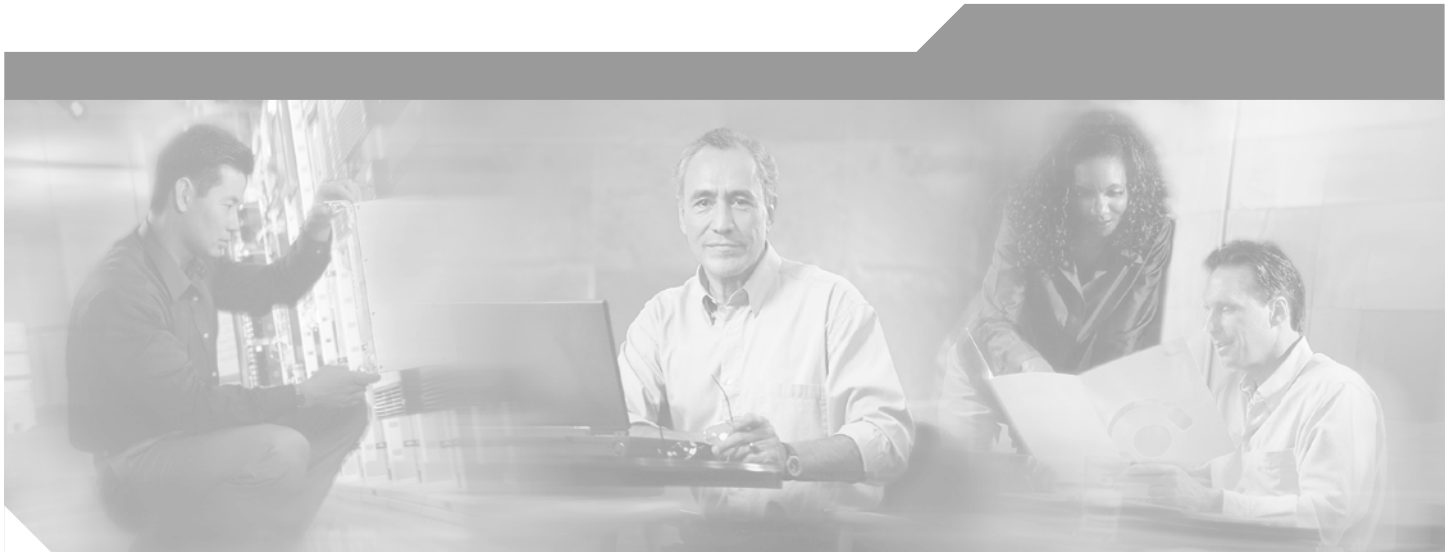

Cisco ONS 15540 ESP Optical Transport Turn-Up and Test Guide

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Preface

This preface describes the purpose, intended audience, organization, and conventions for the *Cisco ONS 15540 ESP Optical Transport Turn-Up and Test Guide*.

Purpose

The *Cisco ONS 15540 ESP Optical Transport Turn-Up and Test Guide* describes acceptance testing procedures for nodes and networks. These procedures allow an installer to verify the installation of a network of Cisco ONS 15540 ESP nodes.

These procedures are performed following hardware installation and initial software configuration, as described in this guide.

For more detailed hardware installation information, refer to the *Cisco ONS 15540 ESP Hardware Installation Guide*. For more detailed software configuration information, refer to the *Cisco ONS 15540 ESP Configuration and Command Reference*.

Audience

This guide helps installers verify the installation of a network of Cisco ONS 15540 ESP nodes.

Organization

The chapters of this guide are as follows:

Chapter	Title	Description
Chapter 1	Safety Information and Pre-installation Tasks	Describes safety considerations for operating the Cisco ONS 15540 ESP. Describes procedures that should be performed prior to installation of hardware.
Chapter 2	Quick Installation Procedures	Describes procedures for installing essential hardware components.
Chapter 3	Software Setup	Describes basic software configuration tasks.

Chapter	Title	Description
Chapter 4	Node Verification Procedures	Describes procedures for verification of each node in the network.
Chapter 5	Network Verification Procedures	Describes procedures for network-level verification. Perform these procedures after completing the node verification procedures.
Appendix A	Node Data Checklist	Provides tables for keeping track of essential data for each node.
Appendix B	Test Results Tables	Provides tables for recording test results and verifying that tests are completed successfully.

Related Documentation

This guide is part of a documentation set that supports the Cisco ONS 15540 ESP. The other documents in the set are as follows:

- *Introduction to DWDM Technology*
- *Regulatory Compliance and Safety Information for the Cisco ONS 15540 ESP*
- *Cisco ONS 15540 ESP Hardware Installation Guide*
- *Cisco ONS 15540 ESP Configuration Guide and Command Reference*
- *Cisco ONS 15540 ESP Troubleshooting Guide*
- *Glossary of Optical Networking Terms*

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 on the World Wide Web at this URL:

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

You can access the Cisco website at this URL:

http://www.cisco.com

International Cisco websites can be accessed from this URL:

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

Ordering Documentation

You can find instructions for ordering documentation at this URL:

http://www.cisco.com/univercd/cc/td/doc/es_inpck/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/index.shtml

- 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 800 553-NETS (6387).

Documentation Feedback

You can submit e-mail 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.

Obtaining Technical Assistance

For all customers, partners, resellers, and distributors who hold valid Cisco service contracts, the Cisco Technical Assistance Center (TAC) provides 24-hour-a-day, award-winning technical support services, online and over the phone. Cisco.com features the Cisco TAC website as an online starting point for technical assistance. If you do not hold a valid Cisco service contract, please contact your reseller.

Cisco TAC Website

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

http://www.cisco.com/tac

Accessing all the tools on the Cisco TAC website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a login ID or password, register at this URL:

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

Opening a TAC Case

Using the online TAC Case Open Tool is the fastest way to open P3 and P4 cases. (P3 and P4 cases are those in which your network is minimally impaired or for which you require product information.) After you describe your situation, the TAC Case Open Tool automatically recommends resources for an immediate solution. If your issue is not resolved using the recommended resources, your case will be assigned to a Cisco TAC engineer. The online TAC Case Open Tool is located at this URL:

http://www.cisco.com/tac/caseopen

For P1 or P2 cases (P1 and P2 cases are those in which your production network is down or severely degraded) or if you do not have Internet access, contact Cisco TAC by telephone. Cisco TAC engineers are assigned immediately to P1 and P2 cases to help keep your business operations running smoothly.

To open a case 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 listing of Cisco TAC contacts, go to this URL:

http://www.cisco.com/warp/public/687/Directory/DirTAC.shtml

TAC Case Priority Definitions

To ensure that all cases are reported in a standard format, Cisco has established case priority definitions.

Priority 1 (P1)—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.

Priority 2 (P2)—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.

Priority 3 (P3)—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.

Priority 4 (P4)—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. Go to this URL to visit the company store:

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

- The Cisco *Product Catalog* describes the networking products offered by Cisco Systems, as well as ordering and customer support services. Access the Cisco Product Catalog at this URL:

  http://cisco.com/univercd/cc/td/doc/pcat/

- *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 online at this URL:

  http://www.ciscopress.com

- *Packet* magazine is the Cisco quarterly publication that provides the latest networking trends, technology breakthroughs, and Cisco products and solutions to help industry professionals get the most from their networking investment. Included are networking deployment and troubleshooting tips, configuration examples, customer case studies, tutorials and training, certification information, and links to numerous in-depth online resources. You can access Packet magazine at this URL:

  http://www.cisco.com/packet

- *iQ Magazine* is the Cisco bimonthly publication that delivers the latest information about Internet business strategies for executives. 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

- Training—Cisco offers world-class networking training. Current offerings in network training are listed at this URL:

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

Safety Information and Pre-installation Tasks

This chapter describes safety information and procedures that should be performed prior to installation of hardware.

This chapter contains the following major sections:

- Safety Information, page 1-1
- Required Equipment, page 1-4
- Before Installing, page 1-7
- Performing Fiber Plant Characterization, page 1-7

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.

For more information on hardware, refer to the *Cisco ONS 15540 ESP Hardware Installation Guide.*

For more information on software, refer to the *Cisco ONS 15540 ESP Configuration Guide and Command Reference.*

Safety Information

This section describes safety considerations for operating the Cisco ONS 15540 ESP. This section includes critical safety warnings, precautions, and ESD guidelines.

Critical Safety Warnings

This section includes warnings that may appear in the Cisco ONS 15540 ESP product documents.

Wrist Strap Warning

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.**

Restricted Area Warning

Warning **This unit is intended for installation in restricted access areas. A restricted access area is where access can only be gained by service personnel through the use of a special tool, lock and key, or other means of security, and is controlled by the authority responsible for the location.**

Qualified Personnel Warning

Warning **Only trained and qualified personnel should be allowed to install or replace this equipment.**

Card Handling Warning

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 Definition

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.**

Disconnect Device Warning

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

DC Protection

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 60VDC, is used on all current-carrying conductors.**

Laser Radiation Warning

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

General Safety Precautions

General safety precautions are not related to any specific procedures and do not appear elsewhere in this publication. Personnel must understand and apply the following precautions during installation and testing of the Cisco ONS 15540 ESP.

- Know standard electrical safety and electrical wiring and connection practices.
- Be familiar with cardio-pulmonary resuscitation (CPR). Obtain this information through the appropriate national authority (such as the Red Cross or the local equivalent). This knowledge is imperative for personnel working with or near voltages with levels capable of causing injury or death.

Recommended Safety Precautions

The following precautions are recommended when working on the Cisco ONS 15540 ESP:

- Do not lift an object alone that could be too heavy for one individual.
- Keep your work area tidy and free of obstructing objects at all times.
- Do not wear loose clothing, jewelry, or other items that could be caught in the components during installation or use.
- Use the equipment only in accordance with the electrical power rating.
- Do not work alone if hazardous conditions may exist in your workplace.
- Install the Cisco ONS 15540 components in compliance with the following local and national electrical codes:
  - In the United States: National Fire Protection Association (NFPA) 70; US National Electrical Code
  - In Canada: Canadian Electrical Code, part I, CSA C22.1
  - Elsewhere: International Electrotechnical Commission (IEC) 364, part 1-7
- Properly ground the equipment.
- Connect only a DC power source that complies with the safety extra-low voltage (SELV) requirements in UL1950, CSA 950, EN 60950, and IEC950 to Cisco ONS 15540 DC power supply input.
- Terminate all laser outputs properly before connecting laser inputs.
- Disconnect the input end of an optical fiber jumper cable before disconnecting the output end.
- Handle glass fiber with care. Glass fiber can be broken if mishandled. Using broken fiber can result in permanent equipment damage.
- Protect skin from exposed glass fiber. It can penetrate the skin.
- Limit the number of personnel that have access to lightwave transmission systems. Personnel should be authorized and properly trained if access to laser emissions is required.
- Limit the use of laser test equipment to authorized, trained personnel during installation and service. This precaution includes using optical loss test (OLT) set, optical spectrum analyzer, and optical time domain reflectometer (OTDR) equipment.

- Exclude any unauthorized personnel from the immediate laser radiation area during service and installation when there is a possibility that the system may become energized. Consider the immediate service area to be a temporary laser-controlled area.
- The Cisco ONS 15540 ESP function in the 1310 to 1550 nm range, which is considered invisible radiation. You cannot see the laser light being emitted by a fiber, a pigtail, or a bulkhead connector. Use appropriate eye protection during fiber-optic system installation or maintenance whenever there is potential for laser radiation exposure, as recommended by the company's health and safety procedures. Observe this precaution whether or not warning labels have been posted.

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 megaohms (Mohms).

Required Equipment

This section lists the required system equipment, cable, and test equipment.

System Requirements

The following equipment is assumed to be present and installed:

- Cisco ONS 15540 chassis and external AC power supply if needed
- Processor cards (1 or 2)
- Air Inlet
- Fan Tray

Cable Requirements

This section lists the cable requirements for the Cisco ONS 15540 ESP.

