Cisco ONS 15454 Reference Manual

Product and Documentation Release 3.3
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Cisco ONS 15454 Reference Manual, Release 3.3

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About this Manual

This manual provides reference information for the Cisco ONS 15454.

To install, turn up, provision, and maintain a Cisco ONS 15454 node and network, refer to the*Cisco ONS 15454 Procedure Guide, Release 3.3*.

For alarm clearning, general troubleshooting,and hardware replacement procedures, refer to the *Cisco ONS 15454 Troubleshooting Guide, Release 3.3*.

Document Organization

Table 1 Cisco ONS 15454 Reference Manual Chapters

Title	Summary
Chapter 1, "Shelf and Backplane Hardware"	Includes descriptions of the rack, backplane, backplane pins, ferrites, power and ground, fan-tray assembly, air filter, and card slots
Chapter 2, "Common Control Cards"	Includes descriptions of the TCC+, XC, XCVT, and XC10G
Chapter 3, "Electrical Cards and Cable"	Includes descriptions of EC-1, DS-1, DS-3, and DS3E cards, card temperature ranges and compatibility, electrical cable, cable connectors, and cable routing
Chapter 4, "Optical Cards"	Includes descriptions of the OC-3, OC-12, OC-48, and OC-192 cards, as well as card temperature rangs and card compatibility
Chapter 5, "Ethernet Cards"	Includes descriptions of the G1000-4, E100T-12, E100T-G, E1000-2, and E1000-2-G cards and gigabit interface converters
Chapter 6, "Card Protection"	Includes electrical and optical card protection methods
Chapter 7, "Cisco Transport Controller Operation"	Includes information about CTC installation, the CTC window, computer requirements, software versions, and database reset and revert
Chapter 8, "Security and Timing"	Includes user set up and security, and node/network timing

Table 1 Cisco ONS 15454 Reference Manual Chapters (continued)

Title	Summary
Chapter 9, "SONET Topologies"	Includes the SONET configurations used by the ONS 15454; including BLSRs, UPSRs, linear ADMs, subtending rings, and optical bus configurations, as well as information about upgrading optical speeds within any configuration
Chapter 10, "IP Networking"	Includes IP addressing scenarios and information about IP networking with the ONS 15454
Chapter 11, "Circuits and Tunnels"	Includes STS and VT, bidirectional or unidirectional, revertive or non-revertive, electrical or optical, multiple and path trace circuit information, as well as DCC tunnels
Chapter 12, "Ethernet Operation"	Includes Ethernet applications for the G series and E series Ethernet cards
Chapter 13, "Performance Monitoring"	Includes performance monitoring statistics for all cards

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Inquiries to Cisco TAC are categorized according to the urgency of the issue:

- Priority level 4 (P4)—You need information or assistance concerning Cisco product capabilities, product installation, or basic product configuration.
- Priority level 3 (P3)—Your network performance is degraded. Network functionality is noticeably impaired, but most business operations continue.
- Priority level 2 (P2)—Your production network is severely degraded, affecting significant aspects of business operations. No workaround is available.
- Priority level 1 (P1)—Your production network is down, and a critical impact to business operations will occur if service is not restored quickly. No workaround is available.

Which Cisco TAC resource you choose is based on the priority of the problem and the conditions of service contracts, when applicable.

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The Cisco TAC Web Site allows you to resolve P3 and P4 issues yourself, saving both cost and time. The site provides around-the-clock access to online tools, knowledge bases, and software. To access the Cisco TAC Web Site, go to the following URL:

http://www.cisco.com/tac

All customers, partners, and resellers who have a valid Cisco services contract have complete access to the technical support resources on the Cisco TAC Web Site. The Cisco TAC Web Site requires a Cisco.com login ID and password. If you have a valid service contract but do not have a login ID or password, go to the following URL to register:

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If you have Internet access, it is recommended that you open P3 and P4 cases through the Cisco TAC Web Site.

