table 1-14 4-Port 1-Gbps/2-Gbps FC Aggregation Card LEDs

LED	Status	Description
STATUS	Off	No power to the board.
	Red	Card is in reset or the LRC is not configured.
	Yellow	Card is out of reset.
	Green	Card is properly initialized.
TX	Green	Port is up and transmit laser is enabled.
RX	Green	Light reception exists at the port.

The 4-port 1-Gbps/2-Gbps FC aggregation card uses single-mode and multimode SFP optics for the client signals. There are no restrictions on populating the line card with SFPs. Table 1-15 lists the characteristics for the SFP optics supported by the 4-port 1-Gbps/2-Gbps FC aggregation card.

Table 1-15 4-port 1-Gbps/2-Gbps FC Aggregation Card SFP Optics Characteristics

Part Number	Protocols or Clock Rate Range Supported	Fiber Type	Wavelength	Connector Type
15500-XVRA-02C1	Gigabit Ethernet ¹ , Fibre Channel (1 Gbps) ² , FICON (1 Gbps), ISC-1 (1-Gbps)	MM 50/125 µm MM 62.5/125 µm	850 nm	LC
15500-XVRA-03B1	Gigabit Ethernet ³ , Fibre Channel (1 Gbps) ⁴ , FICON (1 Gbps), ISC-3 links compatibility mode	SM 9/125 µm	1310 nm	LC
15500-XVRA-03B2	Fibre Channel (1-Gbps and 2-Gbps), FICON (1-Gbps and 2 Gbps)	SM 9/125 µm	1310 nm	LC
15500-XVRA-11B1	Mid-band variable rate 200-Mbps to 1.25-Gbps, ISC-1	SM 9/125 µm	1310 nm	LC
15500-XVRA-12B1	High-band variable rate 1.062-Gbps to 2.488-Gbps, ISC-1, ISC-3	SM 9/125 µm	1310 nm	LC
15454-SFP-GEFC-SX	Fibre Channel (2-Gbps), Fibre Channel (1-Gbps), FICON (1-Gbps and 2 Gbps) ISC-3 (1-Gbps and 2 Gbps)	MM 50/125 µm MM 62.5/125 µm	850 nm	LC
ONS-SE-GEFC-SX	Fibre Channel (2-Gbps), Fibre Channel (1-Gbps), FICON (1-Gbps and 2 Gbps) ISC-3 (1-Gbps and 2 Gbps)	MM 50/125 µm MM 62.5/125 µm	850 nm	LC

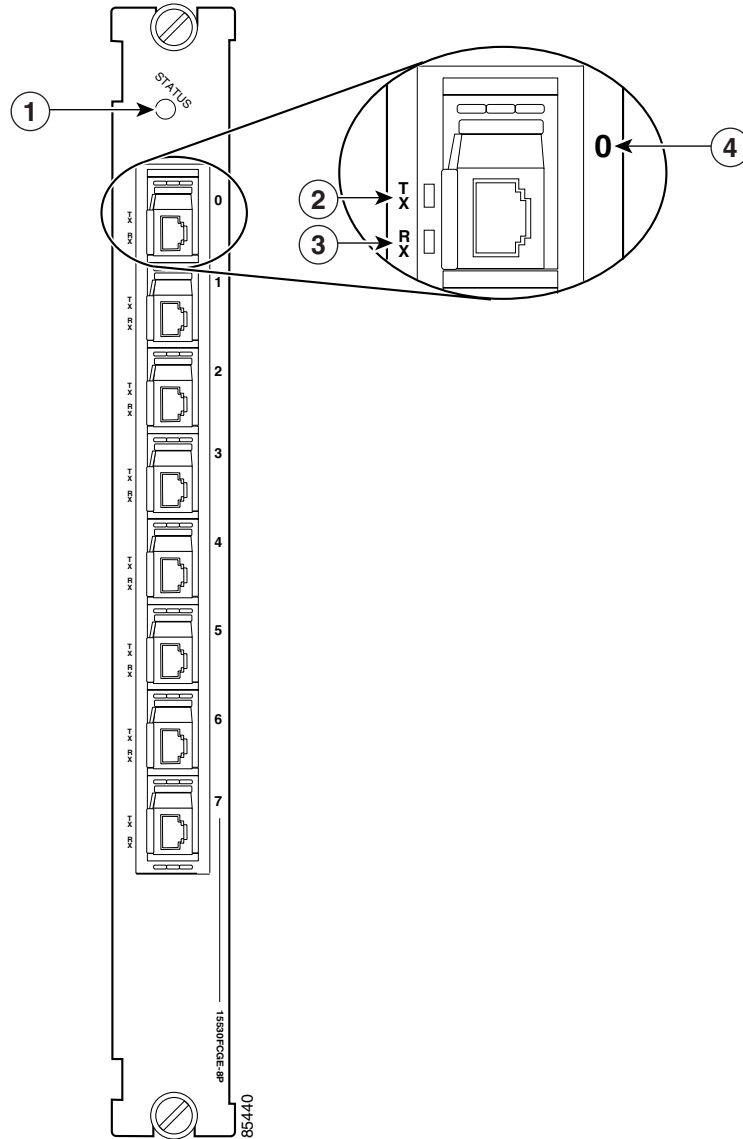
- 1000BASE-SX
- FC-0-100-M5-SN-S and FC-0-100-M6-SN-S standards

3. 1000BASE-LX
4. FC-0-100-SM-LC-S standard

8-Port FC/GE Aggregation Cards

The Cisco ONS 15530 supports a line card specifically for ISC (compatibility and peer mode), FICON, FC (Fibre Channel) and GE (Gigabit Ethernet) traffic. The 8-port Fibre Channel/Gigabit Ethernet aggregation card accepts up to eight SFP (small form-factor pluggable) optics for client traffic. Each SFP optic supports either FC or GE, depending on how it is configured in the CLI. The 8-port FC/GE aggregation card converts client signals from two adjacent port pairs (0–1, 2–3, 4–5, or 6–7) from optical form to electrical form, and then aggregates them into four 2.5-Gbps signals. These aggregated signals pass through the backplane and the switch fabric on the active CPU switch module to a 2.5-Gbps ITU trunk card, a 10-Gbps ITU trunk card, or a 10-Gbps uplink card. The cross connections between the two cards through the backplane and switch fabric are configured using the CLI. The 8-port FC/GE aggregation card has redundant connections over the backplane to the switch fabric on the active and standby CPU switch modules. (See [Figure 1-23](#)).

Figure 1-23 8-Port FC/GE Aggregation Card



1	Card status LED	3	Receive Port status
2	Transmit Port status	4	Port number

Note

The 8-port FC/GE aggregation card also supports FICON traffic at 1 Gbps.

Note

We strongly recommend configuring port pairs as ISC, FICON, FC only or GE only. Mixing FC, FICON, and ISC with GE in a port pair increases the signal latency between nodes.

The Cisco ONS 15530 supports up to four 8-port FC/GE aggregation cards for a total of 32 client signals.

Table 1-16 describes the LEDs on the 8-port FC/GE aggregation card.

Table 1-16 8-Port FC/GE Aggregation Card LEDs

LED	Status	Description
STATUS	Off	No power to the board.
	Red	Card is in reset or the LRC is not configured.
	Yellow	Card is out of reset.
	Green	Card is properly initialized.
TX	Green	Port is up and transmit laser is enabled.
RX	Green	Light reception exists at the port.

The 8-port FC/GE aggregation card uses single-mode and multimode SFP optics for the client signals. There are no restrictions on populating the line card with SFPs. For example, you can mix a single-mode SFP optics with a multimode SFP optics on the same port pair. Table 1-17 lists the characteristics for the SFP optics supported by the 8-port FC/GE aggregation card.

Table 1-17 8-port FC/GE Aggregation Card SFP Optics Characteristics

Part Number	Protocols or Clock Rate Range Supported	Fiber Type	Wavelength	Connector Type
15500-XVRA-02C1	Gigabit Ethernet ¹ , Fibre Channel (1 Gbps) ² , FICON (1 Gbps)	MM 50/125 µm MM 62.5/125 µm	850 nm	LC
15500-XVRA-03B1	Gigabit Ethernet ³ , Fibre Channel (1 Gbps) ⁴ , FICON (1 Gbps), ISC-3 links compatibility mode, ISC peer mode	SM 9/125 µm	1310 nm	LC
15500-XVRA-11B1	Mid-band variable rate 200 Mbps to 1.25 Gbps	SM 9/125 µm	1310 nm	LC
15500-XVRA-11B2	Mid-band variable rate 200 Mbps to 1.25 Gbps	SM 9/125 µm	1310 nm	LC
15500-XVRA-12B1	High-band variable rate 1.062 Gbps to 2.488 Gbps	SM 9/125 µm	1310 nm	LC

1. 1000BASE-SX
2. FC-0-100-M5-SN-S and FC-0-100-M6-SN-S standards
3. 1000BASE-LX
4. FC-0-100-SM-LC-S standard



Note

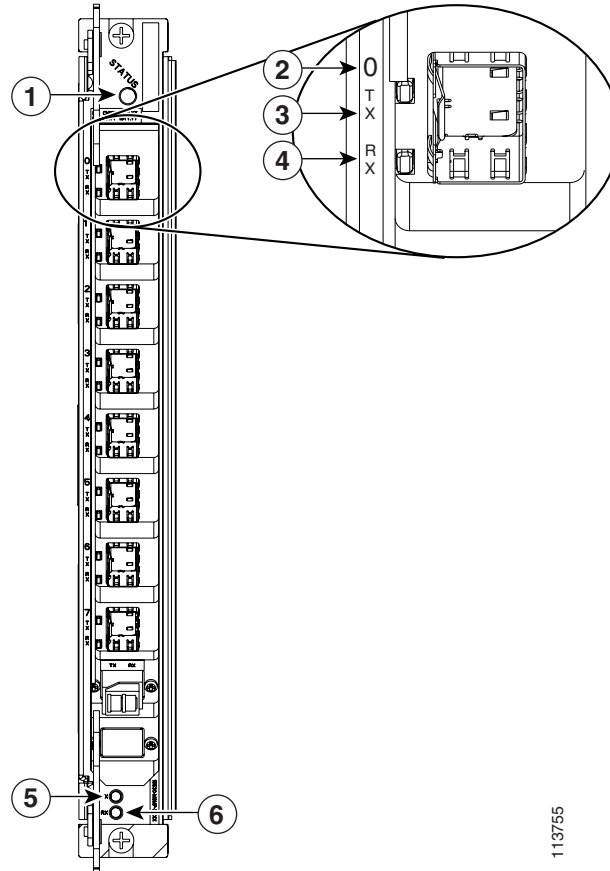
The SFP optics must be purchased separately.

Protocol monitoring is the same as for single mode transponder modules and multimode transponder modules.

8-Port Multi-Service Muxponders

The 8-port multi-service muxponder aggregates up to eight ports of client traffic into 2.5-Gbps DWDM traffic to the trunk. The muxponder transports a mix of different protocols between sites in a metro DWDM network. The protocols that can be aggregated and transported range from high-speed services such as Fibre Channel and Gigabit Ethernet to low-speed services such as OC-3, Fast Ethernet, or even T1 or E1. [Figure 1-24](#) shows a nonsplitter protected 8-port multi-service muxponder.

Figure 1-24 8-Port Multi-Service Muxponder (Nonsplitter)

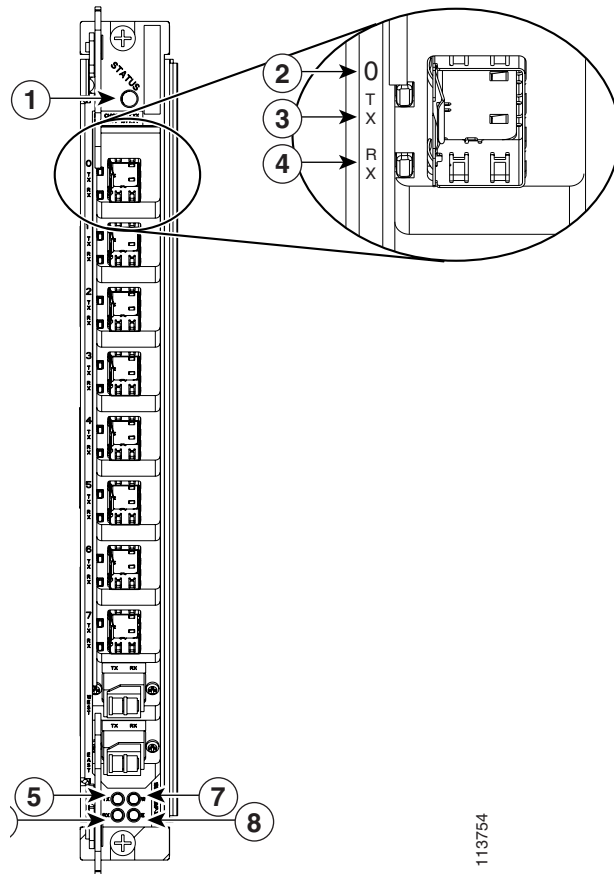


113755

1	Status LED	4	Port Rx (receive) LED
2	Port number	5	Trunk Tx (transmit) LED
3	Port Tx (transmit)	6	Trunk Rx (receive) LED

Figure 1-25 shows a splitter protected 8-port multi-service muxponder.

Figure 1-25 8-Port Multi-Service Muxponder (Splitter)



113754

1	Status LED	5	Trunk Tx (transmit) LED
2	Port number	6	Trunk Rx (receive) LED
3	Port Tx (transmit)	7	Trunk east LED
4	Port Rx (receive)	8	Trunk west LED

Table 1-18 lists the LEDs on the 8-port multi-service muxponder faceplate, their default conditions, and what the conditions indicate.

Table 1-18 8-Port Multi-Service Muxponder LEDs

LED	Status	Description
Status	Off	No power to the muxponder.
	Red	The functional image on the trunk is not configured.
	Yellow	The system clock is not present.
	Blinking green	The muxponder is out of reset, and the system clock is good and waiting for software initialization.
	Green	The muxponder is initialized and operational.
Client port status	Rx green	Port is operational.
	Rx off	Rx link is down.
	Tx green	Transmit enabled.
	Tx off	Transmit disabled.
Trunk status	East green	The muxponder is communicating with the West signal.
	West green	The muxponder is communicating with the East signal.
	Rx green	Light reception exists at the port.
	Txgreen	Transmit enabled.

The 8-port multi-service muxponder uses SFPs for the client signals. There are no restrictions on populating the line card with SFPs. For example, you can mix a single-mode SFP with a multimode SFP on the same card. [Table 1-19](#) lists the characteristics for the SFPs supported by the 8-port multi-service muxponder.

Table 1-19 8-Port Multi-Service Muxponder SFP Characteristics

Part Number	Protocols or Clock Rate Range Supported	Fiber Type	Wavelength	Connector Type
15500-XVRA-10A2	Low band 8 Mbps to 200 Mbps	MM 50/125 μ m MM 62.5/125 μ m	1310 nm	LC
15500-XVRA-10B2	Low band 8 Mbps to 200 Mbps	SM 9/125 μ m	1310 nm	LC
15500-XVRA-11A2	Mid-band 200 Mbps to 622 Mbps	MM 62.5/125 μ m	1310 nm	LC
15500-XVRA-11B2	Mid-band 200 Mbps to 1.25 Gbps	SM 9/125 μ m	1310 nm	LC
15500-XVRA-12B1	High-band 1.062 Gbps to 2.488 Gbps	SM 9/125 μ m	1310 nm	LC
15454-SFP-GEFC-SX	Fibre Channel (2.125 Gbps), Fibre Channel (1 Gbps), Gigabit Ethernet	MM 50/125 μ m MM 62.5/125 μ m	850 nm	LC
15500-XVRA-08D1	T1 ¹ 1.544 Mbps	Copper T1	–	RJ-45
15500-XVRA-09D1	E1 2.044 Mbps	Copper E1	–	RJ-45

Table 1-19 8-Port Multi-Service Muxponder SFP Characteristics (continued)

Part Number	Protocols or Clock Rate Range Supported	Fiber Type	Wavelength	Connector Type
15500-XVRA-10E1 ²	SDI and DVB-ASI ³ Video	Copper Digital Video	–	Mini SMB Coax
15500-XVRA-11D1 ⁴	GE 1.25 Gbps, FE 1.25 Mbps	Copper GE/FE	–	RJ-45

1. DSX-1 interface
2. In a normal operating environment, the maximum digital video application connection length using a Belden 1694A cable is 200 m (218 yd). If the chassis ambient operating temperature is above 45°C (113° F) and ports 0 and 1 are used for video applications with this SFP, the maximum cable connection length supported may be less than the specified 200 m (218 yd), depending on the operating environment.
3. Data Video Broadcast Asynchronous Serial Interface
4. To ensure proper operation of the 15500-XVRA-11D1 SFP, the ambient operating temperature should not exceed 45°C (113°F).

The following warning applies to the copper SFPs listed in [Table 1-19](#).

**Warning**

For connections outside the building where the equipment is installed, the following ports must be connected through an approved network termination unit with integral circuit protection. 15500-XVRA-08D1, 15500-XVRA-09D1, 15500-XVRA-10E1 and 15500-XVRA-11D1. Statement 1044

**Note**

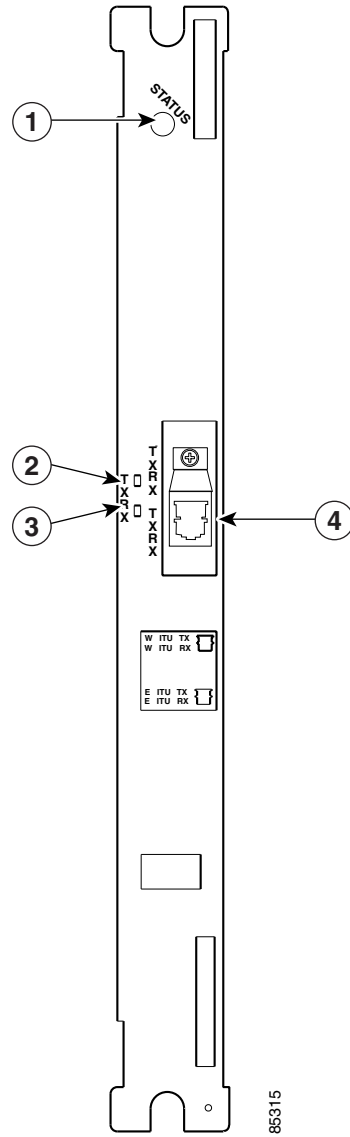
The SFPs must be purchased separately.

2.5-Gbps ITU Trunk Cards

The 2.5-Gbps ITU trunk card sends and receives the ITU grid wavelength signal to and from an OADM module. This card accepts a 2.5-Gbps (3.125-Gbps line rate) electrical signal from either a 10-port ESCON aggregation card or an 8-port FC/GE aggregation card, which is converted to the ITU grid wavelength, or channel. The 2.5-Gbps ITU trunk card has redundant interfaces to the backplane, connecting to the switch fabrics on the active and standby CPU switch modules. The ITU laser is tunable to one of two channel frequencies. There are 16 different 2.5-Gbps ITU trunk cards (for channels 1–2, 3–4, ..., 31–32) to support the 32 channels.

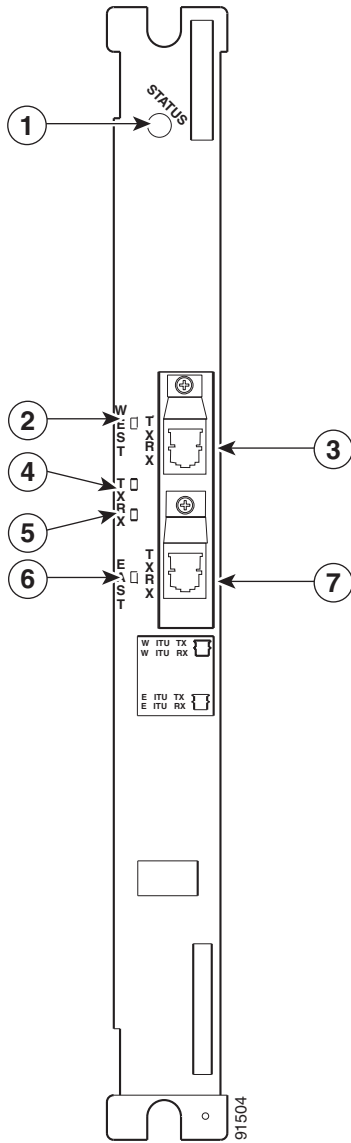
The 2.5-Gbps ITU trunk card has two versions: nonsplitter (shown in [Figure 1-26](#)) and splitter (shown in [Figure 1-27](#)). The nonsplitter version has only one pair of optical connectors on the front panel, which connects to either the east or the west OADM module, and can be used for unprotected, line card protected, or switch fabric protected applications. The card supports 32 channels as shown in [Table A-2 on page A-3](#).

Figure 1-26 2.5-Gbps ITU Trunk Card (Nonsplitter)



1	Card status LED	3	Receive LED
2	Transmit LED	4	Transmit/Receive port

Figure 1-27 2.5-Gbps ITU Trunk Card (Splitter)



1	Card status LED	5	Receive LED
2	West side port LED	6	East side port LED
3	West side port	7	East side port
4	Transmit LED		

Table 1-20 lists and describes the 2.5-Gbps ITU Trunk Card LEDs.

Table 1-20 2.5-Gbps ITU Trunk Card LEDs

LED	Status	Description
STATUS	Green	Card is properly initialized.
WEST	Green	Card is listening to the west side signal.
TX	Green	Port is up and transmit laser is enabled.
RX	Green	Light reception exists at the port.
EAST	Green	Card is listening to the east side signal.

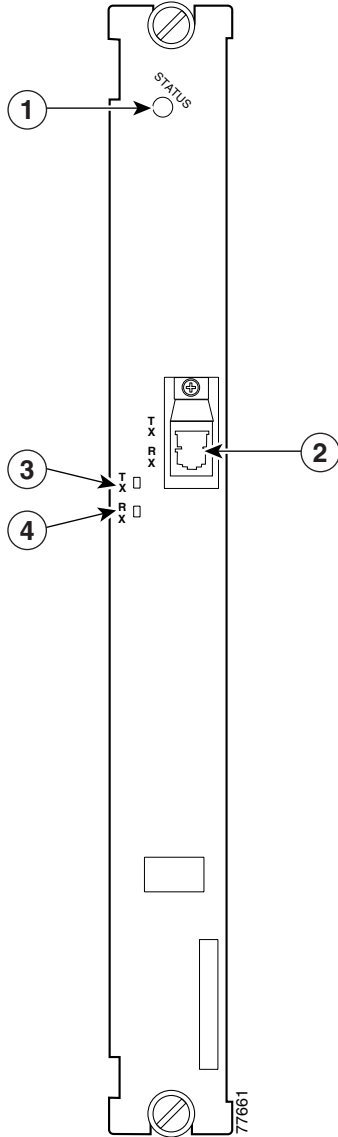
10-Gbps ITU Trunk Cards

The 10-Gbps ITU trunk card sends and receives the ITU grid wavelength signal to and from an OADM module. This card accepts up to four 2.5-Gbps (3.125-Gbps line rate) electrical signals from the 10-port ESCON aggregation cards and 8-port FC/GE aggregation cards, and combines them into one 10-Gbps signal, which is converted to the ITU grid wavelength, or channel. The 10-Gbps ITU trunk card has four separate redundant interfaces to the backplane, each connecting to the switch fabrics on the active and standby CPU switch modules.

The 10-Gbps ITU trunk card has two versions: nonsplitter and splitter. The nonsplitter version has only one pair of optical connectors on the front panel, which connects to either the east or the west OADM module, and can be used for unprotected, line card protected, or switch fabric protected applications (see [Figure 1-28](#)). The splitter version of the 10-Gbps ITU trunk card has two pairs of optical connectors on the front panel, which connect to the east and west OADM modules, and is designed for splitter protected applications (see [Figure 1-29](#)).

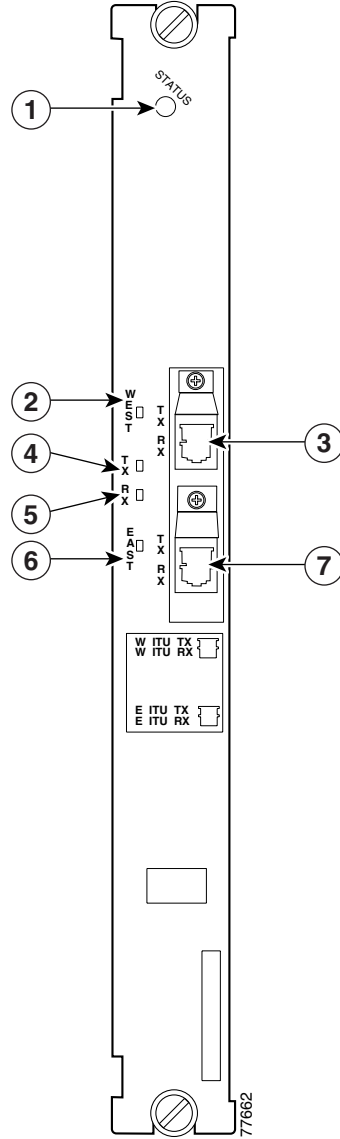
The Cisco ONS 15530 supports up to four 10-Gbps ITU trunk cards for a total of four channels.

Figure 1-28 10-Gbps ITU Trunk Card (Nonsplitter)



1	Card status LED	3	Transmit LED
2	ITU port	4	Receive LED

Figure 1-29 10-Gbps ITU Trunk Card (Splitter)



1	Card status LED	5	Receive LED
2	West side port LED	6	East side port LED
3	West side port	7	East side port
4	Transmit LED		

Table 1-21 describes the 10-Gbps ITU trunk card LED status.

Table 1-21 10-Gbps ITU Trunk Card LEDs

LED	Status	Description
STATUS	Green	Card is properly initialized.
WEST	Green	Card is listening to the west side signal.
TX	Green	Port is up and transmit laser is enabled.
RX	Green	Light reception exists at the port.
EAST	Green	Card is listening to the east side signal.

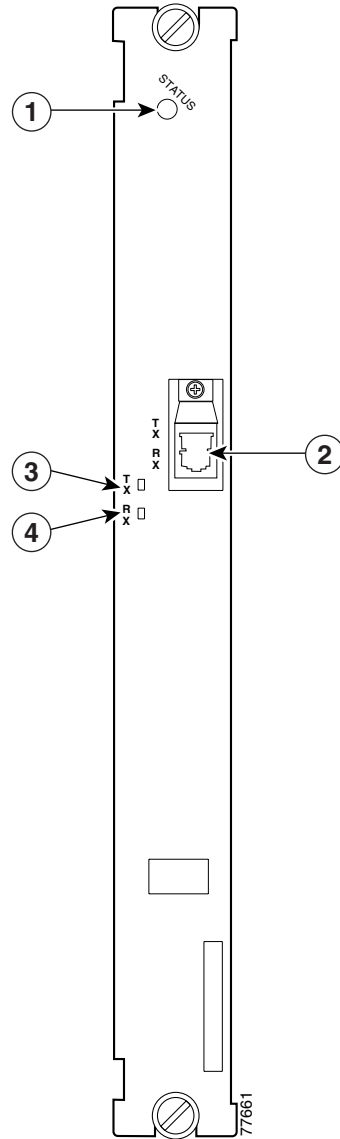
10-Gbps ITU Tunable Trunk Cards

The 10-Gbps ITU tunable trunk card works similar to the 10-Gbps ITU trunk card. The 10-Gbps ITU tunable trunk card sends and receives the ITU grid wavelength signal to and from an OADM module. This card accepts up to four 2.5-Gbps (3.125-Gbps line rate) electrical signals from the 10-port ESCON aggregation cards and 8-port FC/GE aggregation cards, and combines them into one 10-Gbps signal, which is converted to the ITU grid wavelength, or channel. The 10-Gbps ITU tunable trunk card has four separate redundant interfaces to the backplane, each connecting to the switch fabrics on the active and standby CPU switch modules.

The 10-Gbps ITU tunable trunk card has two versions: nonsplitter and splitter. The nonsplitter version has only one pair of optical connectors on the front panel, which connects to either the east or the west OADM module, and can be used for unprotected, line card protected, or switch fabric protected applications (see Figure 1-30). The splitter version of the 10-Gbps ITU tunable trunk card has two pairs of optical connectors on the front panel, which connect to the east and west OADM modules, and is designed for splitter protected applications (see Figure 1-31).

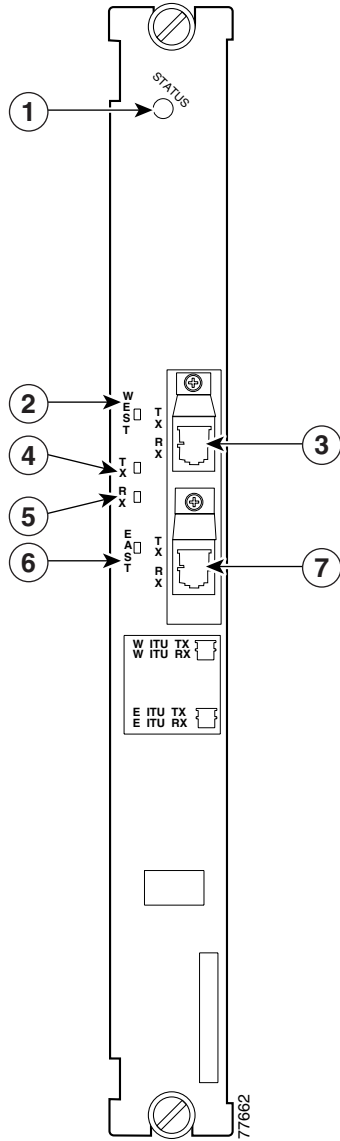
The Cisco ONS 15530 supports up to four 10-Gbps ITU tunable trunk cards for a total of four channels. The 10-Gbps ITU tunable trunk cards are equipped with Universal Transponders (UT1) with tuneable lasers. The cards are programmable to four different frequencies belonging to one of the A, B, C, D, E, F, G, or H bands. For more information on tuneable frequencies, see *Cisco ONS 15530 Planning Guide*.

Figure 1-30 10-Gbps ITU Tunable Trunk Card (Nonsplitter)



1	Card status LED	3	Transmit LED
2	ITU port	4	Receive LED

Figure 1-31 10-Gbps ITU Tunable Trunk Card (Splitter)



1	Card status LED	5	Receive LED
2	West side port LED	6	East side port LED
3	West side port	7	East side port
4	Transmit LED		

Table 1-22 describes the 10-Gbps ITU tunable trunk card LED status.

Table 1-22 10-Gbps ITU Tunable Trunk Card LEDs

LED	Status	Description
STATUS	Green	Card is properly initialized.
WEST	Green	Card is listening to the west side signal.
TX	Green	Port is up and transmit laser is enabled.
RX	Green	Light reception exists at the port.
EAST	Green	Card is listening to the east side signal.

10-Gbps Uplink Cards

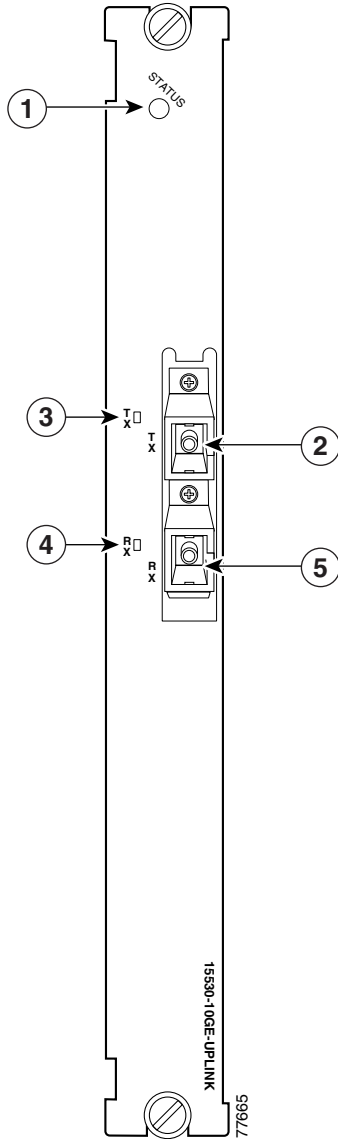
The 10-Gbps uplink card, shown in Figure 1-32, sends and receives a 10-GE 1310-nm signal to and from a 10-GE uplink card on another Cisco ONS 15530, or to and from a 10-GE transponder module on a Cisco ONS 15540 ESP or Cisco ONS 15540 ESPx. This card accepts up to four (3.125-Gbps line rate) electrical signals from 10-port ESCON aggregation cards and 8-port FC/GE aggregation cards, and combines them into one 10-GE signal.