Cisco ONS 15540 ESP cabling

The Cisco ONS 15540 ESP chassis requires the following cables and drawers:

- Mux/demux cabling:
  - Add/drop mux/demux cabling: short cables with MU-MU connectors
  - Terminal mux/demux cabling: short cables with MU-MU connectors
- Transponder module to client cables: medium size cable with SC connectors
  - SM transponder modules: SC to SC SM cable or SC to ST SM cable, 1.0 m or 3.0 m
  - MM transponder modules: SC to SC MM cable or SC to ST MM cable, 1.0 m or 3.0 m
  - Extended range transponder modules: cable depends on SFP optics type. See Table 1-1 and Table 1-2.
  - Y-cables: Multimode or single mode Y-cable
- Trunk cables: MU to SC patch cable or MU to ST patch cable, 1.0 m or 3.0 m

Table 1-1 Fixed Rate SFP Optics Features

Part Number	Supported Protocols	Fiber Type	Wavelength	Connector Type
15500-XVRA-01A2	ESCON, SONET OC-3 SR, SDH STM-1	MM 62.5/125 µm	1310 nm	MT-RJ
15500-XVRA-02C1	Gigabit Ethernet[1], Fibre Channel (1 Gbps)[2]	MM 50/125 µm MM 62.5/125 µm	850 nm	Duplex LC
15500-XVRA-02C2	Fibre Channel (2 Gbps)[3]	MM 50/125 µm MM 62.5/125 µm	850 nm	Duplex LC
15500-XVRA-03B1	Gigabit Ethernet[4], Fibre Channel (1 Gbps)[5]	SM 9/125 µm	1310 nm	Duplex LC
15500-XVRA-03B2	Fibre Channel (1 Gbps[6] and 2 Gbps[7])	SM 9/125 µm	1310 nm	Duplex LC
15500-XVRA-06B1	SONET OC-12 SR[8], SDH STM-4	SM 9/125 µm	1310 nm	Duplex LC
15500-XVRA-07B1	SONET OC-48 SR, SDH STM-16	SM 9/125 µm	1310 nm	Duplex LC

1. 1000BASE-SX
2. FC-0-100-M5-SN-S and FC-0-100-M6-SN-S standards
3. FC-0-200-M5-SN-S and FC-0-200-M6-SN-S standards
4. 1000BASE-LX
5. FC-0-100-SM-LC-S standard
6. FC-0-100-SM-LC-S standard
7. FC-0-200-SM-LC-S standard
8. SR = short range

Table 1-2 Variable Rate SFP Optics Features

Part Number	Clock Rate Range	Protocol Encapsulations Supported	Fiber Type	Wavelength	Connector Type
15500-XVRA-10A1	Low-band 8 Mbps to 200 Mbps	Sysplex (CLO and ETR)[1] (8 Mbps), Fast Ethernet[2] (125 Mbps), SONET OC-3[3] (155.52 Mbps), SDH STM-1 (622 Mbps), ESCON[4] (200 Mbps)	MM 50/125 µm 62.5/125 µm	1310 nm	LC
15500-XVRA-10B1	Low-band 8 Mbps to 200 Mbps	Sysplex (CLO and ETR)[1] (8 Mbps), Fast Ethernet[2] (125 Mbps), SONET OC-3[3] (155.52 Mbps), SDH STM-1 (155.52 Mbps), ESCON[4] (200 Mbps)	SM 9/125 µm	1310 nm	LC
15500-XVRA-11A1	Mid-band 200 Mbps to 622 Mbps	ESCON[4] (200 Mbps), SONET OC-12[3] (622 Mbps), SDH STM-4 (622 Mbps)	MM 50/125 µm 62.5/125 µm	1310 nm	LC
15500-XVRA-11B1	Mid-band 200 Mbps to 1.25 Gbps	ESCON[4] (200 Mbps), SONET OC-12[3] (622 Mbps), SDH STM-4 (622 Mbps), FC[4] (1.062 Gbps), GE[4] (LX) (1.25 Gbps)	SM 9/125 µm	1310 nm	LC
15500-XVRA-12B1	High-band 1.062 Gbps to 2.488 Gbps	FC[4] (1.062 Gbps and 2.125 Gbps), GE[4] (LX) (1.250 Mbps), SONET OC-48 (2.488 Gbps), SDH STM-16 (2.488 Gbps), ISC peer mode (2.125 Gbps)	SM 9/125 µm	1310 nm	LC

1. Manchester coded
2. 4B/5B coded
3. Scrambler 2^{23-1}
4. 8B/10B coded

Test Equipment Requirements

The following test equipment is required:

- Optical Spectrum Analyzer (OSA) capable of reading wavelengths between 1530 nm and 1563 nm
- Optical Time Domain Reflectometer (OTDR)
- Hand-held optical power meter
- Data test set (Ethernet packet generator or analyzer, BERT)
- Fiber cleaning kit
- Optical fiber scope
- Cable installation tool

Before Installing

Before you install the shelf, you must complete the following tasks:

- Unpack and inspect the shelf.
- Maintain a network record.

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.

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.**

Unpacking and Inspecting the Shelf

The Cisco ONS 15540 shelf 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

Performing Fiber Plant Characterization

In order to verify fiber characteristics to qualify the fiber in the network, proper testing is required.

The test measurement results must be documented and will be referred to during acceptance testing of a network, as described in this guide.

This test measurement data can also be used to determine whether your network can support higher bandwidth services such as OC-192, and can help determine network requirements for dispersion compensator modules or amplifiers.

Fiber-optic testing procedures must be performed to measure the following parameters:

- link loss (attenuation)
- optical return loss (ORL)

- polarization mode dispersion (PMD)
- chromatic dispersion
- fiber length

For more information on fiber plant characterization, refer to the *Cisco ONS 15540 ESP Planning Design Guide*.

Quick Installation Procedures

This chapter describes procedures for installing essential hardware components. This section describes common hardware installation tasks. Refer to the *Cisco ONS 15540 ESP Hardware Installation Guide* for complete hardware installation instructions.

This chapter contains the following major sections:

- Preparing to Install the Chassis, page 2-1
- Installing the Chassis, page 2-2
- Installing the Processor Card, page 2-3
- Installing a Redundant Processor Card, page 2-4
- Installing Mux/Demux Motherboards and Mux/Demux Modules, page 2-5
- Installing Line Card Motherboards and Transponder Modules, page 2-7
- Cabling Transponder Modules, page 2-9
- Cabling Mux/Demux Modules, page 2-10
- Shelf Grounding Procedure, page 2-10
- Cleaning the Shelf, page 2-11
- Powering Up the Chassis, page 2-12
- Verifying Installation of Hardware, page 2-13

Preparing to Install the Chassis

The Cisco ONS 15540 ESP chassis 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.

Three chassis fit in a standard rack. However, if you use the external AC-input power supply, you can install two chassis with the power supply.

Perform this procedure to install the Cisco ONS 15540 ESP chassis in a standard 19-inch rack:

Step 1 Place the L brackets on the sides of the chassis.

Step 2 Secure the L brackets to the chassis using the 14 M4 Phillips countersunk-head screws provided in the rack-mount kit. Use seven screws on each L bracket on the sides of the chassis.

Step 3 Place the top cable guide over the top of the chassis. Ensure that the earth contact is visible through the cable guide.

Step 4 Secure the cable guide to the shelf with five 6-32 screws.

Installing the Chassis

To install the Cisco ONS 15540 ESP chassis in the rack, follow these steps:

Step 1 Grasp the bottom edge of the chassis with one hand near the front and the other near the back. With one person at each side of the chassis, slowly lift the chassis in unison.

Step 2 Position the chassis in the rack.

Step 3 Align the mounting holes in the L bracket and the bottom cable management guide with the mounting holes in the equipment rack.

Step 4 Install the 12-24 or 10-32 screws through the elongated holes in the L bracket and into the threaded holes in the mounting post.

Step 5 Place the bottom cable guides over the fan assembly.

Step 6 Secure the cable guide to the rack with the 6-32 screws.

Installing Strain Relief Brackets

The Cisco ONS 15540 ESP system uses a power supply cable strain relief bracket for connections to its power supply and an alarm cable strain relief bracket for alarm cable connections. The strain relief brackets must be installed after the shelf is rack mounted and installed in the rack. The brackets are required for proper function of the power supply and alarm cables.

To install the strain relief brackets, follow these steps:

Step 1 Place the strain relief bracket over the designated slots on the back panel.

Step 2 Use the two screws provided to secure the strain relief bracket to the shelf.

Installing the Processor Card

The mux/demux motherboards, line card motherboards, and processor cards are hot-swappable. We recommend installing the processor cards first and then filling the chassis from slots 0 to 11, left to right.

Perform the following procedure to install the processor card in the Cisco ONS 15540 ESP.

Step 1 Insert the processor card carefully into chassis slot 6. Guide the upper and lower edges of the motherboard or processor card in the tracks until its connectors come into contact with the backplane.

Step 2 Use your thumb and forefinger of each hand to simultaneously push the motherboard or processor card in until it is fully seated in the backplane connector.

Step 3 Use a 3/16-inch flat-blade screwdriver to tighten the captive installation screws.

Step 4 If not installing a redundant processor card, insert a blank card into slot 7.

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

Table 2-1 Processor Card LEDs

LED	Status	Description
Status	Red	A board resets or initially powers on.
	Orange	System initialization.
	Green	Full initialization and operational.
Active	Green	This board is the primary processor and is running IOS software.
Standby	Green	This board is the secondary processor.
Slot 0	Green	Flash PC Card is present.
Slot 1	Green	Flash PC Card is present.
NME[1]		
Full Duplex	Green	Full duplex is running.
	Off	Half duplex is running.
100 Mbps	Green	Operating at 100 Mbps.
	Off	Operating at 10 Mbps.
Link	Green	Link is up.
	Off	Link is down.
ASE[2]		
Full Duplex	Green	Full duplex is running.
	Off	Half duplex is running.
100 Mbps	Green	Operating at 100 Mbps.
	Off	Operating at 10 Mbps.
Link	Green	Link is up.
	Off	Link is down.
Critical Alarm	Yellow	A critical alarm condition exists.

Table 2-1 Processor Card LEDs (continued)

LED	Status	Description
Major Alarm	Yellow	A major alarm condition exists.
Minor Alarm	Yellow	A minor alarm condition exists.
Alarm Cutoff	Yellow	A major or minor alarm condition exists and the cutoff button has been pushed. Turns off by software when the original alarm clears or any new alarm occurs.
History	Yellow	A major or minor alarm occurred. Clears if the History Clear button is pushed and no alarm exists.

1. NME = network management Ethernet
2. ASE = aggregation shelf Ethernet

To install a redundant processor card, perform the next procedure.

For more details about using the Console Ports, NME Ports, and Auxiliary Ports of the processor card, refer to the *Cisco ONS 15540 ESP Configuration Guide and Command Reference.*

Installing a Redundant Processor Card

Perform the following procedure to install the redundant processor card:

Step 1 Insert the processor card carefully into chassis slot 7. Guide the upper and lower edges of the motherboard or processor card in the tracks until its connectors come into contact with the backplane.

Step 2 Use your thumb and forefinger of each hand to simultaneously push the motherboard or processor card in until it is fully seated in the backplane connector.

Step 3 Use a 3/16-inch flat-blade screwdriver to tighten the captive installation screws.

For more details on redundant processors refer to the *Cisco ONS 15540 ESP Configuration Guide and Command Reference*.

Connecting the Console Port

The console port is a female, DCE (data communications equipment), DB-25 receptacle used for connection to a console terminal or modem. There is a console port on both processor cards.

To connect cables to the console port, follow these steps:

Step 1 Place the DB-25 connector in front of the console port on the processor card faceplate.

Step 2 Align the male DB-25 connector with the female console port.

Step 3 Gently push the DB-25 connector into the console port and secure it in place by tightening the side screws on the DB-25 connector.

Step 4 Route the fiber cables down through the cutout holes on the cable management tray out of the right side of the shelf assembly.

Installing Mux/Demux Motherboards and Mux/Demux Modules

The Cisco ONS 15540 ESP chassis uses one optical mux/demux motherboard for unprotected operation or two per system for protected operation.

Installing Mux/Demux Motherboards

You can install up to two motherboards into slot 0 and slot 1. Perform the following procedure to install a mux/demux motherboard.

Note In Cisco ONS 15540 ESP systems, there are additional rules for slot placement of mux/demux modules and line cards. Refer to the *Cisco ONS 15540 ESP Planning Guide*.

Step 1 Remove the backplane side dust covers and transponder side dust covers from the motherboards, and clean the optical connectors. See the "Cleaning Optical Connectors" section on page 2-11.

Step 2 Insert the card carefully into the chassis slot. Guide the upper and lower edges of the motherboard or processor card in the tracks until its connectors come into contact with the backplane.

Step 3 Use your thumb and forefinger of each hand to simultaneously push the card in until it is fully seated in the backplane connector.

Step 4 Use a 3/16-inch flat-blade screwdriver to tighten the captive installation screws.

Step 5 Install blank covers into the unused motherboard slots.

Note Mux/demux motherboards without OSC have no LEDs.

Table 2-2 Mux/Demux Motherboard LEDs

LED	Status	Description
Status	Blinking green	Motherboard has a good system clock from the primary processor and is out of the reset state.
	Solid green	Software initialization is successful.
	Orange	System clock is not present. Board is unavailable.
	Off	Board failure
Tx	Solid green	OSC is present and the optical laser output is enabled.
	Off	OSC is not present and the optical laser output is disabled.
Rx	Solid green	OSC is present and the receiver is enabled.
	Off	OSC is not present and the receiver is disabled.

Installing 4-Channel or 8-Channel Mux/Demux Modules

This section describes the procedure for installing a 4-channel or 8-channel mux/demux module in the Cisco ONS 15540 ESP. To install the module, follow these steps:

Step 1 Remove the dust covers from the module, and clean the optical connectors. See the "Cleaning Optical Connectors" section on page 2-11.

Caution 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.

Step 2 Insert the module carefully into the motherboard slot while guiding the upper and lower edges of the module in the tracks until its connectors come into contact with the backplane connectors. You hear a click when it is connected.

Table 2-2 lists the LEDs on the mux/demux motherboard with OSC faceplate, their default conditions, and what the conditions indicate.

Installing 16-Channel Mux/Demux Modules

This section describes the procedure for installing 16-channel mux/demux modules in the Cisco ONS 15540 ESP. To install the 16-channel mux/demux module, follow these steps:

Step 1 Remove the dust covers from the module, and clean the optical connectors. See the "Cleaning Optical Connectors" section on page 2-11.

Step 2 Insert the correct inset tray for the 16-channel mux/demux module and secure the tray to the motherboard by tightening the screws.

Step 3 Insert the 16-channel mux/demux module with OSC carefully into the top motherboard slot while guiding the upper and lower edges of the module in the tracks until its connectors come into contact with the backplane connectors. You hear a click when it is connected.