Cisco TAC Escalation Center

The Cisco TAC Escalation Center addresses issues that are classified as priority level 1 or priority level 2; these classifications are assigned when severe network degradation significantly impacts business operations. When you contact the TAC Escalation Center with a P1 or P2 problem, a Cisco TAC engineer will automatically open a case.

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Before calling, please check with your network operations center to determine the level of Cisco support services to which your company is entitled; for example, SMARTnet, SMARTnet Onsite, or Network Supported Accounts (NSA). In addition, please have available your service agreement number and your product serial number.

Shelf and Backplane Hardware

This chapter provides a description of Cisco ONS 15454 shelf and backplane hardware. Card and cable descriptions are provided in Chapter 2, "Common Control Cards," Chapter 3, "Electrical Cards and Cable," Chapter 4, "Optical Cards," and Chapter 5, "Ethernet Cards."

For instructions on installing equipment, refer to the *Cisco ONS 15454 Procedure Guide*.

Chapter topics include:

Note The Cisco ONS 15454 assembly is intended for use with telecommunications equipment only.

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

Warning **This equipment must be installed and maintained by service personnel as defined by AS/NZS 3260. Incorrectly connecting this equipment to a general purpose outlet could be hazardous. The telecommunications lines must be disconnected 1) before unplugging the main power connector and/or 2) while the front door is open.**

Warning **The ONS 15454 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, key, or other means of security. A restricted access area is controlled by the authority responsible for the location.**

Warning **The ONS 15454 is suitable for mounting on concrete or other non-combustible surfaces only.**

Caution Unused card slots should be filled with a blank faceplate (Cisco P/N 15454-BLANK). The blank faceplate ensures proper airflow when operating the ONS 15454 without the front door attached, although Cisco recommends that the front door remain attached.

Note The ONS 15454 is designed to comply with GR-1089-CORE Type 2 and Type 4. Install and operate the ONS 15454 only in environments that do not expose wiring or cabling to the outside plant. Acceptable applications include Central Office Environments (COEs), Electronic Equipment Enclosures (EEEs), Controlled Environment Vaults (CEVs), huts, and Customer Premise Environments (CPEs).

1.1 Installation Overview

When installed in an equipment rack, the ONS 15454 assembly is typically connected to a fuse and alarm panel to provide centralized alarm connection points and distributed power for the ONS 15454. Fuse and alarm panels are third-party equipment and are not described in this documentation. If you are unsure about the requirements or specifications for a fuse and alarm panel, consult the user documentation for the related equipment. The front door of the ONS 15454 allows access to the shelf assembly, fan-tray assembly, and cable-management area. The backplanes provide access to alarm contacts, external interface contacts, power terminals, and BNC/SMB connectors.

Warning **The ONS 15454 relies on the protective devices in the building installation to protect against short circuit, overcurrent, and grounding faults. Ensure that the protective devices are properly rated to protect the system, and that they comply with national and local codes.**

Warning **Incorporate a readily-accessible, two-poled disconnect device in the fixed wiring.**

You can mount the ONS 15454 in a 19- or 23-inch rack. The shelf assembly weighs approximately 55 pounds with no cards installed. The shelf assembly includes a front door for added security, a fan tray module for cooling, and extensive cable-management space.

ONS 15454 optical cards have SC connectors on the card faceplate. Fiber optic cables are routed into the front of the destination cards. Electrical cards (DS-1, DS-3, DS3XM-6, and EC-1) require electrical interface assemblies (EIAs) to provide the cable connection points for the shelf assembly. In most cases, EIAs are ordered with the ONS 15454 and come pre-installed on the backplane. See the "Backplane Covers" section on page 1-9 for more information about the EIAs.

The ONS 15454 is powered using -48V DC power. Negative, return, and ground power terminals are accessible on the backplane.

Note In this chapter, the terms "ONS 15454" and "shelf assembly" are used interchangeably. In the installation context, these terms have the same meaning. Otherwise, shelf assembly refers to the physical steel enclosure that holds cards and connects power, and ONS 15454 refers to the entire system, both hardware and software.