The 10-Gbps uplink card has four separate redundant interfaces to the backplane. Each interface connects to the switch fabric on the active and standby CPU switch modules.

The 10-Gbps uplink card has only one version: nonsplitter. The nonsplitter version has only one pair of optical connectors on the front panel and can be used for unprotected or line card protected applications. For splitter protected configurations, the splitter line card motherboards on the Cisco ONS 15540 ESP and the Cisco ONS 15540 ESPx provide the facility protection.

The Cisco ONS 15530 supports up to four 10-Gbps uplink cards for a total of four signals.

Figure 1-32 10-Gbps Uplink Card



1	Card status LED	4	Receive LED
2	Transmit port	5	Receive port
3	Transmit LED		

Table 1-23 describes the 10-Gbps uplink line card LED status.

Table 1-23 10-Gbps Uplink Line Card LEDs

LED	Status	Description
STATUS	Green	Card is properly initialized.
TX	Green	Port is up and transmit laser is enabled.
RX	Green	Light reception exists at the port.



Installing the Cisco ONS 15530

This chapter describes the installation procedures for the Cisco ONS 15530 chassis and its components. This chapter includes the following sections:

- [Before Installing, page 2-1](#)
- [Chassis-Lifting Guidelines, page 2-2](#)
- [Rack-Mounting the Shelf, page 2-4](#)
- [Grounding the Shelf, page 2-14](#)
- [Installing and Removing Line Cards or Motherboards, page 2-17](#)
- [Installing and Removing Modules, page 2-24](#)
- [Replacing the Fan Assembly, page 2-27](#)
- [Power Guidelines, page 2-29](#)
- [Powering Up the Shelf, page 2-31](#)



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.



Note

To ensure that your Cisco IOS software release supports your hardware, see the [“New and Changed Information” section on page vii](#). Also refer to the “Hardware Supported” section of the latest release notes for the Cisco ONS 15530.

Before Installing

Before you install the Cisco ONS 15530, you must complete the following tasks:

- Unpack and inspect the shelf.
- Maintain a network record.
- Assemble required tools and equipment.
- Mount the shelf.

**Caution**

Use extreme care when removing or installing connectors so you do not damage the connector housing or scratch the end-face surface of the fiber. Always install protective covers on unused or disconnected components to prevent contamination. Always clean fiber connectors before installing them.

Unpacking and Inspecting the Shelf

The Cisco ONS 15530 comes with the standard mounting set. The shelf is thoroughly inspected before shipment. If any damage has occurred during transportation or if any item is missing, notify your Cisco customer service representative immediately.

Upon receipt, inspect the equipment as follows:

Step 1 Take inventory.

Compare the equipment inside with the packing slip and the equipment list provided by customer service. If there are any discrepancies, notify the Customer Service Center.

Step 2 Check for external damage.

Visually check all components and immediately report any shipping damage to your customer service representative. Have the following information ready:

- Invoice number of shipper (see packing slip)
- Model and serial number of the damaged unit
- Description of damage
- Effect of damage on the installation

Keep a record of all of your hardware, configuration options, and network settings.

Mounting the Shelf

The unit is designed for rack-mounting in a cabinet rack. Use star-type lock washers on the rack screws to ensure a good conductive connection between the chassis and the rack. For information about installing the units in a customer cabinet, see the instructions from the cabinet manufacturer.

Chassis-Lifting Guidelines

The fully configured system weighs approximately 71 pounds. The chassis is not intended to be moved frequently. Before you install the system, ensure that your site is properly prepared so you can avoid having to move the chassis later to accommodate power sources and network connections.

Two or more people are required to lift the chassis. Each time you lift the chassis or any heavy object, follow these guidelines:

- Never attempt to lift the chassis by yourself. Because of the size and weight of the chassis, use at least two people to safely lift and move it without causing injury or damaging the equipment.
- Ensure that your footing is solid, and balance the weight of the chassis between your feet.

- Lift the chassis slowly; never move suddenly or twist your body as you lift.
- Keep your back straight and lift with your legs, not your back. If you must bend down to lift the chassis, bend at the knees, not at the waist, to reduce the strain on your back muscles.
- Do not remove installed components from the chassis.
- Always disconnect all external cables before lifting or moving the chassis.

To safely lift the chassis, follow these steps:

**Warning**

Two people are required to lift the chassis. To prevent injury, keep your back straight and lift with your legs, not your back.

- Step 1** Each person should stand on either side of the chassis, and place one hand under the air intake at the bottom front of the chassis.
- Step 2** With the other hand, grasp the handle on the chassis and carefully lift the chassis as shown in [Figure 2-1](#) and [Figure 2-2](#).

Figure 2-1 *Lifting the Cisco ONS 15530 CHAS-E*

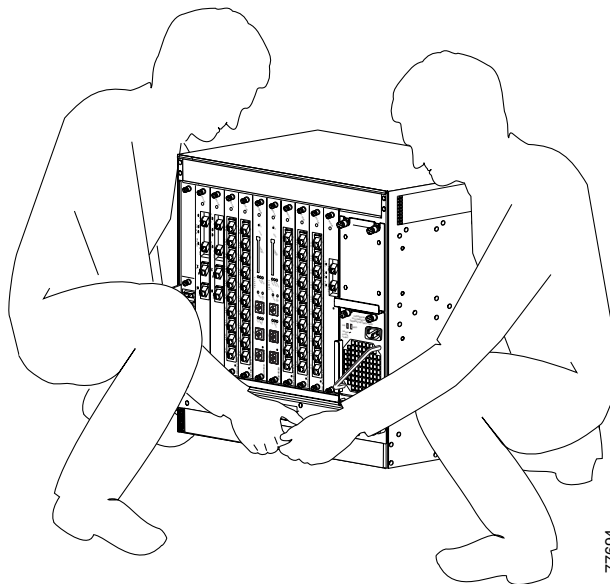
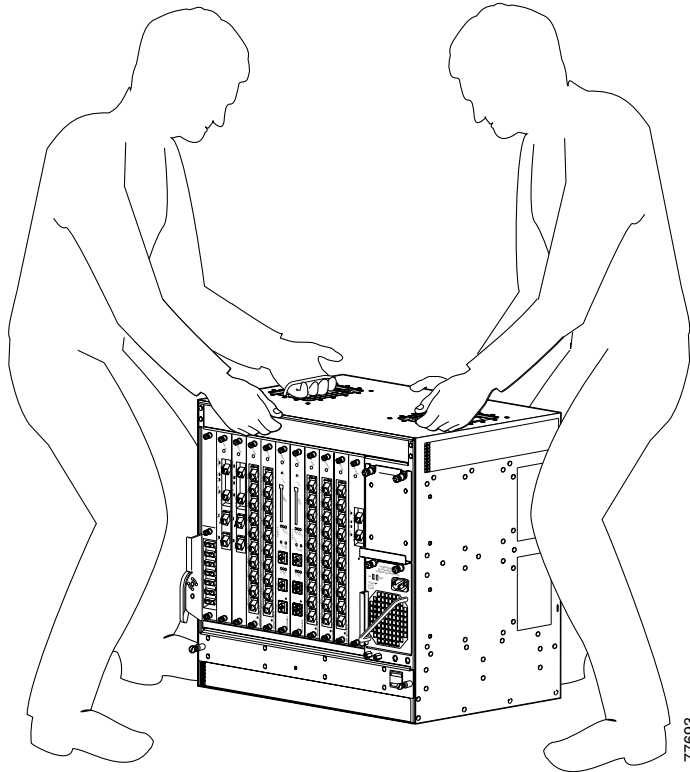


Figure 2-2 Lifting the Cisco ONS 15530 CHAS-N



Rack-Mounting the Shelf

Rack-mounting the shelf is the preferred method of installation for the Cisco ONS 15530. This section gives general rack-mount installation guidelines and explains how to install the rack-mount and cable-management brackets on the Cisco ONS 15530 for the following types of installations:

- [General Rack-Mount Installation Guidelines, page 2-5](#)
- [Flush-Mounting the Cisco ONS 15530 CHAS-N in a 19-Inch Rack, page 2-5](#)
- [Flush-Mounting the Cisco ONS 15530 CHAS-E in a 21-Inch Rack, page 2-7](#)

General Rack-Mount Installation Guidelines

When planning your rack-mount installation, consider the following guidelines:

- Allow a minimum of 11 rack units (17.7 inches or 45.0 cm) of vertical rack space for the Cisco ONS 15530 CHAS-E chassis with the air ramp baffle. The Cisco ONS 15530 CHAS-N chassis requires a minimum of 9 rack units (15.7 inches or 39.9 cm) of vertical rack space. Measure the proposed rack location before mounting the chassis in the rack.



Note The Cisco ONS 15530 CHAS-E chassis cannot be installed in a 19-inch rack.

- Check for obstructions (such as a power strip) that could impair rack-mount installation before using a particular rack. If a power strip does impair a rack-mount installation, remove the power strip before installing the chassis, and then replace it after the chassis is installed.
- Allow sufficient clearance around the rack for maintenance. If the rack is mobile, you can push it back near a wall or cabinet for normal operation and pull it out for maintenance (installing or moving line cards, connecting cables, or replacing or upgrading components). Otherwise, allow 19 inches (48.3 cm) of clearance to remove FRUs (field replaceable units).
- Maintain a minimum clearance of 3 inches (7.62 cm) on the front, top, and sides of the chassis for the cooling air inlet and exhaust ports, respectively. Avoid placing the chassis in an overly congested rack or directly next to another equipment rack; otherwise, the heated exhaust air from other equipment can enter the inlet air vents and cause an over temperature condition inside the chassis.



Caution To prevent chassis overheating, never install a Cisco ONS 15530 in an enclosed rack or room that is not properly ventilated or air conditioned.



Caution Always install the air ramp baffle below the Cisco ONS 15530 CHAS-E.

- Always install heavier equipment in the lower half of a rack to maintain a low center of gravity to prevent the rack from falling over.
- Install and use the cable-management brackets included with the Cisco ONS 15530 to keep cables organized and out of the way of the line cards and CPU switch modules. Ensure that cables from other equipment already installed in the rack do not impair access to the line cards, or require you to disconnect cables unnecessarily to perform equipment maintenance or upgrades.
- Install rack stabilizers (if available) before you mount the chassis.
- Provide an adequate chassis ground (earth) connection for your chassis.

Flush-Mounting the Cisco ONS 15530 CHAS-N in a 19-Inch Rack

The Cisco ONS 15530 CHAS-N can be flush-mounted in a 19-inch equipment rack using the rack-mounting kit provided with your system. The rack-mounting kit contains the following parts:

- Two mounting brackets and screws
- Cable management brackets
- Optional 23-inch rack-mount brackets

**Note**

The Cisco ONS 15530 CHAS-E chassis cannot be installed in a 19-inch rack.

**Warning**

At least three people are required to mount the chassis in the equipment rack: two people are needed to hold the chassis in place while a third person tightens the mounting screws. When handling the chassis, always follow proper lifting practices as outlined in the “Chassis-Lifting Guidelines” section on page 2-2.

To flush-mount the Cisco ONS 15530 CHAS-N chassis in a 19-inch equipment rack, follow these steps :

- Step 1** Attach the mounting brackets to the shelf (see [Figure 2-3](#)).
- Step 2** Lift the shelf into position between the rack posts (requires two people).
- Step 3** Align the mounting bracket holes with the rack post holes (see [Figure 2-4](#)) and attach the shelf to the rack (performed by the third person).

Figure 2-3 Attaching Mounting Brackets to Shelf

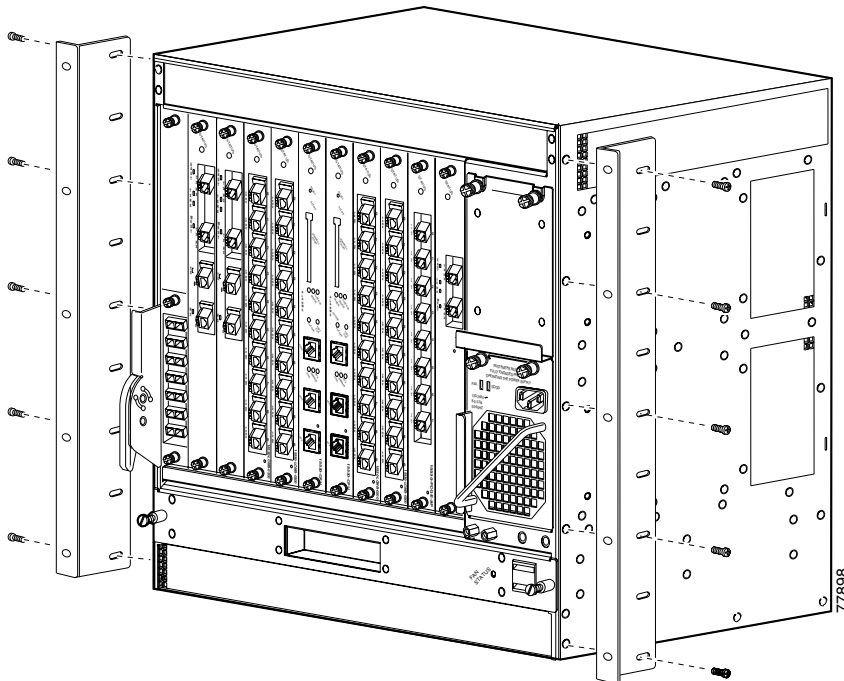
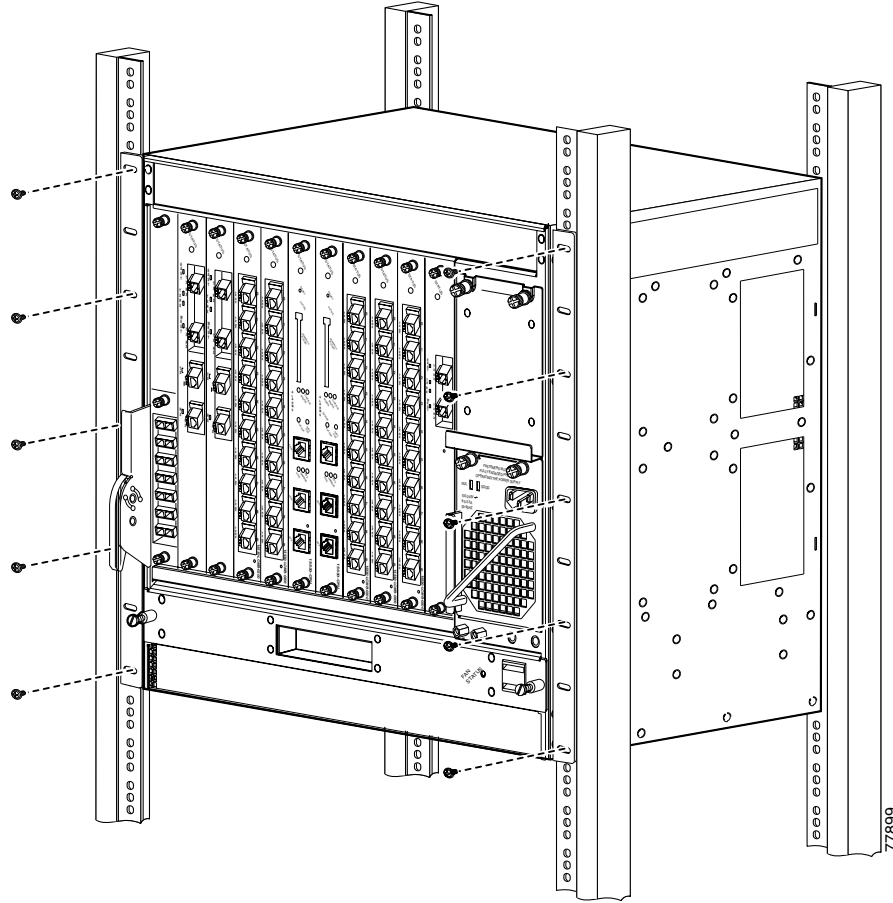


Figure 2-4 Attaching Shelf to Equipment Rack



- Step 4** Check that all release levers are in the closed position, the chassis mounting screws are tight, and all CPU switch module and line card captive screws are tight.

Flush-Mounting the Cisco ONS 15530 CHAS-E in a 21-Inch Rack

The Cisco ONS 15530 CHAS-E can be flush-mounted in a 21-inch equipment rack using the rack-mounting kit provided with your system. The rack-mounting kit contains the following parts:

- Two mounting brackets and screws
- Cable management brackets



Caution

At least three people are required to mount the chassis in the equipment rack: two people are needed to hold the chassis in place while a third person tightens the mounting screws. When handling the chassis, always follow proper lifting practices as outlined in the [“Chassis-Lifting Guidelines”](#) section on [page 2-2](#).

To flush-mount the Cisco ONS 15530 CHAS-N chassis in a 19-inch equipment rack, use the following steps:

-
- Step 1** Attach the mounting brackets to the shelf (see [Figure 2-5](#)).
 - Step 2** Lift the shelf into position between the rack posts (requires two people).
 - Step 3** Align the mounting bracket holes with the rack post holes (see [Figure 2-6](#)) and attach the shelf to the rack (performed by the third person).

Figure 2-5 Attaching Mounting Brackets to Shelf

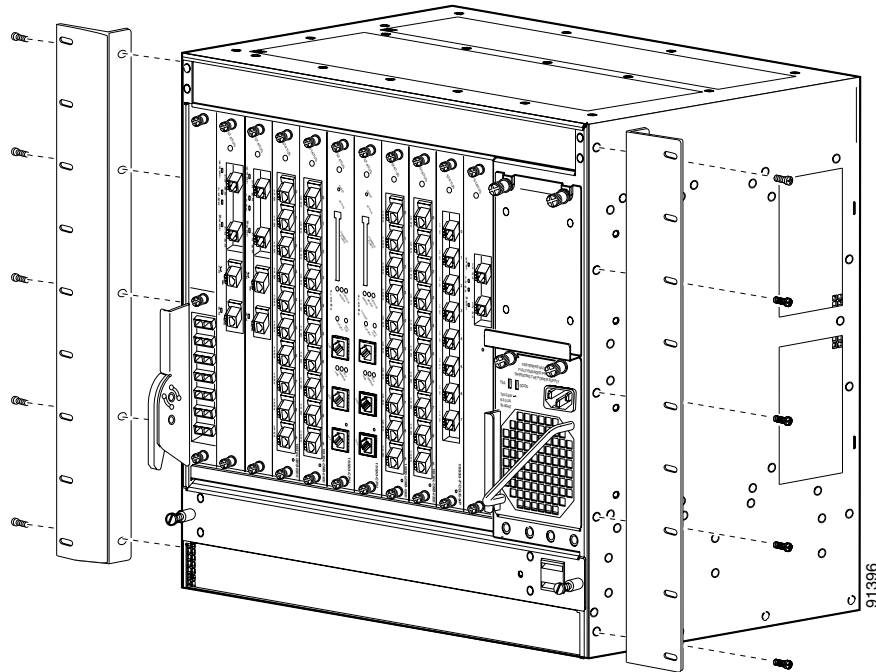
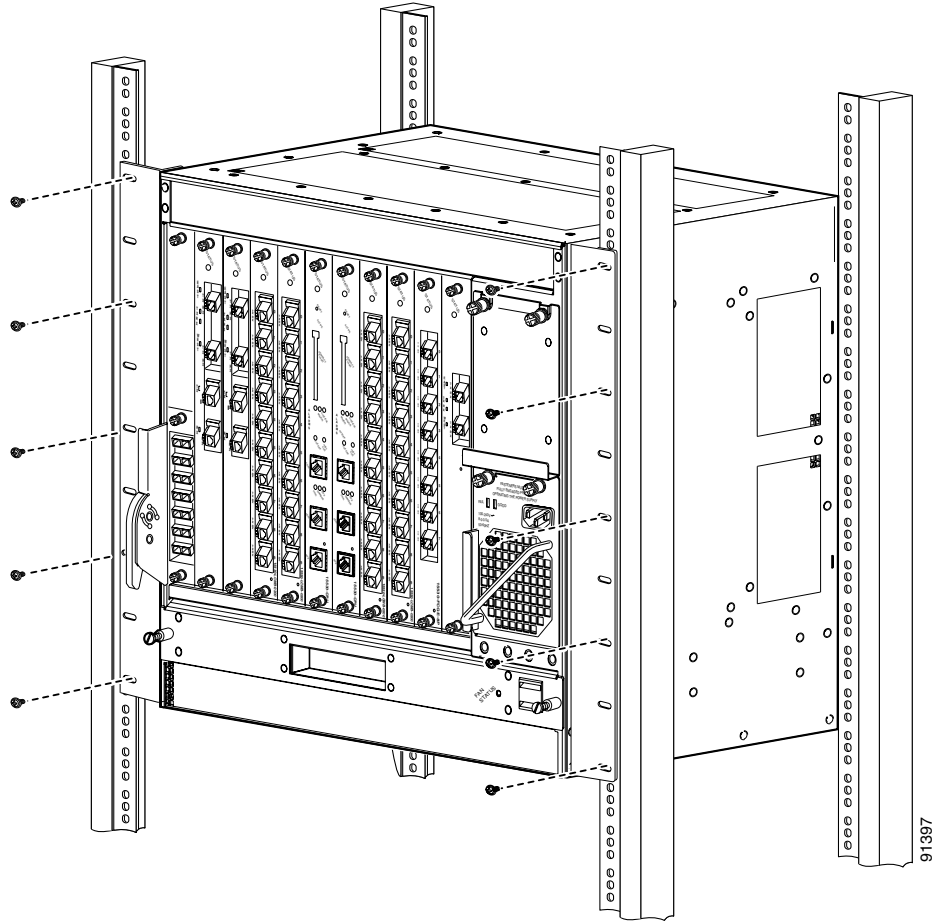


Figure 2-6 Attaching Shelf to Equipment Rack



- Step 4** Check that all release levers are in the closed position, the chassis mounting screws are tight, and all CPU switch module and line card captive screws are tight.
- Step 5** Proceed to the [“Attaching the Air Ramp Baffle”](#) section on page 2-10.
-

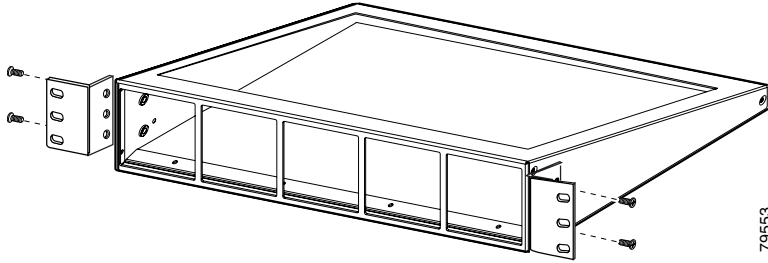
Attaching the Air Ramp Baffle

The air ramp baffle redirects the intake of cooling air from directly below, to the front of the Cisco ONS 15530 CHAS-E chassis, while deflecting hot exhaust air from equipment installed below.

To attach the air ramp baffle to the Cisco ONS 15530 CHAS-E chassis, follow these steps:

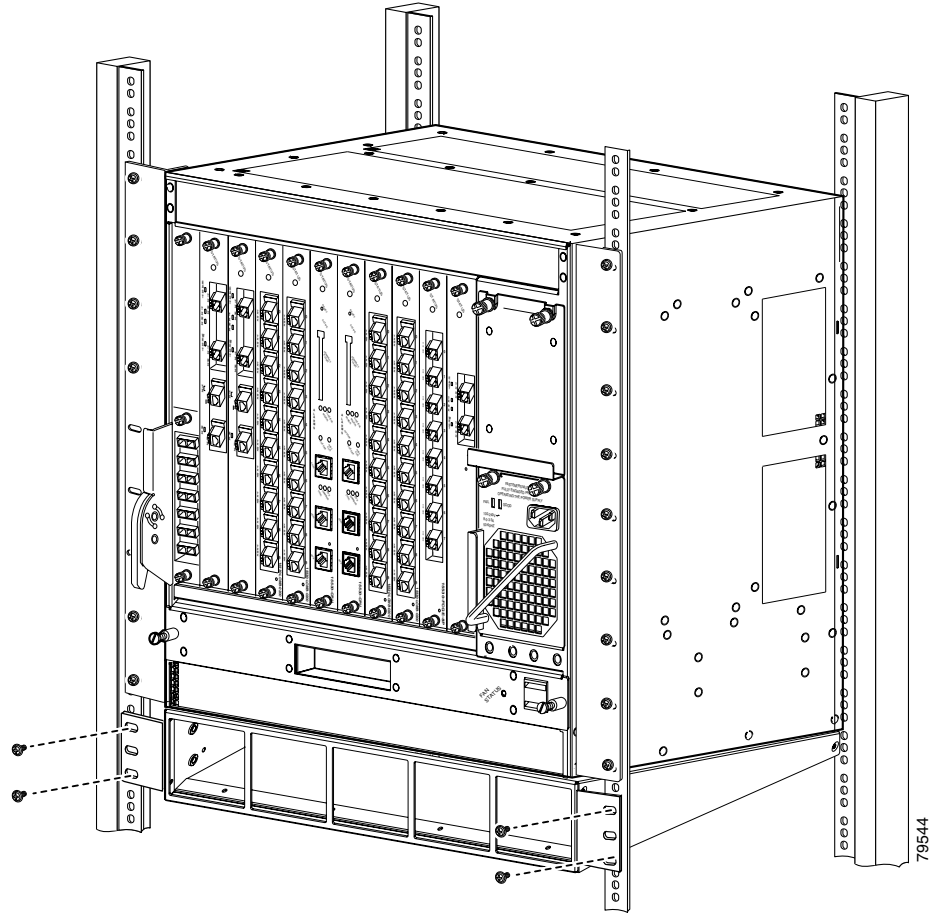
- Step 1** Attach the mounting brackets to the air ramp baffle as shown in [Figure 2-7](#).

Figure 2-7 Air Ramp Baffle Mounting Brackets



- Step 2** Position the air ramp baffle directly under the Cisco ONS 15530 CHAS-E chassis.
- Step 3** Screw the air ramp baffle to the equipment rack as shown in [Figure 2-8](#).

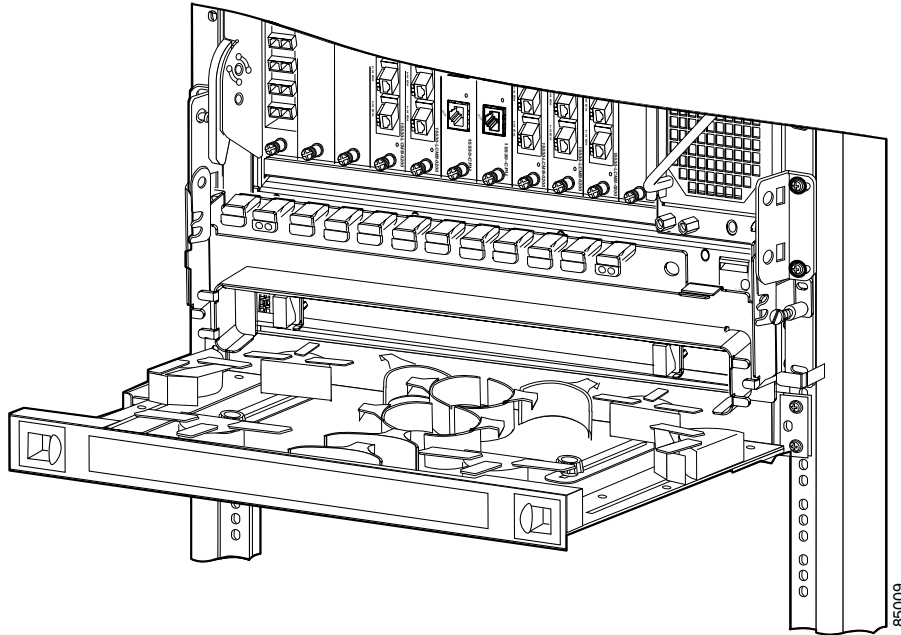
Figure 2-8 Installing the Air Ramp Baffle



Installing the Fiber Routing Management System

The fiber routing management system contains two main components; the cable routing tray and the cable routing drawer. The fiber routing tray is installed directly over the fan assembly, and the fiber routing drawer is installed below the Cisco ONS 15530 chassis. (See [Figure 2-9](#).)

Figure 2-9 Fiber Management System

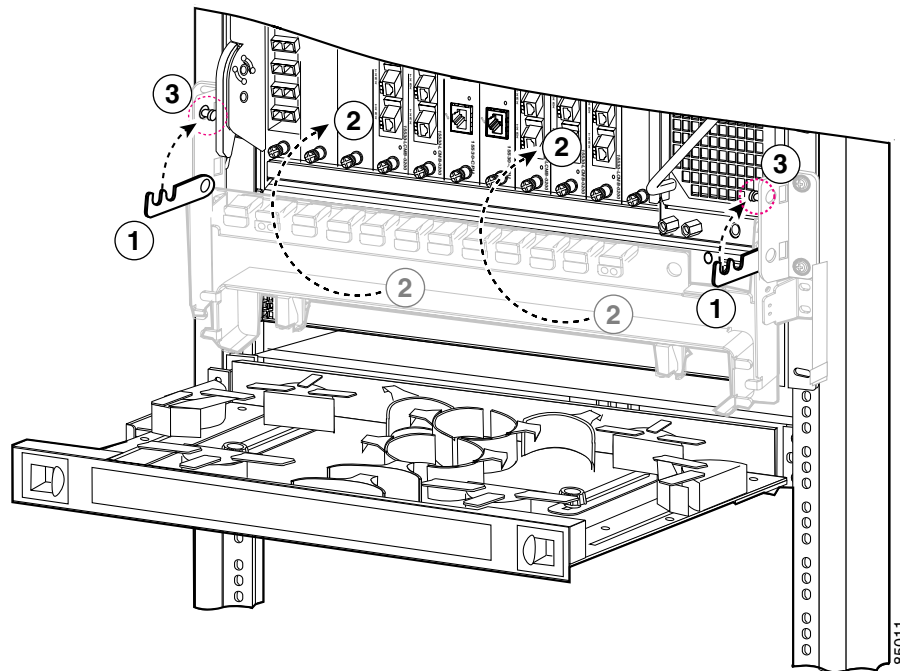


Installing the Fiber Routing Tray

To install the fiber routing tray, follow these steps:

- Step 1** Place the fiber routing tray (2) over the fan assembly, ensuring that the fan assembly can be accessed when the fiber routing tray is locked (1 and 2) in the raised position. (See [Figure 2-10](#).)

Figure 2-10 Raising the Fiber Routing Tray



1	Hook	3	Latch
2	Flip up		

- Step 2** Secure the fiber routing tray to the rack with four 12-24 screws, two on each side.
- Step 3** Hold the fiber routing drawer with both hands and position it in the rack beneath the chassis. (See [Figure 2-9](#).)
- Step 4** Align the mounting holes on the bracket with the mounting holes in the equipment rack.
- Step 5** Install the 12-24 or 10-32 screws through the elongated holes in the brackets and into the threaded holes in the mounting post. Repeat this step for the other side.