Step 4 If you are installing a second 16-channel mux/demux module, insert the module without OSC carefully into the bottom motherboard slot while guiding the upper and lower edges of the module in the tracks until its connectors come into contact with the backplane connectors. You hear a click when it is connected.

Installing Line Card Motherboards and Transponder Modules

You can install up to eight hot-swappable line card motherboards in slots 2 to 5 and 8 to 11 of the Cisco ONS 15540 ESP chassis.

Each line card motherboard holds up to four transponder modules that have a single protocol-transparent and bit-rate transparent external interface to the client side network and an internal interface that connects over the system's backplane to the mux/demux modules. The transponder modules are hot-pluggable, allowing in-service upgrades and replacement.

Transponders are available in single-mode, and multimode. Line card motherboards are available with or without splitter protection.

Note In Cisco ONS 15540 ESP systems, there are additional rules for slot placement of mux/demux modules and line cards. For more information on shelf rules, refer to the *Cisco ONS 15540 ESP Planning Guide*.

Installing Line Card Motherboards

Perform the following procedure to install the line card motherboard.

Step 1 Remove the backplane side dust covers and the transponder side dust covers from the motherboard, and clean the optical connectors. See the "Cleaning Optical Connectors" section on page 2-11.

Step 2 Insert the motherboard carefully into the chassis slot while guiding the upper and lower edges of the motherboard in the tracks until its connectors come into contact with the backplane.

Step 3 Use the handles to push the line card motherboard in until it is fully seated in the backplane connector.

Step 4 Use a 3/16-inch flat-blade screwdriver to tighten the captive installation screws.

Step 5 Install blank covers into the unused motherboard slots.

Table 2-3 lists the LEDs on the line card motherboard faceplate, their default conditions, and what the conditions indicate.

Table 2-3 Line Card Motherboard LEDs

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

Installing SM Transponder Modules or MM Transponder Modules

Perform the following procedure to install SM transponder modules or MM transponder modules.

Step 1 Remove the dust covers from the module, and clean the optical connectors. See the "Cleaning Optical Connectors" section on page 2-11.

Step 2 Lift the latch handle on the transponder module and insert the module carefully into the motherboard slot while guiding the upper and lower edges of the module in the tracks until its connectors come into contact with the backplane connectors. You hear a click when it is connected.

Step 3 Push the latch on the module down to secure the module in place.

Table 2-4 lists the LEDs for the extended range transponder module.

Table 2-4 SM Transponder or MM Transponder Module LEDs

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

Installing Extended Range Transponder Modules

Perform the following procedure to install extended range transponder modules.

Step 1 Remove the dust covers from the module, and clean the optical connectors. See the "Cleaning Optical Connectors" section on page 2-11.

Step 2 Install the transceiver by inserting it into the extended range transponder. Push the transceiver until it is securely set in the module.

Step 3 Lift the latch handle on the extended range transponder module and insert the module carefully into the motherboard slot while guiding the upper and lower edges of the module in the tracks until its connectors come into contact with the backplane connectors. You hear a click when it is connected.

Step 4 Push the latch on the module down to secure the module in place.

Table 2-5 lists the LEDs for the extended range transponder module.

Table 2-5 Extended Range Transponder Module LEDs

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

Cabling Transponder Modules

To install fiber-optic cables in the Cisco ONS 15540 ESP, a fiber cable with the corresponding connector type must be connected to the transmit and receive ports on the modules. On Cisco ONS 15540 optical ports, the top connector is Transmit and the bottom connector is Receive. Label the transmit and receive and the working and protection fibers at each end of the fiber span to avoid confusion with cables that are similar in appearance.

Step 1 Place the connector in front of the connection point on the transponder module faceplate. Each transponder module has at least one transmit and one receive connector to create an optical carrier port.

Step 2 Align the keyed ridge of the cable connector with the receiving slot on the faceplate connection point. Gently push the cable connector into the faceplate connection point until the connector snaps into place.

Step 3 Route fiber cables through the cable retaining clips on the optical card faceplate into the cable management tray on the bottom of the shelf assembly.

Step 4 Route the fiber cables from the cable management tray out of the right side of the shelf assembly through cutout holes from the cable management tray.

Cabling Mux/Demux Modules

This section describes the connections between pairs of mux/demux modules and between mux/demux modules and mux/demux motherboards in the Cisco ONS 15540 ESP. The assumption is made that the motherboard and modules are already installed and checked.

Connecting Mux/Demux Module and OSC Ports

Perform the following steps to connect the motherboard and module. Use MU-MU connectors (short fiber length) to connect OSC ports of the motherboard to OSC In and OSC Out on the module.

Step 1 Connect OSC Tx from the motherboard to OSC In on the module.

Step 2 Connect OSC Rx from the motherboard to OSC Out on the module.

Connecting 4-Channel or 8-Channel Mux/Demux Modules

If you have more than one 4-channel or 8-channel mux/demux module, perform the following steps to cascade the modules. Use MU-MU connectors (short fiber length) to connect the modules.

Step 1 Connect the Thru Out port of the module with the DWDM Trunk to Trunk In of the next module in slot 0.

Step 2 Connect the Thru Out of the remaining modules to Trunk In of the next module in slot 0.

Step 3 Perform the steps above for Thru In and Trunk Out in the same slot. Repeat the steps above for slot 1.

Step 4 Connect the trunk fiber to the mux/demux module.

Shelf Grounding Procedure

This section describes how to connect the Cisco ONS 15540 to earth ground. You must complete this procedure before connecting system power or powering up your shelf.

Tip If you use the cable management guides, install the grounding equipment after you install the top cable management guide.

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.

Step 2 Insert the stripped end of the grounding wire into the open end of the grounding lug.

Step 3 Use the crimping tool to secure the grounding wire in place in the grounding lug.

Step 4 Locate the grounding receptacle on the chassis.

Step 5 Remove the label that covers the grounding receptacle.

Note Step 6 is optional if you are not using the top cable management guide.

Step 6 Place the lug mounting adapter against the grounding receptacle at the top of the chassis.

Step 7 Place the grounding lug against the lug mounting adapter.

Step 8 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 9 Install the locking washers and nuts; tighten them to secure the grounding lug to the grounding receptacle.

Step 10 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 15540.

Cleaning the Shelf

Be careful with the airflow system when you clean the chassis. If the cleaning process must be done while the system is running, be aware that the airflow system is in operation. Clean the chassis with a damp cloth only and 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 might be emitted from the end of the fiber or connector. Do not stare into the beam or view directly with optical instruments.**

Cleaning Optical Connectors

When installing your optical connectors, consider the following issues:

- Dirty optical 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, use a lint-free alcohol pad from a cleaning kit to clean the ferrule, the protective white tube around the fiber, and the end-face surface of the fiber.
- 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.

Use a swab saturated with isopropyl alcohol to clean the end-surfaces. Use dry, oil-free compressed air after applying the isopropyl alcohol.

To clean the optical connectors, follow these steps:

Step 1 Wipe the ferrules and end-face surfaces of the connector gently with an alcohol pad from the cleaning kit. Be sure that the pad makes full contact with the end-face surfaces. Wait five seconds for the surfaces to dry and repeat.

Step 2 Blow dry the connectors with canned, dry, oil-free, compressed air.

Step 3 Use a magnifying glass to inspect the ferrule.

The connectors used inside the system have been cleaned by the manufacturer and connected to the adapters in the proper manner. The operation of the system should be error free if the customer provides clean connectors on the application side, follows the previous directions, and ensures the following:

- Clean the connectors using lens tissues before connecting to the adapters. Use pure alcohol to remove soil.
- Do not clean the inside of the connector adapters. Do not use force or quick movements when connecting the fiber optic connectors in the adapters.
- Cover the connector adapters to avoid soiling or contaminating the inside of the adapters while cleaning the chassis. When not using the connectors, cover the connectors and adapters to avoid the inside of the adapters or the surface of the connectors from getting dirty.

Note If the surface is not clean or does not have a uniform shine, repeat the process using a fresh surface of the alcohol pad.

Powering Up the Chassis

Before powering up the chassis, the following conditions must be met:

- The system is set for the correct AC (or DC) power voltages. Refer to the *Cisco ONS 15540 ESP Hardware Installation Guide* for power voltages.
- You must verify the rectifier status. Use a voltmeter on the DC output of the rectifier to verify the operational status of the rectifier.
- The power cables are connected to the system.
- A console terminal is connected to the system.

Verifying the Power Up

Once you have met the conditions in the "Powering Up the Chassis" section, power up the system. The CLI (command-line interface) prompts you to enter the initial configuration dialog. Answer no to this prompt:

Would you like to enter the initial dialog? [yes]: no

You see the following user EXEC prompt:

Switch>

Step 1 Verify that the Status LED is green.

Step 2 Verify that the Active LED on the primary processor and the Standby LED on the standby processor are both green.

Step 3 Verify that alarm LEDs are off.

Step 4 Verify that LEDs on mux/demux modules and line card modules are green.

Step 5 Perform a **show hardware** command to verify the status of both power supplies. The status for both power supplies should be OK.

```
Power-Supply Module

Power-Supply A is : OK
Power-Supply B is : OK
```

Verifying Installation of Hardware

Verify that all hardware is correctly installed by performing a **show hardware** command.

Verify that all modules in the chassis are reported in the proper slot. Verify that the modules have the correct hardware version and software version.

Example

The following example shows how to verify the hardware installation:

```
Switch# show hardware

-------------------------------------------------------------------------------
Manhattan_Backplane_PHASE_0 named Switch, Date: 00:46:49 UTC Thu Oct 24 2002
-------------------------------------------------------------------------------

-------------------------------------------------------------------------------
Back-Plane Information
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
Model     Ver Serial No.   MAC-Address       MAC-Size RMA No RMACode MFG-Date
--------- --- ------------ ----------------- -------- ------ ------- -----------
Manhattan 3.0 TBC05031556  00-00-16-44-28-eD 16       0x00   0x00    02/16/2001
-------------------------------------------------------------------------------
Slot Orderable Product No.     Part No.   Rev Serial No.   Mfg. Date  H/W Ver.
---- ------------------------- ---------- --- ------------ ---------- ----------
0/*  15540-MMMB-0100=         73-5656-03 A0  CAB0608MMEX  03/08/2002 3.0
0/0  15540-MDXA-16AD           05-0893-01 2   402114       06/21/2001 1.0
0/2  15540-MDXA-16EH           05-0894-01 2   402273       06/21/2001 1.0
1/*  15540-MMMB-0100=         73-5656-03 A0  CAB0604MDBF  03/25/2002 3.0
```

```
1/0  15540-MDXB-08A0            30-1318-01 2   401394       06/21/2001 1.0
1/2  15540-MDXA-08C0=          74-2657-01 A1  ANX06040003  01/21/2002 1.0
1/3  MA-MDXA-08D0               30-1317-01 2   401118       06/21/2001 1.0
2/*  15540-LCMB-0100=          73-5813-05 02  CAB0525J5VB  02/15/2001 5.1
2/0  15540-TSP1-01B3=          68-XXXX-XX 02  CAB0537KE7Y  02/23/2001 3.0
2/1  15540-TSP1-01B3=          68-1510-02 02  CAB06190EWM  05/24/2002 2.1
2/2  15540-TSP1-03B3=          73-5757-02 02  sak04490026  02/23/2001 2.31
2/3  15540-TSP1-03B3=          68-1511-02 02  CAB06190EWL  05/24/2002 2.1
3/*  15540-LCMB-0100=          68-1372-02 C0  CAB0607MK5V  03/01/2002 5.0
5/*  15540-LCMB-0100=          68-1372-01 16  CAB0517HLSF  06/25/2001 5.1
5/3  15540-TSP1-15B3=          68-1429-01 B0  CAB0549LRNZ  01/04/2002 4.5
6/*   15540-CPU                      73-5621-02 02  CAB0505GZH3  02/15/2001 2.5
7/*   15540-CPU                      73-5621-02 03  CAB0510HATF  02/16/2001 2.3
11/* 15540-LCMB-0100=          73-5813-05 05  CAB0516HKE2  03/30/2001 5.1
11/0 15540-TSP1-29B3=          68-1436-01 B0  CABO549LRP7  01/02/2002 2.5
11/3 15540-TSP1-31B3=          73-5757-02 10  CAB0518HN8Y  05/23/2001 2.3


--------------------------------------------------------------------------------
Power-Supply Module
--------------------------------------------------------------------------------
Power-Supply A is : OK
Power-Supply B is : OK
```

Software Setup

This chapter describes procedures for basic software configuration.

This chapter contains the following major sections:

- Configuring Management Access, page 3-1
- Configuring Transponder Module Interfaces, page 3-6
- Configuring Patch Connections, page 3-8
- Configuring SNMP, page 3-11

Before performing the procedures in this section, the Cisco IOS software must have booted and the Cisco IOS prompt must be in EXEC mode.

Use the data checklist forms to record such information as IP address and host name for each node. Refer to this information when performing the procedures in this section.

Refer to the *Cisco ONS 15540 ESP Configuration Guide and Command Reference* for more detailed configuration information.

Configuring Management Access

Perform the following procedures to configure the enable password and secret password, configure IP access on the NME interface, and configure the host name.

Configuring the Enable Password and Secret Password

You can configure both an enable password and an enable secret password. For maximum security, the enable password should be different from the enable secret password.