Install the ONS 15454 in compliance with your local and national electrical codes:

- United States: National Fire Protection Association (NFPA) 70; United States National Electrical Code
- Canada: Canadian Electrical Code, Part I, CSA C22.1
- Other countries: If local and national electrical codes, are not available, refer to IEC 364, Part 1 through Part 7.

Warning **Dispose of this product according to all national laws and regulations.**

1.2 Rack Installation

Warning **To prevent the equipment from overheating, do not operate it in an area that exceeds the maximum recommended ambient temperature of 131°F (55°C) unless configured for inversion temperature (I-temp). All I-temp rated components are -40°C to +65°C. To prevent airflow restriction, allow at least 3 inches (7.6 cm) of clearance around the ventilation openings.**

The ONS 15454 is mounted in a 19- or 23-inch equipment rack. The shelf assembly projects five inches from the front of the rack. It mounts in both EIA-standard and Telcordia-standard racks. The shelf assembly is a total of 17 inches wide with no mounting ears attached. Ring runs are not provided by Cisco and may hinder side-by-side installation of shelves where space is limited.

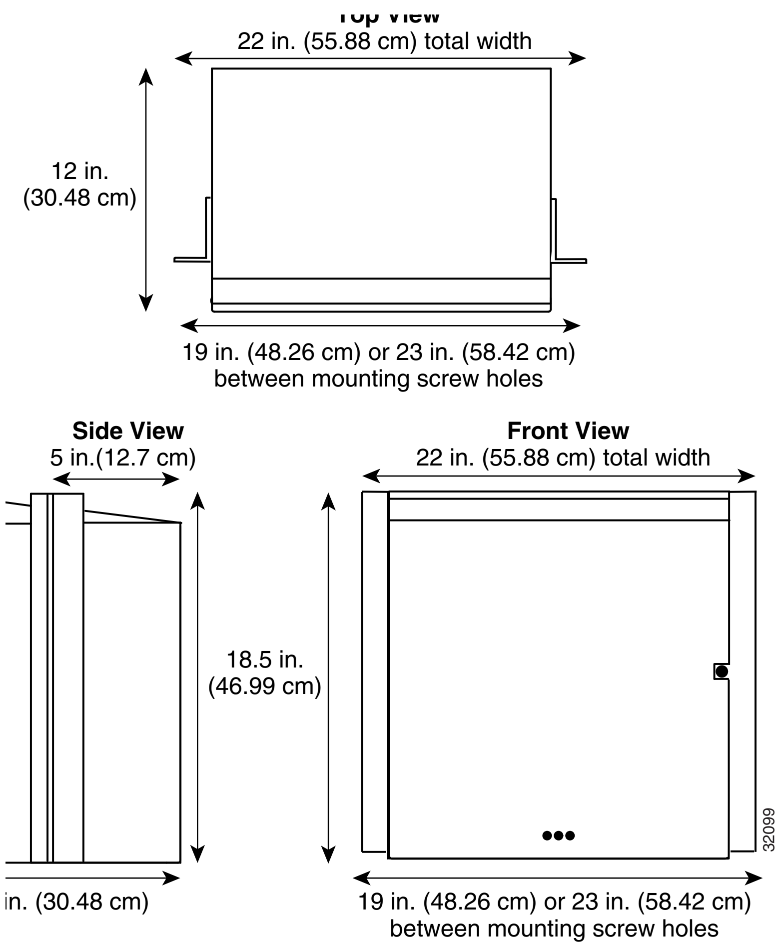
The ONS 15454 measures 18.5 inches high, 19 or 23 inches wide (depending on which way the mounting ears are attached), and 12 inches deep (47 by 48.3 by 30.5 cm). You can install up to four ONS 15454s in a seven-foot equipment rack. The ONS 15454 must have 1 inch of airspace below the installed shelf assembly to allow air flow to the fan intake. If a second ONS 15454 is installed underneath the shelf assembly, the air ramp on top of the lower shelf assembly provides the air spacing needed and should not be modified in any way. Figure 1-1 shows the dimensions of the ONS 15454.