Installing the Fiber Routing Drawer

To install the fiber routing drawer, follow these steps:

-
- Step 1** Hold the drawer with both hands and position the drawer in the rack beneath the chassis. (See [Figure 2-9](#).)
 - Step 2** Align the mounting holes on the bracket with the mounting holes in the equipment rack.
 - Step 3** Install the 12-24 or 10-32 screws through the elongated holes in the brackets and into the threaded holes in the mounting post. Repeat this step for the other side.
-

Grounding the Shelf

Two system (earth) grounding holes are provided under the power supplies at the bottom right of the shelf.

Shelf Grounding Guidelines

To make an adequate grounding connection, you need the following parts and tools:

- Grounding lug.
- Two M4 (metric) hex-head screws with locking washers.
- One grounding wire (6 AWG recommended).
- Number 2 Philips head screwdriver.
- Crimping tool. This tool must be large enough to accommodate the girth of the grounding lug when you crimp the grounding cable into the lug.
- Wire-stripping tool.

**Note**

The grounding lug and M4 screws are included in your accessory kit that ships with the system.

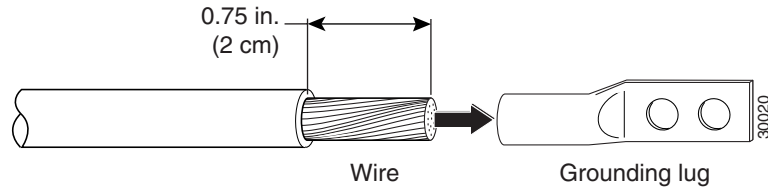
Shelf Grounding Procedures

This section describes how to connect the Cisco ONS 15530 to earth ground. You must complete this procedure before connecting system power or powering up your shelf.

To ground the shelf, follow these steps:

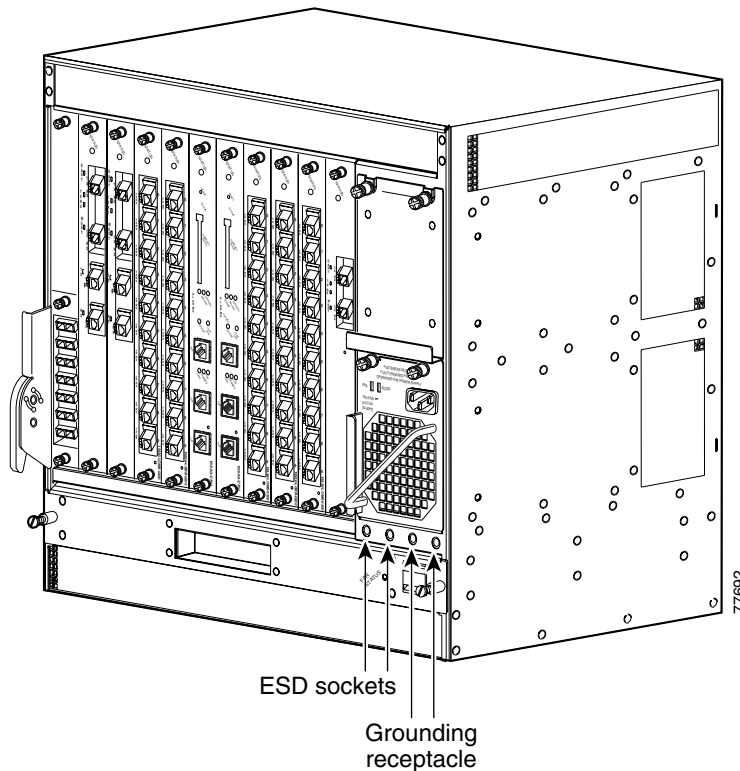
- Step 1** Use a wire-stripping tool to remove approximately 0.75 inch (20 mm) of the covering from the end of the grounding wire (see [Figure 2-11](#)).

Figure 2-11 Attaching the Grounding Wire to Grounding Lug



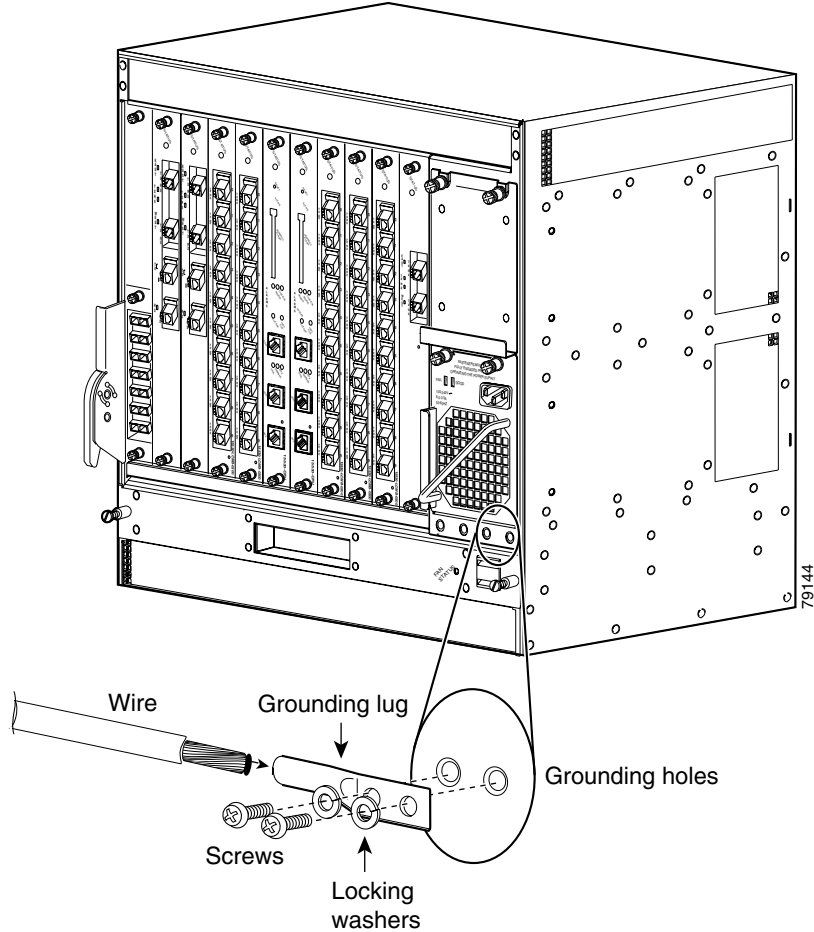
- Step 2** Insert the stripped end of the grounding wire into the open end of the grounding lug (see [Figure 2-11](#)).
- Step 3** Use the crimping tool to secure the grounding wire in place in the grounding lug.
- Step 4** Locate the grounding receptacles on the chassis (see [Figure 2-12](#)).

Figure 2-12 Cisco ONS 15530 ESD Sockets



- Step 5** Place the grounding lug against the grounding receptacle at the bottom right of the chassis (see [Figure 2-13](#)).

Figure 2-13 Installing the Grounding Lug



- Step 6** Insert two screws through the holes in the grounding lug and the grounding receptacle. Ensure that the grounding lug does not interfere with other hardware or rack equipment.
- Step 7** Install the locking washers and nuts; tighten them to secure the grounding lug to the grounding receptacle.
- Step 8** Prepare the other end of the grounding wire and connect it to an appropriate grounding point in your site to ensure adequate earth ground for the Cisco ONS 15530.

**Note**

The Grounding lug shown in [Figure 2-13](#) should be positioned at a 45 degree angle to allow room for cables.

Preventing ESD Damage

Electrostatic discharge (ESD) damage occurs when electronic cards or components are mishandled and can result in complete or intermittent failures. Note the following guidelines before you install or service the system:

- Always wear an ESD-preventive wrist or ankle strap when handling electronic components. Connect one end of the strap to an ESD jack or an unpainted metal component on the system (such as a captive installation screw).
- Handle cards by the faceplates and edges only; avoid touching the printed circuit board and connector pins.
- Place any removed component on an antistatic surface or in a static shielding bag.
- Avoid contact between the cards and clothing. The wrist strap only protects the card from ESD voltages on the body; ESD voltages on clothing can still cause damage.

**Note**

For safety, periodically check the resistance value of the antistatic strap. The measurement should be between 1 and 10 megohms (Mohms).

Installing and Removing Line Cards or Motherboards

The line cards and modules used on the Cisco ONS 15530 are hot-swappable. This section describes the procedures for installing and removing the following line cards and motherboards from the chassis:

- ESCON aggregation cards
- 4-port 1-Gbps/2-Gbps FC aggregation cards
- 8-port FC/GE aggregation cards
- 8-port multi-service muxponders
- 2.5-Gbps ITU trunk cards
- 10-Gbps ITU trunk cards
- 10-Gbps ITU tunable trunk cards
- 10-Gbps uplink cards
- Transponder line cards
- Carrier motherboards
- CPU switch modules

Installing Line Cards or Motherboards

To install a line card or motherboard, follow these steps:

-
- Step 1** Take the new line card or motherboard from the shipping container.
- Step 2** Insert the line card or motherboard carefully into the chassis slot while guiding the upper and lower edges line card or of the motherboard in the tracks until its connectors come into contact with the backplane.

- Step 3** Use the release levers to push the line card or motherboard or processor card in until it is fully seated in the backplane connector.
 - Step 4** Push the release levers in simultaneously to lock the line card or motherboard into the slot.
 - Step 5** Use a number 1 Philips screwdriver to tighten the captive installation screws.
 - Step 6** Check the LED to ensure proper installation while powered.
-

Removing Line Cards or Motherboards

To remove a line card or motherboard, follow these steps:

- Step 1** Remove all cables from the line card or motherboard.
 - Step 2** Install appropriate dust covers on the fiber cable connectors and the blind plugs into the connectors on the motherboard.
 - Step 3** Use a number 1 Philips screwdriver to loosen the captive installation screws.
 - Step 4** Pull the release levers out to release the line card or motherboard from the slot in the chassis.
 - Step 5** Use the release levers to pull the line card or motherboard out of the chassis.
 - Step 6** Place the removed line cards in a container appropriate for shipping and storage.
-

Installing SFPs into Aggregation Cards and Muxponders

To install SFPs into the ESCON aggregation cards, 8-port FC/GE aggregation cards, and 8-port multi-service muxponders, follow these steps:

- Step 1** Take the desired SFP from the shipping container.
 - Step 2** Install the SFP by inserting it in the aggregation card or muxponder.
 - Step 3** Push the SFP until you hear a click. The click indicates that it is securely set in the module.
-

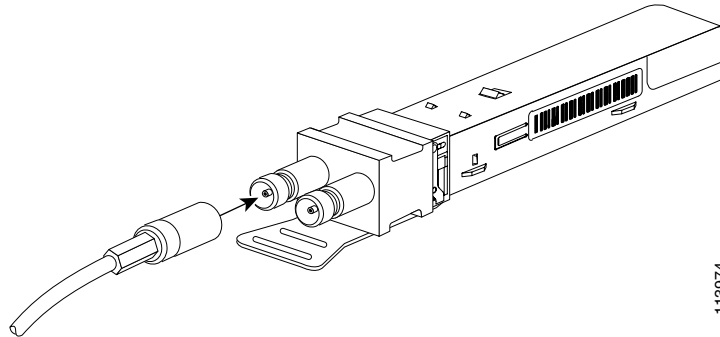
Installing SFP with Mini SMB Coax Connectors

To install the 15500-XVRA-10E1SFP with mini SMB coax connectors into the 8-port multi-service muxponder, follow these steps:

- Step 1** Take the desired SFP from the shipping container.
- Step 2** Install the mini SMB coax connector into the SFP by pushing the cable into the SFP. (See [Figure 2-14.](#))



Note If you are installing the 15500-XVRA-10E1, you must attach the cable to the SFP before installing the SFP into the 8-port multi-service muxponder.

Figure 2-14 Installing the 15500-XVRA-10E1 SFP

- Step 3** Twist the cable to secure it in the SFP.
- Step 4** Install the SFP by inserting it in the muxponder.

**Tip**

In an unlikely event of the pull-tab is damaged or missing, use a screwdriver to push on the hinge pin to unlock the SFP cage latch and pull the SFP out from SFP port

Removing SFP from Aggregation Cards and Muxponders

The SFPs used on the aggregation cards and muxponders have different types of connectors. The different connector types on the SFP optics are:

- RJ-45 connector (for 8-port multi-service muxponders)
- MT-RJ connector (for ESCON aggregation cards)
- LC connector (for 8-port FC/GE aggregation cards)
- Mini SMB coax connector (for 8-port multi-service muxponders)

Each connector requires a different method of removal.

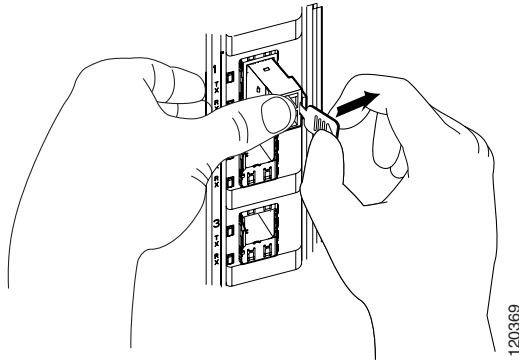
**Note**

Use the **show hardware** command to see what SFP you have currently installed in your module.

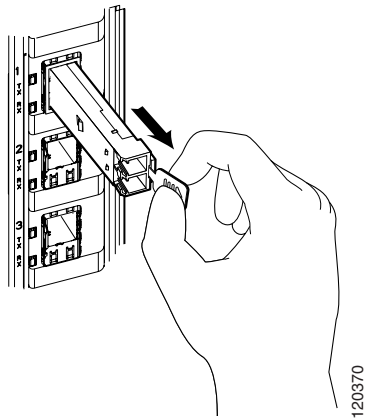
Removing Pull Tab SFPs with RJ-45 Connectors

To remove an SFP with an RJ-45 connector from the muxponder, follow these steps:

- Step 1** Remove the cable from the desired SFP.
- Step 2** Use the thumb on your left hand to push against the RJ-45 connector.
- Step 3** Use your right hand to pull the pull tab on the SFP.
- Step 4** Rotate the SFP while simultaneously pushing against the connector and pulling the pull tab. This releases the SFP from the latch lock of the cage. (See [Figure 2-15](#).)

Figure 2-15 Releasing the SFP

Step 5 Pull the SFP out and place it in a container appropriate for shipping and storage. (See [Figure 2-16](#).)

Figure 2-16 Removing the SFP**Tip**

In an unlikely event of the pull-tab is damaged or missing, use a screwdriver to push on the hinge pin to unlock the SFP cage latch and pull the SFP out from SFP port

**Note**

SFPs with RJ-45 connectors require cabling after it is installed, and removal of cables is required before removing the SFP from the card.

Removing Non-Pull Tab SFPs with RJ-45 Connectors

To remove an SFP with an RJ-45 connector from the muxponder, follow these steps:

-
- Step 1** Remove the cable from the desired SFP.
 - Step 2** Pull the latch on the SFP out. This releases the SFP from the latch lock of the cage.
 - Step 3** Pull the SFP out and place it in a container appropriate for shipping and storage.
-

**Note**

SFPs with RJ-45 connectors require cabling after it is installed, and removal of cables is required before removing the SFP from the card.

Removing SFP Optics with MT-RJ Connectors

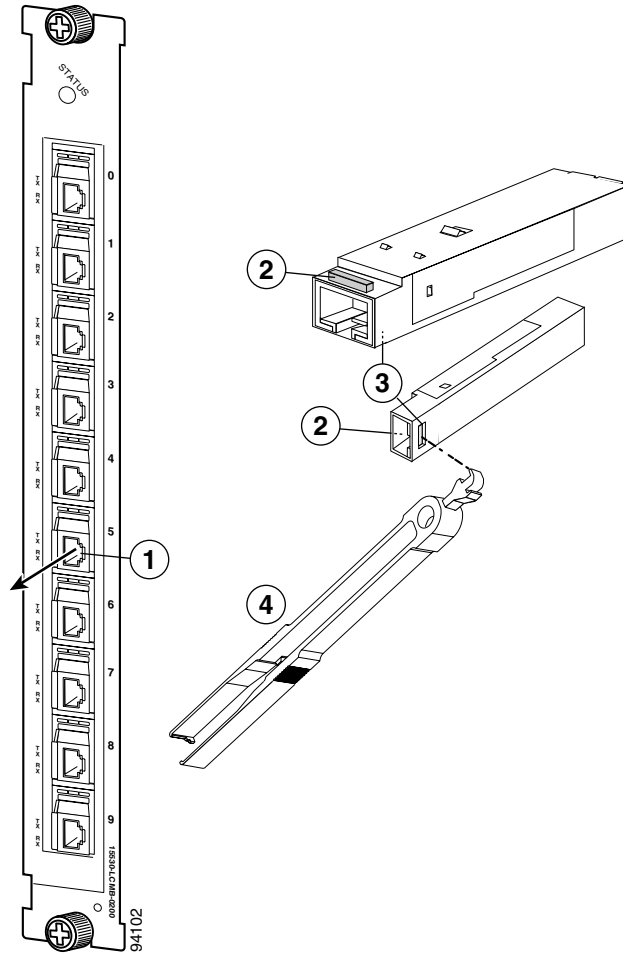
**Note**

You need the SFP extraction and cable installation and removal tool to remove the SFP with the MT-RJ connector.

To remove an SFP with an MT-RJ connector from the ESCON aggregation card, follow these steps:

-
- Step 1** Remove the cable from the desired SFP.
- Step 2** Remove the SFP from the module by pushing against the lever on the SFP to release it from the module. (See [Figure 2-17](#).)

Figure 2-17 Removing the SFP with MT-RJ Connector



1	SFP placement in the module	3	Hole where the SFP extraction end of the tool is inserted (two views)
2	Lever on the SFP (two views)	4	SFP extraction and cable installation and removal tool

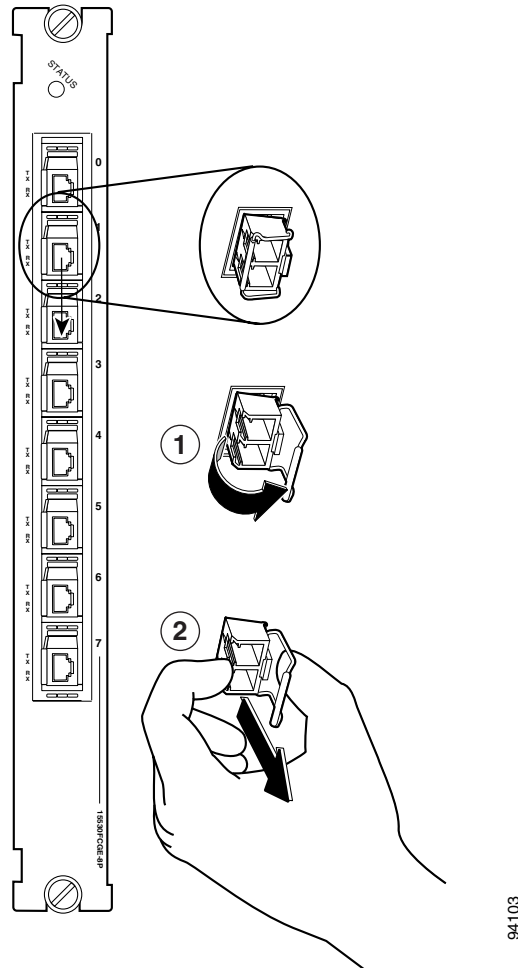
- Step 3** Use the extraction tool to remove the SFP by inserting it into the side of the transceiver and pulling it out of the module. (See [Figure 2-17](#).)
- Step 4** Place the removed SFP in a container appropriate for shipping and storage.

Removing SFP Optics with LC Connectors

To remove an SFP with an LC connector from the 8-port FC/GE aggregation card, follow these steps:

-
- Step 1** Remove the cable from the desired SFP.
- Step 2** Remove the SFP from the module by pulling the latch on top of the SFP to release it from the module. (See [Figure 2-18](#).)

Figure 2-18 Removing the Transceiver with the LC Connector



1	Release the latch.	2	Pull out the SFP optics.
----------	--------------------	----------	--------------------------

- Step 3** Continue to pull the latch down and use the latch to pull the SFP out of the module. (See [Figure 2-18](#).)
- Step 4** Place the removed SFP in a container appropriate for shipping and storage.
-

Removing SFPs with Mini SMB Coax Connectors

To remove the 15500-XVRA-10E1 SFP with mini SMB coax connectors(MINISMB/BNC=) from the 8-port multi-service muxponder, follow these steps:

-
- Step 1** Use the thumb on your left hand to push against the SFP.
 - Step 2** Use your right hand to pull the pull tab on the SFP.
 - Step 3** Twist the SFP slightly to unlock it from the latch lock of the cage.
 - Step 4** Remove the desired SFP from the 8-port multi-service muxponder.



Note If you are removing the 15500-XVRA-10E1, you must remove the SFP from the muxponder before detaching the cable.

- Step 5** Twist the connector to loosen the cable.
 - Step 6** Pull the connector from the SFP.
 - Step 7** Place the removed SFP in a container appropriate for shipping and storage.
-

Installing and Removing Modules

The modules used on the Cisco ONS 15530 are hot-swappable. This section describes the procedures for installing and removing the OADM (optical add drop multiplexing) module, the PSM (protection switch modules), the OSC (optical supervisory channel) module, the WB-VOA (wide-band variable optical attenuator) module, and the PB-OE (per-band power equalizer) module.



Warning

During this procedure, wear grounding wrist straps to avoid ESD damage to the card. Do not directly touch the backplane with your hand or any metal tool, or you could shock yourself.

Installing OADM Modules and PSMs

Slot 0 of the Cisco ONS 15530 chassis holds half height OADM modules and PSMs.

To install an OADM module or PSM, follow these steps:

-
- Step 1** Remove the module or the filler module from slot 0 of the Cisco ONS 15530 chassis.
 - Step 2** Take a new module from the shipping container.
 - Step 3** Insert the module carefully into slot 0 of the Cisco ONS 15530 chassis while guiding the upper and lower edges of the module in the tracks until its connectors come into contact with the backplane connectors. Place the module locking lever in place, and then use a number 1 Philips screwdriver to tighten the module locking lever.

- Step 4** Attach the appropriate cables.
 - Step 5** Check the LEDs to ensure proper installation.
-

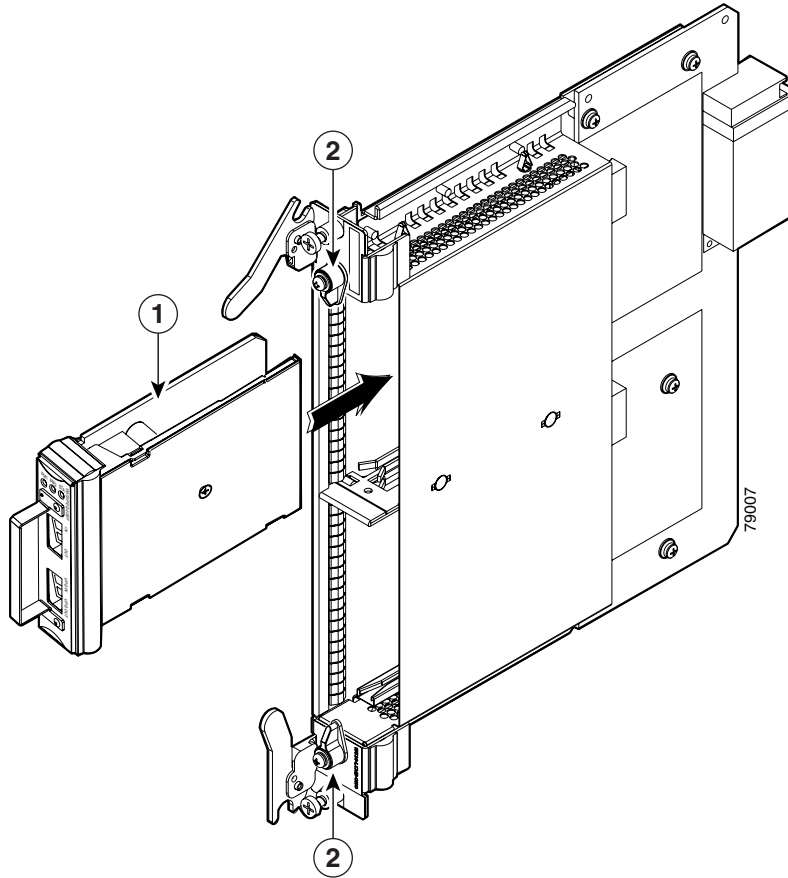
Installing OSC Modules, WB-VOA Modules, and PB-OE Modules

Up to two OSC modules can be installed in the carrier motherboard, one module for the west direction and one for the east direction. The WB-VOA module and PB-OE module are also installed in the carrier motherboard.

To install the OSC module, the WB-VOA module, or the PB-OE module, follow these steps:

- Step 1** Disconnect all optical fiber connections from the WB-VOA and PB-OE modules.
- Step 2** Remove the module or the filler module from the carrier motherboard.
- Step 3** Take a new module from the shipping container.
- Step 4** Insert the module carefully into the carrier motherboard (see [Figure 2-19](#)) slot while guiding the upper and lower edges of the module in the tracks until its connectors come into contact with the backplane connectors. Place the module locking lever in place, and then use a number 1 Philips screwdriver to tighten the module locking lever.

Figure 2-19 Module Insertion in Carrier Motherboard



1	Module	2	Module locking lever
---	--------	---	----------------------

- Step 5** Attach the appropriate cables.
- Step 6** Check the LEDs to ensure proper installation.

Save the filler modules with the packaging material.

Removing Modules



Warning

High-performance devices on this card can get hot during operation. To remove the card, hold it by the faceplate and bottom edge. Allow the card to cool before touching any other part of it or before placing it in an antistatic bag.



Warning

Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.

To remove a module from the Cisco ONS 15530 without interrupting system operation, follow these steps:

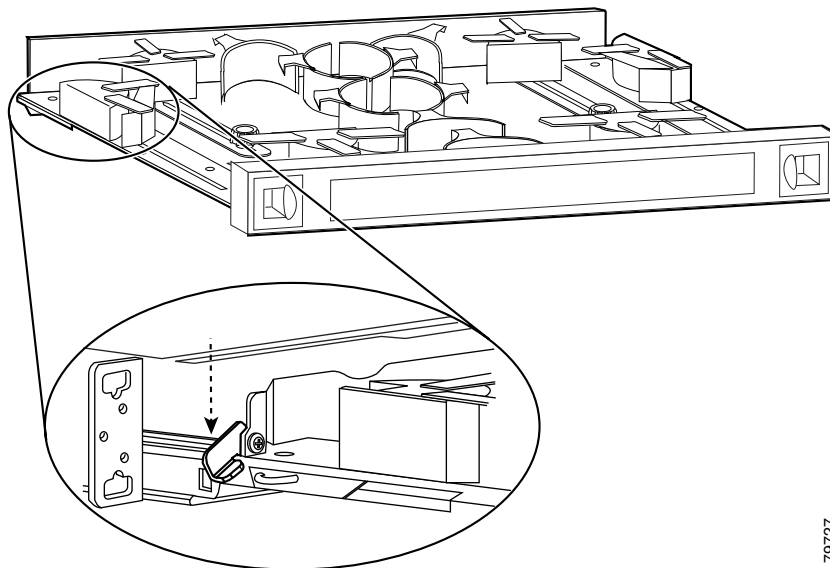
-
- Step 1** Remove all cables from the desired module.
 - Step 2** Use a number 1 Philips screwdriver to loosen the module locking lever (see [Figure 2-19](#)).
 - Step 3** Remove the module by carefully pulling it out of its slot.
 - Step 4** Reinstall the blank filler module.
 - Step 5** Place the removed module in a container appropriate for shipping and storage.
-

Replacing the Fan Assembly

To replace the fan assembly in the Cisco ONS 15530, follow these steps:

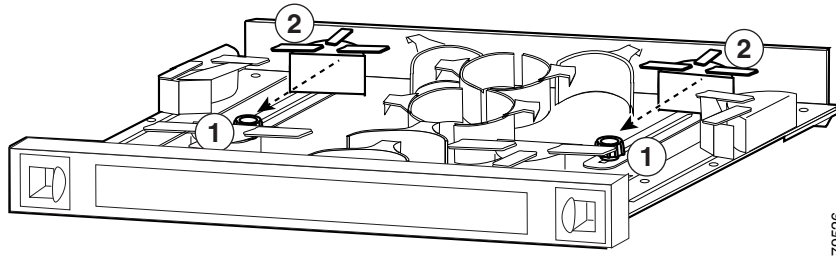
-
- Step 1** Open and pull out the cable storage drawer installed immediately beneath the chassis that holds the system fiber optic cables.
 - Step 2** Lock the drawer by pushing the lever down at the back left side of the drawer. (See [Figure 2-20](#).)

Figure 2-20 Drawer Lock



Step 3 Untwist the black fasteners in the drawers to loosen the cable guide spools. (See [Figure 2-21](#))

Figure 2-21 *Loosening the Cables*



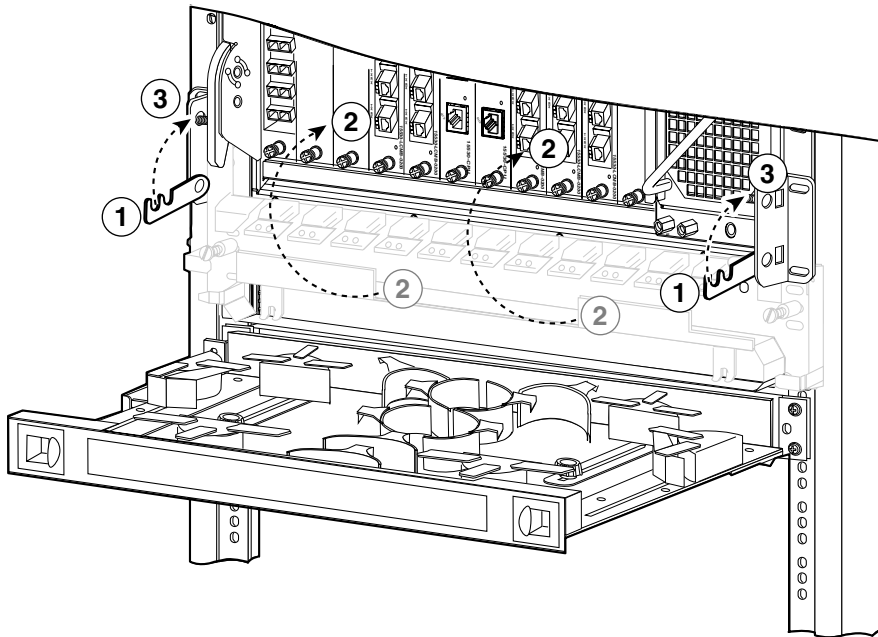
79526

1	Fasteners	2	Spools
---	-----------	---	--------

Step 4 Push the spools down towards the black fasteners. Carefully pull out the cables from the spools towards the outside of the drawers. (See [Figure 2-21](#).)

Step 5 Flip the cable management tray up so that it no longer covers the fan tray. (See [Figure 2-22](#).)

Figure 2-22 *Hooking the Cable Management Tray*



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1	Hook	3	Latch
2	Flip up		

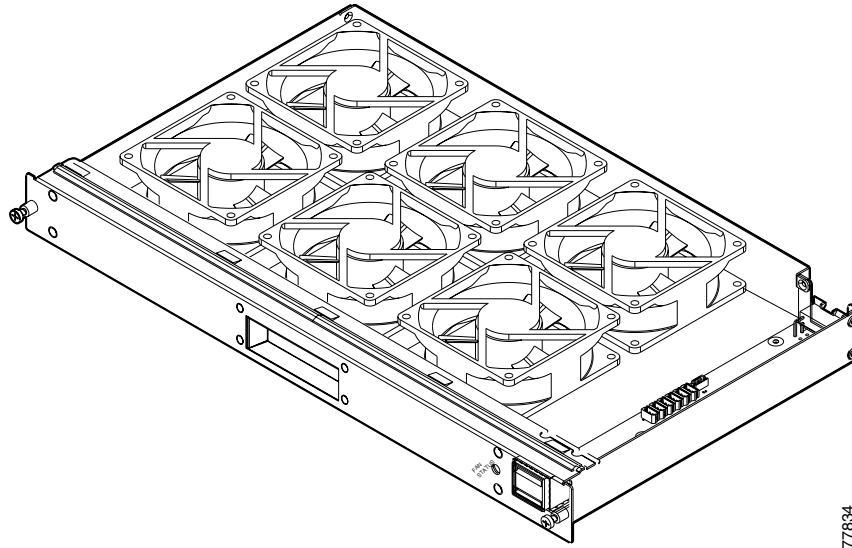
Step 6 Attach the hook on the tray to the rack mount part of the tray on the rack so that it stays in the up position.