Configuring the Enable Password

The enable password is a nonencrypted password. It can contain any number of uppercase and lowercase alphanumeric characters. Give the enable password only to users permitted to make configuration changes.

Enter the following CLI command:

```
Switch(config)# enable password password
```

Configuring the Enable Secret Password

The enable secret password is a secure, encrypted password. By setting an encrypted password, you can prevent unauthorized configuration changes. On systems running Cisco IOS software, you must type in the enable secret password before you can access global configuration mode.You must type in the enable secret password to access boot ROM software.

An enable secret password contains from 1 to 25 uppercase and lowercase alphanumeric characters. The first character cannot be a number. Spaces are valid password characters. Leading spaces are ignored; trailing spaces are recognized.

Enter the following CLI command:

```
Switch(config)# enable secret password
```

Configuring IP Access on the NME interface

The Fast Ethernet interface, or NME (network management Ethernet), on the active processor card, named *fastethernet 0*, is the management interface that allows multiple, simultaneous Telnet or SNMP network management sessions.

You can remotely configure the Cisco ONS 15540 through the Fast Ethernet interface, but first you must configure an IP address so that the active processor card is reachable.

Note Before you begin to manually configure an NME interface, obtain its IP address and IP subnet mask. Also make sure the console cable is connected to the console port.

To configure IP access on the NME port fastethernet 0 from the CLI, perform these steps from the console interface:

	Command	Purpose
Step 1	Switch> **enable** Switch#	Enters privileged EXEC mode.
Step 2	Switch# **configure terminal** Switch(config)#	Enters global configuration mode.
Step 3	Switch(config)# **interface fastethernet 0** Switch(config-if)#	Enters interface configuration mode on interface fastethernet 0, the NME port on the active processor card.
Step 4	Switch(config-if)# **ip address** *ip-address subnet-mask*	Specifies the IP address and IP subnet mask for the management port interface.
Step 5	Switch(config-if)# **speed** {**10** | **100** | **auto**}	Specifies the transmission speed. The default is **auto** (autonegotiation).
Step 6	Switch(config-if)# **duplex** {**auto** | **full** | **half**}	Specifies the duplex mode. The default is **auto** (autonegotiation).

	Command	Purpose
Step 7	Switch(config-if)# **exit** Switch(config)#	Returns to global configuration mode.
Step 8	Switch(config)# **ip default-gateway** *ip-address*	Specifies the address of the default IP gateway node.

Example

The following example shows how to configure IP access on the NME interface fastethernet 0:

```
Switch(config)# interface fastethernet0
Switch(config-if)# ip address 192.31.7.18 255.255.255.0
Switch(config-if)# exit
Switch(config)# ip default-gateway 192.31.7.1
```

Configuring Host Name

In addition to passwords and an IP address, you must configure the host name. To configure the host name, perform the following steps:

	Command	Purpose
Step 1	Switch# **configure terminal** Switch(config)#	Enters global configuration mode.
Step 2	Switch(config)# **hostname** *name*	Specifies a system name.
Step 3	*name*(config)# **end** *name*#	Returns to privileged EXEC mode. The prompt indicates that the host name has been set to the new name.
Step 4	*name*# **copy system:running-config nvram:startup-config**	Saves your configuration changes to NVRAM.

Example

The following example shows how to configure the host name:

```
Switch# configure terminal
Switch(config)# hostname node1
node1(config)# end
node1(config)# copy system:running-config nvram:startup-config
```

Configuring IP on the OSC (Optional)

Configuring IP on the OSC allows you to use one Cisco ONS 15540 node in the network to monitor all the other Cisco ONS 15540 nodes in the network. The OSC is a point-to-point signal so any IP configuration valid for point-to-point interfaces is usable.

IP addressing on the OSC can be configured two ways:

- An IP address for each OSC wave interface with each address on a separate subnet
- An unnumbered address for the OSC wave interfaces which reference another numbered interface

The IP address of the reference interface is used as the IP packet source address. Use a loopback interface as the reference interface since it is always up. Configure the IP address for each node in a separate subnet.

Note You can alternatively use the IP address of the NME interface (fastethernet 0) for the reference address instead of the loopback interface.

To configure IP on an OSC wave interface, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface loopback 1** Switch(config-if)#	Selects the loopback interface to configure and enters interface configuration mode.
Step 2	Switch(config-if)# **ip address** *ip-address subnet-mask*	Configures the IP address and subnet for the interface.
Step 3	Switch(config-if)# **exit** Switch(config)#	Exits interface configuration mode and returns to global configuration mode.
Step 4	Switch(config)# **interface fastethernet 0** Switch(config-if)#	Selects the NME interface to configure and enters interface configuration mode.
Step 5	Switch(config-if)# **ip address** *ip-address subnet-mask*	Configures the IP address and subnet for the interface.
Step 6	Switch(config-if)# **exit** Switch(config)#	Exits interface configuration mode and returns to global configuration mode.
Step 7	Switch(config)# **interface wave 0** Switch(config-if)#	Selects the wave interface on slot 0.
Step 8	Switch(config-if)# **ip unnumbered loopback 1**	Configures an unnumbered interface referencing the loopback interface.
Step 9	Switch(config-if)# **no shutdown**	Configures the interface to a no shutdown state.
Step 10	Switch(config-if)# **exit** Switch(config)#	Exits interface configuration mode and returns to global configuration mode.
Step 11	Switch(config)# **interface wave 1** Switch(config-if)#	Selects the wave interface on slot 1.
Step 12	Switch(config-if)# **ip unnumbered loopback 1**	Configures an unnumbered interface referencing the loopback interface.
Step 13	Switch(config-if)# **no shutdown**	Configures the interface to a no shutdown state.

	Command	Purpose
Step 14	Switch(config-if)# **exit** Switch(config)#	Exits interface configuration mode and returns to global configuration mode.
Step 15	Switch(config)# **ip route** *prefix prefix-mask interface*	Configures IP static routes for some or all destinations.
	or	or
	Switch(config)# **router ospf** *process-id*	Configures OSPF as the routing protocol.
	Switch(config-router)# **network** *network-address wildcard-mask* **area** *area-id*	
	or	or
	Switch(config)# **router eigrp** *as-number*	Configures EIGRP as the routing protocol.
	Switch(config-router)# **network** *network-number* [*network-mask*]	
	or	or
	Switch(config)# **router bgp** *as-number*	Configures BGP as the routing protocol.
	Switch(config-router)# **network** *network-number* [**mask** *network-mask*]	
	Switch(config-router)# **neighbor** {*ip-address* | *peer-group-name*} **remote-as** *number*	

Example

The following example shows how to configure IP on an OSC wave interface:

```
Switch(config)# interface loopback 1
Switch(config-if)# ip address 192.31.7.18 255.255.255.0
Switch(config-if)# exit
Switch(config)# interface fastethernet0
Switch(config-if)# ip address 192.31.7.19 255.255.255.0
Switch(config-if)# exit
Switch(config)# interface wave0
Switch(config-if)# ip unnumbered loopback 1
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# interface wave1
Switch(config-if)# ip unnumbered loopback 1
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# router ospf 109
Switch(config-router)# network 131.108.20.0 0.0.0.255 area 10.9.50.0
Switch(config-router)# network 131.108.0.0 0.0.255.255 area 2
Switch(config-router)# network 131.109.10.0 0.0.0.255 area 3
Switch(config-router)# network 0.0.0.0 255.255.255.255 area 0
```

Note For detailed information about configuring routing protocols, refer to the *Cisco IOS IP and IP Routing Configuration Guide*.

Configuring Transponder Module Interfaces

To configure transponder module interfaces, you must configure the signal transmission rate by specifying either the protocol encapsulation or the clock rate. You must then perform a no shutdown command on the interfaces.

If you are configuring extended range transponders, refer to Table 1-1 on page 1-5 to configure the appropriate protocol for the transceiver.

To configure the transponder interfaces, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface transparent** *slot*/*subcard*/**0** Switch(config-if)#	Selects the interface to configure and enters interface configuration mode.
Step 2	Switch(config-if)# **encapsulation** {**fastethernet** | **fddi** | **gigabitethernet** | **escon**} or	Specifies Fast Ethernet, FDDI, Gigabit Ethernet, or ESCON. OFC is disabled.
	Switch(config-if)# **encapsulation sysplex clo**	Specifies Sysplex CLO[1]. OFC[2] is disabled. Forward laser control is enabled on both the transparent and wave interfaces. OFC is disabled.
	or	
	Switch(config-if)# **encapsulation sysplex etr**	Specifies Sysplex ETR[3]. OFC is disabled.
	or	
	Switch(config-if)# **encapsulation sysplex isc** {**compatibility** | **peer [1g** | **2g]**}	Specifies ISC[4] compatibility mode (1 Gbps) or peer mode (1 Gbps or 2 Gbps). OFC is enabled for compatibility mode and disabled for peer mode.
	or	
	Switch(config-if)# **encapsulation ficon** {**1g** | **2g**}	Specifies FICON and rate. OFC is disabled.
	or	
	Switch(config-if)# **encapsulation sonet** {**oc3** | **oc12** | **oc48**}	Specifies SONET as the signal protocol and OC-3, OC-12, or OC-48 as the transmission rate. OFC is disabled.
	or	
	Switch(config-if)# **encapsulation sdh** {**stm-1** | **stm-4** | **stm-16**}	Specifies SDH as the signal protocol and STM-1, STM-4, or STM-16 as the transmission rate. OFC is disabled.
	or	
	Switch(config-if)# **encapsulation fibrechannel** {**1g** | **2g**} [**ofc** {**enable** | **disable**}]	Specifies Fibre Channel as the signal protocol and 1 Gbps or 2 Gbps as the transmission rate. Enables or disables OFC. OFC is disabled by default.
	or	
	Switch(config-if)# **clock rate** *value*	Specifies the signal transmission clock rate without an associated protocol. OFC is disabled.
Step 3	Switch(config-if)# **monitor enable**	Enables protocol monitoring. Protocol monitoring is supported only for certain protocol encapsulations.

	Command	Purpose
Step 4	Switch(config-if)# **topology neighbor** {**name** *node-name* | **ip-address** *node-ip-address* | **mac-address** *node-mac-address*} {**port** {**name** *port-name* | **ip-address** *port-ip-address* | **mac-address** *port-mac-address*}} [**receive** | **transmit**]	Configures the network topology information for the client equipment.
Step 5	Switch(config-if)# **topology neighbor agent ip-address** *ip-address*	Specifies the address of the network topology agent on a neighboring node.
Step 6	Switch(config-if)# **no shutdown**	Enables the interface.
Step 7	Switch(config-if)# **exit** Switch(config)#	Exits interface configuration mode and returns to global configuration mode.
Step 8	Switch(config)# **interface wave** *slot*/*subcard*/**0** Switch(config-if)#	Selects the interface to configure and enters interface configuration mode.
Step 9	Switch(config-if)# **laser frequency** *number*	Selects the frequency for the laser to transmit to the trunk. Each transponder module can transmit one of two frequencies. The default is the lower channel frequency.
Step 10	Switch(config-if)# **no shutdown**	Enables the interface.
Step 11	Switch(config-if)# **exit** Switch(config)#	Exits interface configuration mode and returns to global configuration mode.
Step 12	Switch(config)# **interface wavepatch** *slot*/*subcard*/**0** Switch(config-if)#	Perform this step for both splitter and non-splitter modules.
Step 13	Switch(config-if)# **no shutdown**	Enables the interface.
Step 14	Switch(config-if)# **exit** Switch(config)#	Exits interface configuration mode and returns to global configuration mode.
Step 15	Switch(config)# **interface wavepatch** *slot*/*subcard*/**1** Switch(config-if)#	If you have a splitter interface module, perform this step.
Step 16	Switch(config-if)# **no shutdown**	Enables the interface.
Step 17	Switch(config-if)# **end** Switch#	Returns to privileged EXEC mode.
Step 18	Switch# **copy system:running-config nvram:startup-config**	Saves your configuration changes to NVRAM.

1. CLO = control link oscillator
2. OFC = open fiber control
3. ETR = external timer reference
4. ISC = Intersystem Channel Links

Example

The following example shows how to configure the transponder interfaces:

```
Switch# configure terminal
Switch(config)# interface transparent 2/0/0
Switch(config-if)# encapsulation sonet oc48
Switch(config-if)# monitor enable
Switch(config-if)# topology neighbor ip-address 192.31.7.11 port ip-address 192.31.7.13
Switch(config-if)# topology neighbor agent ip-address 192.31.7.20
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# interface wave 2/0
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# interface wavepatch 2/0/0
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# interface wavepatch 2/0/1
Switch(config-if)# no shutdown
Switch(config-if)# end
Switch# copy system:running-config nvram:startup-config
```

Configuring Patch Connections

To configure patch connections on the Cisco ONS 15540, perform the following steps:

Step 1 Configure the patch connections between the mux/demux modules (required).

Step 2 Configure the patch connections between the OSC (optical supervisory channel) interface on the mux/demux motherboards and the mux/demux modules (required if the OSC is present).