Note The 10 Gbps compatible shelf assembly (15454-SA-ANSI) and fan-tray assembly (15454-FTA3 or 15454-FTA3-T) are required with the ONS 15454 XC-10G, OC-192, G1000-4, and OC-48 any slot (AS) cards.

Warning **The ONS 15454 should be installed in the lower rack position or mounted above another ONS 15454 shelf assembly.**

Warning **The ONS 15454 must have 1 inch of airspace below the installed shelf assembly to allow air flow to the fan intake. The air ramp (the angled piece of sheet metal on top of the shelf assembly) provides this spacing and should not be modified in any way.**

Figure 1-1 Cisco ONS 15454 dimensions



1.2.1 Reversible Mounting Bracket

Caution Use only the fastening hardware provided with the ONS 15454 to prevent loosening, deterioration, and electromechanical corrosion of the hardware and joined material.

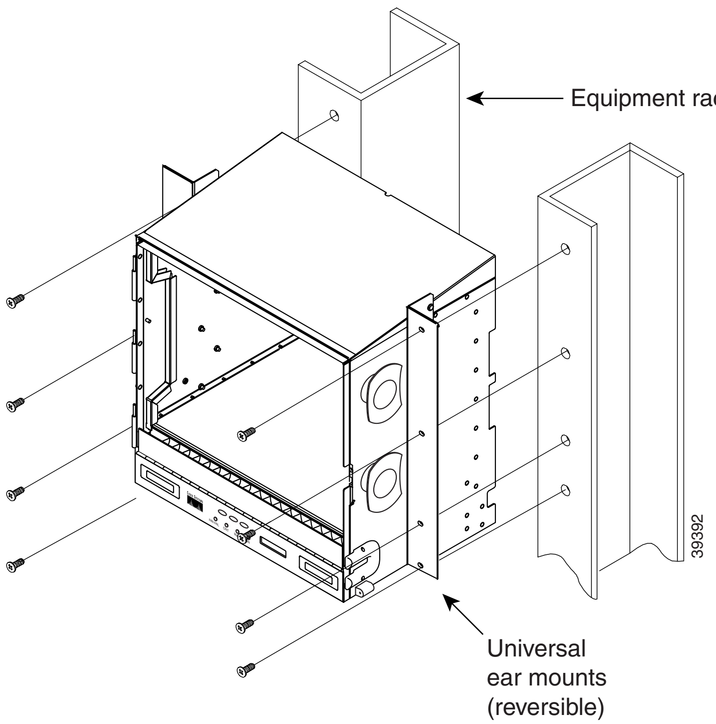
Caution When mounting the ONS 15454 in a frame with a non-conductive coating (such as paint, lacquer, or enamel) either use the thread-forming screws provided with the ONS 15454 shipping kit, or remove the coating from the threads to ensure electrical continuity.

The shelf assembly comes preset for installation in a 23-inch rack, but you can reverse the mounting bracket to fit the smaller, 19-inch rack.

1.2.2 Mounting a Single Node

Mounting the ONS 15454 in a rack requires a minimum of 18.5 inches of vertical rack space and one additional inch for air flow. To ensure the mounting is secure, use two to four #12-24 mounting screws for each side of the shelf assembly. Figure 1-2 shows the rack mounting position for the ONS 15454.

Figure 1-2 Mounting an ONS 15454 in a rack



Two people should install the shelf assembly; however, one person can install it using the temporary set screws included. The shelf assembly should be empty for easier lifting. The front door can also be removed to lighten the shelf assembly.

Note If you are installing the fan-tray air filter using the bottom (external) brackets provided, mount the brackets on the bottom of the shelf assembly before installing the ONS 15454 in a rack.