Step 7 Unscrew the captive installation screws on the fan assembly.

Step 8 Grasp the fan assembly captive installation screws and pull them towards you.

- Step 9** Pull the fan assembly out of the bay and put it aside. See [Figure 2-23](#).

Figure 2-23 Fan Assembly



- Step 10** Place the new fan assembly into the front chassis cavity so it rests on the chassis. Lift the fan assembly up slightly and align the top and bottom guides.
- Step 11** Push the fan assembly into the chassis until the captive installation screws meet the chassis.
- Step 12** Tighten each of the captive installation screws.
- Step 13** Power up the system and verify fan assembly operation by checking the fan assembly status. The fan status is normal when the fan assembly LED is green.

Power Guidelines

Follow these precautions and recommendations when planning power connections to the Cisco ONS 15530:

- Check the power at your site before installation and periodically after installation to ensure that you are receiving clean power. Install a power conditioner if necessary.
- Provide proper grounding to avoid damage from lightning and power surges.



Caution

This product requires short-circuit (overcurrent) protection, to be provided as part of the building installation. Install only in accordance with national and local wiring regulations.

**Note**

The Cisco ONS 15530 installation must comply with all applicable codes and is approved for use with copper conductors only. The ground bond fastening hardware should be of compatible material and preclude loosening, deterioration, and electrochemical corrosion of hardware and joined material. Attachment of the chassis ground to a central office or other interior ground system should be made with a 6-AWG, copper ground conductor at a minimum.

Power Connection Guidelines for DC-Powered Systems

The DC-input power supply allows the Cisco ONS 15530 to operate at –48 VDC nominal in North America and –60 VDC in Europe.

See [Appendix A, “Specifications,”](#) for system power specifications, including input voltage and operating frequency ranges.

**Note**

The DC return is to remain isolated from the system frame and chassis (DC-I).

**Warning**

A readily accessible disconnect device must be incorporated in the building's installation wiring.

**Warning**

This product relies on the building's installation for short-circuit (overcurrent) protection. Ensure that a Listed and Certified fuse or circuit breaker, 25A minimum 60 VDC, is used on all current-carrying conductors.

Plant Wiring Guidelines

Following are guidelines for setting up the plant wiring and cabling at your site. When planning the location of the new system, consider the distance limitations for signaling, EMI, and connector compatibility, as described in the following sections.

Interference Considerations

When wires are run for any significant distance in an electromagnetic field, interference can occur between the field and the signals on the wires. This fact has two implications for the construction of plant wiring:

- Bad wiring practice can result in radio interference emanating from the plant wiring.
- Strong EMI, especially when it is caused by lightning or radio transmitters, can destroy the signal drivers and receivers in the Cisco ONS 15530.

**Note**

To predict and remedy strong EMI, you may also need to consult experts in radio frequency interference (RFI).

If you use twisted-pair cable in your plant wiring with a good distribution of grounding conductors, the plant wiring is unlikely to emit radio interference. If you exceed the recommended distances, use a high-quality twisted-pair cable with one ground conductor for each data signal when applicable.

If wires exceed recommended distances, or if wires pass between buildings, give special consideration to the effect of a lightning strike in your vicinity. The electromagnetic pulse caused by lightning or other high-energy phenomena can easily couple enough energy into unshielded conductors to destroy electronic devices. If you have had problems of this sort in the past, you may want to consult experts in electrical surge suppression and shielding.

Cabling Guidelines

The size of your networks and the distances between connections depend on the type of signal, the signal speed, and the transmission media (the type of cabling used to transmit the signals). For example, standard coaxial cable has a greater channel capacity than twisted-pair cabling. The distance and rate limits in the following descriptions are the IEEE recommended maximum speeds and distances for signaling; however, you can usually get good results at speeds and distances far greater than these. For example, the recommended maximum rate for V.35 is 2 Mbps, but it is commonly used at 4 Mbps without any problems. If you understand the electrical problems that might arise and can compensate for them, you should get good results with rates and distances greater than those shown here; however, do so at your own risk.

When preparing your site for network connections to the Cisco ONS 15530, you must consider a number of factors related to each type of interface:

- The type of cabling required for each type (fiber, thick or thin coaxial, foil twisted-pair, or unshielded twisted-pair cabling)
- Distance limitations for each signal type
- The specific cables you need to connect each interface
- Any additional interface equipment you need, such as transceivers, hubs, switches, modems, channel service units (CSUs), or data service units (DSUs)

Before you install the Cisco ONS 15530, have all additional external equipment and cables on hand. For ordering information, contact a customer service representative.

The extent of your network and the distances between network interface connections depend in part on the following factors:

- Signal type
- Signal speed
- Transmission medium

The distance and rate limits referenced in the following sections are the IEEE-recommended maximum speeds and distances for signaling purposes. Use this information as a guideline in planning your network connections *prior to* installing the Cisco ONS 15530.

Powering Up the Shelf

System power is supplied by redundant –48 VDC or by redundant 120–240 VAC power supplies located on the right side of the chassis. The Cisco ONS 15530 supports the use –48 VDC and 120–240 VAC power supplies used together to provide redundancy.

Connecting DC-Input Power



Warning

A readily accessible disconnect device must be incorporated in the building's installation wiring.



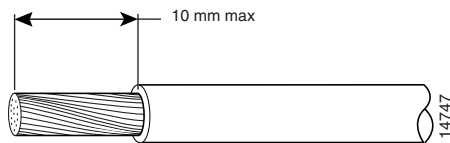
Warning

This product relies on the building's installation for short-circuit (overcurrent) protection. Ensure that a Listed and Certified fuse or circuit breaker 25A, minimum 60 VDC, is used on all current-carrying conductors.

To apply DC-input power to your Cisco ONS 15530, follow these steps:

- Step 1** Strip not more than 0.4 inches (10 mm) of insulation off the ends of the DC power leads (see [Figure 2-24](#)).

Figure 2-24 Stripping Insulation



- Step 2** Connect the ground wire to the power supply ground terminal (see [Figure 2-25](#)).

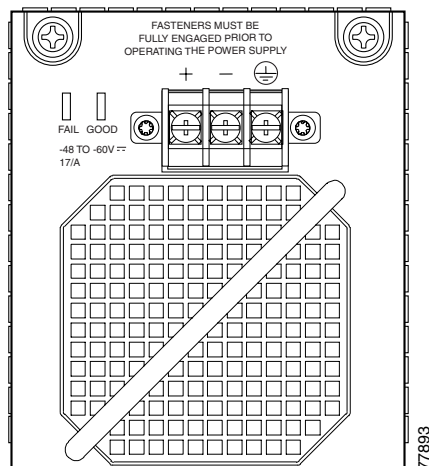


Note

The ground connections should always be connected first and disconnected last.

- Step 3** Connect the positive DC power lead from the external power source to the positive (+) DC terminal (see [Figure 2-25](#)).

Figure 2-25 DC Power Supply

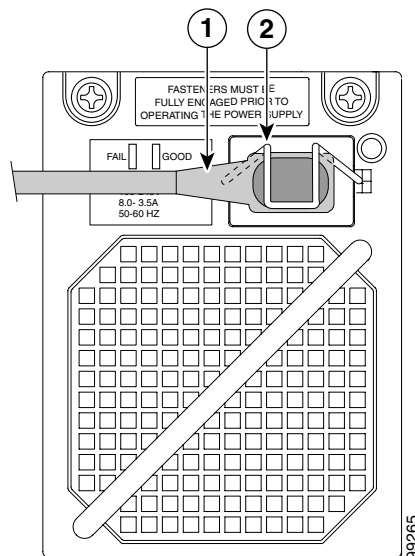


- Step 4** Connect the negative DC power lead from the external power source to the negative (–) DC terminal (see [Figure 2-25](#)).
- Step 5** If you are installing redundant DC power, repeat [Step 3](#) and [Step 4](#) on the second power supply, connecting to a second external power source.

Connecting AC-Input Power

The Cisco ONS 15530 can be powered directly from the facility VAC input through the Cisco ONS 15530 120–240 VAC power supply (see [Figure 2-26](#)). A retention clip secures the power cord to the power supply.

Figure 2-26 120–240 VAC Power Supply



1	Power cord	2	Retention clip
----------	------------	----------	----------------

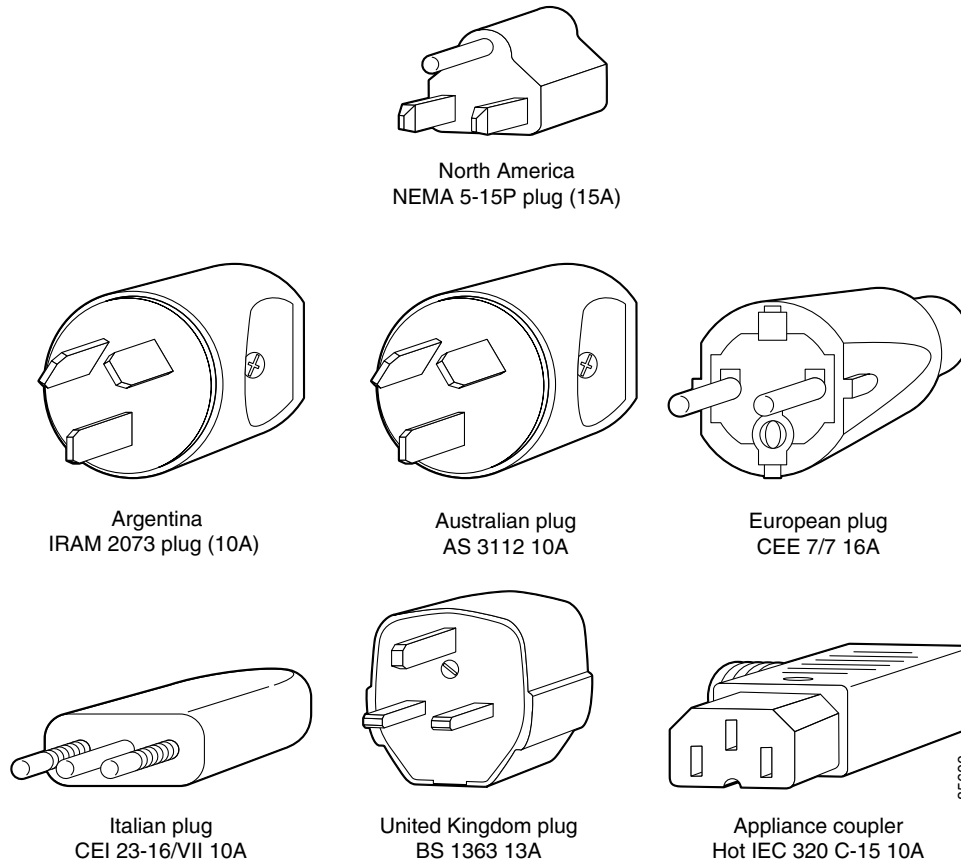


Note

The AC power cord that connects to the Cisco ONS 15530 120–240 VAC power supply power cord and then to the building AC is not shipped with the Cisco ONS 15530. You must order this power cord separately.

The AC-input power supply differ in plug type; make sure you have the correct style for your site (see [Figure 2-27](#) and [Table 2-1](#).) All AC-input power supply power cords measure 8 feet (2.5 m). We recommend that you:

- Install an uninterruptable power source where possible.
- Install proper grounding to avoid damage from lightning and power surges (see the “[Grounding the Shelf](#)” section on page 2-14).

Figure 2-27 AC Power Cords**Table 2-1 AC Power Cord Options**

Label	Description	Product Number
North America	120 VAC, 60 Hz AC power cord	15500-CAB-AC
Argentina	250 VAC, 50 Hz AC power cord	15500-CAB-ACR
Australian	240 VAC, 50 Hz AC power cord	15500-CAB-ACA
European	230 VAC, 50 Hz AC power cord	15500-CAB-ACE
Italian	220 VAC, 50 Hz AC power cord	15500-CAB-ACI
United Kingdom	240 VAC, 50 Hz AC power cord	15500-CAB-ACU
Switzerland (not shown)	240 VAC, 50 Hz AC power cord	15500E-CAB-ACS

Table 2-2 lists the nominal and acceptable value ranges for source AC power.

Table 2-2 Source AC Power Specifications

Specifications	Nominal Value	Acceptable Range
AC input voltage	100 to 240 VAC, single phase	90 to 255 VAC
AC input line frequency	50/60 Hz	47 to 63 Hz
AC input current	8 A @100 VAC 3.5 A @240 VAC	—

Installing and Removing the Power Supplies

To install an AC or DC power supply, follow these steps:

-
- Step 1** Remove the power supply from its packaging.
 - Step 2** Grasp the power supply handle with one hand. Place your other hand underneath to support the bottom of the external power supply.
 - Step 3** Place the power supply correctly at the bay opening.
 - Step 4** Carefully slide the power supply into the bay. Make sure that the power supply is installed completely and that the faceplate is flush with the chassis.
 - Step 5** Secure the power supply installation by securing the captive installation screws at the top of the power supply.
-

To power on the chassis, see the [“Powering Up the Shelf” section on page 2-31](#).

To remove an AC or DC power supply, follow these steps:

-
- Step 1** Unplug the power cord on an AC power supply or remove the negative, positive, and ground connections from the DC power supply.



Note The ground connections should always be connected first and disconnected last.

- Step 2** Unscrew the captive installation screws at the top of the power supply.
 - Step 3** Grasp the power supply handle with one hand and pull the power supply out of the bay. Place your other hand underneath to support the bottom of the external power supply.
-



Connecting the Cisco ONS 15530

The Cisco ONS 15530 uses RJ-45, SC, MT-RJ and MU connectors on the faceplates of the line cards and modules. Fiber optic cables are routed to the cable management guides that are at the top and bottom of the shelf. The Cisco ONS 15530 is powered by 120–240 VAC or –48 VDC power. Positive, negative, and ground power terminals are accessible on the front of the chassis.

This chapter describes how to connect the Cisco ONS 15530 to the network and contains the following sections:

- [Connector Types, page 3-2](#)
- [Preparing for Network Connections, page 3-3](#)
- [Cleaning the Shelf and Connectors, page 3-4](#)
- [Connecting the CPU Switch Module, page 3-5](#)
- [Connecting the OSC Module, page 3-13](#)
- [Connecting the PSM, page 3-14](#)
- [Connecting the Transponder Line Card, page 3-17](#)
- [Connecting the OADM Module, page 3-19](#)
- [Connecting the ESCON Aggregation Card, page 3-20](#)
- [Connecting the 4-Port 1-Gbps/2-Gbps FC Aggregation Card, page 3-20](#)
- [Connecting the 8-Port FC/GE Aggregation Card, page 3-21](#)
- [Connecting the 8-Port Multi-Service Muxponder, page 3-23](#)
- [Connecting the 2.5-Gbps ITU Trunk Card, page 3-24](#)
- [Connecting the 10-Gbps ITU Tunable and Non tunable Trunk Card, page 3-26](#)
- [Connecting the 10-Gbps Uplink Card, page 3-28](#)
- [Connecting the WB-VOA and PB-OE Modules, page 3-28](#)
- [Connecting a Multi-Shelf Node, page 3-34](#)
- [Cable Management, page 3-39](#)



Note

To ensure that your Cisco IOS software release supports your hardware, see the [“New and Changed Information” section on page vii](#). Also refer to the “Hardware Supported” section of the latest release notes for the Cisco ONS 15530.

**Note**

For power supply cable connecting information, see the “Powering Up the Shelf” section on page 2-31.

Connector Types

Various types of connectors are used to connect the line cards and modules of the Cisco ONS 15530 to each other and the Internet. Table 3-1 lists the connector types used on each line card and module. Figure 3-1 through Figure 3-4 show the connector types.

Table 3-1 Line Card and Module Connector Types

Card/Module	Connector Type(s)
CPU switch module	RJ-45 (Figure 3-1)
OSC module	MU (Figure 3-4)
Transponder line card	MU (Figure 3-4), SC-Type (Figure 3-2)
OADM module	MU (Figure 3-4)
4-Port 1-Gbps/2-Gbps FC aggregation card	MU (Figure 3-4)
8-Port FC/GE aggregation card	MU (Figure 3-4)
ESCON aggregation card	MT-RJ (Figure 3-3)
10-Gbps ITU tunable and non tunable trunk card	MU (Figure 3-4)
10-Gbps uplink line card	SC-Type (Figure 3-2)
WB-VOA module	MU (Figure 3-4)
PB-OE module	MU (Figure 3-4)
PSM	MU (Figure 3-4)

Figure 3-1 RJ-45 Connector

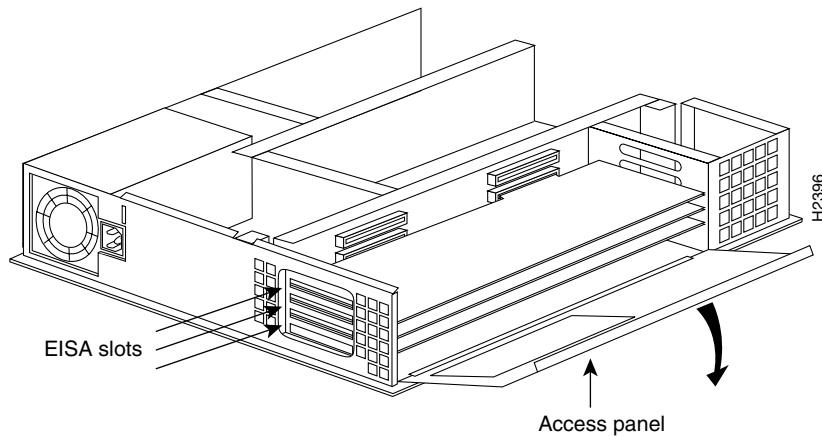


Figure 3-2 Simplex SC-Type Connector

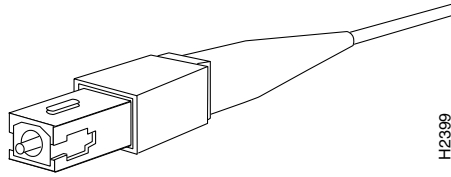


Figure 3-3 MTRJ Connector

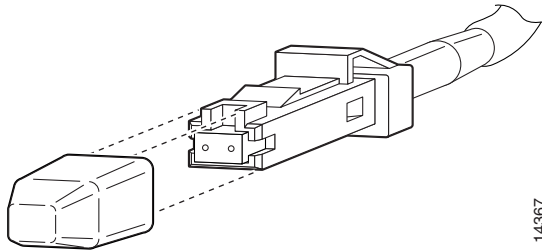
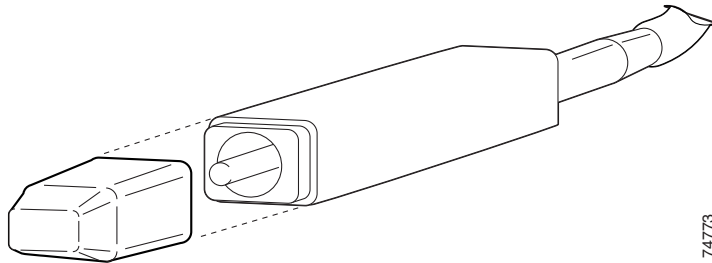


Figure 3-4 MU Connector



Preparing for Network Connections

When preparing your site for network connections to the Cisco ONS 15530, consider the following for each type of interface:

- Cabling required for each type
- Distance limitations for each signal type
- Additional interface equipment needed

Before installing the component, have all additional external equipment and cables on hand.

Cleaning the Shelf and Connectors

If the cleaning process must be done while the system is running, be aware that the airflow system is in operation. Be careful of the following:

- Do not touch the airflow system while fans are operating.
- Do not use wet tissues for cleaning the chassis.
- Do not use any harsh or abrasive cleaning agents.

**Warning**

Invisible laser radiation may be emitted from the end of the fiber or connector. Do not stare into the beam or view directly with optical instruments.

Fiber optic connectors are used to connect two fibers together. When these connectors are used in a communication system, proper connection becomes a critical factor. Fiber optic cable connectors can be damaged by improper cleaning and connection procedures. Dirty or damaged fiber optic connectors can result in not repeatable or inaccurate communication.

Fiber optic connectors differ from electrical or microwave connectors. In a fiber optic system, light is transmitted through an extremely small fiber core. Because fiber cores are often 62.5 microns or less in diameter, and dust particles range from a tenth of a micron to several microns in diameter, dust and any contamination at the end of the fiber core can degrade the performance of the connector interface where the two cores meet. Therefore, the connector must be precisely aligned and the connector interface must be absolutely free of trapped foreign material.

Connector, or insertion, loss is a critical performance characteristic of a fiber optic connector. Return loss is also an important factor. It specifies the amount of reflected light; the lower the reflection the better the connection. The best physical contact connectors have return losses better than -40 dB, although -20 to -30 dB is more common.

The connection quality depends on two factors: the type of connector and the proper cleaning and connection techniques. Dirty fiber connectors are a common source of light loss. Keep the connectors clean at all times and keep the dust cover installed when not in use.

Before installing any type of cable or connector, refer to *Cisco ONS 15530 Cleaning Procedures for Fiber Optic Connections*.

When cleaning fiber components, procedures must be followed precisely and carefully with the goal of eliminating any dust or contamination. A clean component connects properly; a dirty component may transfer contamination to the connector, or it may even damage the optical contacts. Inspecting, cleaning, and re-inspecting are critical steps that must be done before making any fiber connection.

As a general rule, whenever there is a significant, unexplained loss of light, clean the connectors.

**Caution**

Use extreme care when removing or installing connectors so you do not damage the connector housing or scratch the end-face surface of the fiber. Always install filler modules on unused or disconnected components to prevent contamination. Always clean fiber connectors before installing them.

Connecting the CPU Switch Module

The CPU switch module has three RJ-45 ports on the front of the card. This section provides the procedures for making the following connections:

- Ethernet network management cable connections
- Connecting a terminal to a console port
- Auxiliary modem connection

Keep the following guidelines in mind when connecting external cables to the Cisco ONS 15530:

- Avoid crossing high-power lines with any interface cables.
- Verify all cabling limitations (particularly distance) before powering on the system.

Ethernet Network Management Cable Connections

The CPU switch module provides an Ethernet port to a LAN for a 10BASE-T or 100BASE-T connection for network management. Use the following procedures to connect the Cisco ONS 15530 to an Ethernet network.

**Note**

Each CPU switch module must have an Ethernet port connection (typically to the same Ethernet hub) if you are running a redundant configuration in the chassis.

Connecting to a 10BASE-T Ethernet Network

To make a 10BASE-T Ethernet connection, you need the following additional equipment (not included with your Cisco ONS 15530):

- An Ethernet hub (such as a Cisco Micro Hub)
- An Ethernet cable that meets the following specifications:
 - RJ-45 (male) to RJ-45 (male) straight-through cable
 - 100-ohm category 3, 4, or 5 cable, no longer than 328 feet (100 meters)

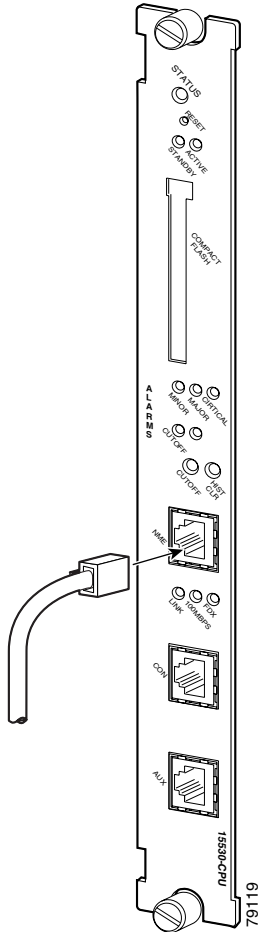
You can identify a straight-through Ethernet cable either by using a cable tester or by making a visual inspection. To make a visual inspection, hold the two ends of a cable side by side, with the tab for each at the back.

- The wire connected to the left-most pin (pin 1) on one connector should be the same color as the wire connected to the left-most pin on the other connector.
- The same rule applies to pins 2 through 8 on each connector. The color of the wire attached to a pin on one connector should match the color of the wire attached to the corresponding pin on the other connector.

To connect the CPU switch module to a 10BASE-T Ethernet LAN, follow these steps:

- Step 1** Connect one end of the Ethernet cable to the RJ-45 port on the primary CPU switch module, labeled NME (see [Figure 3-5](#)).

Figure 3-5 Connecting 10BASE-T to Ethernet Port



- Step 2** Run the cable up and through the cable management bracket and connect the other end of the Ethernet cable to any unoccupied port on the Ethernet hub.
- Step 3** Check the LINK LED on the CPU switch module faceplate (below the NME) port.
This LED is green if the CPU switch module is correctly connected to the 10BASE-T Ethernet LAN.

Connecting to a 100BASE-T Ethernet Network

To make a 100BASE-T Ethernet connection, you need the following additional equipment (not included with your Cisco ONS 15530):

- An Ethernet hub (such as a Cisco Micro Hub)
- An Ethernet UTP cable that meets the following specifications:
 - RJ-45 (male) to RJ-45 (male) straight-through cable.
 - 100-ohm category 5 cable no longer than 328 feet (100 meters). (Cisco Systems does not supply Category 5 UTP cables; these cables are available commercially.)

You can identify a straight-through Ethernet cable either by using a cable tester or by making a visual inspection. To make a visual inspection, hold the two ends of a cable side by side, with the tab for each at the back.

- The wire connected to the left-most pin (pin 1) on one connector should be the same color as the wire connected to the left-most pin on the other connector.
- The same rule applies to pins 2 through 8 on each connector. The color of the wire attached to a pin on one connector should match the color of the wire attached to the corresponding pin on the other connector.

**Note**

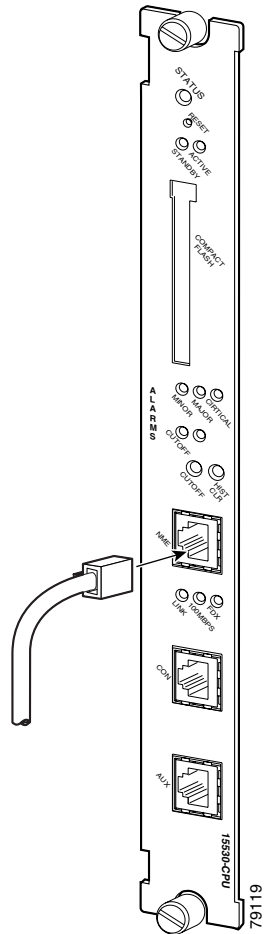
Shielded cables, which are grounded at both ends, are required to be used on the 10/100/1000 Ethernet port in order to be in compliance with requirement R4-11 in GR-1089-Core for a Central Office environment. This is not a requirement for customer premise installations.

The port labeled NME on the CPU switch module is configurable for 100-Mbps full-duplex or half-duplex operation (half-duplex is the default) and supports IEEE 802.3, Ethernet, and IEEE 802.3u interfaces compliant with 100BASE-T specifications.

To connect the CPU switch module to a 100BASE-T Ethernet LAN, follow these steps:

- Step 1** Connect one end of the Ethernet cable to the RJ-45 port on the primary CPU switch module, labeled NME (see [Figure 3-6](#)).

Figure 3-6 Connecting 100BASE-T to Ethernet Port



- Step 2** Run the cable up and through the cable management bracket and connect the other end of the Ethernet cable to any unoccupied port on the Ethernet hub.
- Step 3** Check the LINK LED on the CPU switch module (below the NME port). This LED is green if the CPU switch module is correctly connected to the 100BASE-T Ethernet LAN.

Connecting a Terminal to the Console Port

The Cisco ONS 15530 CPU switch module has an asynchronous serial (EIA/TIA-232) RJ-45 console port labeled CON on its front panel. You can connect this port to most types of terminals through use of the console cable kit that is included with your Cisco ONS 15530. The console cable kit contains:

- One RJ-45 to RJ-45 crossover cable
- One RJ-45 to DB-25 (female) adapter
- One RJ-45 to DB-9 (female) adapter

A crossover cable reverses pin connections from one end to the other. In other words, it connects pin 1 (at one end) to pin 8 (at the other end), pin 2 to pin 7, pin 3 to pin 6, and so on. You can identify a crossover cable by comparing the two modular ends of the cable. Hold the cable ends in your hand, side-by-side, with the tabs at the back. Ensure that the wire connected to the outside (left) pin of the left plug (pin 1) is the same color as the wire connected to the outside (right) pin of the right plug (pin 8).

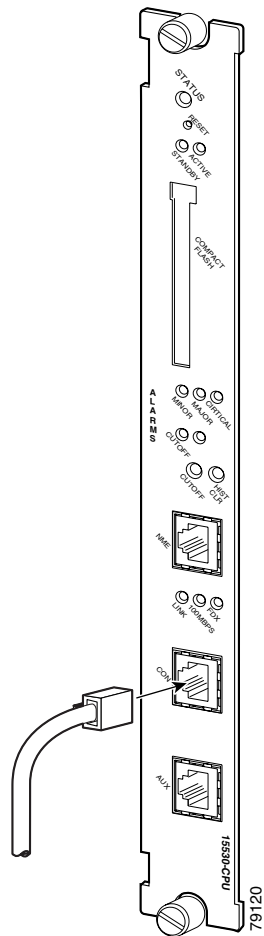
To connect a terminal to the console port on a CPU switch module, follow these steps:

**Note**

Each CPU switch module must have a console port connection (typically to a terminal server) if you are running a redundant configuration in the chassis.

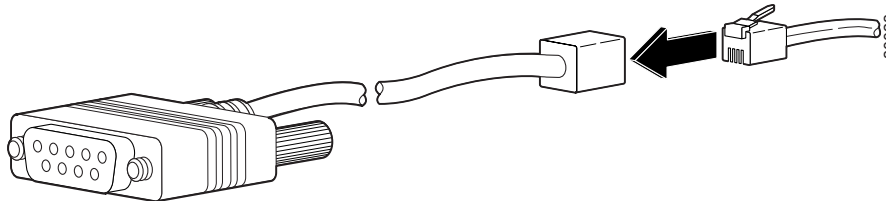
- Step 1** Connect one end of the RJ-45 crossover cable to the serial RJ-45 port (CON) on the CPU switch module (see [Figure 3-7](#)).

Figure 3-7 Console Port Connection on the CPU Switch Module



- Step 2** Run the cable up and through the cable management bracket (not supplied) and connect the other end of the RJ-45 crossover cable to the RJ-45 adapter (see [Figure 3-8](#)). If your terminal is equipped with one of the following:
- DB-25 serial connector, use the RJ-45-to-DB-25 adapter.
 - DB-9 serial connector, use the RJ-45-to-DB-9 adapter.