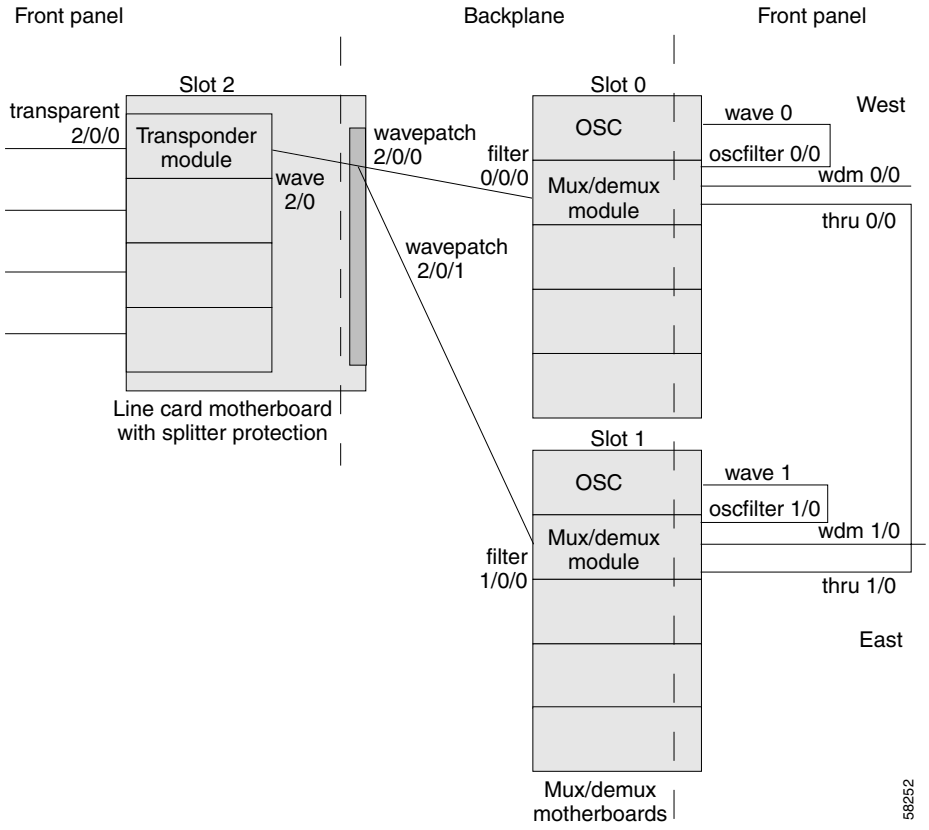
Table 3-1 describes the types of patch connections on the Cisco ONS 15540.

Table 3-1 Patch Connection Types

Patch Connection	Description
Thru interface to wdm interface or wdm interface to thru interface	Connection between two add/drop mux/demux modules in the same chassis slot
Thru interface to thru interface	Connection between two add/drop mux/demux modules in different chassis slots
Filterband interface to filtergroup interface or filtergroup interface to filterband interface	Connection between the terminal mux/demux module supporting channels 1 through 16 and the terminal mux/demux module supporting channels 17 through 32 in the same chassis slot or in different chassis slots
OSC wave interface to OSC oscfilter interface or OSC oscfilter interface to OSC wave interface	Connection between the OSC wave interface on the mux/demux motherboard and the OSC oscfilter interface on the mux/demux module in the same chassis slot

Figure 3-1 shows and example of interfaces and their relationships on the Cisco ONS 15540 ESP.

Figure 3-1 Optical Cross Connection Example on the Cisco ONS 15540 ESP



To configure patch connections between mux/demux modules within the same shelf, use the following global configuration commands:

Command	Purpose
patch thru *slot/subcard1* **wdm** *slot/subcard2* or **patch wdm** *slot/subcard1* **thru** *slot/subcard2*	Configures the patch connection between two add/drop mux/demux modules in the same chassis slot.
patch thru *slot1/subcard1* **thru** *slot2/subcard2*	Configures the patch connection between two add/drop mux/demux modules in different chassis slots.

Command	Purpose
patch filterband *slot1*/*subcard1*/*port1* **filtergroup** *slot2*/*subcard2*/*port2* or **patch filtergroup** *slot1*/*subcard1*/*port1* **filterband** *slot2*/*subcard2*/*port2*	Configures the patch connection between a terminal mux/demux module supporting channels 1 through 16 and a terminal mux/demux module supporting channels 17 through 32 in the same chassis slot or in different chassis slots.
patch wave *slot* **oscfilter** *slot*/*subcard* or **patch oscfilter** *slot*/*subcard* **wave** *slot*	Configures the patch connection between the OSC wave interface on the mux/demux motherboard and the OSC oscfilter interface on the mux/demux module in the same chassis slot.

Note If you correctly patch your mux/demux modules, **patch** command configuration is not necessary for the signal to pass from the client to the trunk fiber. However, without correct **patch** command configuration, CDP is unable to locate the wdm interfaces that connect to the trunk fiber and discover the topology neighbors. For more information on network monitoring, refer to the *Cisco ONS 15540 ESP Configuration and Command Reference Guide*.

Example

The following example shows how to configure the patch connections between OSC interfaces and between mux/demux modules:

```
Switch# configure terminal
Switch(config)# patch thru 0/0 wdm 0/1
Switch(config)# patch thru 0/1 wdm 0/2
Switch(config)# patch thru 0/2 thru 1/0
Switch(config)# patch thru 1/1 wdm 1/0
Switch(config)# patch thru 1/2 wdm 1/1
Switch(config)# patch wave 0 oscfilter 0/0
Switch(config)# patch wave 1 oscfilter 1/2
```

Configuring SNMP

As a basic test of whether SNMP is functioning correctly, you will verify that you can receive a generic SNMP trap, the entity trap. Perform a **shutdown** command and **no shutdown** command on an interface to trigger entity traps. Verify that you receive the entity traps.

To configure and test SNMP functionality, perform the following commands:

	Command	Purpose
Step 1	Switch(config)# **snmp-server community public RO**	Defines the password-like community access string sent with the notification, and assigns read only permission for the MIB objects accessible to the community.
Step 2	Switch(config)# **snmp-server community private RW**	Defines the password-like community access string sent with the notification, and assigns read and write permission for the MIB objects accessible to the community.
Step 3	Switch(config)# **snmp-server enable traps**	Enables SNMP trap notifications.
Step 4	Switch(config)# **interface transparent** *slot*/*subcard*/**0** Switch(config-if)#	Selects the interface to configure and enters interface configuration mode.
Step 5	Switch(config-if)# **shutdown**	Disables the interface.
Step 6	Switch(config-if)# **no shutdown**	Enables the interface.

Example

The following example shows how to configure and test SNMP functionality:

```
Switch# configure terminal
Switch(config)# snmp-server community public RO
Switch(config)# snmp-server community private RW
Switch(config)# snmp-server enable traps
Switch(config)# interface transparent 2/2/0
Switch(config-if)# shutdown
Switch(config-if)# no shutdown
```

Node Verification Procedures

Use the procedures in this chapter to perform basic node verification. Note that details of isolating possible problems are not described here.

Before performing the procedures in this chapter, you must install the chassis, power it up, and complete the hardware and software installation and verification tasks of the previous chapter.

This chapter contains the following major sections:

- Required Equipment, page 4-1
- Optical Power and Frequency Checks, page 4-2
- Verifying the Interfaces, page 4-7
- Verifying Laser Frequency, page 4-11
- Testing the Bit Error Rate, page 4-13
- Checking Alarms, page 4-14

Required Equipment

You need the following test equipment:

- Handheld power meter
- Optical spectrum analyzer
- Fiber cleaning kit
- Attenuators
- MU-SC connector (per DWDM interface)
- Traffic generator for bit error rate testing

Optical Power and Frequency Checks

Perform the following procedures to verify power levels at the DWDM trunk interfaces and the client interfaces.

- Verifying power levels at the DWDM trunk interfaces
- Verifying power levels on the client interfaces

Verifying Power Levels at the DWDM Trunk Interfaces

This section lists procedures for measuring and verifying the power levels at the DWDM trunk interfaces. Following the procedures are tables listing power specifications.

Verifying Transmit Launch Power and Insertion Losses

Perform the following steps to verify the transmit launch power and insertion losses:

Step 1 Power up the OSA and make sure that the OSA wavelength value range is set in the 1530 to 1563 nm range.

Step 2 Connect an OSA to the Tx of the trunk port on the mux/demux connected to the trunk fiber slot 0.

Step 3 Check and record all power levels and frequencies.

Step 4 Using the following tables, compute Minimum Tx power (dBm) minus Maximum Loss (dBm).

Step 5 Verify that the Tx optical power measurements are greater than the above figure.

Step 6 Loop back the Trunk Out port to the Trunk In port on the mux/demux module with a 10 dB attenuator.

Caution You must add attenuation so that receive power is not too high and does not damage the receiver.

Step 7 Perform a **show interface wave** command to check the optical power.

Step 8 Refer to the below optical budget losses and compute total losses for connectors and filters.

Step 9 Verify that the optical power figure listed by Cisco IOS is greater than the following figure:

```
Minimum Tx power (dBm) - total losses
(Total losses = maximum link loss (dBm) + attenuation + other insertion losses)
```

Step 10 Repeat Step 8 through Step 10 for each interface.

Step 11 Repeat Step 1 through Step 10 for the other trunk side, slot 1.

Table 4-1 lists trunk side optical power specifications. Note that for extended range (with SFP) and transparent transponders the specifications are very similar.

Table 4-1 Trunk Side Laser Specifications

Receiver specification	Minimum	Typical	Maximum
Receive sensitivity		–32 dBm	–28 dBm
Receive overload			–8 dBm
Input wavelength	1430 nm		1580 nm
Transmitter power	4 dBm	6 dBm	8 dBm
Output wavelength	1530.33 nm		1560.61

Table 4-2 shows the optical link loss for the splitter and unprotected motherboards supported by the Cisco ONS 15540 in the transmit and receive directions.

Table 4-2 Optical Link Loss for Line Card Motherboards

Line Card Motherboard Type and Direction	Loss (dB)
Splitter motherboard Tx	4.5
Splitter motherboard Rx	1.8
Unprotected motherboard Tx	1.0
Unprotected motherboard Rx	1.0

Table 4-3 shows the optical link loss for the data channels between the 4-channel or 8-channel add/drop mux/demux modules and the transponders, and between the pass-through add and drop connectors on the modules.

Table 4-3 Optical Link Loss for Data Channels Through the Add/Drop Mux/Demux Modules

Optical Mux/Demux Module Type	Trunk IN to Line Card Motherboard (Data Drop) (dB)	Line Card Motherboard to Trunk OUT (Data Add) (dB)	Trunk IN to Thru OUT (Pass-through Drop) (dB)	Thru IN to Trunk OUT (Pass-through Add) (dB)
4-channel with OSC	4.1	4.1	1.5	1.5
8-channel with OSC	4.8	4.8	2.0	2.0
4-channel without OSC	4.1	4.1	1.0	1.0
8-channel without OSC	4.8	4.8	1.5	1.5

Table 4-4 list the optical link loss for the 32-channel terminal mux/demux modules.

Table 4-4 Optical Link Loss for Data Channels Through the 32-Channel Terminal Mux/Demux Modules

Optical Mux/Demux Module Type	IN to Line Card Motherboard (Data Drop) (dB)	Line Card Motherboard to OUT (Data Add) (dB)
32-channel (channels 1–32)	5.4	5.4

Table 4-5 shows the optical link loss for the OSC between the mux/demux motherboard and the optical mux/demux modules.

Table 4-5 Optical Link Loss for the OSC Through the Optical Mux/Demux Modules

Optical Mux/Demux Module Type	Trunk IN to OSC Transceiver (dB)	OSC Transceiver to Trunk OUT (dB)
4-channel with OSC	2.8	2.8
8-channel with OSC	3.3	3.3
32-channel with OSC	7.1	7.1

Verifying Power Levels on the Client Interfaces

Perform the following steps to check the client side interface Tx power.

Step 1 Run a jumper cable from the client Tx port of the first client interface module to the external power meter.

Note When using a jumper cable to test, the cable should be pretested for its own loss and the same cable should be used for all tests.

Step 2 Set the wavelength on the power meter to 1310 nm.

Step 3 Measure and record the output power of the client side transmit.

Step 4 Compare the measured power with the specifications provided in Table 4-6.

Step 5 Repeat these steps for all other interfaces.

Table 4-6 lists the optical power of the client side interfaces for SM transponders and MM transponders.

Table 4-6 Client Side Laser Specifications - SM Transponder and MM Transponder

	Single Mode Transponder			Multimode Transponder		
Receiver specification	**Minimum**	**Typical**	**Maximum**	**Minimum**	**Typical**	**Maximum**
Bit rate	16 Mbps		2.5 Gbps	16 Mbps		622 M
Receive sensitivity	–19 dBm	–23 dBm[1]		–25 dBm	–28 dBm	
Receive overload			–1.5 dBm			–8 dBm
Input wavelength	1249 nm[2]		1600 nm	1249 nm		1600 nm
Transmitter power	–5 dBm	–2 dBm	0 dBm	–5 dBm	–2 dBm	0 dBm
Output wavelength	1260 nm		1360 nm	1260 nm		1360 nm

1. dBm = decibels per milliwatt. 0 dBm is defined as 1 mW at 1 kHz of frequency and at 600 ohms of impedance.
2. nm = nanometers.

Note For extended range transponders the optical launch power and receive sensitivity is SFP dependent. If the specifications of the client equipment interfaces do not fall within these ranges, attenuators might be required.

Table 4-7 lists the optical power of the client side interfaces for extended range transponders.