1.2.3 Mounting Multiple Nodes

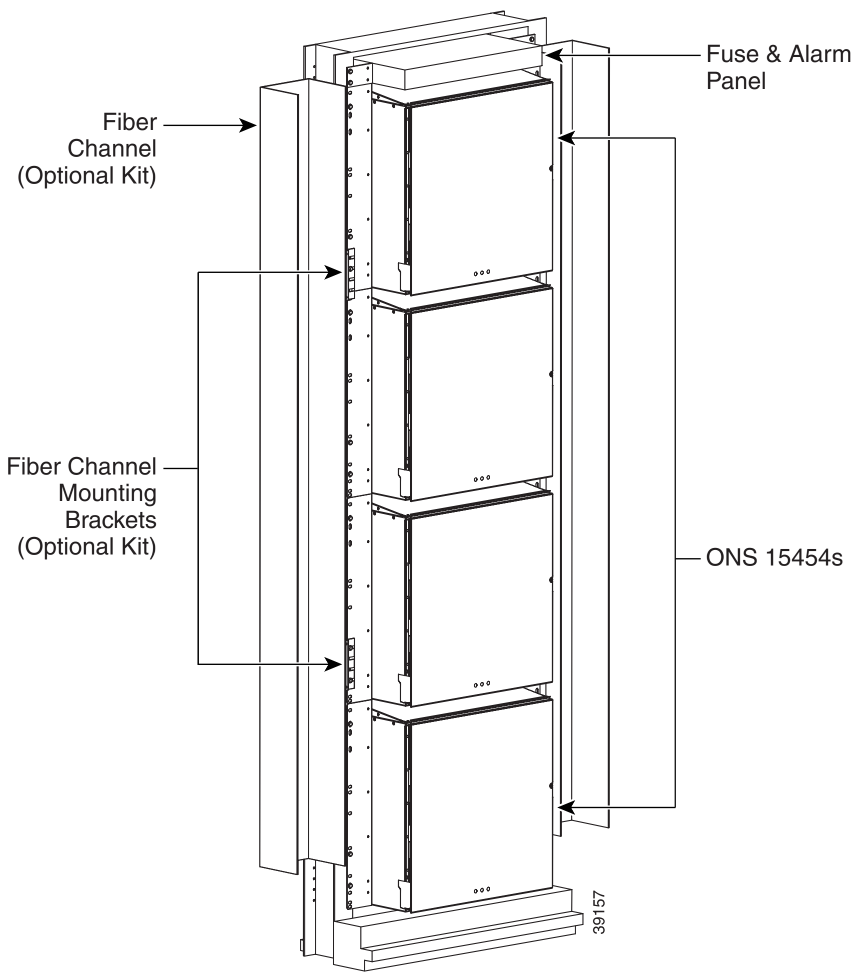
Most standard seven-foot racks can hold four ONS 15454s and a fuse and alarm panel. However, unequal flange racks are limited to three ONS 15454s and a fuse and alarm panel or four ONS 15454s and a fuse and alarm panel from an adjacent rack.

If you are using the external (bottom) brackets to install the fan-tray air filter, you can install three shelf assemblies in a standard seven-foot rack. If you are not using the external (bottom) brackets, you can install four shelf assemblies in a rack. The advantage to using the bottom brackets is that you can replace the filter without removing the fan tray.

1.2.3.1 ONS 15454 Bay Assembly

The Cisco ONS 15454 Bay Assembly simplifies ordering and installing the ONS 15454 because it allows you to order shelf assemblies pre-installed in a seven-foot rack. The Bay Assembly is available in a three- or four-shelf configuration. The three-shelf configuration includes three ONS 15454 shelf assemblies, a pre-wired fuse and alarm panel, and two cable-management trays. Optional fiber channels can be ordered. The four-shelf configuration includes four ONS 15454 shelf assemblies and a pre-wired fuse and alarm panel. Optional fiber channels can be ordered. A four shelf ONS 15454 Bay Assembly is shown in Figure 1-3.