Figure 3-8 Connecting an RJ-45-to-DB-9 Console Cable Adapter



- Step 3** Connect the adapter to your video terminal to complete the cable connection.
- Step 4** Power on your video terminal.
- Step 5** Configure your video terminal to match the following default console port settings:
- 9600 baud
 - 8 data bits
 - No parity generation or checking
 - 1 stop bit
 - No flow control

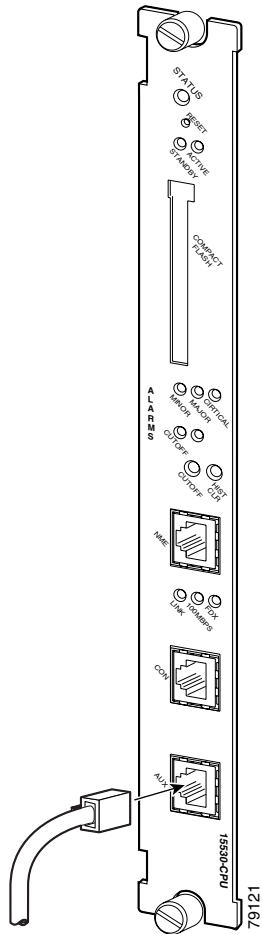
Auxiliary Modem Connection

This asynchronous EIA/TIA-232 serial port connects a modem to the CPU switch module for remote administrative access.

To connect the Cisco ONS 15530 to a modem, follow these steps:

- Step 1** Connect one end of the modem cable to the RJ-45 port on the primary CPU switch module, labeled AUX (see [Figure 3-9](#)).

Figure 3-9 Connecting Modem Cable to Auxiliary Port



- Step 2** Run the cable up and through the cable management bracket and connect the other end of the cable to your modem.

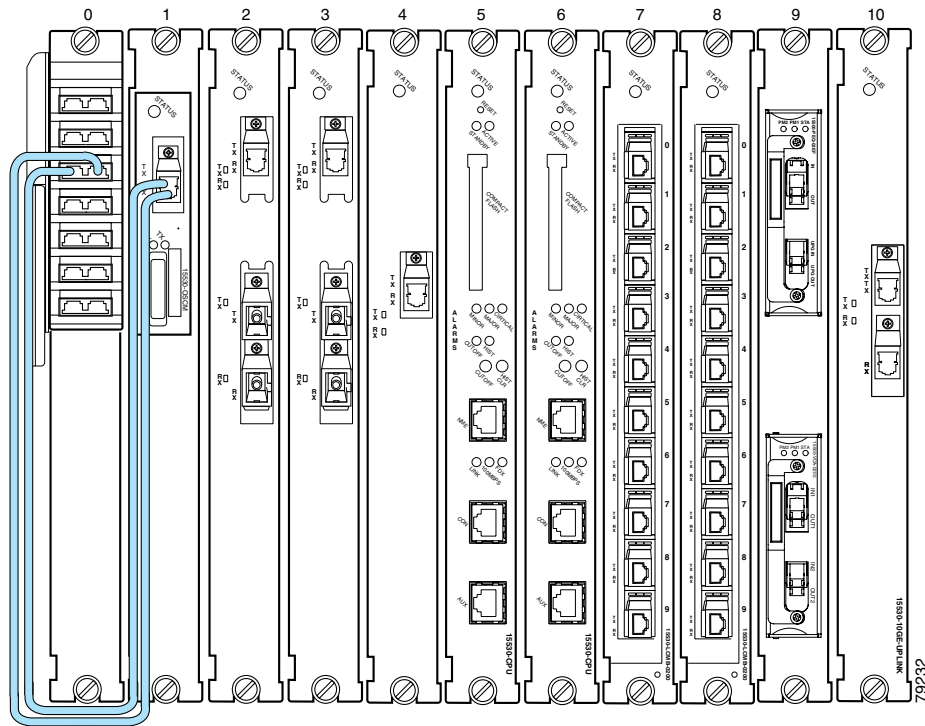
Connecting the OSC Module

One or two OSC modules can be installed in the carrier motherboard. When two OSC modules are installed, one module is for the west direction and one is for the east direction.

The OSC modules are connected to the OADM modules before they terminate on a neighboring node. To install the OSC cables proceed as follows:

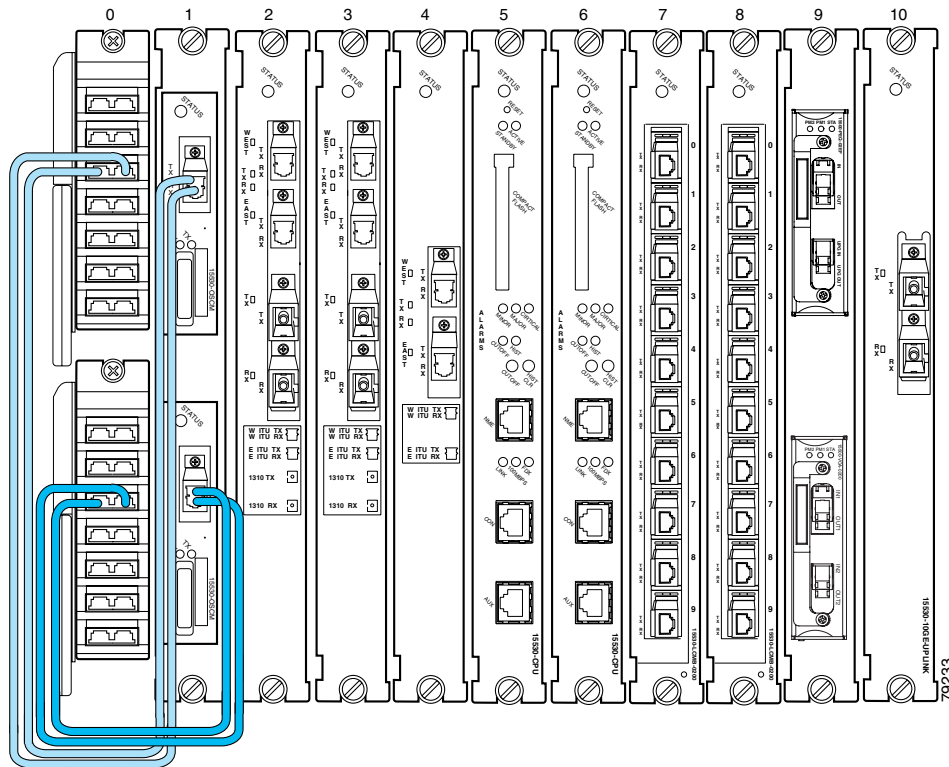
- Step 1** Connect the OSC module TX port to the OSC IN port of the OADM module (see [Figure 3-10](#)).

Figure 3-10 OSC Module Cable Connections



- Step 2** Connect the OSC module RX port to the OSC OUT port of the OADM module (see [Figure 3-10](#)).
- Step 3** If a second OSC module has been installed, repeat Step 1 and Step 2, connecting the second OSC module to the second OADM module as shown in [Figure 3-11](#).

Figure 3-11 Dual OSC Module Cable Connections



Connecting the PSM

The PSM (protection switch module) is a shelf replaceable unit that plugs into one of the OADM subslots in the shelf. The unit has a front panel set of MU connectors that interface with the trunk fiber in a 1+1 protection scheme.

To install fiber optic cables in the Cisco ONS 15530, a fiber cable with the corresponding connector type must be connected to the transmit and receive ports on the modules. We recommend that you label the transmit, receive, and the working and protection fibers at each end of the fiber span to avoid confusion with cables that are similar in appearance. Labels are shipped with the system.



Warning

Invisible laser radiation may be emitted from the end of the fiber or connector. Do not stare into the beam or view directly with optical instruments.



Note

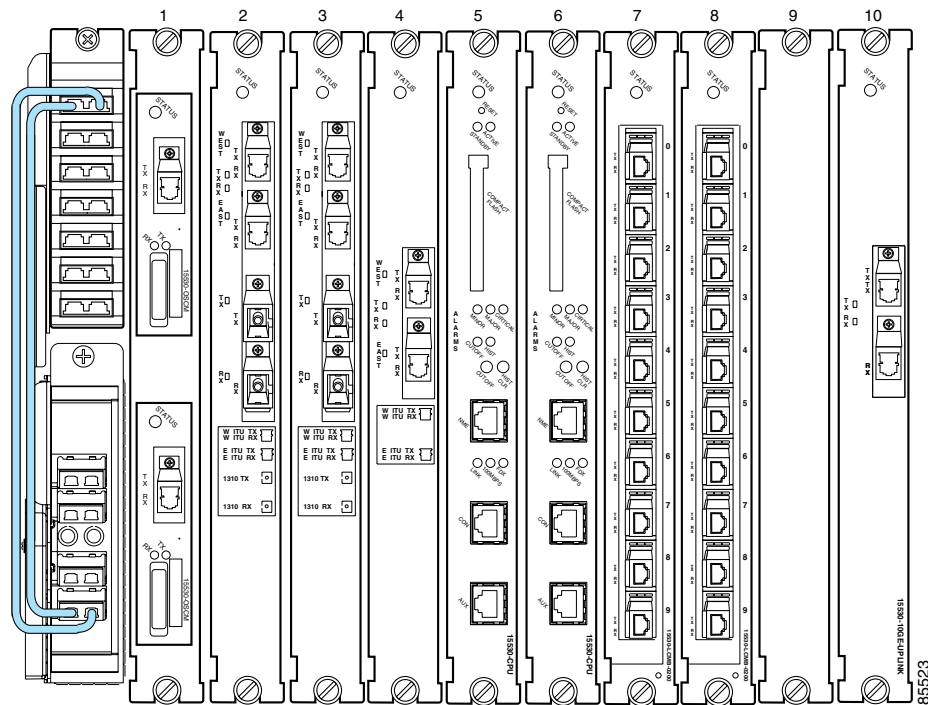
Clean all fiber connectors thoroughly. Dust particles can degrade performance. Put caps on any fiber connectors that are not in use.

Cabling PSMs

To attach and route fiber optic cables for the PSM and OADM module, follow these steps:

- Step 1** Route the MU fiber cables from the TRUNK IN and TRUNK OUT ports on the OADM module down through the cable management tray (see [Figure 3-12](#)).

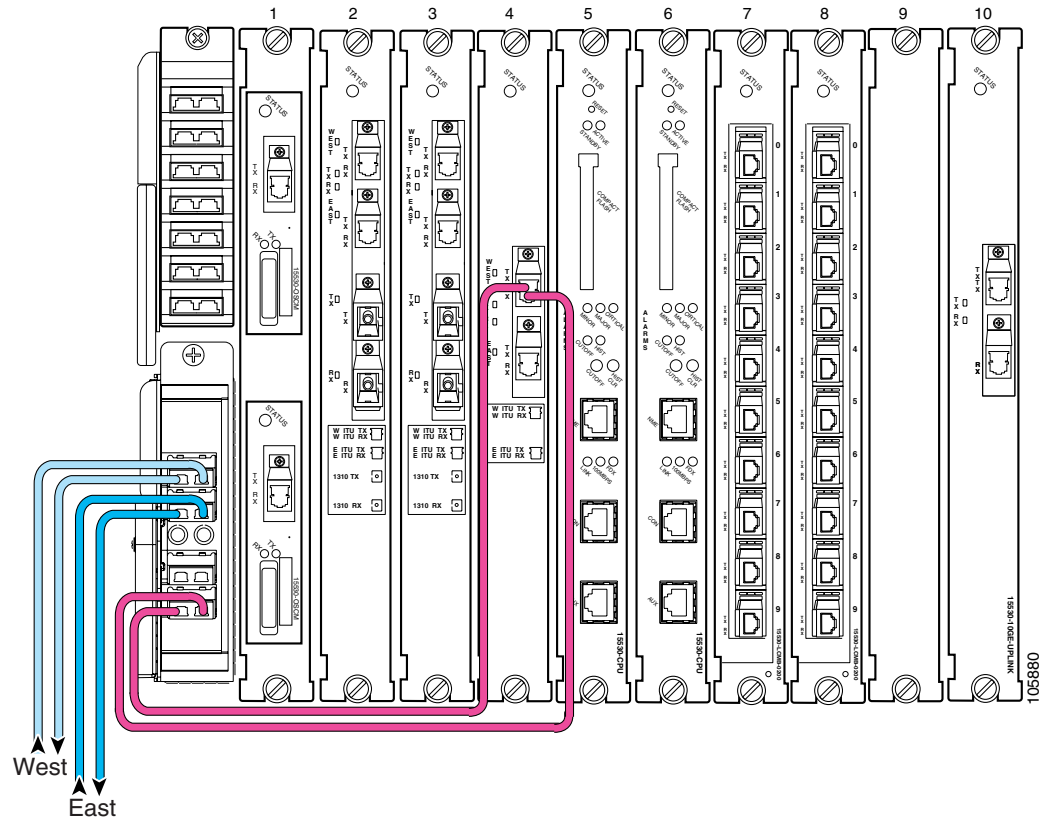
Figure 3-12 PSM Cable Connections



- Step 2** Route the cable out of the left side of the tray, down the vertical cable guides, and in through the left side of the cable storage drawer.
- Step 3** Route the cable through the cable storage drawer and out the right side. Bring the cable up and into the right side of the cable management tray and continue to route the cable throughout until you come to the bottom of the PSM.

The PSM supports direct connections from the ITU trunk cards, transponder line cards, and 10-Gbps uplink cards. [Figure 3-13](#) shows a the PSM directly connected to a 2.5-Gbps ITU trunk card.

Figure 3-13 PSM Cabled to a 2.5-Gbps ITU Trunk Card



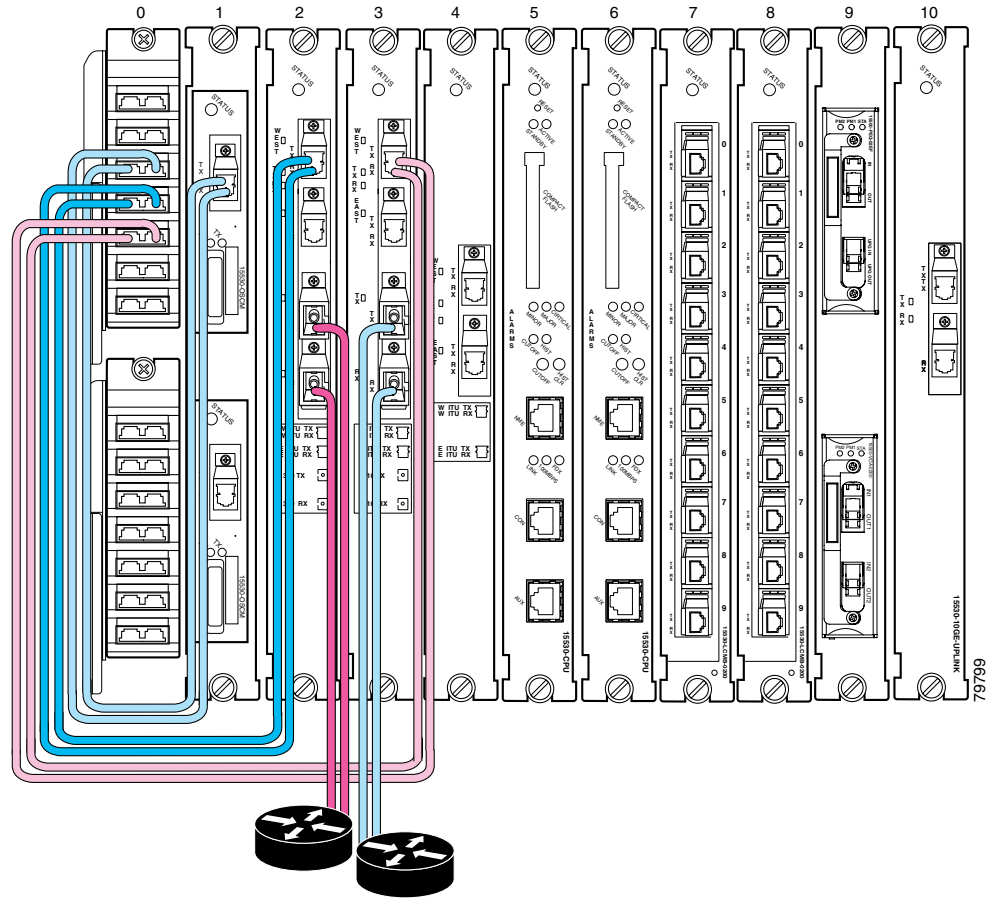
To connect the PSM, follow these steps:

-
- Step 1** Use MU cables to connect the WEST TX RX ports of the PSM to the appropriate west side equipment for your configuration.
 - Step 2** Use MU cables to connect the EAST TX RX ports of the PSM to the appropriate east side equipment for your configuration.
 - Step 3** Use MU cables to connect the MUX/DEMUX OUT IN ports of the PSM to the TX RX ports of the 2.5-Gbps ITU trunk card.
-

Connecting the Transponder Line Card

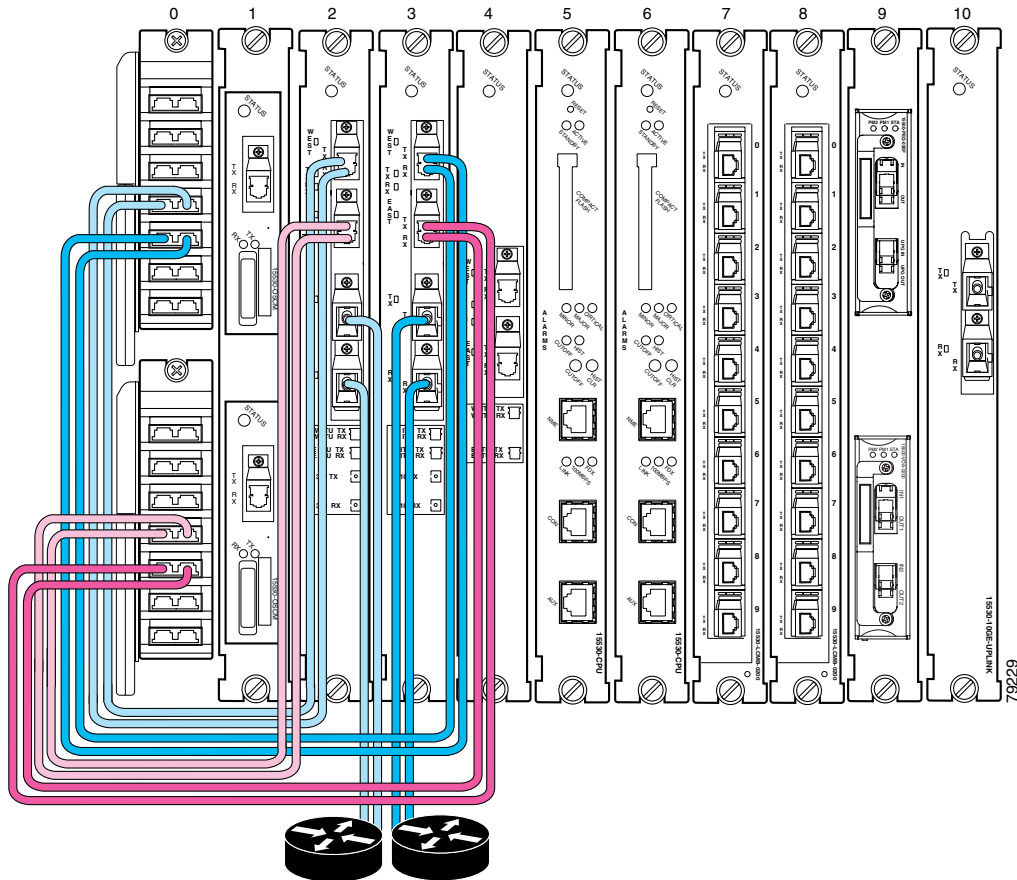
The transponder line card receives a single client signal, converts it into an ITU wavelength or channel, and sends it to the OADM module. Figure 3-14 shows the cable connections in an unprotected configuration. The ITU transmit port of the transponder line card is connected to the Coexists IN port of the OADM module and the ITU receive port is connected to the Coexists OUT port. The client side transmit and receive ports on the transponder line card are connected to the client router.

Figure 3-14 Transponder Line Card Cable Connections (Unprotected)



In a splitter configuration the connections are the same, with the addition of a second set of ITU ports on the transponder line card. In a splitter configuration the two sets of ITU ports are labeled WEST and EAST and two OADM modules are required. Figure 3-15 shows the cable connections in a splitter configuration.

Figure 3-15 Transponder Line Card Cable Connections (Splitter)

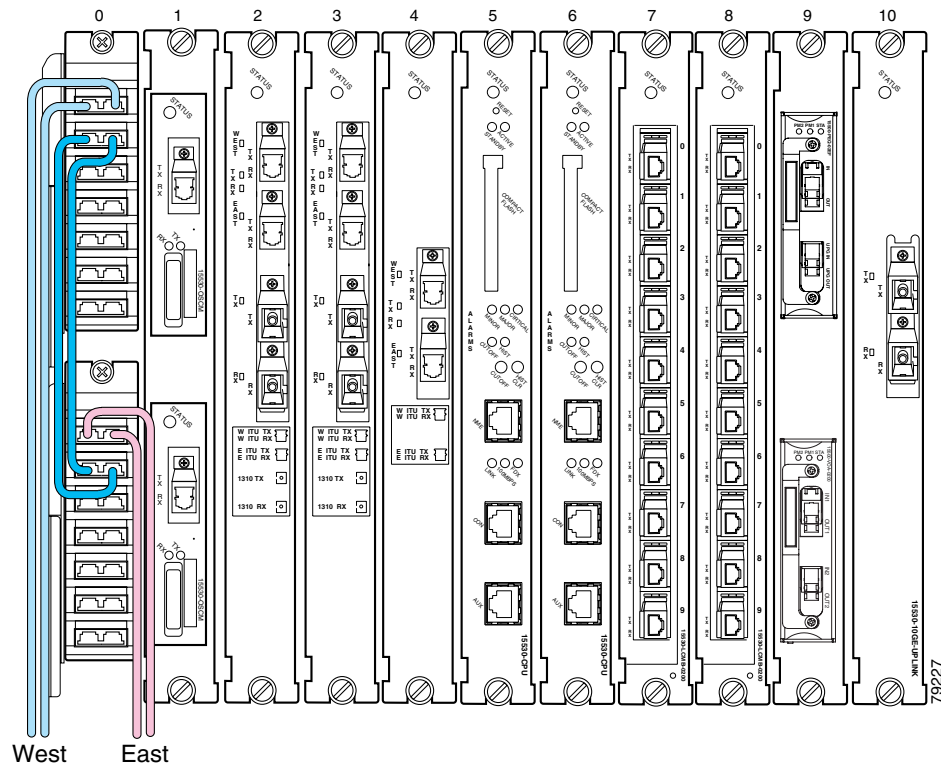


Connecting the OADM Module

The OADM module takes signals from the transponder line cards and the 10-Gbps ITU trunk cards, multiplexes the signals, and puts the multiplexed signal on the network. In the reverse direction, the OADM modules demultiplexes incoming signals and sends them to the transponder line cards and the 10G ITU line cards. See the “Connecting the PSM” section on page 3-14 and the “Connecting the 10-Gbps ITU Tunable and Non tunable Trunk Card” section on page 3-26 for specific information on these connections.

Figure 3-16 shows the OADM module network connections in a splitter configuration. The TRUNK_IN and TRUNK_OUT ports of the first OADM module are connected to the west side trunk. The TRUNK_IN and TRUNK_OUT ports of the second OADM module are connected to the east side trunk. In addition the MID_IN port of the first OADM module is connected to the MID_OUT port of the second OADM module, and the MID_OUT port of the first OADM module is connected to the MID_IN port of the second OADM module.

Figure 3-16 OADM Module Trunk Cable Connections



Connecting the ESCON Aggregation Card

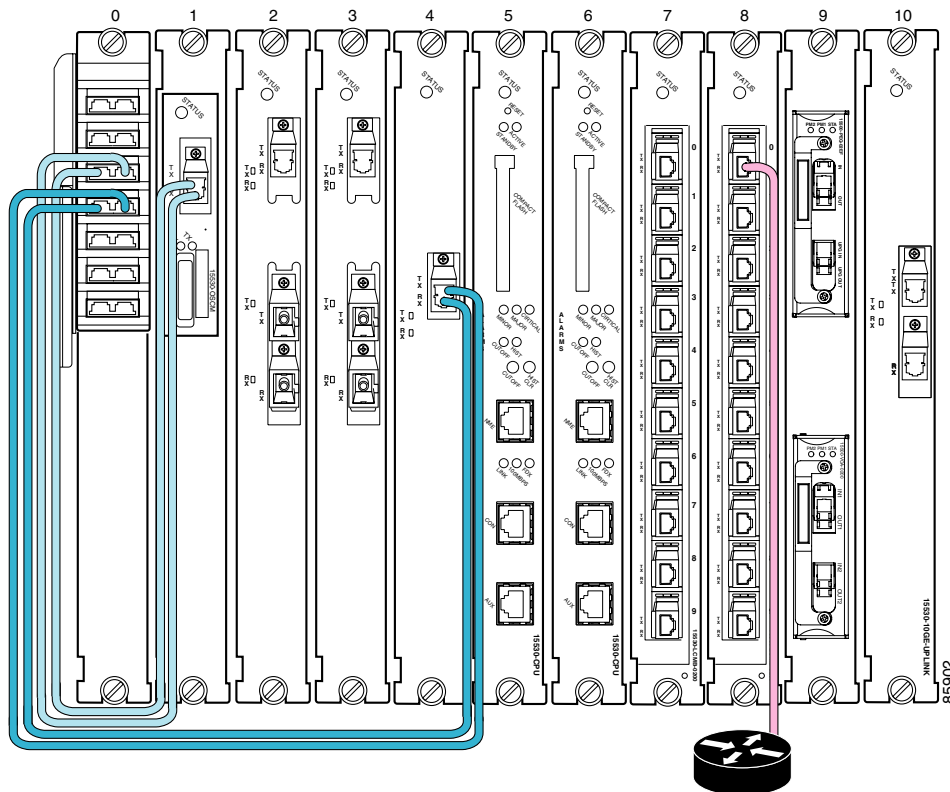
The ESCON aggregation card converts up to 10 client signals from optical to electrical and aggregates them into a single 2.5-Gbps signal. The aggregated signal is then sent through the backplane and the active switch fabric to either a 2.5-Gbps ITU trunk card, 10-Gbps ITU trunk card, or a 10-Gbps uplink line card. [Figure 3-17](#) shows the connections.



Note

Only use Cisco-certified SFP optics for the ESCON aggregation cards.

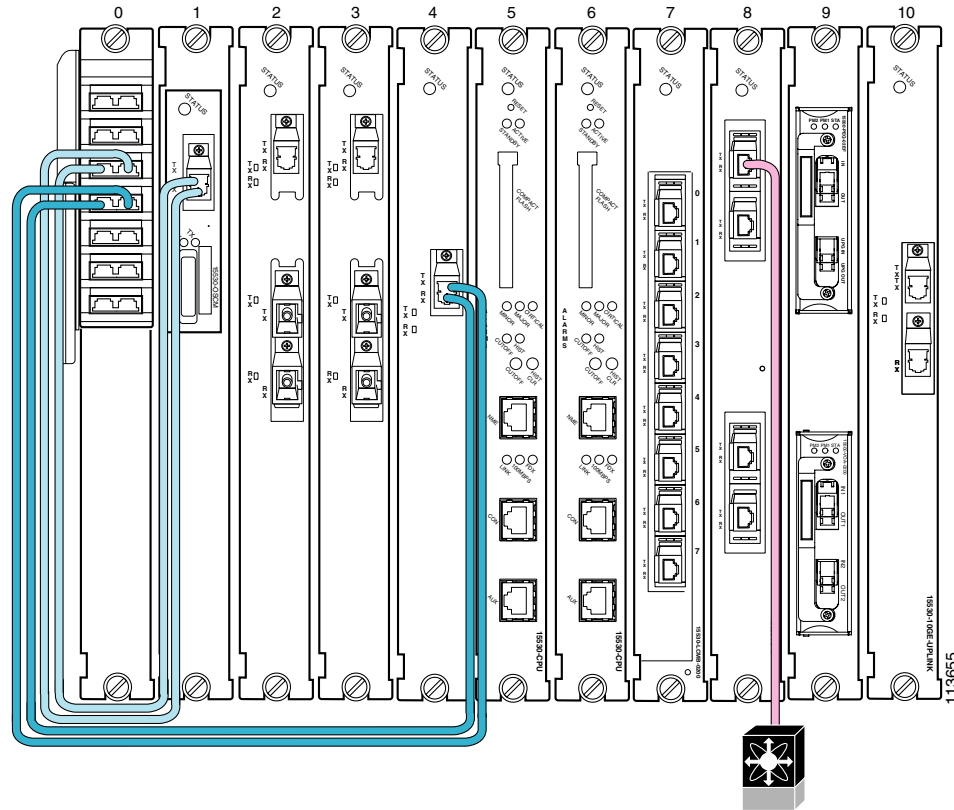
Figure 3-17 ESCON Aggregation Card Cable Connections (Unprotected)



Connecting the 4-Port 1-Gbps/2-Gbps FC Aggregation Card

The 4-port 1-Gbps/2-Gbps FC aggregation card accepts up to four Cisco-certified SFP (small form-factor pluggable) optics for client traffic. Each SFP supports Fibre Channel, FICON, or ISC depending on how it is configured in the CLI. The 4-port 1-Gbps/2-Gbps FC aggregation card converts client signals from optical form to electrical form, and then aggregates them into four 2.5-Gbps signals over the backplane. These aggregated signals pass through the backplane and the switch fabric on the active CPU switch module to a 2.5-Gbps ITU trunk card, a 10-Gbps ITU trunk card, or a 10-Gbps uplink card. The cross connections between the two cards through the backplane and switch fabric are configured using the CLI. The 4-port 1-Gbps/2-Gbps FC aggregation card has redundant connections over the backplane to the switch fabric on the active and standby CPU switch modules. [Figure 3-18](#) shows the connections.

Figure 3-18 4-port 1-Gbps/2-Gbps FC Aggregation Card Cable Connections



The Cisco ONS 15530 supports up to four 4-port 1-Gbps/2-Gbps FC aggregation cards for a total of 16 unprotected and protected client signals and up to three 4-port 1-Gbps/2-Gbps FC aggregation cards for 12 protected client signals.

The 4-port 1-Gbps/2-Gbps FC aggregation cards is configurable on a single port basis. The SFPs enable this card to support four Fibre channel, FICON, or ISC interfaces running at full speed. The card has four ports on the client side and four 2.5-GE lanes on the trunk side.

The 4-port 1-Gbps/2-Gbps FC aggregation card uses single-mode and multimode SFPs for the client signals. There are no restrictions on populating the line card with SFPs. For example, you can mix a single-mode SFP optic with a multimode SFP optic.



Note

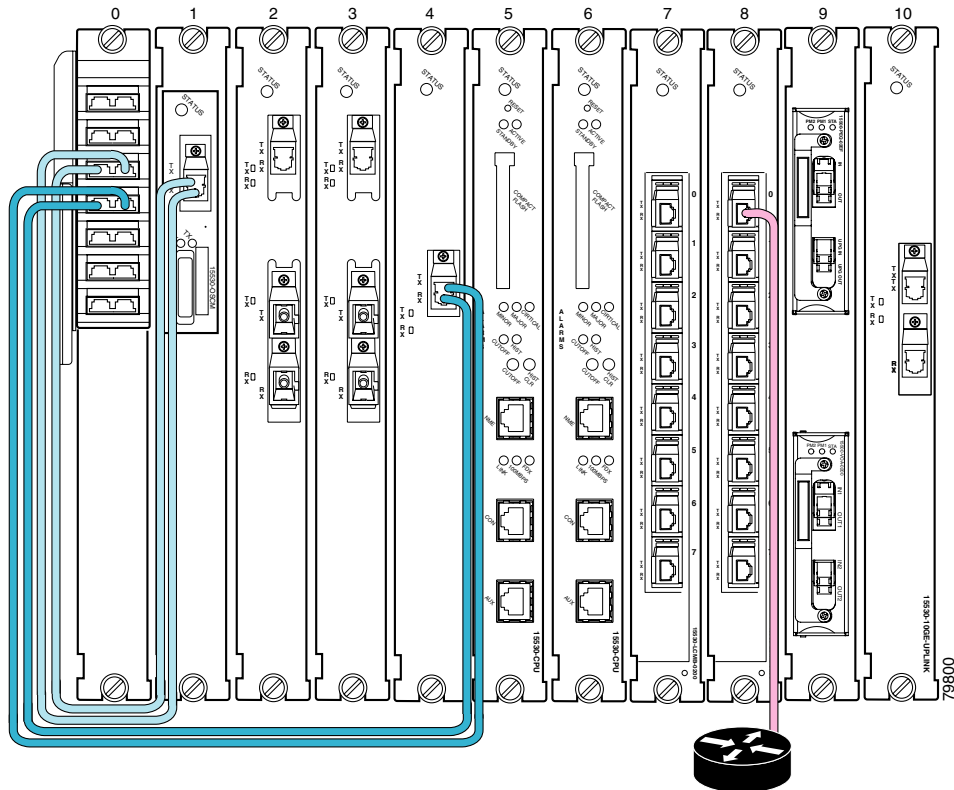
Only use Cisco-certified SFPs for the 4-port 1-Gbps/2-Gbps FC aggregation cards.