Table 4-7 Selectable Transceiver Receiver and Laser Specifications

Receiver Specification	Minimum	Typical	Maximum
ESCON, SONET OC-3, and SDH STM-1 MM			
Bit rate	10 Mbps		200 Mbps
Receive sensitivity	–33 dBm		–14 dBm
Receive overload			–14 dBm
Input wavelength	1280 nm		1380 nm
Transmitter power	–19.5 dBm		–15 dBm
Output wavelength	1280 nm	1320 nm	1380 nm
Gigabit Ethernet and Fibre Channel MM			
Bit rate		1.0625 Gbps, 1.25 Gbps	
Receive sensitivity		–21 dBm	–18 dBm
Receive overload			–13.5 dBm
Input wavelength	770 nm		860 nm
Transmitter power	–9.5 dBm		–4 dBm
Output wavelength	830 nm		860 nm

Table 4-7 Selectable Transceiver Receiver and Laser Specifications (continued)

Receiver Specification	Minimum	Typical	Maximum
Gigabit Ethernet and Fibre Channel SM			
Bit rate		1.0625 Gbps, 1.25 Gbps	
Receive sensitivity		–25 dBm	–20.5 dBm
Receive overload	–3 dBm		
Input wavelength	1270 nm		1600 nm
Transmitter power	–9.5 dBm		–3 dBm
Output wavelength	1275 nm		1350 nm
Gigabit Ethernet and Fibre Channel (1 Gbps and 2 Gbps) SM			
Bit rate		1.0625 Gbps, 2.125 Gbps	
Receive sensitivity (<= 1.06 Gbps)		–24 dBm	–20.5 dBm
Receive sensitivity (> 1.06 Gbps)		–22 dBm	–20.5 dBm
Input wavelength	1270 nm		1600 nm
Transmitter power	–9.5 dBm		–3 dBm
Output wavelength	1275 nm		1350 nm
Fibre Channel (2 Gbps) MM			
Bit rate		1.062 Gbps, 2.125 Gbps	
Receive sensitivity (<= 1.06 Gbps)		–22 dBm	–18 dBm
Receive sensitivity (> 1.06 Gbps)		–20 dBm	–15 dBm
Receive overload (<= 1.06 Gbps)			–13.5 dBm
Receive overload (> 1.06 Gbps)		–18 dBm	–12.1 dBm
Input wavelength	770 nm		860 nm
Transmitter power	–9 dBm		–4 dBm
Output wavelength	830 nm		860 nm
SONET OC-12 SM			
Bit rate	50 Mbps	622 Mbps	700 Mbps
Receive sensitivity	–28 dBm	–31 dBm	
Receive overload	–7 dBm	–3 dBm	
Input wavelength	1100 nm		1600 nm
Transmitter power	–15 dBm	–11 dBm	–8 dBm

Table 4-7 Selectable Transceiver Receiver and Laser Specifications (continued)

Receiver Specification	Minimum	Typical	Maximum
Output wavelength	1261 nm	1310 nm	1360 nm
SONET OC-48 SM			
Bit rate	155 Mbps		2667 Mbps
Receive sensitivity		–22 dBm	–18 dBm
Receive overload	–3 dBm		
Input wavelength	1270 nm		1600 nm
Transmitter power	–9.5 dBm		–3 dBm
Output wavelength	1285 nm		1340 nm

Verifying the Interfaces

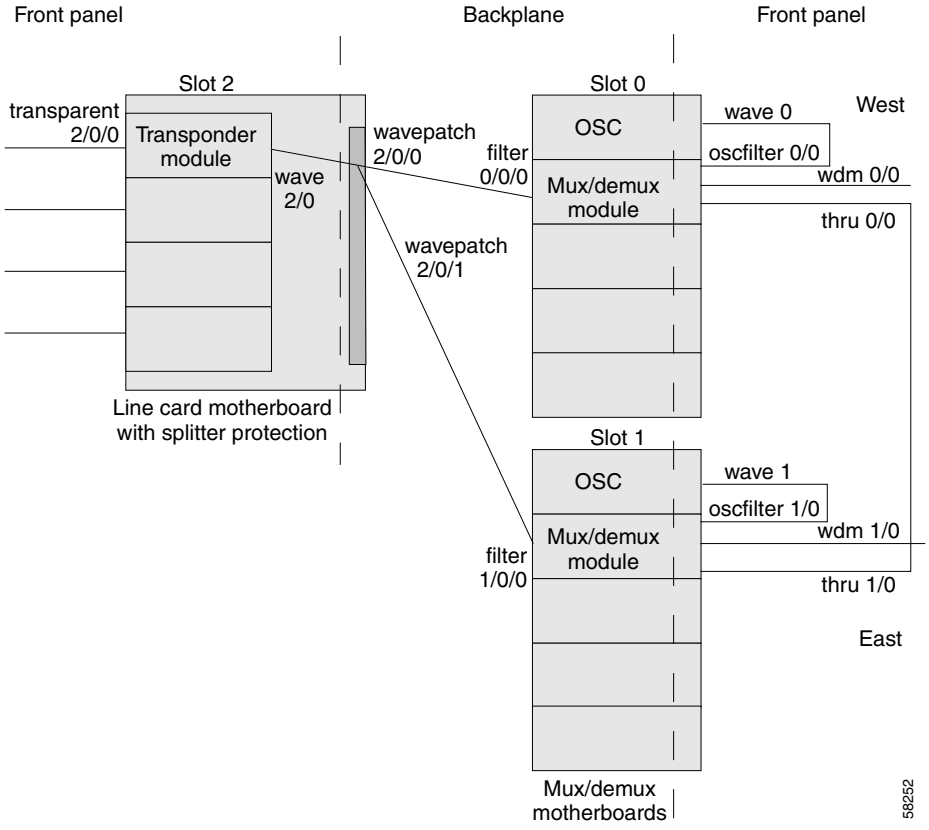
Figure 4-1 on page 4-8 show examples of interfaces on the Cisco ONS 15540 ESP.

Although the interfaces do not yet carry traffic, verify that the interfaces are administratively up on the client, DWDM trunk, and OSC. Use the **show interfaces** commands as described in this section. Perform these commands for the following interfaces:

- Transparent interfaces
- Transponder wave interfaces
- OSC wave interfaces
- Wavepatch interfaces

For more information on interfaces, refer to the *Cisco ONS 15540 ESP Configuration Guide and Command Reference*.

Figure 4-1 Optical Cross Connection Example on the Cisco ONS 15540 ESP




```
Switch# show interfaces transparent 11/3/0
Transparent11/3/0 is up, line protocol is up
  Signal quality: Good
  Encapsulation: Sonet    Rate: oc48
  Signal monitoring: on
  Time of last "monitor" state change 00:02:20
  Time of last "encapsulation" change 00:02:23
  Forward laser control: Off
  Loopback not set

  Configured threshold Group: None
  Section code violation error count(bip1): 0
  Number of errored seconds(es): 0
  Number of severely errored seconds(ses): 0
  Number of severely errored framing seconds(sefs): 0
  Last clearing of "show interface" counters 00:02:23
  Hardware is transparent

Switch# show interfaces wave 11/3
Wave11/3 is up, line protocol is up
  Channel: 32   Frequency: 195.9 Thz   Wavelength: 1530.33 nm
  Active Wavepatch         : Wavepatch11/3/1
  Splitter Protected       : No
  Signal quality           : Good
  Receiver power level     : -26.54 dBm
  Forward laser control    : Off
  Laser safety control     : Off
  Osc physical port        : No
  Wavelength used for inband management: No
```

```
  Loopback not set

  Configured threshold Group: None
  Section code violation error count(bip1): 1
  Number of errored seconds(es): 1
  Number of severely errored seconds(ses): 0
  Number of severely errored framing seconds(sefs): 0

  Last clearing of "show interface" counters 00:02:33
  Hardware is data_only_port

Switch# show interfaces wave0
Wave0 is up, line protocol is up
  Channel: 0    Frequency: 191.9 Thz   Wavelength: 1562.23 nm
  Signal quality           : Good
  Laser safety control     : Off
  Osc physical port        : Yes
  Wavelength used for inband management: No

OSC interface
  Number of times SF threshold exceeded: 0
  Number of times SD threshold exceeded: 0
  Code violation and running disparity error count( 8b10b cvrd): 914
  Last clearing of "show interface" counters never
  Hardware is OSC_phy_port
  MTU 1492 bytes, BW 10000000 Kbit, DLY 0 usec,
     reliability 239/255, txload 1/255, rxload 1/255
  Encapsulation SNAP, loopback not set
  Last input 00:00:01, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     191 packets input, 13849 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out

Switch# show interfaces wavepatch 11/3/0
Wavepatch11/3/0 is up, line protocol is up
  Receiver power level: -24.77 dBm
  Hardware is passive_port

Switch# show interfaces wavepatch 11/3/1
Wavepatch11/3/1 is up, line protocol is up
  Receiver power level: Unknown
  Hardware is passive_port
```

Perform a **show connect intermediate** command. This command shows the complete path of the traffic through all components and interfaces.

```
Switch# show connect intermediate
client/       wave           wave            wdm
wave          client         patch   filter   trk  channel
------------  ------------  -------  ------  ----- -------
Tran2/1/0     Wave2/1        2/1/0*  0/0/1    0/0    2
                             2/1/1   1/0/1    1/0    2
Tran2/3/0     Wave2/3        2/3/0*  0/0/3    0/0    4
                             2/3/1   1/0/3    1/0    4
Tran11/0/0    Wave11/0      11/0/0   0/2/12  0/2/1   29
                            11/0/1*  1/3/4    1/3    29
Tran11/3/0    Wave11/3      11/3/0   0/2/15  0/2/0   32
                            11/3/1*  1/3/7    1/3    32
```

Perform a **show patch detail** command.

```
Switch# show patch detail
Patch Interface     Patch Interface     Type       Dir   Error
------------------  ------------------  ---------  ----  ----------------
Filter0/0/1         Wavepatch2/1/0      AUTOMATIC  Both
Filter0/0/3         Wavepatch2/3/0      AUTOMATIC  Both
Filter0/2/12        Wavepatch11/0/0     AUTOMATIC  Both
Filter0/2/15        Wavepatch11/3/0     AUTOMATIC  Both
Filter1/0/1         Wavepatch2/1/1      AUTOMATIC  Both
Filter1/0/3         Wavepatch2/3/1      AUTOMATIC  Both
Filter1/3/4         Wavepatch11/0/1     AUTOMATIC  Both
Filter1/3/7         Wavepatch11/3/1     AUTOMATIC  Both
```

Perform a **show fast ethernet 0** command.

```
Switch# show fast ethernet 0
FastEthernet0 is up, line protocol is up
  Hardware is AmdFE, address is 0000.1644.28ed (bia 0000.1644.28ed)
  Internet address is 172.20.54.155/29
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Half-duplex, 100Mb/s, 100BaseTX/FX
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:00, output 00:00:01, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue :0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     342 packets input, 117639 bytes
     Received 316 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog
     0 input packets with dribble condition detected
     94 packets output, 6390 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
```

Verifying Laser Frequency

The laser frequency (channel number) corresponds with the frequency label on the transponder faceplate. Make sure that the laser frequency (channel number) is configured to the proper wavelength using the **show interfaces wave** command. Compare the frequency with the expected frequency as shown by the **show optical wavelength mapping** command.

Note In case the frequency does not match the expected result, check to make sure that the transponder is installed in the correct subslot. For more information on shelf rules, refer to the *Cisco ONS 15540 ESP Planning Guide*.

```
Switch# show interfaces wave 11/3
Wave11/3 is up, line protocol is up
  Channel: 32   Frequency: 195.9 Thz   Wavelength: 1530.33 nm
  Active Wavepatch          : Wavepatch11/3/1
  Splitter Protected        : No
  Signal quality            : Good
  Receiver power level      : -26.54 dBm
  Forward laser control     : Off
  Laser safety control      : Off
  Osc physical port         : No
  Wavelength used for inband management: No
  Loopback not set

  Configured threshold Group: None
  Section code violation error count(bip1): 1
  Number of errored seconds(es): 1
  Number of severely errored seconds(ses): 0
  Number of severely errored framing seconds(sefs): 0

  Last clearing of "show interface" counters 00:02:33
  Hardware is data_only_port
```

Table 4-8 lists the channels, wavelengths, and frequencies for each band.

Table 4-8 Channel to Wavelength Mapping

Cisco ONS 15540 Band	Cisco ONS 15540 Channel	ITU Channels	ITU Wavelength[1]	ITU Frequency[2]
OSC[3]		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

Table 4-8 Channel to Wavelength Mapping (continued)

Cisco ONS 15540 Band	Cisco ONS 15540 Channel	ITU Channels	ITU Wavelength[1]	ITU Frequency[2]
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
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. Wavelengths in vacuum in nm
2. Frequency in THz, 100 GHz grid
3. OSC = optical supervisory channel

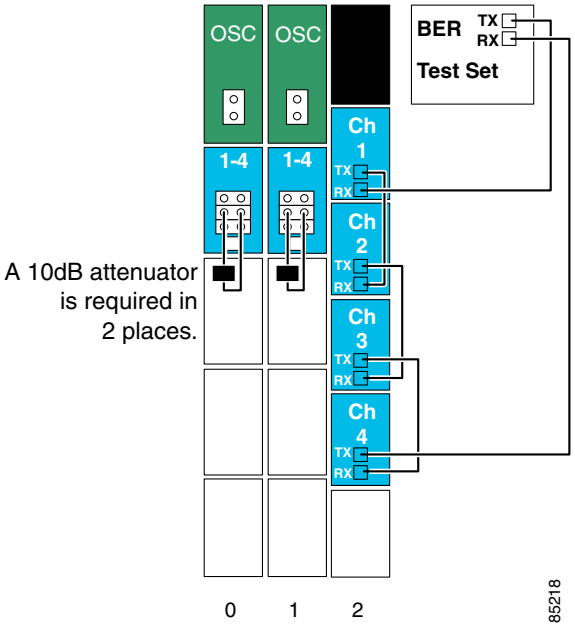
Testing the Bit Error Rate

Perform the following procedure to test bit error rate errors:

Step 1 Measure the power level on the BER test transmit and use appropriate attenuation. Connect the BER test set transmit port to the receive port of the first transponder interface to be tested.