Figure 1-3 A four-shelf ONS 15454 Bay Assembly

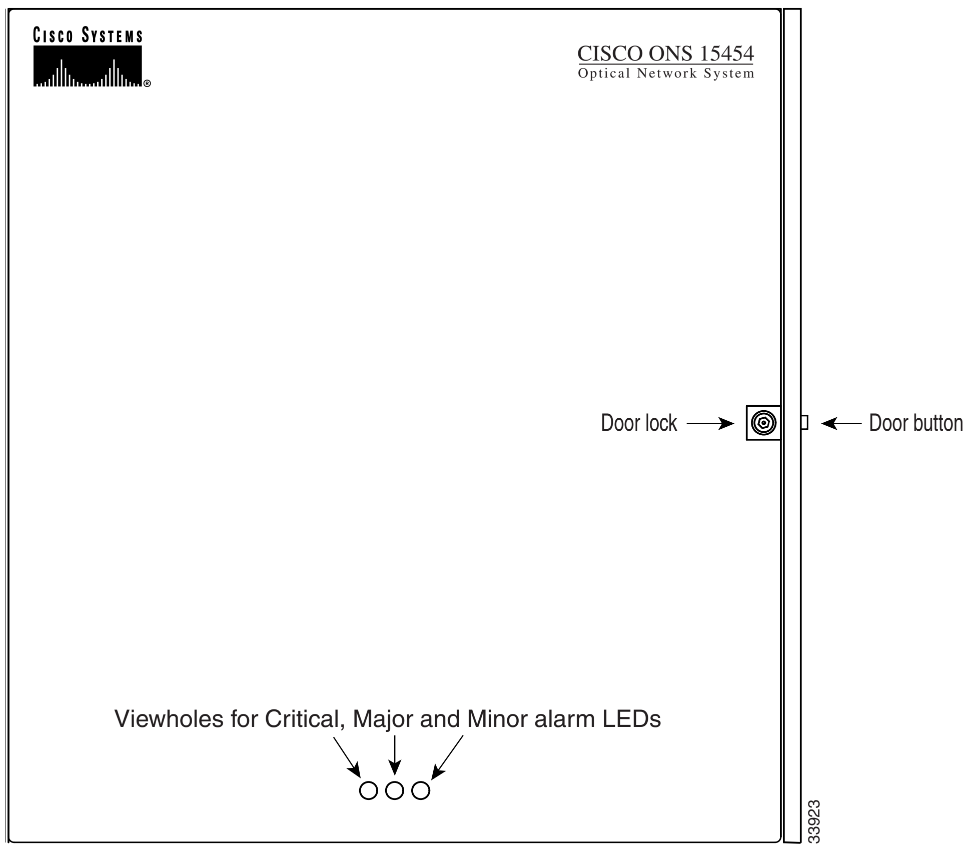


1.3 Front Door

The Critical, Major, and Minor alarm LEDs visible through the front door indicate whether a Critical, Major, or Minor alarm is present anywhere on the ONS 15454. These LEDs must be visible so technicians can quickly determine if any alarms are present. You can use the LCD to further isolate alarms.