Connecting the 8-Port FC/GE Aggregation Card

The 8-port FC/GE aggregation card accepts up to eight Cisco-certified SFP (small form-factor pluggable) optics for client traffic. Each SFP supports either FC, FICON, GE or ISC, depending on how it is configured in the CLI. The 8-port FC/GE aggregation card converts client signals from two adjacent port pairs (0–1, 2–3, 4–5, or 6–7) from optical form to electrical form, and then aggregates them into four 2.5-Gbps signals over the backplane. These aggregated signals pass through the backplane and the switch fabric on the active CPU switch module to a 2.5-Gbps ITU trunk card, a 10-Gbps ITU trunk card, or a 10-Gbps uplink card. The cross connections between the two cards through the backplane and switch

fabric are configured using the CLI. The 8-port FC/GE aggregation card has redundant connections over the backplane to the switch fabric on the active and standby CPU switch modules. [Figure 3-19](#) shows the connections.

Figure 3-19 8-Port FC/GE Aggregation Card Cable Connections



Note

We strongly recommend configuring port pairs as FC only or GE only. Mixing FC and GE in a port pair increases the FC signal latency between nodes.

The Cisco ONS 15530 supports up to four 8-port FC/GE aggregation cards for a total of 32 unprotected client signals and up to three 8-port FC/GE aggregation cards for 24 protected client signals.

The 8-port FC/GE aggregation card is configurable on a single port basis. The SFPs enable this card to support eight Fibre channel or Gigabit Ethernet interfaces running at full speed. The card has eight ports on the client side and four 2.5-GE lanes on the trunk side.

The 8-port FC/GE aggregation card uses single-mode and multimode SFP optics for the client signals. There are no restrictions on populating the line card with SFPs. For example, you can mix a single-mode SFP optic with a multimode SFP optic in the same port pair.



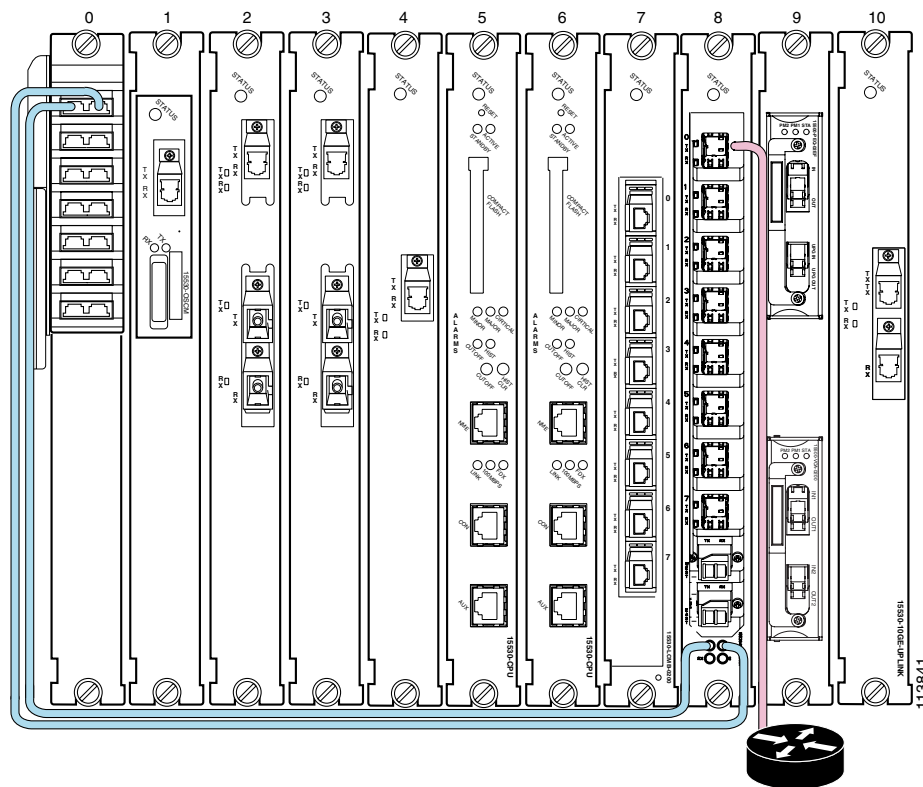
Note

Only use Cisco-certified SFP optics for the 8-port FC/GE aggregation cards.

Connecting the 8-Port Multi-Service Muxponder

The 8-port multi-service muxponder accepts up to eight Cisco-certified SFPs for client traffic. Each SFP supports different protocols that can be aggregated and transported ranging from high-speed services such as Fibre Channel and Gigabit Ethernet to low-speed services such as OC-3, Fast Ethernet, T1, or E1, depending on how it is configured in the CLI. The 8-port multi-service muxponder is configurable on a single port basis. The Cisco ONS 15530 supports up to four 8-port multi-service muxponders for a total of 32 unprotected client signals and up to three 8-port multi-service muxponders for 24 protected client signals. [Figure 3-20](#) shows the possible connections.

Figure 3-20 8-Port Multi-Service Muxponder Cable Connections



Note

Only use Cisco-certified SFPs for the 8-port multi-service muxponder.

Connecting the 2.5-Gbps ITU Trunk Card

The 2.5-Gbps ITU trunk card has three redundant interfaces to the backplane that pass signals to and from the line cards. The optical ports on the front of the line card are connected to the OADM module. The TX port of the 2.5-Gbps ITU trunk card is connected to the CHxxxIN port of the OADM module and the RX port is connected to the CHxxxOUT port. [Figure 3-21](#) shows these connections in an unprotected configuration.

Figure 3-21 2.5-Gbps ITU Trunk Card Cable Connections (Unprotected)

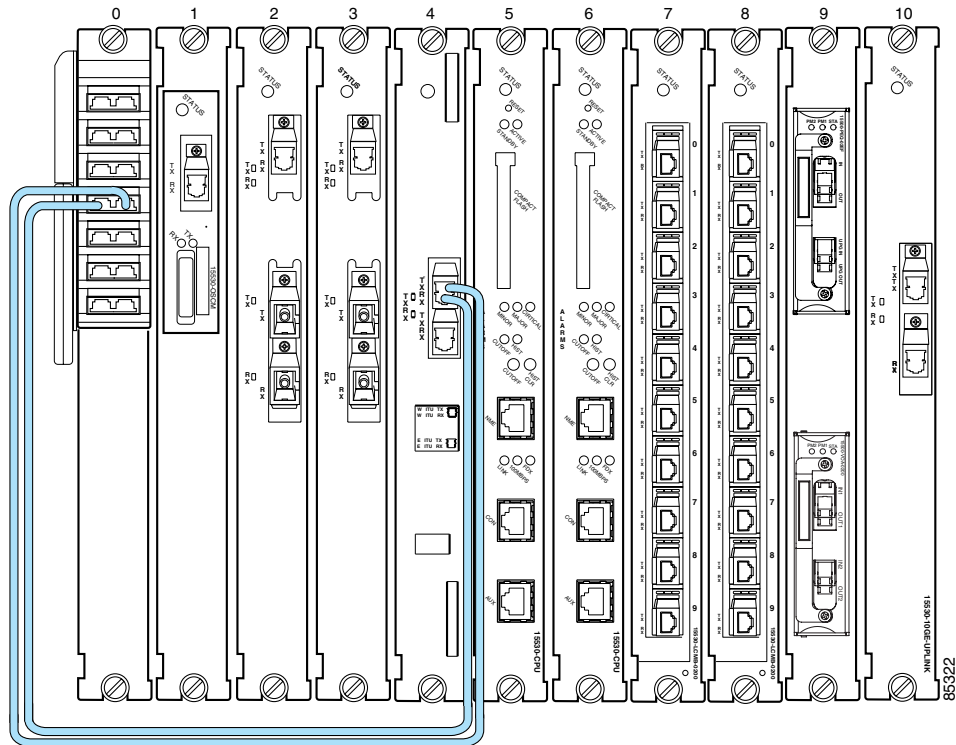
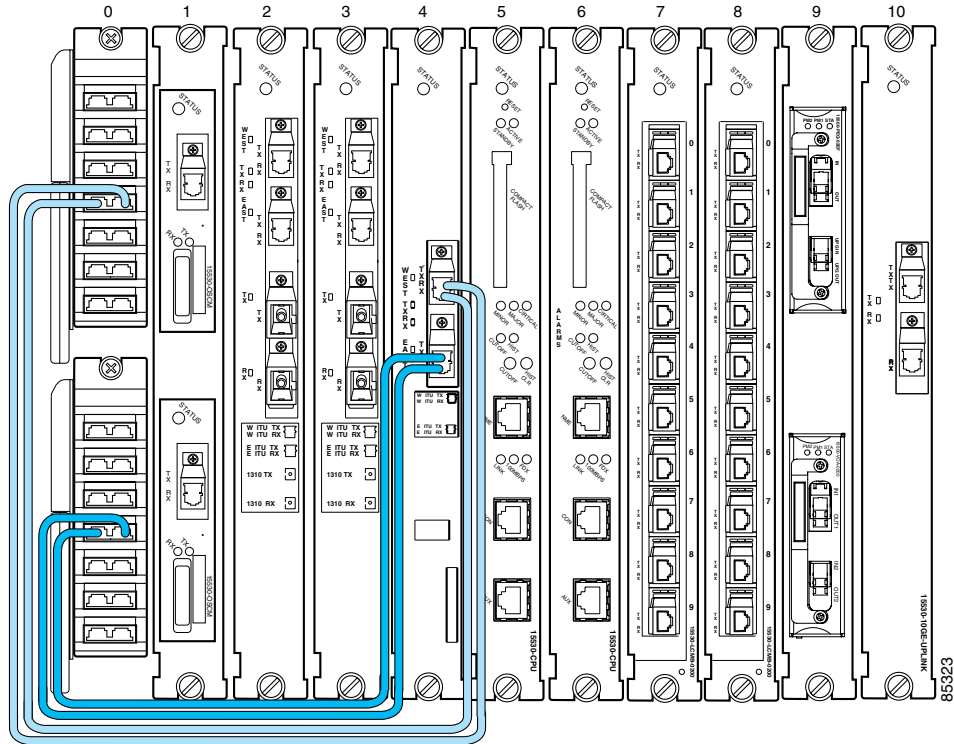


Figure 3-22 shows these connections in a splitter configuration. The WEST port connections go to the first OADM module and the EAST port connections go to the second OADM module.

Figure 3-22 2.5-Gbps ITU Trunk Card Cable Connections (Splitter)



Connecting the 10-Gbps ITU Tunable and Non tunable Trunk Card

The 10-Gbps ITU trunk card, both tunable and non tunable, has four separate redundant interfaces to the backplane that passes signals to and from the line cards. The optical ports on the front of the line card are connected to the OADM module. The TX port of the 10-Gbps ITU trunk card is connected to the CHxxxIN port of the OADM module and the RX port is connected to the CHxxxOUT port. [Figure 3-23](#) show these connections in an unprotected configuration.

Figure 3-23 10-Gbps ITU Tunable or Non tunable Trunk Card Cable Connections (Unprotected)

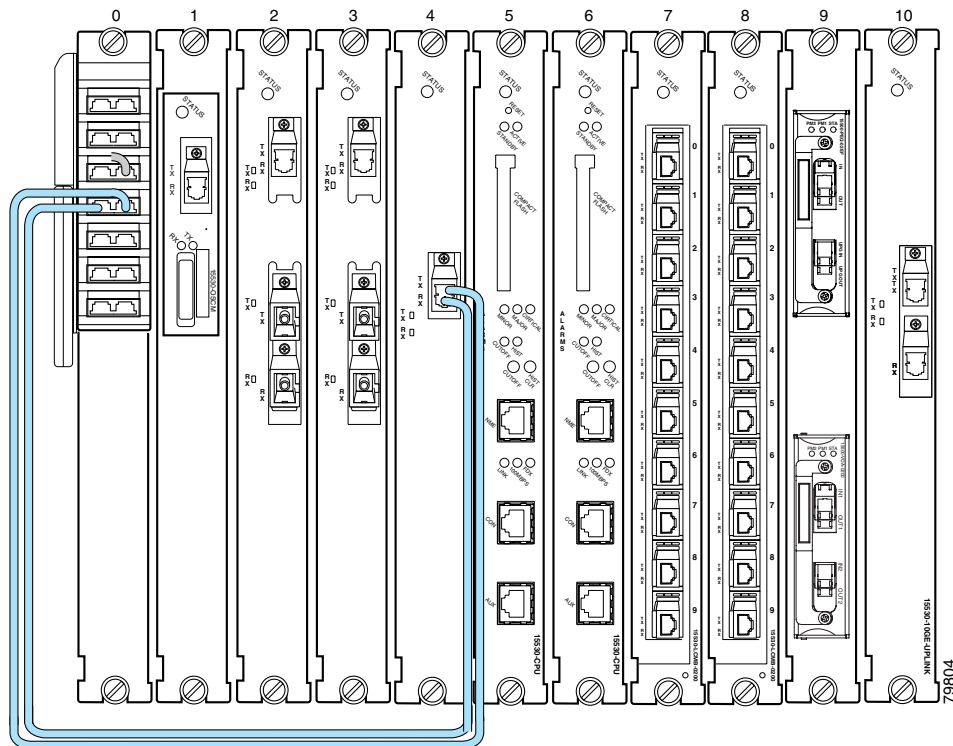
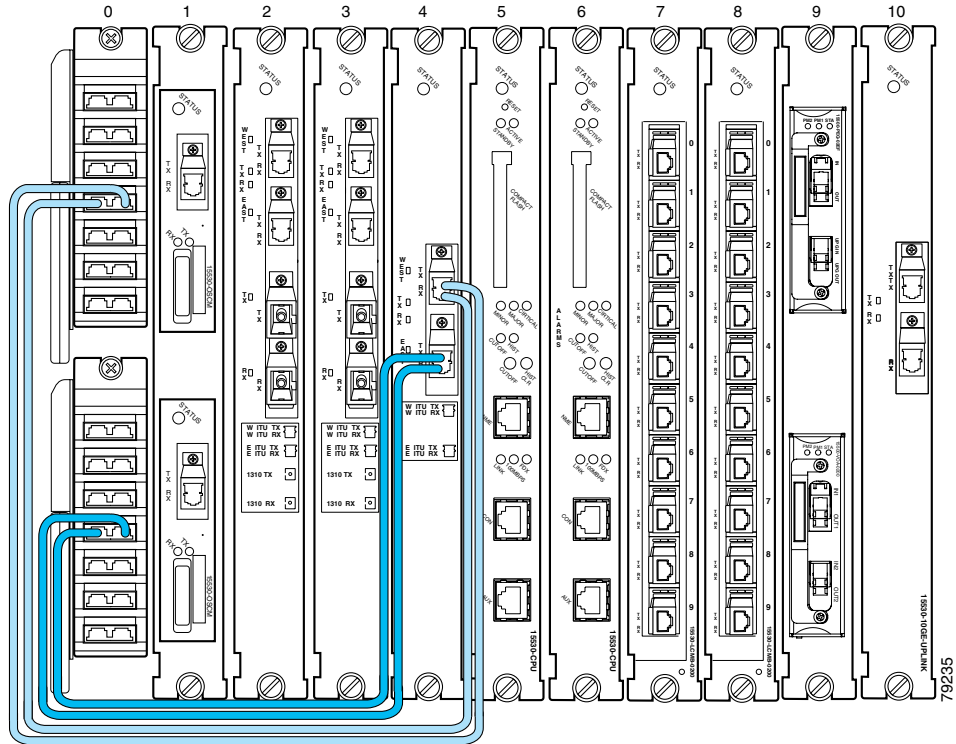


Figure 3-24 shows these connections in a splitter configuration. The WEST port connections go to the first OADM module and the EAST port connections go to the second OADM module.

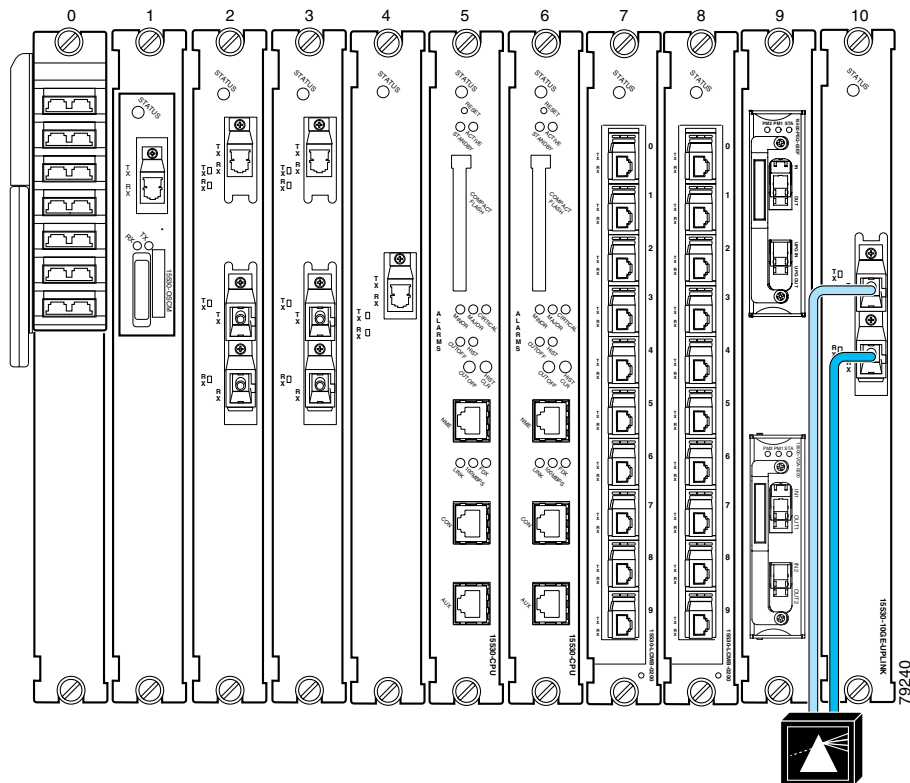
Figure 3-24 10-Gbps ITU Tunable or Non tunable Trunk Card Cable Connections (Splitter)



Connecting the 10-Gbps Uplink Card

The 10-Gbps uplink card sends and receives a 10-GE 1310-nm signal to and from a 10-GE transponder module on a Cisco ONS 15540 ESP or Cisco ONS 15540 ESPx. This card accepts up to four 2.5-Gbps (3.125-Gbps line rate) electrical signals from ESCON line cards and combines them into a 10-GE signal. This signal is converted to a 1310 nm wavelength signal. [Figure 3-25](#) shows the cable connections.

Figure 3-25 10-Gbps Uplink Line Card Cable Connections



Connecting the WB-VOA and PB-OE Modules

The WB-VOA and PB-OE modules allow the Cisco ONS 15530 to extend the inter-nodal and ring circumference distances, and to extend the number of nodes supported for hubbed ring, and meshed ring networks by equalizing power levels. The WB-VOA and PB-OE modules can be configured in several ways.

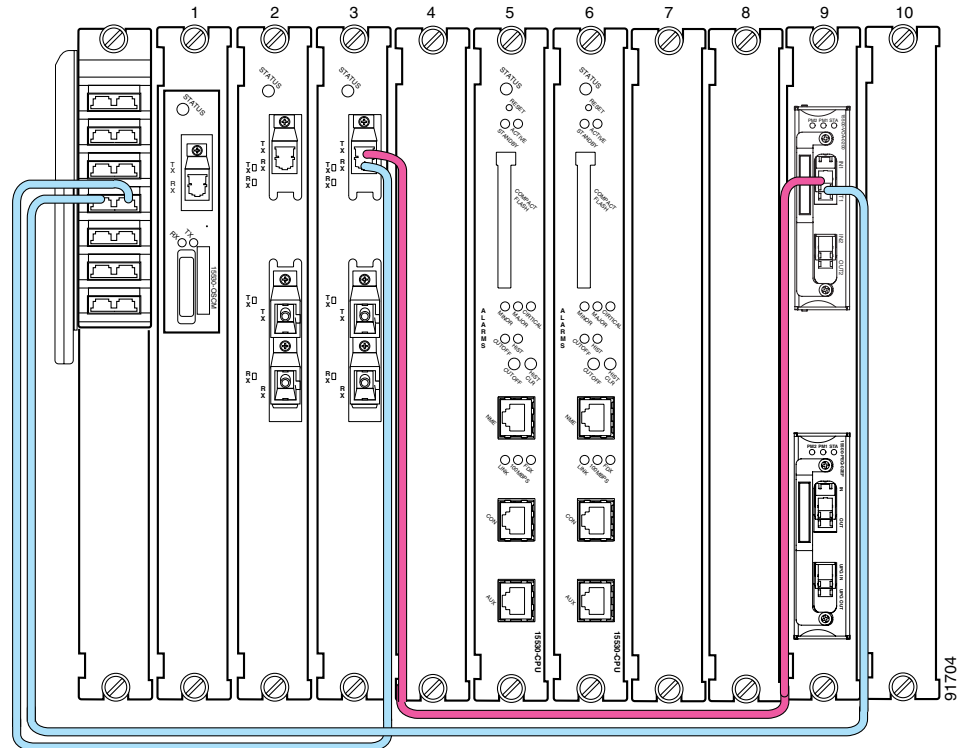
This section includes the following topics:

- [Per-Channel Equalization, page 3-29](#)
- [WB-VOA Attenuation on the Receive Side, page 3-30](#)
- [WB-VOA on the Trunk, page 3-31](#)
- [PB-OE on the Trunk to Equalizing Add Channel Power to Pass Through Power, page 3-32](#)
- [Using PB-OE Modules to Terminate Unused Bands, page 3-33](#)

Per-Channel Equalization

Figure 3-26 shows an example of per-channel equalization in an unprotected configuration. In this example, the WB-VOA is the top module in slot 9.

Figure 3-26 Per Channel Equalization (Unprotected)



Note

The OSC channels can also be equalized.

To install the cables, follow these steps:

- Step 1** Connect the IN port of the WB-VOA module to the TX port of the transponder.
- Step 2** Connect the OUT port of the WB-VOA module to the channel IN port of the OADM.
- Step 3** Connect the RX port of the transponder to the channel OUT port of the OADM.



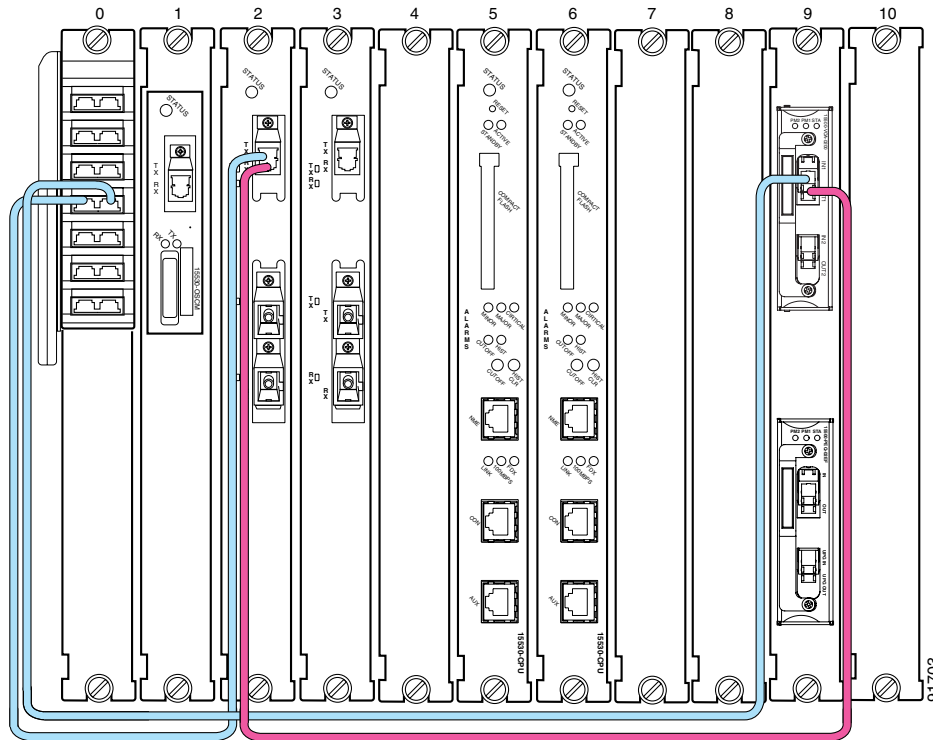
Note

The IN ports on the OADM module (slot 0) are on the left, the OUT ports are on the right. (See [Figure 1-16 on page 1-21](#)).

WB-VOA Attenuation on the Receive Side

The WB-VOA module can be connected on the receive side to attenuate the signal. [Figure 3-27](#) shows an example of WB-VOA attenuation on the receive side in an unprotected configuration. In this example, the WB-VOA is the top module in slot 9.

Figure 3-27 WB-VOA Attenuation on the Receive Side (Unprotected)



To install the cables, follow these steps:

-
- Step 1** Connect the IN port of the WB-VOA module to the channel OUT port of the OADM.
 - Step 2** Connect the OUT port of the WB-VOA module to the RX port of the transponder.
 - Step 3** Connect the TX port of the transponder to the channel IN port of the OADM.

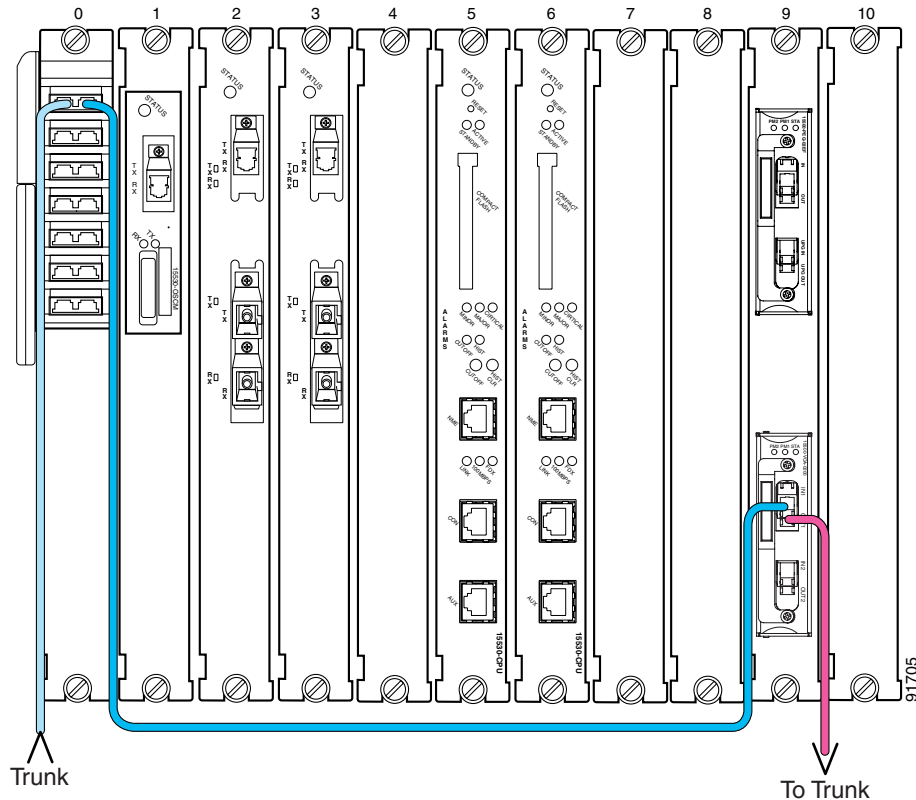


Note The IN ports on the OADM module (slot 0) are on the left, the OUT ports are on the right. (See [Figure 1-16](#) on [page 1-21](#)).

WB-VOA on the Trunk

The WB-VOA module can be connected to attenuate the trunk signal leaving the node. [Figure 3-28](#) shows an example of these cable connections on an unprotected configuration. In this example, the WB-VOA is the bottom module in slot 9.

Figure 3-28 WB-VOA on Trunk (TX Side)



To connect the WB-VOA on the trunk, follow these steps:

- Step 1** Connect the outside trunk to the TRUNK_IN port of the OADM module.
- Step 2** Connect the TRUNK_OUT port of the OADM module to the IN port of the WB-VOA module.
- Step 3** Connect the OUT port of the WB-VOA module to the outside trunk.

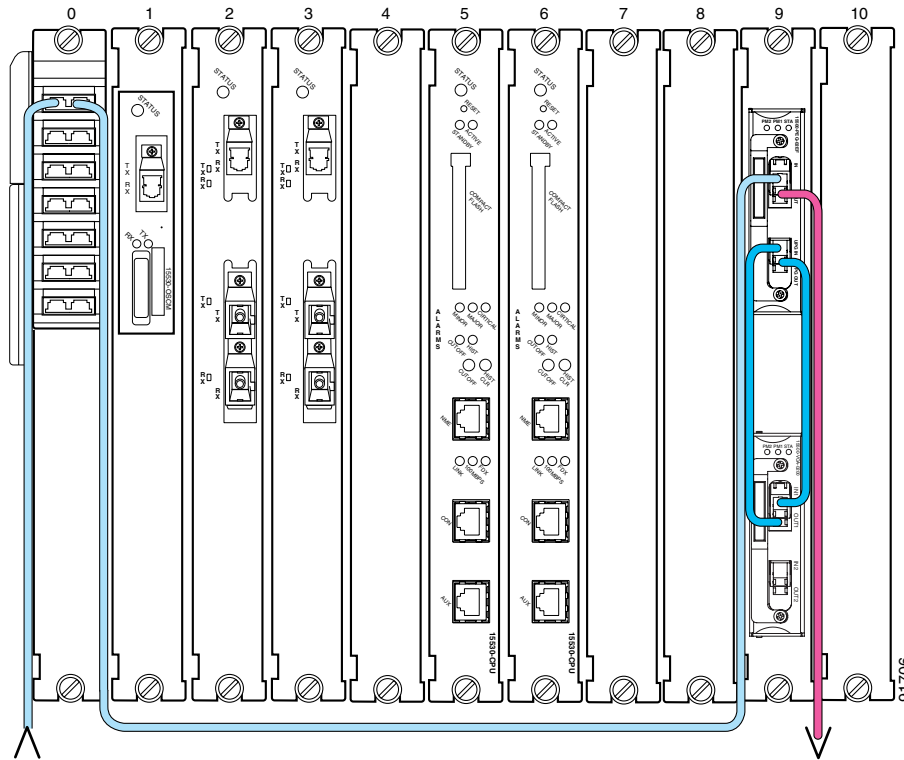


Note The IN ports on the OADM module (slot 0) are on the left, the OUT ports are on the right. (See [Figure 1-16](#) on page 1-21).

PB-OE on the Trunk to Equalizing Add Channel Power to Pass Through Power

The PB-OE provides per-band attenuation on the trunk. [Figure 3-29](#) shows an example of an unprotected configuration of a PB-OE module cabled on the trunk. In this example, the PB-OE is the top module in slot 9, and the WB-VOA is the bottom module in slot 9.