Step 2 Measure the power level on all the interfaces using the hand-held power meter. Daisy-chain the remaining interfaces with the appropriate attenuation (approximately 5 dB) in between. The transmit port of the last interface connects to the receive port of the BER test set (see Figure 4-2).

Figure 4-2 Testing Bit Error Rate



Step 3 Loop back the WDM interfaces on the mux/demux modules on slot 0 and slot 1 that connect to the trunk fiber. For systems with splitter motherboards, add 5dB of attenuators to make sure that the laser receive power is not too high. For non-splitter motherboards, add 10 dB of attenuation to make sure that laser receive power is not too high.

Step 4 Clear all errors on the BER test set.

Step 5 Perform a **show interface** command for each transponder interface.

Step 6 Start the BER test, and verify that the test runs error free for 15 minutes.

If there are errors within the 15 minute test period, remove the daisy chain configuration and try to isolate the problem by performing the BER test on each individual channel.

Step 7 If the system uses splitter protection, perform a **shutdown** command on the active wavepatch interface and a **no shut** command on the inactive wavepatch interface.

Step 8 Clear all errors on the BER test set.

Step 9 Perform a **show interface** command for each transponder interface.

Step 10 Start the BER test, and verify that the test runs error free for 15 minutes.

If there are errors within the 15 minute test period, remove the daisy chain configuration and try to isolate the problem by performing the BER test on each individual channel.

Checking Alarms

Verify that alarms are generated for the following common fault conditions.

Table 4-9 Verifying Alarms are Generated for Common Fault Conditions

Action	Alarm Generated
Remove the client Rx and verify that a loss of light alarm is generated. Perform the **show facility-alarm status** command.	Loss of light alarm on the client Rx
Remove the trunk cable and verify a loss of light alarm on the wave interface. Perform the **show facility-alarm status** command.	Loss of light alarm on the wave interface
Use a SONET analyzer to inject errors such as loss of frame, and verify that corresponding alarms are generated. To perform this test, you must have either an SM transponder that is configured for SONET, an MM transponder that is configured for SONET, or an extended range transponder that has a SONET SFP. Perform the **show facility-alarm status** command.	There should be an alarm generated according to the injected error.
Configure threshold levels for signal degrade and signal fail (use the **show threshold list** command to see current threshold levels). Use the analyzer to degrade the signal by injecting errors, and verify that a threshold alarm is displayed.	Signal degrade and signal fail threshold alarms

Example

The following example shows how do display the alarm status information:

```
Switch# show facility-alarm status
Source: Chassis         Severity: CRITICAL Description: 0    Chassis fan tray missing
Source: Transponder SC  Severity: MAJOR    Description: 0    Access to Tsp card failed
Source: Transponder SC  Severity: MINOR    Description: 1    Access to IDPROM failed
Source: Transponder SC  Severity: MAJOR    Description: 2    Line laser failure detected
```

Verifying Redundancy of Dual Processor Cards

The Cisco ONS 15540 ESP runs in redundant mode only if certain conditions are met. Verify that the prerequisites in Table 4-10 have been met. Then perform the commands as described in the following table.

Table 4-10 Prerequisites for Installing a Redundant Processor Card

Requirement	Notes
Two processor cards are required. The processor cards have identical hardware configurations.	The processor cards must have identical configurations such as DRAM size. Perform a **show redundancy capability** command.
Both processor cards have the same functional image.	After power up, this can be verified with a **show hardware** command.
Both processor cards are running compatible system images.	System images are compatible across one major release.
Both the running and startup configurations are automatically synchronized between the processor cards.	Perform a **show redundancy** command. Verify that the running and startup configurations are listed as synchronized.
Both processor cards are set to autoboot (default setting).	Perform a **show version** command. Verify that the configuration register reads 0x2102.

These examples show the output of the **show redundancy capability**, **show redundancy**, and **show version** commands. The **show redundancy** command displays capabilities for the active and standby processor cards. Verify that all results in the Sby Compat columns indicate OK.

```
Switch# show redundancy capability
CPU capability support
Active CPU  Sby CPU    Sby Compat        CPU capability description
---------- ---------- ---------- ----------------------------------------
   96 MB      96 MB   OK          CPU DRAM size
   32 MB      32 MB   OK          CPU PMEM size
  512 KB     512 KB   OK          CPU NVRAM size
   16 MB      16 MB   OK          CPU Bootflash size
   3.5        3.5     OK          CPU hardware major.minor version
   1.20       1.18    OK          CPU functional major.minor version

Linecard driver major.minor versions, (counts: Active=18, Standby=18)

 Active CPU  Sby CPU   Sby Compat  Drv ID     Driver description
 ---------- ---------- ---------- ------ ---------------------------------
    1.1        1.1     OK          0x1000 CPU w/o Switch Fabric
    1.1        1.1     OK          0x1001 Fixed Transponder, w/monitor
    1.1        1.1     OK          0x1002 Fixed Transponder, no monitor
    1.1        1.1     OK          0x1003 Pluggable Transponder, w/monitor
    1.1        1.1     OK          0x1004 Pluggable Transponder, no monitor
    1.1        1.1     OK          0x1005 Line Card Motherboard
    1.1        1.1     OK          0x1006 Backplane
    1.1        1.1     OK          0x1007 32-ch Mux/Demux
    1.1        1.1     OK          0x1008 Fixed 4-ch Mux/Demux, no OSC
    1.1        1.1     OK          0x1009 Fixed 8-ch Mux/Demux, no OSC
    1.1        1.1     OK          0x100A Modular 4-ch Mux/Demux, no OSC
    1.1        1.1     OK          0x100B Modular 8-ch Mux/Demux, no OSC
    1.1        1.1     OK          0x100C 32-ch Array Wave Guide
    1.1        1.1     OK          0x100D Mux/Demux Motherboard
    1.1        1.1     OK          0x100E Modular 4-ch Mux/Demux plus OSC
```

```
    1.1        1.1     OK          0x100F Modular 8-ch Mux/Demux plus OSC
    1.1        1.1     OK          0x1010 Mux-Demux Motherboard, no OSC
    1.1        1.1     OK          0x1011 Line Card Motherboard, no splitter

Software sync client versions, listed as version range X-Y.
 X indicates the oldest peer version it can communicate with.
 Y indicates the current sync client version.
 Sync client counts: Active=2, Standby=2

 Active CPU  Sby CPU   Sby Compat  Cl ID  Redundancy Client description
 ---------- ---------- ----------- ----- -----------------------------------
 ver  1-1   ver  1-1   OK          17    CPU Redundancy
 ver  1-1   ver  1-1   OK          6     OIR Client

Backplane IDPROM comparison
 Backplane IDPROM field      Match Local CPU            Peer CPU
 -------------------------- ----- -------------------- --------------------
 idversion                  YES   1                    1
 magic                      YES   153                  153
 card_type                  YES   4102                 4102
 order_part_num_str         YES   N/A                  N/A
 description_str            YES   Manhattan_Backplane_PHASE_0
                                                       Manhattan_Backplane_PHASE_0
 board_part_num_str         YES   73-5655-03           73-5655-03
 board_revision_str         YES   02                   02
 serial_number_str          YES   TBC05031572          TBC05031572
 date_of_manufacture_str    YES   02/16/2001           02/16/2001
 deviation_numbers_str      YES   0                    0
 manufacturing_use          YES   0                    0
 rma_number_str             YES   0x00                 0x00
 rma_failure_code_str       YES   0x00                 0x00
 oem_str                    YES   Cisco_Systems        Cisco_Systems
 clei_str                   YES
 snmp_oid_substr            NO    0
 schematic_num_str          YES   92-4113-03           92-4113-03
 hardware_major_version     YES   3                    3
 hardware_minor_version     YES   0                    0
 engineering_use_str        YES   1                    1
 crc16                      OK    5913                 24184
 user_track_string          NO    lab
 diagst                     YES   ^A                    ^A
 board_specific_revision    YES   1                    1
 board_specific_magic_number YES  153                  153
 board_specific_length      YES   56                   56
 mac_address_block_size     YES   16                   16
 mac_address_base_str       YES   0000164428fb0        0000164428fb0
 cpu_number                 OK    1                    1
 optical_backplane_type     YES   255                  255
```

Perform a **show redundancy** command. Verify that the running and startup configurations are listed as synchronized, as shown in the highlighted portion of the output.

```
Redundant system information
-----------------------------
Available Uptime:              14 minutes
sysUpTime (switchover clears): 14 minutes
Switchover Count:              0

Inter-CPU Communication State: UP
Last Restart Reason:           Normal boot

Last Running Config sync:      0 minutes
Running Config sync status:    In Sync
Last Startup Config sync:      0 minutes
```

```
Startup Config sync status:    In Sync

This CPU is the Active CPU.
-------------------------------
Slot:                          7
Time since CPU Initialized:    14 minutes
Image Version:                 ONS-15540 Software (ONS15540-I-M), Version 12.1(10)EV2,
EARLY DEPLOYMENT RELEASE SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Image File:                    bootflash:ons15540-i-mz.121-10.EV2
Software Redundancy State:     ACTIVE
Hardware State:                ACTIVE
Hardware Severity:             0

Peer CPU is the Standby CPU.
-------------------------------
Slot:                          6
Time since CPU Initialized:    0 minutes
Image Version:                 ONS-15540 Software (ONS15540-I-M), Version 12.1(10)EV2,
EARLY DEPLOYMENT RELEASE SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Image File (on sby-CPU):       bootflash:ons15540-i-mz.121-10.EV2
Software Redundancy State:     STANDBY HOT
Hardware State:                STANDBY
Hardware Severity:             0
Privilege Mode:                Enabled
```

Perform a **show version** command. Verify that the configuration register reads 0x2102, as shown in the highlighted portion of the output.

```
Switch# show version
Cisco Internetwork Operating System Software
IOS (tm) ONS-15540 Software (ONS15540-I-M), Version 12.1(10)EV2, EARLY DEPLOYMENT RELEASE
SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Copyright (c) 1986-2002 by cisco Systems, Inc.
Compiled Mon 07-Oct-02 13:30 by eaarmas
Image text-base: 0x60010950, data-base: 0x60700000

ROM: System Bootstrap, Version 12.1(10r)EV1, RELEASE SOFTWARE (fc1)
BOOTLDR: ONS-15540 Software (ONS15540-I-M), Version 12.1(10)EV2, EARLY DEPLOYMENT RELEASE
SOFTWARE (fc1)

man4 uptime is 16 minutes
System returned to ROM by reload at 15:00:43 PDT Mon Oct 21 2002
System restarted at 15:01:32 PDT Mon Oct 21 2002
System image file is "bootflash:ons15540-i-mz.121-10.EV2"

cisco ONS15540 (RM7000) processor with 98304K/32768K bytes of memory.
R7000 CPU at 234Mhz, Implementation 39, Rev 2.1, 256KB L2, 2048KB L3 Cache

Last reset from s/w nmi
2 FastEthernet/IEEE 802.3 interface(s)
509K bytes of non-volatile configuration memory.

16384K bytes of Flash PCMCIA card at slot 0 (Sector size 128K).
16384K bytes of Flash internal SIMM (Sector size 256K).
Standby CPU is up
Standby CPU has 98304K/32768K bytes of memory.
Configuration register is 0x2102
```

Network Verification Procedures

After completing the tests on all nodes, the installer should perform the following network-level verification procedures.

Note Before performing the procedures in this section, the nodes must have been installed and configured. All cabling must be complete.

This chapter contains the following major sections:

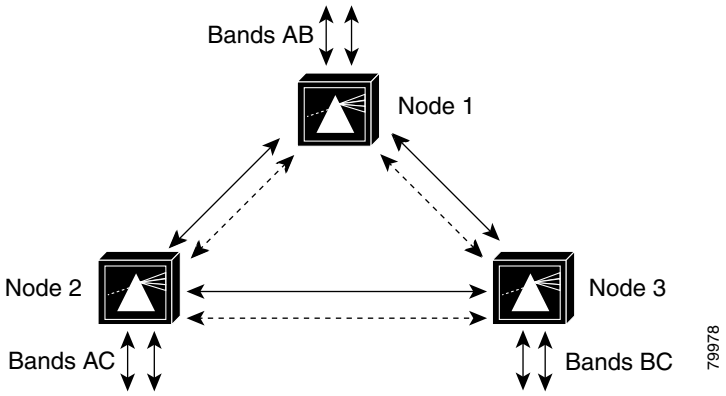
- Performing System Span Testing, page 5-1
- Checking Connectivity between OSCs, page 5-4
- Checking Power with an OSA, page 5-5
- Testing the Bit Error Rate, page 5-6

Performing System Span Testing

This section describes how to perform system span testing in a meshed ring configuration.