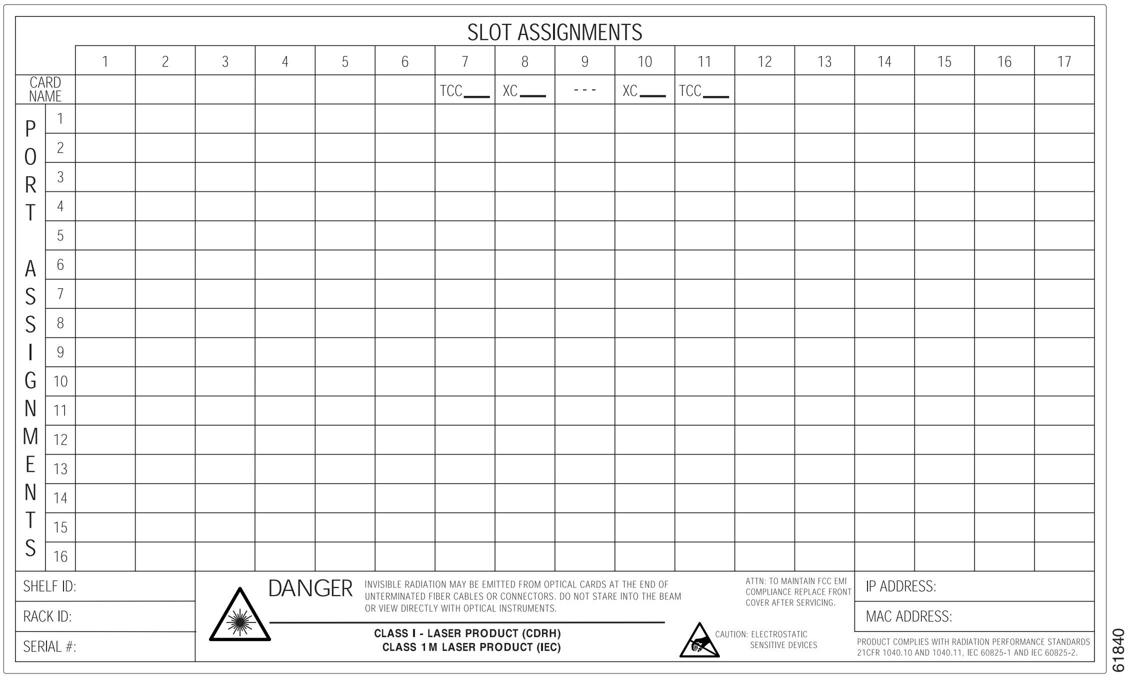
The ONS 15454 features a locked door to the front compartment. A pinned hex key that unlocks the front door ships with the ONS 15454. A button on the right side of the shelf assembly releases the door. The front door (Figure 1-4) provides access to the shelf assembly, cable-management tray, fan-tray assembly, and LCD screen.

Figure 1-4 The ONS 15454 front door



You can remove the front door of the ONS 15454 to provide unrestricted access to the front of the shelf assembly. An erasable label (Figure 1-5) is pasted on the inside of the front door. You can use the label to record slot assignments, port assignments, card types, node ID, rack ID, and serial number for the ONS 15454.

Figure 1-5 The front-door erasable label



Note The front door label also includes the Class I and Class 1M laser warning shown in the laser warning on the front-door label (Figure 1-6).

Figure 1-6 The laser warning on the front-door label

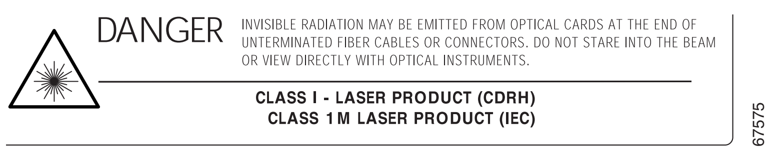
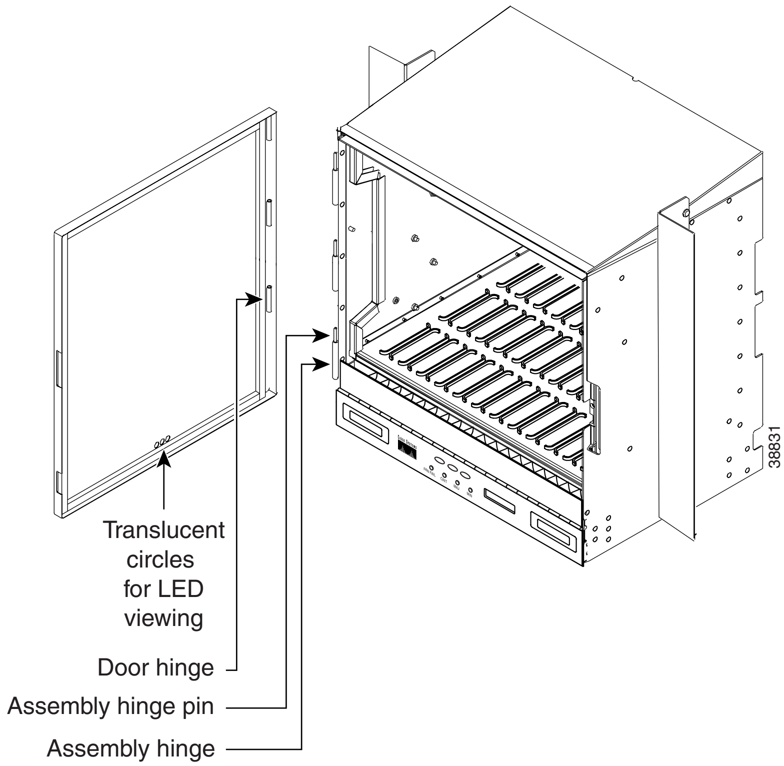