Figure 3-29 PB-OE on the Trunk (Unprotected)



To install the cables in an unprotected configuration, follow these steps:

- Step 1** Connect the OUT port of the PB-OE module to the trunk.
- Step 2** Connect the IN port of the PB-OE module to TRUNK_OUT port of the OADM.
- Step 3** Connect the TRUNK_IN port of the OADM to the outside trunk.
- Step 4** Connect the UPG_IN port of the PB-OE module to the OUT port of the WB-VOA module.
- Step 5** Connect the UPG_OUT port of the PB-OE module to the IN port of the WB-VOA module.



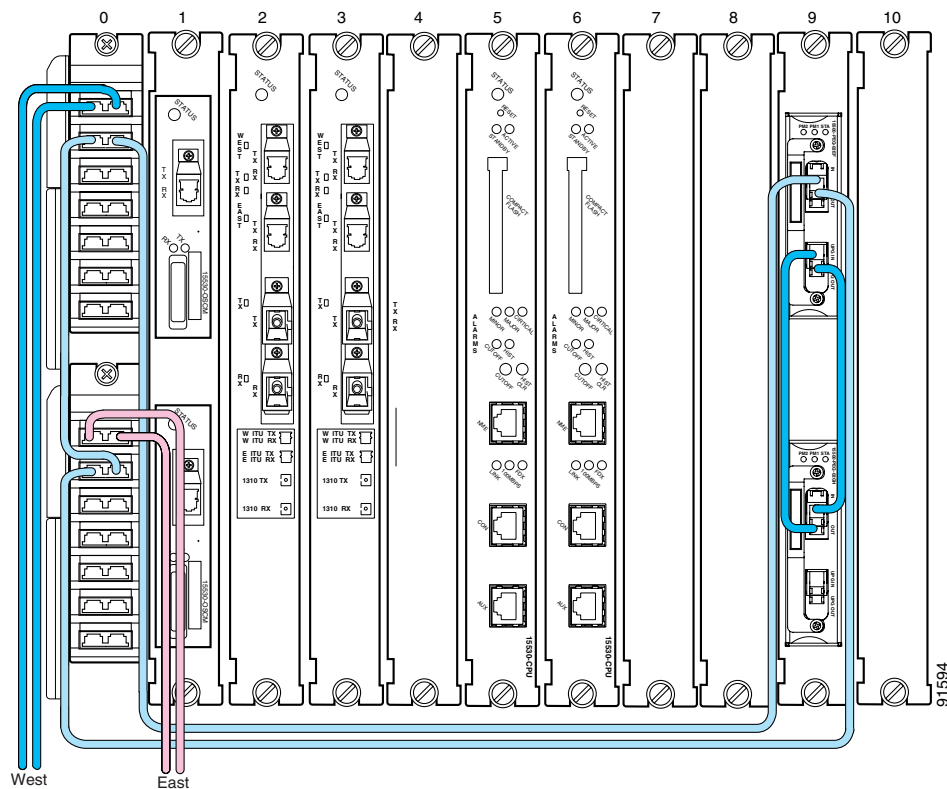
Note The IN ports on the OADM module (slot 0) are on the left, the OUT ports are on the right. (See [Figure 1-16](#) on page 1-21).

Using PB-OE Modules to Terminate Unused Bands

PB-OE modules can be used to equalize power and terminate unused bands, eliminating potential lasing effects. This configuration is also known as an optical seam. Place optical seams in meshed ring topologies where there are no nodes equivalent to the hub node in a hubbed ring topology where all the used and unused bands terminate. Be sure to have PB-OE modules in the optical seam to equalize every added band on the network.

Figure 3-30 shows an example of two PB-OE modules configured to equalize bands E, F, G and H and terminate the unused bands in the west to east direction only. The east to west direction can be configured on any node.

Figure 3-30 Using PB-OE Modules to Terminate Unused Bands



To install the cables in this configuration, follow these steps:

- Step 1** Connect the MID_IN port of the first OADM module to the MID_OUT port of the second OADM module.
- Step 2** Connect the MID_OUT port of the first OADM module to the IN port of the first PB-OE module.
- Step 3** Connect the MID_IN port of the second OADM module to the OUT port of the first PB-OE module.
- Step 4** Connect the UPG_IN port of the first PB-OE module to the OUT port of the second PB-OE module.
- Step 5** Connect the UPG_OUT port of the first PB-OE module to the IN port of the second PB-OE module.

- Step 6** Connect the TRUNK_IN and TRUNK_OUT ports of the first OADM module to the west side trunks.
- Step 7** Connect the TRUNK_IN and TRUNK_OUT ports of the second OADM module to the east side trunks.

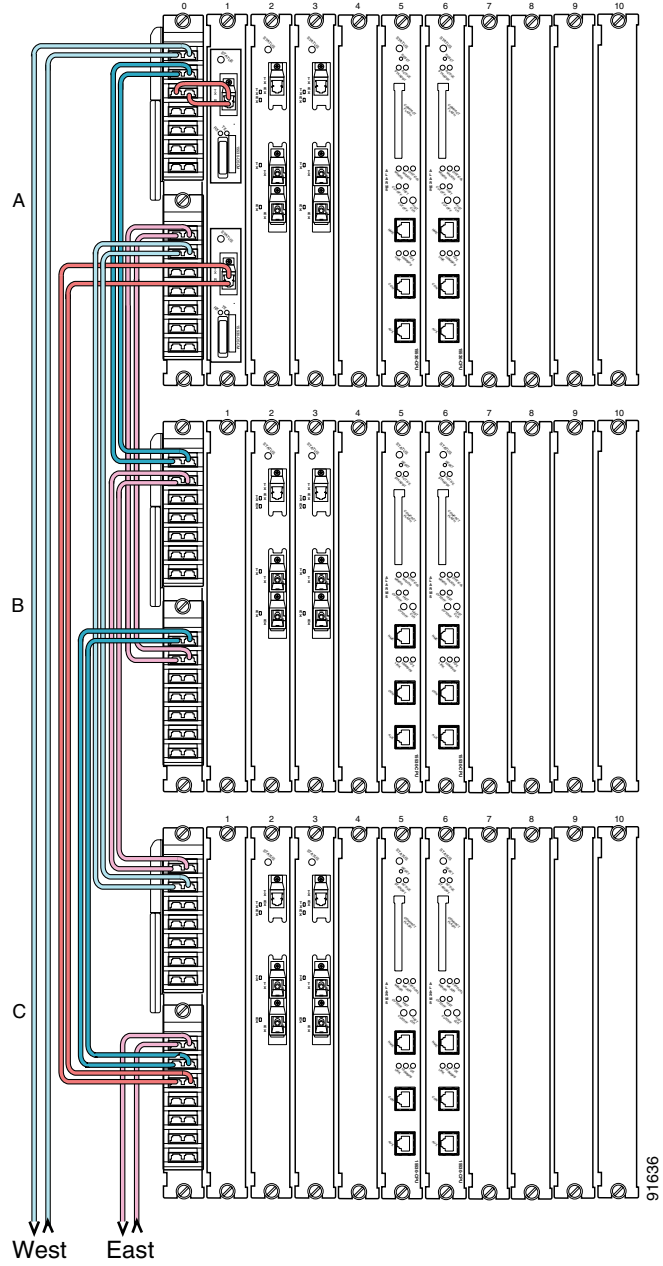


Note The IN ports on the OADM module (slot 0) are on the left, the OUT ports are on the right. (See [Figure 1-16 on page 1-21](#)).

Connecting a Multi-Shelf Node

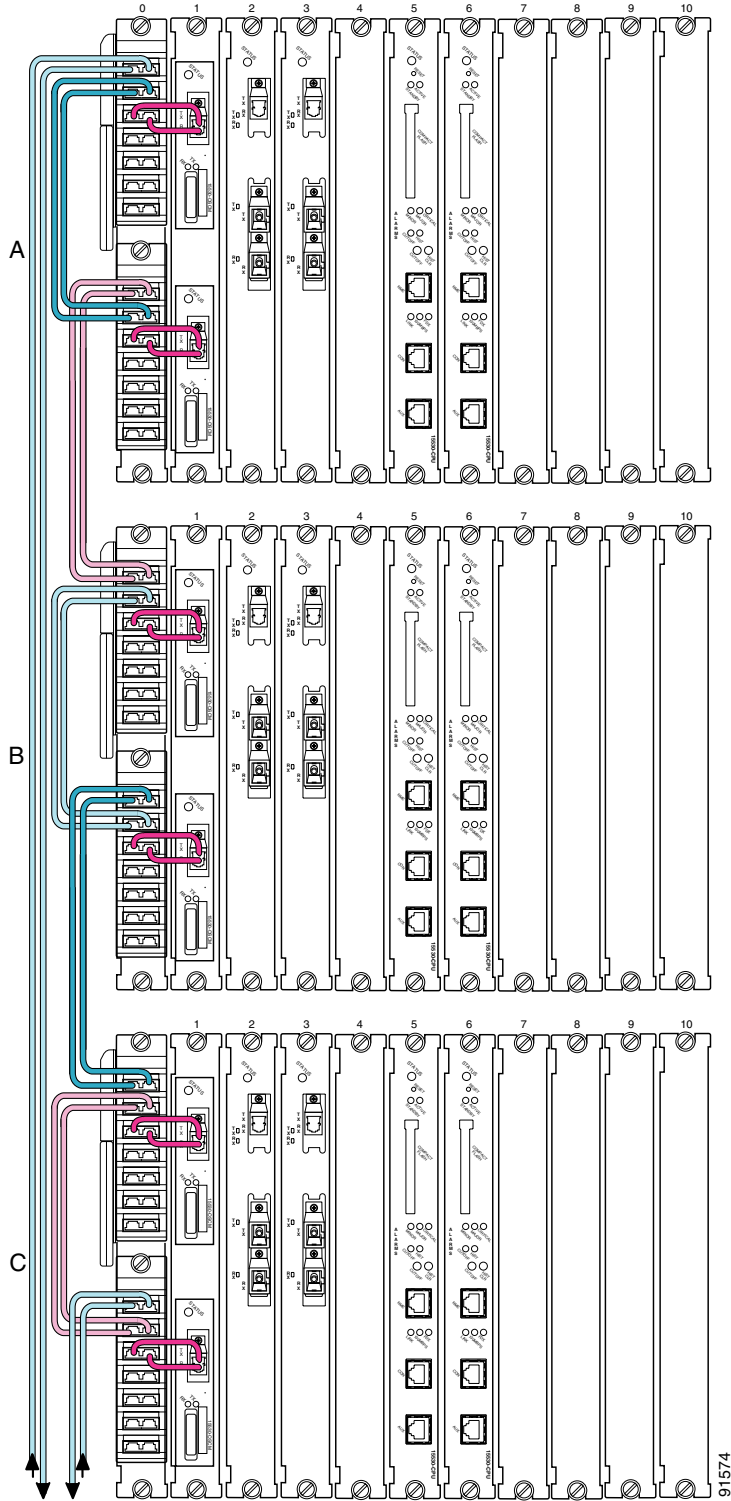
There are a number of ways to configure a multi-shelf node. [Figure 3-31](#) and [Figure 3-32](#) are two examples of how multi-shelf nodes can be connected. [Figure 3-31](#) shows a configuration of cascaded OADMs which supports multiple bands in the node and [Figure 3-32](#) shows a three shelf node with OSC modules that are added and dropped on each shelf.

Figure 3-31 Cascading the OADMs on a Multi-Shelf Node



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Figure 3-32 Basic Cable Connections on a Multi-Shelf Node



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To connect a three shelf node with cascaded OADMs, follow these steps:

-
- Step 1** Connect the cables of the first OADM module in slot 0 of shelf A as follows:
- Connect the TRUNK_IN and the TRUNK_OUT ports of the first OADM in shelf A to the west side trunk.
 - Connect the MID_IN port of the first OADM in shelf A to the TRUNK_OUT port of the first OADM in shelf B.
 - Connect the MID_OUT port of the first OADM in shelf A to the TRUNK_IN port of the first OADM in shelf B.
- Step 2** Connect the cables of the second OADM module in slot 0 of shelf A as follows:
- Connect the TRUNK_IN port of the second OADM in shelf A to the MID_OUT port of the second OADM in shelf B.
 - Connect the TRUNK_OUT port of the second OADM in shelf A to the MID_IN port of the second OADM in shelf B.
 - Connect the MID_IN port of the second OADM in shelf A to the MID_OUT port of the first OADM in shelf C.
 - Connect the MID_OUT port of the second OADM in shelf A to the MID_IN port of the first OADM in shelf C.
- Step 3** In addition to the cables already connected to the first OADM module in slot 0 of shelf B, make the following connections:
- Connect the MID_IN port of the first OADM in shelf B to the TRUNK_OUT port of the first OADM in shelf C.
 - Connect the MID_OUT port of the first OADM in shelf B to the MID_OUT port of the first OADM in shelf C.
- Step 4** In addition to the cables already connected to the second OADM module in slot 0 of shelf B, make the following connections:
- Connect the TRUNK_IN port of the second OADM in shelf B to the MID_OUT port of the second OADM in shelf C.
 - Connect the TRUNK_OUT port of the second OADM in shelf B to the MID_IN port of the second OADM in shelf C.
- Step 5** Connect the TRUNK_IN and the TRUNK_OUT ports of the second OADM in shelf C to the east side trunk.



Note The IN ports on the OADM module (slot 0) are on the left, the OUT ports are on the right. (See [Figure 1-16 on page 1-21](#)).

To connect a three shelf node in a splitter configuration where the OSC modules are added and dropped on each shelf, follow these steps:

-
- Step 1** Connect the cables of the first OADM module in slot 0 of shelf A as follows:
- Connect the OSC IN port of the OADM to the TX port of the OSC module.
 - Connect the OSC OUT port of the OADM to the RX port of the OSC module.
 - Connect the MID_IN port of the first OADM on shelf A to the MID_OUT of the second OADM on the shelf A.
 - Connect the MID_OUT port of the first OADM on shelf A to the MID_IN of the second OADM on the shelf A.
 - Connect the TRUNK_IN port and the TRUNK_OUT port of the first OADM on shelf A to the west side trunk.
- Step 2** In addition to the cables already connected to the second OADM module in slot 0 of shelf A, make the following connections:
- Connect the OSC IN port of the OADM to the TX port of the OSC module.
 - Connect the OSC OUT port of the OADM to the RX port of the OSC module.
 - Connect the TRUNK_IN port of the second OADM on shelf A to the TRUNK_OUT port of the first OADM on shelf B.
 - Connect the TRUNK_OUT port of the second OADM on shelf A to the TRUNK_IN port of the first OADM on shelf B.
- Step 3** In addition to the cables already connected to the first OADM module in slot 0 of shelf B, make the following connections:
- Connect the OSC IN port of the OADM to the TX port of the OSC module.
 - Connect the OSC OUT port of the OADM to the RX port of the OSC module.
 - Connect the MID_IN port of the first OADM on shelf B to the MID_OUT of the second OADM on the shelf B.
 - Connect the MID_OUT port of the first OADM on shelf B to the MID_IN of the second OADM on the shelf B.
- Step 4** In addition to the cables already connected to the second OADM module in slot 0 of shelf B, make the following connections:
- Connect the OSC IN port of the OADM to the TX port of the OSC module.
 - Connect the OSC OUT port of the OADM to the RX port of the OSC module.
 - Connect the TRUNK_IN port of the second OADM on shelf B to the TRUNK_OUT port of the first OADM on shelf C.
 - Connect the TRUNK_OUT port of the second OADM on shelf B to the TRUNK_IN port of the first OADM on shelf C.

- Step 5** In addition to the cables already connected to the first OADM module in slot 0 of shelf C, make the following connections:
- Connect the OSC IN port of the OADM to the TX port of the OSC module.
 - Connect the OSC OUT port of the OADM to the RX port of the OSC module.
 - Connect the MID_IN port of the first OADM on shelf C to the MID_OUT of the second OADM on the shelf C.
 - Connect the MID_OUT port of the first OADM on shelf C to the MID_IN of the second OADM on the shelf C.
- Step 6** In addition to the cables already connected to the second OADM module in slot 0 of shelf C, make the following connections:
- Connect the OSC IN port of the OADM to the TX port of the OSC module.
 - Connect the OSC OUT port of the OADM to the RX port of the OSC module.
 - Connect the TRUNK_IN port and the TRUNK_OUT port of the first OADM on shelf C to the east side trunk.



Note The IN ports on the OADM module (slot 0) are on the left, the OUT ports are on the right. (See [Figure 1-16 on page 1-21](#)).

Cable Management

Due to the flexibility and complexity of configurations available with the Cisco ONS 15530, managing the placement and storage of the fiber optic cables is a must. To avoid confusion and ensure the integrity of the fiber optic cables used with the Cisco ONS 15530, we recommend that both ends of all fiber optic cables be labelled. Labels for this purpose are shipped with the system.

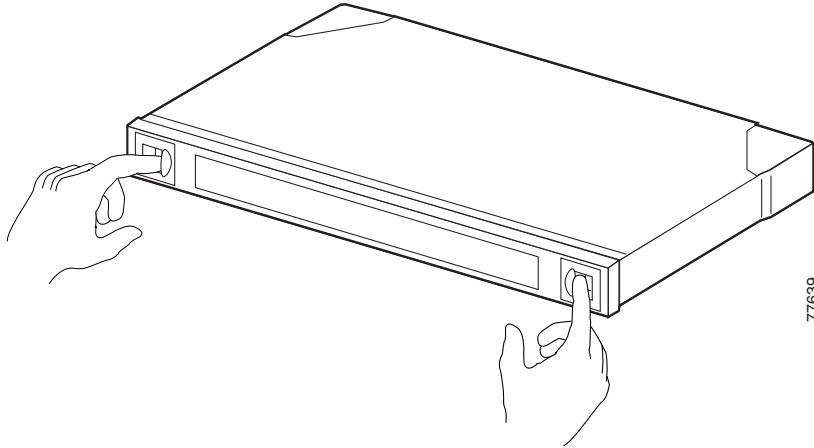


Note The cable storage drawer can accommodate attenuators that are available from optical component distributors.

The cable storage drawer provides the management system for the cabling. The following procedures describe how to connect the cables on your system.

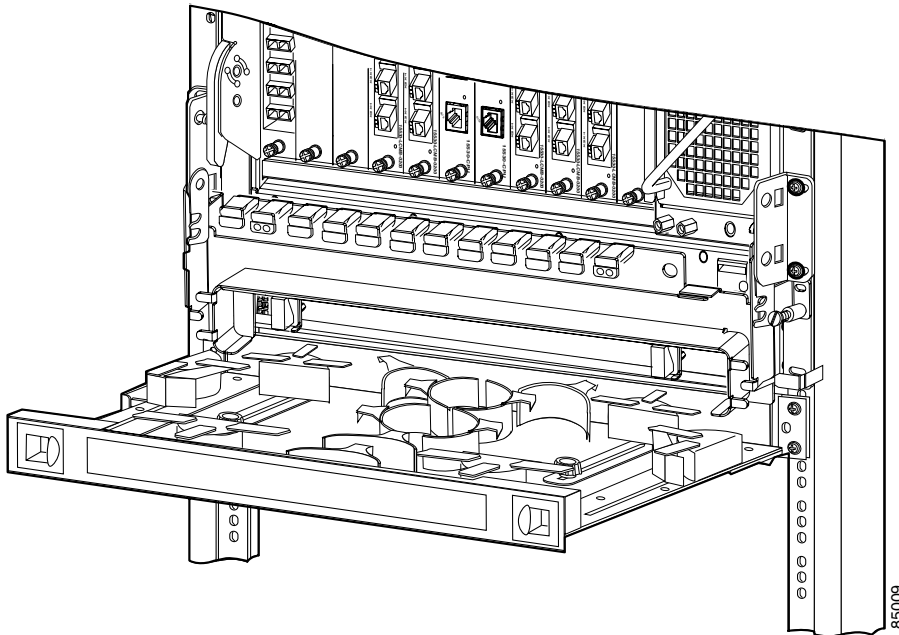
- Step 1** Open the cable storage drawer by pushing the tabs in to release the lock on the drawer (see [Figure 3-33](#)).

Figure 3-33 Opening the Cable Storage Drawer



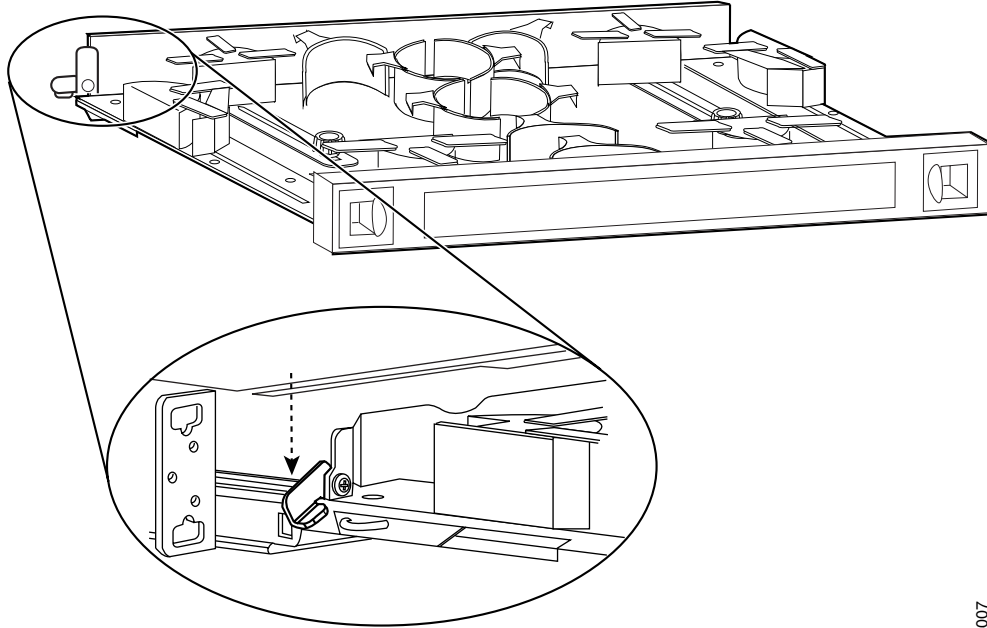
- Step 2** Pull out the cable storage drawer (see [Figure 3-34](#)).

Figure 3-34 Pulling out the Cable Storage Drawer



- Step 3** Lock the drawer in the open position by pushing the latch at the back left of the drawer down into the locked position (see [Figure 3-35](#)).

Figure 3-35 Locking the Cable Storage Drawer Open

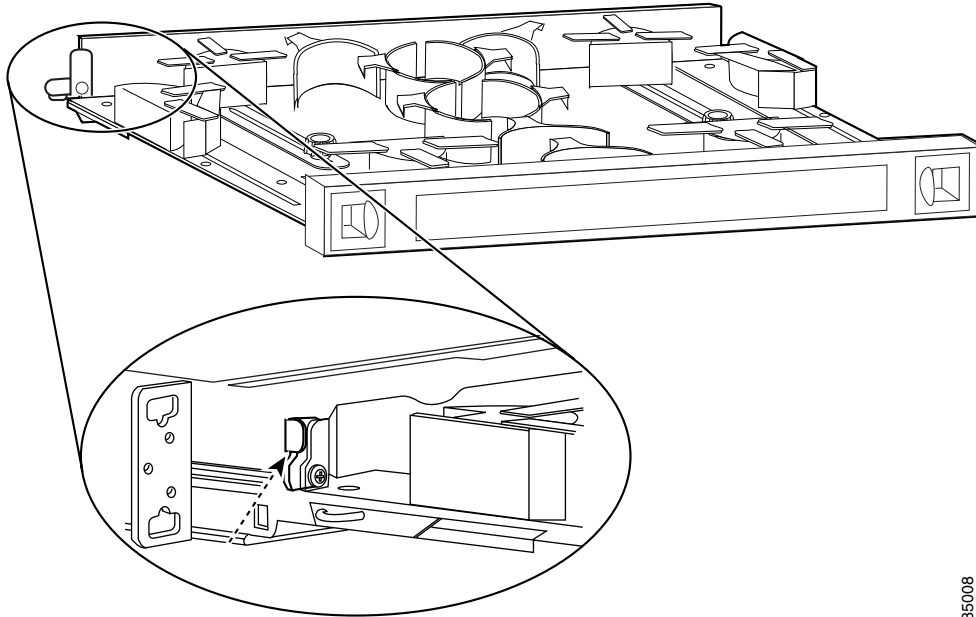


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- Step 4** Install the fiber optic cables as discussed in the preceding sections.
- Step 5** Route the excess cable of each connection down through the cable storage drawer.
- Step 6** Route the cable around the sliding cable retainers on both sides of the drawer and around the appropriate stationary retainers to take up the cable slack.

- Step 7** When all cables have been connected and neatly routed, unlock and close the drawer. To unlock the cable storage drawer, move the latch at the rear of the drawer into an upright position. (See [Figure 3-36](#).)
- Step 8** Use the supplied cable ties to secure the cables to the rack.

Figure 3-36 *Unlocking the Cable Storage Drawer*



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Specifications

This appendix describes the specifications for the chassis, line cards, and the carrier motherboard and modules used in the Cisco ONS 15530 system. This appendix includes the following sections:

- [Chassis Specifications, page A-2](#)
- [Channel to Wavelength Mapping, page A-3](#)
- [OADM Module Specifications, page A-4](#)
- [PSM Specifications, page A-5](#)
- [OSC Module Specifications, page A-5](#)
- [PB-OE and WB-VOA Module Specifications, page A-6](#)
- [Transponder Line Card Specifications, page A-7](#)
- [ESCON Aggregation Card Specifications, page A-8](#)
- [4-Port 1-Gbps/2-Gbps FC Aggregation Card, page A-9](#)
- [8-Port FC/GE Aggregation Card, page A-10](#)
- [8-Port Multi-Service Muxponder Specifications, page A-12](#)
- [2.5-Gbps ITU Trunk Card Specifications, page A-14](#)
- [10-Gbps ITU Tunable and Non tunable Trunk Card Specifications, page A-15](#)
- [10-Gbps Uplink Card, page A-16](#)
- [SFP Specifications, page A-16](#)

Chassis Specifications

Table A-1 lists the specifications for the Cisco ONS 15530.

Table A-1 Cisco ONS 15530 Specifications

Description	Specification
Environmental	
Temperature, ambient operating	32 to 104°F (0 to +40°C)
Humidity (RH ¹), ambient (non-condensing) operating	5 to 95%
Altitude, operating and non-operating	Minimum -197 ft (-60 m) Maximum 6500 ft (2000 m)
Cisco ONS 15530 CHAS-E	
Dimensions (H x W x D)	14.4 x 17.3 x 10.1 in. (365.9 x 439.4 x 256.5 mm)
Weight	Empty chassis: 27.5 lbs (12.25 kg) Fully loaded: 71 lbs (32.21 kg)
Cisco ONS 15530 CHAS-N	
Dimensions (H x W x D)	15.7 x 17.3 x 10.1 in. (398.8 x 439.4 x 256.5 mm)
Weight	Empty chassis: 27.0 lbs (12.25 kg) Fully loaded: 71 lbs (32.21 kg)
AC-Input Power	
AC-input voltage	100 to 240 VAC (nominal) 85 to 264 VAC (full range)
Power consumption maximum	600W
Heat dissipation	2048 BTU/hr
DC-Input Power	
DC-input voltage	-48 to -60 VDC (nominal) -40.5 to -72 VDC (full range)
Power consumption maximum	600W (fully configured system)
Heat dissipation	2048 BTU/hr

1. RH = relative humidity

Channel to Wavelength Mapping

Table A-2 lists the channels, wavelengths, and frequencies for each band.

Table A-2 Channel to Wavelength Mapping

Cisco ONS 15530 Band	Cisco ONS 15530 Channel	ITU ¹ Channel	ITU Wavelength ²	ITU Frequency ³
OSC ⁴		19	1562.23	191.9000
A	1	21	1560.61	192.100
	2	22	1559.79	192.200
	3	23	1558.98	192.300
	4	24	1558.17	192.400
B	5	26	1556.55	192.600
	6	27	1555.75	192.700
	7	28	1554.94	192.800
	8	29	1554.13	192.900
C	9	31	1552.52	193.100
	10	32	1551.72	193.200
	11	33	1550.92	193.300
	12	34	1550.12	193.400
D	13	36	1548.51	193.600
	14	37	1547.72	193.700
	15	38	1546.92	193.800
	16	39	1546.12	193.900
E	17	41	1544.53	194.100
	18	42	1543.73	194.200
	19	43	1542.94	194.300
	20	44	1542.14	194.400
F	21	46	1540.56	194.600
	22	47	1539.77	194.700
	23	48	1538.98	194.800
	24	49	1538.19	194.900

Table A-2 Channel to Wavelength Mapping (continued)

Cisco ONS 15530 Band	Cisco ONS 15530 Channel	ITU ¹ Channel	ITU Wavelength ²	ITU Frequency ³
G	25	51	1536.61	195.100
	26	52	1535.82	195.200
	27	53	1535.04	195.300
	28	54	1534.25	195.400
H	29	56	1532.68	195.600
	30	57	1531.90	195.700
	31	58	1531.12	195.800
	32	59	1530.33	195.900

1. ITU = International Telecommunication Union
2. Wavelengths in vacuum in nm
3. Frequency in THz, 100 GHz grid
4. OSC = optical supervisory channel

OADM Module Specifications

Table A-3 shows the maximum optical link loss for the data channels between the 4-channel OADM modules and the line cards, and between the pass-through add and drop connectors on the OADM modules.



Note

The optical specifications described in this section are only for the individual components and should not be used to characterize the entire network performance.

Table A-3 OADM Module Specifications

Type of OADM Modules	Trunk IN to Line Card (Data Drop)	Line Card to Trunk OUT (Data Add)	Trunk IN to Thru OUT (Pass-Through Drop)	Thru IN to Trunk OUT (Pass-Through Add)
4-channel with OSC	4.1 dB	4.1 dB	1.5 dB	1.5 dB
4-channel without OSC	4.1 dB	4.1 dB	1.0 dB	1.0 dB

PSM Specifications

Table A-4 and Table A-5 lists the PSM (protection switch module) card and optical specifications for the Cisco ONS 15530.


Note

The optical specifications described in this section are only for the individual components and should not be used to characterize the entire network performance.

Table A-4 PSM Card Specifications

Description	Specification
Dimensions	3.7 x 9 in. (9.4 x 22.9 cm)
Weight	3.5 lbs (1.59 kg)
Connector	MU
Receive overload	17 dBm

Table A-5 PSM Optical Specifications

Port	Insertion Loss		
	Minimum (dB)	Maximum (dB)	Ripple (dB)
Rx_West to monitor	19	21	0.5
Rx_West to common out		1.7	0.4
Rx_East to monitor	19	21	0.5
Rx_East to common out		1.7	0.4
TX_Common to Tx_West	2.7	3.7	0.3
Tx_Common to Tx_East	2.7	3.7	0.3


Note

The accuracy of the power detector is ± 1.9 dB over the entire C band and temperature range.

OSC Module Specifications

Table A-6 lists the OSC module receiver and transmitter specifications.


Note

The optical specifications described in this section are only for the individual components and should not be used to characterize the entire network performance.

Table A-6 OSC Module Specifications

Description	Specification	
Fiber type	SM ¹ 9 micron	
Connector	MU	
Output wavelength	1562.23 ITU channel	
Receiver	Minimum	Maximum
Receive sensitivity	-19 dBm	
Receive overload		-1.5 dBm
Input wavelength	1249 nm	1600 nm
Transmitter	Minimum	Maximum
Transmitter power	5 dBm	10 dBm
Dispersion tolerance		3200 ps/nm

1. SM = single mode.

PB-OE and WB-VOA Module Specifications

[Table A-7](#) contains specifications for the Cisco ONS 15530 single-band PB-OE module. [Table A-8](#) contains specifications for the Cisco ONS 15530 single and dual WB-VOA modules.