A meshed ring is a physical ring that has the logical characteristics of a mesh. While traffic travels on a physical ring, the logical connections between individual nodes are meshed. An example of this type of configuration, which is sometimes called a *logical mesh*, is shown in Figure 5-1.

Figure 5-1 Meshed Ring Topology Example



Verifying a Meshed Ring Configuration

This example procedure shows how to verify the path of each band in a meshed ring. You will test each band in both directions around the ring. Record test measurements in Table A-4 in Appendix A, "Node Data Checklist."

Note Prior to performing this procedure, the node must be installed and configured and all cabling must be completed. To optimize the power budget, mux/demux cabling should be done to minimize insertion loss.

Note You must modify this procedure according to the design of your own meshed ring by testing each node pair for each band in your ring.

Step 1 Make sure that necessary configuration for that particular chassis and interfaces are followed as described above. The specific data rate corresponding to the generator should be configured on the interfaces.

Step 2 Connect a signal generator to node 1 and loopback the transponder at the peer node for band A, node 2.

Step 3 Using an Optical Spectrum Analyzer, measure and record the wavelengths and their optical power on band A between node 1 and node 2. Take measurements at Trunk Out of slot 0 of node 1, and at the Trunk In of slot 1 of node 2.

Step 4 In systems with a splitter-protected configuration, perform a **shutdown** command on the active interface on node 1, and a **no shutdown** command on the inactive interface. For example:

```
Switch# configure terminal
Switch(config)# interface wavepatch 2/0/0
Switch(config-intf)# shutdown
Switch(config-intf)# interface wavepatch 2/0/1
Switch(config-intf)# no shutdown
```

On node 2, also perform a **shutdown** command on the active interface, and a **no shutdown** command on the inactive interface. For example:

```
Switch# configure terminal
Switch(config)# interface wavepatch 2/0/0
Switch(config-intf)# shutdown
Switch(config-intf)# interface wavepatch 2/0/1
Switch(config-intf)# no shutdown
```

Step 5 Using an OSA, measure and record the wavelengths and their optical power on band A between node 2 and peer node 1. Take measurements at the Trunk Out of slot 0 of node 2, and at the Trunk In of slot 1 of node 1.

Step 6 Connect a signal generator to node 2 and loopback the transponder at the peer node for band C, node 3.

Step 7 Using an OSA, measure and record the wavelengths and their optical power on band C between node 2 and node 3. Take measurements at the Trunk Out of slot 0 of node 2, and at Trunk In of slot 1 of node 3.

Step 8 In systems with a splitter-protected configuration, perform a **shutdown** command on the active interface on node 2, and a **no shutdown** command on the inactive interface. For example:

```
Switch# configure terminal
Switch(config)# interface wavepatch 2/0/0
Switch(config-intf)# shutdown
Switch(config-intf)# interface wavepatch 2/0/1
Switch(config-intf)# no shutdown
```

On node 3, also perform a **shutdown** command on the active interface, and a **no shutdown** command on the inactive interface. For example:

```
Switch# configure terminal
Switch(config)# interface wavepatch 2/0/0
Switch(config-intf)# shutdown
Switch(config-intf)# interface wavepatch 2/0/1
Switch(config-intf)# no shutdown
```

Step 9 Using an OSA, measure and record the wavelengths and their optical power on band C between node 3 and node 2. Take measurements at the Trunk Out of slot 0 of node 3, and at Trunk In of slot 1 of node 2.

Step 10 Connect a signal generator to node 3 and loopback the transponder at the peer node for band B, node 1.

Step 11 Using an OSA, measure and record the wavelengths and their optical power on band B between node3 and node 1. Take measurements at the Trunk Out of slot 0 of node 3, and at Trunk In of slot 1 of node 1.

Step 12 In systems with a splitter-protected configuration, perform a **shutdown** command on the active interface on node 3, and a **no shutdown** command on the inactive interface. For example:

```
Switch# configure terminal
Switch(config)# interface wavepatch 2/0/0
Switch(config-intf)# shutdown
Switch(config-intf)# interface wavepatch 2/0/1
Switch(config-intf)# no shutdown
```

On node 1, also perform a **shutdown** command on the active interface, and a **no shutdown** command on the inactive interface. For example:

```
Switch# configure terminal
Switch(config)# interface wavepatch 2/0/0
Switch(config-intf)# shutdown
Switch(config-intf)# interface wavepatch 2/0/1
Switch(config-intf)# no shutdown
```

Step 13 Using an OSA, measure and record the wavelengths and their optical power on band B between node 1 and node 3. Take measurements at Trunk Out of slot 0 of node 1, and at the Trunk In of slot 1 of node 3.

Step 14 Log into each node and issue the following CLI command to record wavelength and power as seen by Cisco IOS software.

Switch# **show interfaces wave** *slot/subslot*

Step 15 Repeat these tests for all channels on all bands between the nodes.

Step 16 Compare expected results (from network design), recorded/measured results and results as seen by Cisco IOS software.

If the results for a particular wavelength do not match, make sure fibers are fully inserted and transponder modules are inserted in the correct slots. Clean the fibers and connectors, and rerun the test.

If the results still do not match, there may be a hardware problem. On the Cisco ONS 15540 ESP, there may be a problem with the optical backplane. Remove the transponder module and install it in another slot, and rerun the test. Otherwise, there may be a problem with the transponder generating that wavelength.

Checking Connectivity between OSCs

Perform this procedure for each pair of neighbor nodes to check connectivity between OSCs.

Step 1 Use the **show oscp interface** command to display OSCP (Optical Supervisory Channel Protocol) status information for the OSC interfaces.

The following example shows how to display status information for the local and remote interfaces running OSCP.

```
Switch# show oscp interface wave 0
Codes: Bndl - bundling identifier, Pri - OSCP selection priority
       OSCP - dedicated wavelength channel, CDL - in-band wavelength channel

OSCP Interface(s)
 Local Port    Port ID Type Status  OSCP St Bndl Pri  Rem Port ID Rem Node Id
 ~~~~~~~~~~~~~ ~~~~~~~ ~~~~ ~~~~~~  ~~~~~~~ ~~~~ ~~~  ~~~~~~~~~~~ ~~~~~~~~~~~~~~~
  Wave0         1000000 OSCP  Active  2way      0   0  1000000     0000.1644.28fb
```

Step 2 Verify that Active is displayed under the Status field. This indicates that the local port status is active.

If the status is not Active, the interface is not enabled. Perform a **no shutdown** command.

```
Switch# configure terminal
Switch(config)# interface wave 0
Switch(config-intf)# no shutdown
```

Step 3 Verify that 2way is displayed under the OSCP St field. This indicates that Hello messages have been received from the neighbor indicating that the neighbor has received Hello packets from this node.

Checking CDP Connectivity

Use the **show cdp neighbors** command to check whether the node can see other nodes in the topology.

Ping the node IP address.

```
Switch# show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater

Device ID        Local Intrfce     Holdtme    Capability  Platform  Port ID
man4             Wave1              127         R S       ONS15540  Wave1
man4             Wave0              127         R S       ONS15540  Wave0
```

Checking Power with an OSA

Perform this test to compare the measured power levels to the expected power levels given by a network design tool or by the result of a manual design power calculation. The measured power should be within an acceptable range from the expected power.

Use the wavelength spectrum application of an OSA to perform the following tests. Take measurements at several points in the ring.

Step 1 Check the channel count and power from the wavelength screen.

Step 2 Check the equalization of power. The wavelength screen displays the power peaks and the table format screen displays the measurements.

Step 3 Check the Optical Signal to Noise Ratio (OSNR) of each wavelength on each line fiber. The OSNR figures are listed in the table format screen.

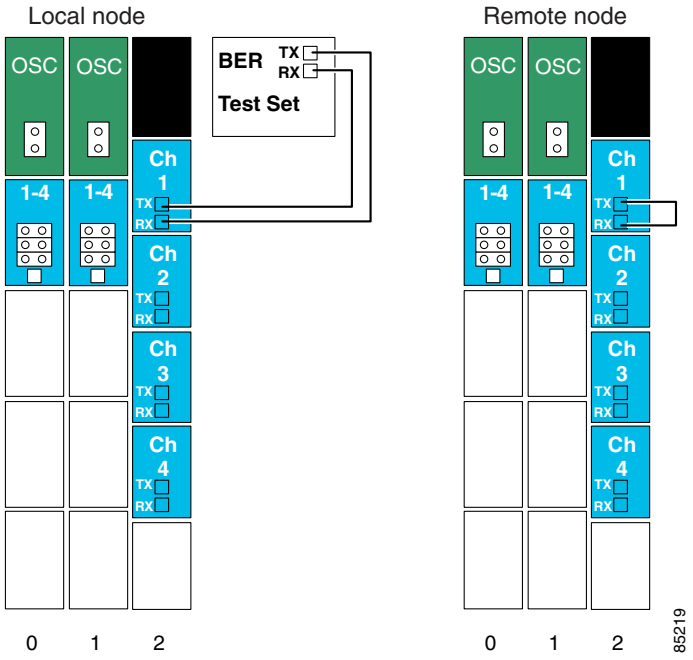
Testing the Bit Error Rate

Perform the following procedure to test bit error rate errors for each wavelength:

Step 1 Connect the BER test set transmit port to the receive port of the first interface to be tested.

Step 2 At the peer node, loopback the transponder interface supporting the same channel (Figure 5-2) with appropriate attenuation (typically 5 dB).

Figure 5-2 Testing Bit Error Rate



Step 3 Clear all errors on the Bit Error Rate (BER) test set.

Step 4 Start the traffic with the BER test set.

Step 5 Perform a show interface command for the transponder interface.

Step 6 Verify that the BER test runs error free for 15 minutes.

Step 7 If the system uses splitter protection, perform a **shutdown** command on the active interface and a **no shutdown** command on the inactive interface and perform the test measurement.

Step 8 Clear all errors on the BER test set.

Step 9 Perform a **show interface** command for the transponder interface.

Step 10 Verify that the BER test runs error free for 15 minutes.

Step 11 Repeat this test for all channels on every node.

Node Data Checklist

The tables in this appendix are used to keep track of data for each node. Make copies of these tables to record information for additional nodes.

Use Table A-1 to keep track of essential node data, such as IP address, hostname, and IDs.

Table A-1 Node Data Checklist

Node data	Value
Node IP address	
Node IP subnet mask	
Node hostname	
Node ID	

Use Table A-2 to keep track of customer site information, such as customer name, the site name, the location of the equipment, and the system configuration (network topology, number of CPUs).

Table A-2 Customer Information

Customer data	Value
Customer name	
Site name	
Location	
System Configuration	

Use Table A-3 to record contact information for the engineers responsible for installation and verification of the node.

Table A-3 Team Information

Team data	Value
Lead Engineer	
Test Engineer	
Test Engineer	
Date	

Use Table A-4 to record the expected power from the network design, and the power measured by the OSA during system span testing.

Refer to the "Verifying a Meshed Ring Configuration" section on page 5-2.

Table A-4 Expected and Measured Power for Channels in the Network

Channel	Expected Power	OSA Measured Power

Test Results Tables

This appendix contains tables and checklists to use during the turn-up and test of a Cisco ONS 15540.

Table B-1 Test Results for Cisco ONS 15540 ESP

Test or Procedure	Expected Result (After Power-up)	Notes
Performing Fiber Plant Characterization on page 1-7	Tested fiber meets the specifications listed in that section.	
Installing Line Card Motherboards and Transponder Modules on page 2-7	The “Status” LED is green.	
Installing SM Transponder Modules or MM Transponder Modules on page 2-8	All LEDs on the module are off (default).	
Installing Extended Range Transponder Modules on page 2-9	All LEDs on the module are off (default).	
Cabling Mux/Demux Modules on page 2-10	Use a power meter to confirm that the top OSC port on the motherboard is Tx and the bottom is Rx. Conduct the check for slot 0 as well as slot 1.	
Verifying the Power Up on page 2-13	The Status LED is green. The Active LED on the primary processor and the Standby LED on the standby processor are both green. The alarm LEDs are off.	
Verifying Installation of Hardware on page 2-13	All modules in the chassis are reported in the proper slot by Cisco IOS software. The modules have the correct hardware version and software version.	
Configuring Patch Connections on page 3-8	Confirm that the interfaces are administratively up.	
Verifying Transmit Launch Power and Insertion Losses on page 4-2	Tx optical power and wavelengths are in line with figures in the power specification tables.	
Verifying Power Levels on the Client Interfaces on page 4-4	Measured power matches the specifications provided.	

Table B-1 Test Results for Cisco ONS 15540 ESP (continued)

Test or Procedure	Expected Result (After Power-up)	Notes
Verifying Laser Frequency on page 4-11	The laser frequency (channel number) is configured to the proper wavelength.	
Testing the Bit Error Rate on page 4-13	The test runs error free for 15 minutes.	
Checking Alarms on page 4-14	Alarms are generated for the listed fault conditions.	
Verifying a Meshed Ring Configuration on page 5-2	Expected results (from network design), measured results, and results as seen by Cisco IOS software match.	
Checking Connectivity between OSCs on page 5-4	Active is displayed under the Status field. 2way is displayed under the OSCP St. field.	
Checking Power with an OSA on page 5-5	Channel count, power, power equalization, and OSNR meet the network design requirements.	
Testing the Bit Error Rate on page 5-6	The test runs error free for 15 minutes.	

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