Note

The optical specifications described in this section are only for the individual components and should not be used to characterize the entire network performance.

Table A-7 Cisco ONS 15530 Single-Band and Dual-Band PB-OE Module Specifications

Parameter	Specification
Maximum attenuation	30 dB
Attenuation resolution	0.1 dB
In-out isolation for drop/equalized band path	50 dB
In-out isolation for upgrade band path	50 dB
Input power range	-26 to 11 dBm

Table A-8 Cisco ONS 15530 Single and Dual WB-VOA Modules Specification

Parameter	Specification
Operating wavelength range	1530 to 1565 nm
Maximum attenuation	30 dB
Attenuation resolution	0.1 dB
Input power range	-28 to 21 dBm

Transponder Line Card Specifications

Table A-9 lists the transponder line card receiver and transmitter specifications for the client side lasers.



Note

The optical specifications described in this section are only for the individual components and should not be used to characterize the entire network performance.

Table A-9 Client Side Optical Specifications

Description	Specification			
Fiber type	SM ¹ 9 micron			
Connector	SC			
Receiver	SM Minimum	SM Maximum	MM ² Minimum	MM Maximum
Receive sensitivity	-19 dBm		-25 dBm	
Receive overload		-1.5 dBm		-8 dBm
Input wavelength	1249 to 1600 nm ³		1249 to 1600 nm	
Optical reflectance	-27 dB ⁴			
Receiver fiber pigtail	MM 50 micron		MM 62.5 micron	
Transmitter	SM Minimum	SM Maximum	MM ⁵ Minimum	MM Maximum
Output wavelength	1260 to 1360 nm		1260 to 1360 nm	
Transmitter power	-5 dBm	0 dBm	-5 dBm	0 dBm

1. SM = single mode
2. MM = multimode
3. nm = nanometers
4. dB = decibels
5. MM = multimode

Table A-10 lists the transponder line card receiver and transmitter specifications for the trunk side lasers.



Note

Optical loss due to splitter modules and connectors should be included in the optical budget calculation.

Table A-10 Trunk Side Optical Specifications

Description	Specification	
Fiber type	SM 9 micron	
Connector	MU	
Receiver	Minimum	Maximum
OSNR ^{1, 2}	19 dB	
Receive sensitivity ²	-28 dBm	
Receive overload		-8 dBm
Input wavelength	1260 nm	1580 nm

Table A-10 *Trunk Side Optical Specifications (continued)*

Description	Specification	
	Minimum	Maximum
Transmitter power	5 dBm	10 dBm
Dispersion tolerance		3200 ps/nm ³

1. OSNR = optical signal-to-noise ratio.
2. Add the proper network-level penalty to the OSNR and/or receive power based on your actual network topology characteristics, such as dispersion.
3. ps/nm = picoseconds per nanometer.

ESCON Aggregation Card Specifications

[Table A-11](#) lists SFP optics supported by the 10-port ESCON aggregation card. The optical power characteristics of the supported SFP optics are listed in the [SFP Specifications](#) section.


Note

The optical specifications described in this section are only for the individual components and should not be used to characterize the entire network performance.

Table A-11 *SFPs Supported by ESCON Aggregation Cards*

SFP Part Number	Description
15500-XVRA-01A2	ESCON, OC-3/ STM-1 SR
15500-XVRA-10A1	Low-band 8 Mbps to 200 Mbps
15500-XVRA-10B1	Low-band 8 Mbps to 200 Mbps
15500-XVRA-11A1	Mid-band 200 Mbps to 622 Mbps
15500-XVRA-11B1	Mid-band 200 Mbps to 1.25 Gbps
15500-XVRA-12B1	High-band 1.062 Gbps to 2.488 Gbps

[Table A-12](#) lists the maximum added end-to-end latency is from the ESCON aggregation cards aggregating and separating the client signals.


Note

The ESCON latency values have been determined by simulation and are approximate.

Table A-12 Latency for ESCON Aggregation Cards

Traffic Mix on Transmitting Node	Maximum Added End-to-End Latency ¹			
	No GE	1518-Byte GE Packets	4470-Byte GE Packets	10,230-Byte GE Packets
ESCON only	8.5 μ s			
ESCON and FC/FICON on the same 10-Gbps ITU trunk card	8.5 μ s			
ESCON and GE only on the same 10-Gbps ITU trunk card		10 μ s	12.5 μ s	17 μ s

1. The latency values are based on configuration of correct transmit buffer sizes as described in the [Cisco ONS 15530 Configuration Guide](#).

4-Port 1-Gbps/2-Gbps FC Aggregation Card

The 4-port 1-Gbps/2-Gbps FC aggregation cards support the SFPs listed in [Table A-13](#). The optical power characteristics of the supported SFPs are listed in the [SFP Specifications](#) section. Only use Cisco-certified SFPs for the 4-port 1-Gbps/2-Gbps FC aggregation cards. If the specifications of the client equipment interfaces do not fall within these ranges, attenuators or amplifiers might be required.



Note

The optical specifications described in this section are only for the individual components and should not be used to characterize the entire network performance.

Table A-13 SFPs Supported by the 4-port 1-Gbps/2-Gbps FC Aggregation Card

Part Number	Protocols or Clock Rate Range Supported
15500-XVRA-02C1	Gigabit Ethernet ¹ , Fibre Channel (1 Gbps) ² , FICON (1 Gbps)
15500-XVRA-03B1	Gigabit Ethernet ³ , Fibre Channel (1 Gbps) ⁴ , FICON (1 Gbps), ISC-3 links compatibility mode
15500-XVRA-03B2	Fibre Channel (1 Gbps and 2 Gbps), FICON (1 Gbps and 2 Gbps)
15500-XVRA-11B1	Mid-band variable rate 200 Mbps to 1.25 Gbps
15500-XVRA-12B1	High-band variable rate 1.062 Gbps to 2.488 Gbps
15454-SFP-GEFC-SX	Fibre Channel (2 Gbps), Fibre Channel (1 Gbps), Gigabit Ethernet, FICON (1 Gbps and 2 Gbps)

- 1000BASE-SX
- FC-0-100-M5-SN-S and FC-0-100-M6-SN-S standards
- 1000BASE-LX
- FC-0-100-SM-LC-S standard

Table A-14 and Table A-15 show the latency value for the various configurations on the transmitting node.

FC and FICON traffic on interfaces with buffer credits enabled with the **flow control** command are not affected by latency.

Table A-14 1-Gbps FC and FICON Latency Values for 4-Port 1-Gbps/2-Gbps Aggregation Cards

Traffic Mix on Transmitting Node	Maximum Added End-to-End Latency			
	No GE	1518-Byte GE Packets	4470-Byte GE Packets	10,232-Byte GE Packets
FC/FICON only on the 2.5-Gbps aggregated signal carried over a 2.5-Gbps ITU trunk card (single port in the portgroup)	12.2 micro seconds			
FC/FICON only on the 2.5-Gbps aggregated signal carried over a 2.5-Gbps ITU trunk card (two ports in the portgroup)	12.7 micro seconds			
FC/FICON only on a 2.5-Gbps aggregated signal carried over a 10-Gbps ITU trunk card (single port in the portgroup)	11.6 micro seconds			
FC/FICON only on a 2.5-Gbps aggregated signal carried over a 10-Gbps ITU trunk card (two ports in the portgroup)	12.1 micro seconds			
FC/FICON only on a 2.5-Gbps aggregated signal mixed with GE on the same 10-Gbps ITU trunk card (single port in portgroup)		12.8 micro seconds	15.2 micro seconds	23.9 micro seconds
FC/FICON only on a 2.5-Gbps aggregated signal mixed with GE on the same 10-Gbps ITU trunk card (two ports in portgroup)		13.5 micro seconds	16.8 micro seconds	26.2 micro seconds

Table A-15 2-Gbps FC and FICON Latency Values for 4-Port 1-Gbps/2-Gbps Aggregation Cards

Traffic Mix on Transmitting Node	Maximum Added End-to-End Latency			
	No GE	1518-Byte GE Packets	4470-Byte GE Packets	10,232-Byte GE Packets
FC/FICON only on the 2.5-Gbps aggregated signal carried over a 2.5-Gbps ITU trunk card	10.6 μ s			
FC/FICON only on a 2.5-Gbps aggregated signal carried over a 10-Gbps ITU trunk card	9.9 μ s			
FC/FICON only on a 2.5-Gbps aggregated signal mixed with GE on the same 10-Gbps ITU trunk card		12.1 μ s	15.4 μ s	25.1 μ s

8-Port FC/GE Aggregation Card

The optical power characteristics of the SFP (small form-factor pluggable) optics for the 8-port Fibre Channel/Gigabit Ethernet aggregation cards are shown in Table A-16. The optical power characteristics of the supported SFP optics are listed in the [SFP Specifications](#) section. Only use Cisco-certified SFP optics for the 8-port FC/GE aggregation cards. If the specifications of the client equipment interfaces do not fall within these ranges, attenuators or amplifiers might be required.

**Note**

The optical specifications described in this section are only for the individual components and should not be used to characterize the entire network performance.

Table A-16 SFPs Supported by the 8-port FC/GE Aggregation Card

SFP Part Number	Description
15500-XVRA-02C1	Gigabit Ethernet ¹ , Fibre Channel (1 Gbps) ² , FICON (1 Gbps)
15500-XVRA-03B1	Gigabit Ethernet ³ , Fibre Channel (1 Gbps) ⁴ , FICON (1 Gbps), ISC-3 links compatibility mode
15500-XVRA-11B1	Mid-band variable rate 200 Mbps to 1.25 Gbps
15500-XVRA-12B1	High-band variable rate 1.062 Gbps to 2.488 Gbps

- 1000BASE-SX
- FC-0-100-M5-SN-S and FC-0-100-M6-SN-S standards
- 1000BASE-LX
- FC-0-100-SM-LC-S standard

**Note**

The MTU (maximum transmission unit) for the 8-port FC/GE aggregation card is 10,232 bytes.

The 8-port FC/GE aggregation card adds latency to FC traffic. [Table A-17](#) shows the FC latency values for different configurations of the 8-port FC/GE aggregation card.

Table A-17 FC and FICON Latency Values for 8-Port FC/GE Aggregation Cards

Traffic Mix on Transmitting Node	Maximum Added End-to-End Latency ¹ (Time and Distance)			
	No GE ²	1518-Byte GE Packets	4470-Byte GE Packets	10,232-Byte GE Packets
FC ³ /FICON ⁴ only on the 2.5-Gbps aggregated signal carried over a 2.5-Gbps ITU ⁵ trunk card	18.8 μs (3.8 km)			
FC/FICON only on a 2.5-Gbps aggregated signal carried over a 10-Gbps ITU trunk card	19.9 μs (4.0 km)			
FC/FICON only on a 2.5-Gbps aggregated signal mixed with GE on the same 10-Gbps ITU trunk card		22.2 μs (4.4 km)	24.8 μs (5.0 km)	36.3 μs (7.3 km)
FC/FICON and GE on the same 2.5-Gbps aggregated signal carried over a 2.5-Gbps ITU trunk card		27.9 μs (5.6 km)	47.1 μs (9.4 km)	83.6 μs (16.7 km)
FC/FICON and GE on the same 2.5-Gbps aggregated signal carried over a 10-Gbps ITU trunk card		39.2 μs (7.8 km)	77.1 μs (15.4 km)	151.1 μs (30.2 km)

- The latency values are based on configuration of correct transmit buffer sizes as described in the *Cisco ONS 15530 Configuration Guide*.
- GE = Gigabit Ethernet

3. FC = Fibre Channel
4. FICON = Fiber Connection
5. ITU = International Telecommunication Union

8-Port Multi-Service Muxponder Specifications

Table A-18 lists the 8-port multi-service muxponder receiver and transmitter specifications. Optical loss because of splitter modules and connectors should be included in the optical budget calculation.



Note

The optical specifications described in this section are only for the individual components and should not be used to characterize the entire network performance.

Table A-18 8-Port Multi-Service Muxponder ITU Trunk Specifications

Description	Specification	
Fiber type	G.652 (SMF-25)	
Connector	MU-PC	
Receiver sensitivity	OSNR^{1, 2}	Dispersion
-26 dBm	20 dB	±1000 ps/nm ³
-24 dBm	21 dB	1000 to 2100 ps/nm
-23 dBm	2 dB	2100 to 3200 ps/nm
Receiver	Minimum	Maximum
Overload		-8 dBm
Wavelength	1260 nm	1580 nm
Transmitter	Minimum	Maximum
Transmitter power	5 dBm	10 dBm

1. OSNR = optical signal-to-noise ratio.
2. Add the proper network-level penalty to the OSNR and/or receive power based on your actual network topology characteristics, such as dispersion.
3. ps/nm = picoseconds per nanometer.

The SFPs supported on the 8-port multi-service muxponder are shown in Table A-19. The optical power characteristics and other specifications of the supported SFPs are listed in the “SFP Specifications” section on page A-16. Only use Cisco-certified SFPs for the 8-port multi-service muxponder.



Note

The optical specifications described in this section are only for the individual components and should not be used to characterize the entire network performance.

Table A-19 SFPs Supported by the 8-Port Multi-Service Muxponder

Part Number	Protocols or Clock Rate Range Supported
15500-XVRA-10A2	Low band 8 Mbps to 200 Mbps
15500-XVRA-10B2	Low band 8 Mbps to 200 Mbps
15500-XVRA-11A2	Mid-band 200 Mbps to 622 Mbps
15500-XVRA-11B2	Mid-band 200 Mbps to 1.25 Gbps
15500-XVRA-12B1	High-band 1.062 Gbps to 2.488 Gbps
15500-XVRA-08D1	T1 ¹ 1.544 Mbps
15500-XVRA-09D1	E1 2.044 Mbps
15500-XVRA-10E1	SDI and DVB-ASI video ^{2, 3}
15500-XVRA-11D1	GE 1.25 Gbps, FE 1.25 Mbps ⁴
ONS-SE-GEFC-SX	Fibre Channel (2.125 Gbps), Fibre Channel (1 Gbps), Gigabit Ethernet

1. DSX-1 interface
2. In a normal operating environment, the maximum digital video application connection length using a Belden 1694A cable is 200 m (218 yd). If the chassis ambient operating temperature is above 45°C (113° F) and ports 0 and 1 are used for video applications with this SFP, the maximum cable connection length supported may be less than the specified 200 m (218 yd), depending on the operating environment.
3. DVB-ASI = Digital Video Broadcast Asynchronous Serial Interface.
4. To ensure proper operation of the 15500-XVRA-11D1 SFP, the ambient operating temperature should not exceed 45°C (113°F).

Table A-20 lists the typical latencies for the 8-port multi-service muxponder.

Table A-20 Latency Values for the 8-Port Multi-Service Muxponder

Protocol	Unidirectional End-to-End Latency with 0 km Fiber	
	Typical	Maximum
ESCON	10 µs	13 µs
Fibre Channel	4 µs	6 µs
Gigabit Ethernet optical	6 µs	8 µs
Gigabit Ethernet copper	9 µs	11 µs
Fast Ethernet optical	14 µs	17 µs
Fast Ethernet copper	18 µs	20 µs
SDI	17 µs	20 µs
DVB-ASI	9 µs	11 µs

SDI Jitter Performance

SDI video signal is compliant to the ANSI/SMPTE 259M-1997 standard. [Table A-21](#) lists the SDI jitter performance values for the 8-port multi-service muxponder.

Table A-21 SDI Jitter Performance Values for the 8-Port Multi-Service Muxponder

Hp Filter	10 Hz	1 kHz	10 kHz	100 kHz
Jitter Generation (p-p)	0.5 UI ¹	0.06 UI	0.06 UI	0.06 UI
UI / Time	1.85 ns	220 ps	220 ps	220 ps

1. Maximum jitter generation is below SMPTE 259 M specification of 0.2 UI (0.74 ns) with the exception of low-frequency timing jitter. However, a purely digital system will operate correctly with significant amounts of low-frequency jitter as also indicated in Annex B of SMPTE 259M of the Timing Jitter Specification.

If your configuration uses an on-board system clock for trunk multiplexing, the client OC-3 wander generation may exceed the GR-253 specification of less than 60 ns MTIE (maximum time interval error) on greater than 10-second intervals and 20 ns MTIE on less than 1-second intervals. Because the MTIE can reach 100 ns across all observation intervals with this configuration, we do not recommend using the OC-3 transport for deriving the network clock. Other applications operate normally. If needed, the trunk multiplex clock can be configured to use one of the client OC-3 receive clocks. In this configuration, the OC-3 wander generation is fully compliant to GR-253 specification.

2.5-Gbps ITU Trunk Card Specifications

[Table A-22](#) lists the 2.5-Gbps ITU trunk card receiver and transmitter specifications. Optical loss due to splitter modules and connectors should be included in the optical budget calculation.



Note

The optical specifications described in this section are only for the individual components and should not be used to characterize the entire network performance.

Table A-22 2.5-Gbps ITU Trunk Card Optical Specifications

Description	Specification	
Fiber type	SM ¹ 9 micron	
Connector	MU	
Receiver	Minimum	Maximum
OSNR ^{2, 3}	19 dB	
Receive sensitivity ³	-28 dBm	
Receive overload		-8 dBm
Input wavelength	1260 nm	1580 nm
Transmitter	Minimum	Maximum
Transmitter power	5 dBm	10 dBm
Dispersion tolerance		3200 ps/nm ⁴

1. SM = single mode.

2. OSNR = optical signal-to-noise ratio.
3. Add the proper network-level penalty to the OSNR and/or receive power based on your actual network topology characteristics, such as dispersion.
4. ps/nm = picoseconds per nanometer.

10-Gbps ITU Tunable and Non tunable Trunk Card Specifications

Table A-23 lists the specifications for tunable and non tunable 10-Gbps ITU trunk card for the client side lasers. Optical loss due to splitter modules and connectors should be included in the optical budget calculation.



Note

The optical specifications described in this section are only for the individual components and should not be used to characterize the entire network performance.

Table A-23 10-Gbps ITU Tunable and Non tunable Trunk Card Specifications

Description	Specification	
Fiber type	ITU-T G.652	
Connector	MU	
Receiver	Minimum	Maximum
OSNR ^{1, 2}	26 dB	
Receive sensitivity ²	-22 dBm	
Receive overload		-8 dBm
Input wavelength	1430 nm	1580 nm
Transmitter	Minimum	Maximum
Output power	1 dBm	6 dBm
Dispersion tolerance		± 1000 ps/nm ³

1. OSNR = optical signal-to-ratio.
2. Add the proper network level penalty to the OSNR and/or receive power based on your actual network topology characteristics, such as dispersion.
3. ps/nm = picosecond per nanometer.

10-Gbps Uplink Card

Table A-24 lists the specifications for the 10-Gbps uplink cards supported by the Cisco ONS 15530 in the transmit and receive directions.


Note

The optical specifications described in this section are only for the individual components and should not be used to characterize the entire network performance.

Table A-24 10-Gbps Uplink Card Specifications

Description	Specification	
Fiber type	SM ¹ 1310 nm	
Connector	SC	
Dimensions	10.4 x 1.105 x 8.797 in. (264.2 x 28.1 x 223.4 mm)	
Bit rate	10 GE LAN-PHY	
Receiver	Minimum	Maximum
Receive sensitivity	-13.23 dBm	
Receive overload		0.5 dBm
Stressed receive sensitivity		-10.3 dBm
Transmitter	Minimum	Maximum
Transmit power	-5.2 dBm	0.5 dBm
Wavelength range	1260 nm	1355 nm

1. SM = single mode

SFP Specifications

Table A-25 lists the specifications for the Cisco ONS 15530 fixed rate SFP optics.


Note

Only use Cisco-certified SFP optics for the 8-port FC/GE and ESCON aggregation cards.

Table A-25 Fixed Rate SFP Optics Specifications

Description	Specification
Part number	15500-XVRA-01A2
ESCON, OC-3/STM-1 MM	
Dimensions (H x W x D)	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)
Data rate	155 Mbps, 200 Mbps
Wavelength	1310 nm
Fiber type	MM, 50 μm, 62.5 μm

Table A-25 Fixed Rate SFP Optics Specifications (continued)

Description	Specification	
Connector type	MT-RJ	
Cladding diameter	125 µm	
Receiver	Minimum	Maximum
Receive sensitivity	-33 dBm	-14 dBm
Input wavelength	1280 nm	1380 nm
Transmitter	Minimum	Maximum
Transmitter power	-19.5 dBm	-15 dBm
Output wavelength	1280 nm	1380 nm
Part number	15500-XVRA-02C1	
Gigabit Ethernet, Fibre Channel (1 Gbps), and FICON (1 Gbps) MM, ISC-1 (1-Gbps)		
Dimensions	0.486 x 0.522 x 2.24 in (1.23 x 1325.9 x 5.69 cm)	
Data rate	1.0625 Gbps, 1.25 Gbps	
Wavelength	850 nm	
Fiber type	MM, 50 micron, 62.5 micron	
Connector type	LC	
Cladding diameter	125 µm	
	Minimum	Maximum
Receive sensitivity	-18 dBm	
Stressed receive sensitivity		-13.5 dBm
Input wavelength	770 nm	860 nm
Transmitter power	-9.5 dBm	-4 dBm
Output wavelength	830 nm	860 nm
Part number	15500-XVRA-03B1	
GE, FC (1 Gbps), and FICON (1 Gbps) SM		
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate	1.0625 Gbps, 1.25 Gbps	
Wavelength	1310 nm	
Fiber type	MM, 50 µm, 62.5 µm	
Connector type	LC	
Cladding diameter	125 µm	
Receiver	Minimum	Maximum
Receive sensitivity	-18 dBm	
Stressed receive sensitivity	-13.5 dBm	
Input wavelength	770 nm	860 nm
Transmitter	Minimum	Maximum

Table A-25 Fixed Rate SFP Optics Specifications (continued)

Description	Specification	
Transmitter power	-9.5 dBm	-4 dBm
Part number	15500-XVRA-03B1	
Gigabit Ethernet, Fibre Channel (1 Gbps), FICON (1 Gbps) SM		
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate	1.0625 Gbps, 1.25 Gbps	
Wavelength	1310 nm	
Fiber type	SM, 9/125 µm	
Connector type	LC	
Receiver	Minimum	Maximum
Input power	-20.5 dBm	-3 dBm
Input wavelength	1270 nm	1600 nm
Transmitter	Minimum	Maximum
Transmitter power	-9.5 dBm	-3 dBm
Output wavelength	1275 nm	1350 nm
Part number	15500-XVRA-03B2	
Fibre Channel (1 Gbps and 2 Gbps) and FICON (1 Gbps and 2 Gbps) SM		
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate	1.0625 Gbps, 2.125 Gbps	
Wavelength	1310 nm	
Fiber type	SM, 9/125 µm	
Connector type	LC	
Receiver	Minimum	Maximum
Receive sensitivity	-20.5 dBm	
Input wavelength	1270 nm	1600 nm
Transmitter	Minimum	Maximum
Transmitter power	-9.5 dBm	-3 dBm
Output wavelength	1275 nm	1350 nm

Table A-26 lists the specifications for the Cisco ONS 15530 variable rate SFP optics.

**Note**

Only use Cisco-certified SFP optics for the 4-port 1-Gbps/2-Gbps FC aggregation cards, 8-port FC/GE aggregation cards, 8-port multi-service muxponders, and ESCON aggregation cards.

Table A-26 Variable Rate SFP Optics Specifications

Description	Specification	
Part number	15500-XVRA-10A1	
Supported protocol encapsulations	ESCON (MM)	
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate	8 to 200 Mbps	
Wavelength	1310 nm	
Fiber type	MM 50/125 μ m MM 62.5/125 μ m	
Connector type	LC	
Receiver	Minimum	Maximum
Receive sensitivity @10 ⁻¹² BER ¹	-32 dBm	
Receive sensitivity @10 ⁻¹⁵ BER	-29 dBm	
Receive overload @10 ⁻¹² BER		-14 dBm
Input wavelength	1100 nm	1600 nm
Transmitter	Minimum	Maximum
Transmitter power	-19 dBm	-14 dBm
Output wavelength	1280 nm	1380 nm
Part number	15500-XVRA-10A2	
Supported protocol encapsulations	ESCON (MM)	
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate	8 to 200 Mbps	
Wavelength	1310 nm	
Fiber type	MM 50/125 μ m MM 62.5/125 μ m	
Connector type	LC	
Receiver	Minimum	Maximum
Receive sensitivity @10 ⁻¹² BER ²	-32 dBm	
Receive sensitivity @10 ⁻¹⁵ BER	-29 dBm	
Receive overload @10 ⁻¹² BER		-14 dBm
Input wavelength	1100 nm	1600 nm
Transmitter	Minimum	Maximum
Transmitter power	-19 dBm	-14 dBm
Output wavelength	1280 nm	1380 nm
Part number	15500-XVRA-10B1	
Supported protocol encapsulations	ESCON (SM)	
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate range	8 Mbps to 200 Mbps	

Table A-26 Variable Rate SFP Optics Specifications (continued)

Description	Specification	
Wavelength	1310 nm	
Fiber type	SM, 9/125 μ m	
Connector type	LC	
Receiver	Minimum	Maximum
Receive sensitivity @10 ⁻¹² BER	-32 dBm	
Receive overload @10 ⁻¹² BER		-3 dBm
Input wavelength	1100 nm	1600 nm
Transmitter	Minimum	Maximum
Transmitter power	-8 dBm	-4 dBm
Output wavelength	1260 nm	1360 nm
Part number	15500-XVRA-10B2	
Supported protocol encapsulations	ESCON (SM)	
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate range	8 Mbps to 200 Mbps	
Wavelength	1310 nm	
Fiber type	SM, 9/125 μ m	
Connector type	LC	
Receiver	Minimum	Maximum
Receive sensitivity @10 ⁻¹² BER	-32 dBm	
Receive overload @10 ⁻¹² BER		-3 dBm
Input wavelength	1100 nm	1600 nm
Transmitter	Minimum	Maximum
Transmitter power	-8 dBm	-4 dBm
Output wavelength	1260 nm	1360 nm
Part number	15500-XVRA-11A1	
Supported protocol encapsulations	ESCON, OC-12/STM-4	
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate range	200 Mbps to 622 Mbps	
Wavelength	1310 nm	
Fiber type	MM 62.5/125 μ m	
Connector type	LC	
Receiver	Minimum	Maximum
Receive sensitivity @10 ⁻¹⁰ BER	-26 dBm	
Receive sensitivity @10 ⁻¹² BER	-25 dBm	
Maximum receive power @10 ⁻¹⁰ BER		-14
Input wavelength	1100 nm	1600 nm

Table A-26 Variable Rate SFP Optics Specifications (continued)

Description	Specification	
Transmitter	Minimum	Maximum
Transmitter power	-20 dBm	-14 dBm
Output wavelength	1270 nm	1380 nm
Part number	15500-XVRA-11A2	
Supported protocol encapsulations	ESCON, OC-12/STM-4	
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate range	200 Mbps to 622 Mbps	
Wavelength	1310 nm	
Fiber type	MM 62.5/125 μ m	
Connector type	LC	
Receiver	Minimum	Maximum
Receive sensitivity @ 10^{-10} BER	-26 dBm	
Receive sensitivity @ 10^{-12} BER	-25 dBm	
Maximum receive power @ 10^{-10} BER		-14
Input wavelength	1100 nm	1600 nm
Transmitter	Minimum	Maximum
Transmitter power	-20 dBm	-14 dBm
Output wavelength	1270 nm	1380 nm
Part number	15500-XVRA-11B1	
Supported protocol encapsulations	FC, FICON, GE, ISC-1	
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	
Data rate range	200 Mbps to 1.25 Gbps	
Wavelength	1310 nm	
Fiber type	SM, 9/125 μ m	
Connector type	LC	
Receiver	Minimum	Maximum
Receive sensitivity @ 10^{-12} BER	-19 dBm	
Maximum receive power @ 10^{-12} BER		-3 dBm
Input wavelength	1100 nm	1600 nm
Transmitter	Minimum	Maximum
Transmitter power	-11 dBm	-3 dBm
Output wavelength	1285 nm	1345 nm
Part number	15500-XVRA-11B2	
Supported protocol encapsulations	FC, FICON, GE, ISC-1	
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)	

Table A-26 Variable Rate SFP Optics Specifications (continued)

Description	Specification	
Data rate range	200 Mbps to 1.25 Gbps	
Wavelength	1310 nm	
Fiber type	SM, 9/125 μ m	
Connector type	LC	
Receiver	Minimum	Maximum
Receive sensitivity @10 ⁻¹² BER	-19 dBm	
Maximum receive power @10 ⁻¹² BER		-3 dBm
Input wavelength	1100 nm	1600 nm
Transmitter	Minimum	Maximum
Transmitter power	-11 dBm	-3 dBm
Output wavelength	1285 nm	1345 nm
Part number	15500-XVRA-12B1	
Supported protocol encapsulations	FC, FICON, GE, ISC-1, ISC-3	
Dimensions	0.486 x 0.522 x 2.24 in (1.23 x 1325.9 x 5.69 cm)	
Data rate range	1.062 Mbps to 2.488 Gbps	
Wavelength	1310 nm	
Fiber type	SM, 9/125 μ m	
Connector type	LC	
Receiver	Minimum	Maximum
Receive sensitivity @10 ⁻¹⁰ BER	-18 dBm	
Maximum receive power @10 ⁻¹⁰ BER		-3 dBm
Input wavelength	1100 nm	1600 nm
Transmitter	Minimum	Maximum
Transmitter power	-10 dBm	-3 dBm
Output wavelength	1266 nm	1360 nm
Part number	15454-SFP-GEFC-SX	
Supported protocol encapsulations	Fibre Channel (2.125 Gbps), Fibre Channel (1 Gbps), Gigabit Ethernet	
Dimensions	0.486 x 0.522 x 2.24 in (1.23 x 1325.9 x 5.69 cm)	
Data rate range	1.062 Gbps, 1.25 Gbps, 2.125 Gbps	
Wavelength	830 to 860 nm	
Fiber type	MM 50/125 μ m, MM 62.5/125 μ m	
Connector type	Duplex LC	
Receiver		
Receive sensitivity @2.125 Gbps	-18 mW	

Table A-26 Variable Rate SFP Optics Specifications (continued)

Description	Specification	
Receive sensitivity @1.25 Gbps	-20 dBm	
Receive sensitivity @1.06 Gbps	-20 mW	
Maximum receive power	0 dBm	
Receiver	Minimum	Maximum
Input wavelength	770 nm	860 nm
Transmitter	Minimum	Maximum
Transmitter power	-9 dBm	-3.5 dBm
Output wavelength	830 nm	860 nm

1. BER = bit error rate
2. BER = bit error rate

Table A-27 lists the specifications for the copper SFPs supported on the 8-port multi-service muxponder.

Table A-27 **Copper SFP Specifications**

Description	Specification
Part number	15500-XVRA-08D1
T1 1.544 Mbps	
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)
Data rate	1.544 Mbps
Fiber type	Copper T1
Connector type	RJ-45
CAT5K cable	600 ft (182.9 m)
Part number	15500-XVRA-09D1
E1 2.044 Mbps	
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)
Data rate	2.044 Mbps
Fiber type	Copper E1
Connector type	RJ-45
CAT5K cable	450 ft (137 m)
Part number	15500-XVRA-10E1
SDI and DVB-ASI Video 270Mbps	
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)
Data rate	270Mbps
Fiber type	Copper digital video
Connector type	SMB/BNC
Balden 1694A cable	656 ft (200 m)
Part number	15500-XVRA-11D1
GE 1.25 Gbps, FE 1.25 Mbps	
Dimensions	0.486 x 0.522 x 2.24 in. (1.23 x 1325.9 x 5.69 cm)
Data rate	GE 1.25 Gbps, FE 1.25 Mbps
Fiber type	Copper GE/FE
Connector type	RJ-45
CAT5K cable	Cu GE and FE is 100 m (328.08 ft)



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