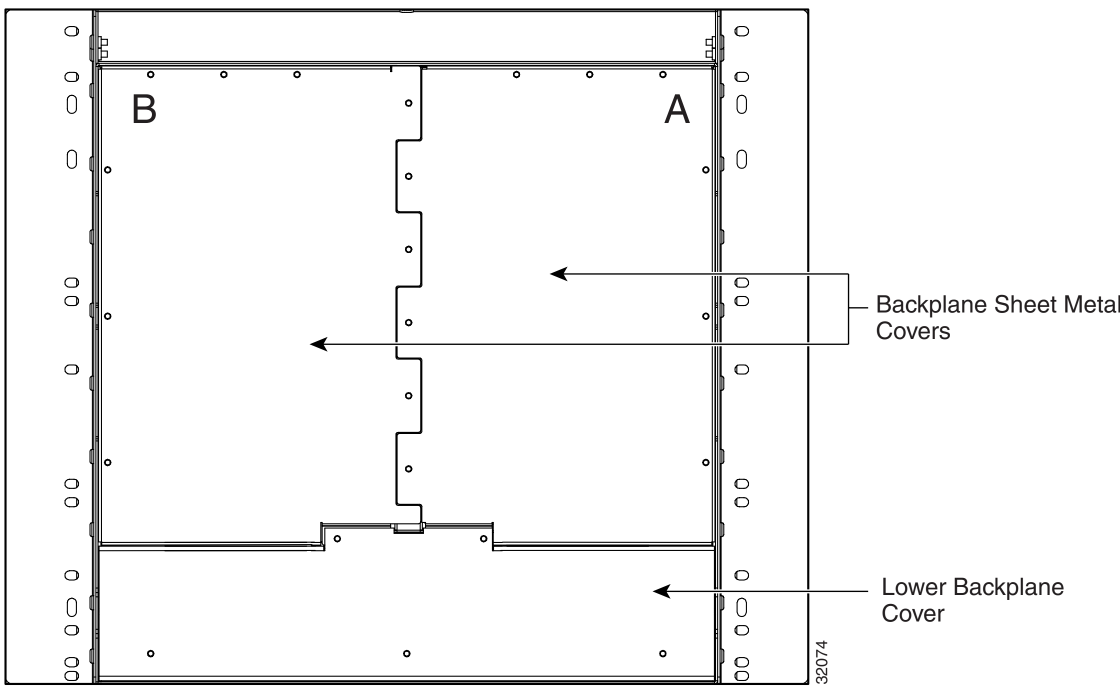
Figure 1-7 Removing the ONS 15454 front door



1.4 Backplane Covers

If a backplane does not have an EIA panel installed, it should have two sheet metal backplane covers (one on each side of the backplane). Each cover is held in place with nine 6-32 x 3/8 inch Phillips screws.

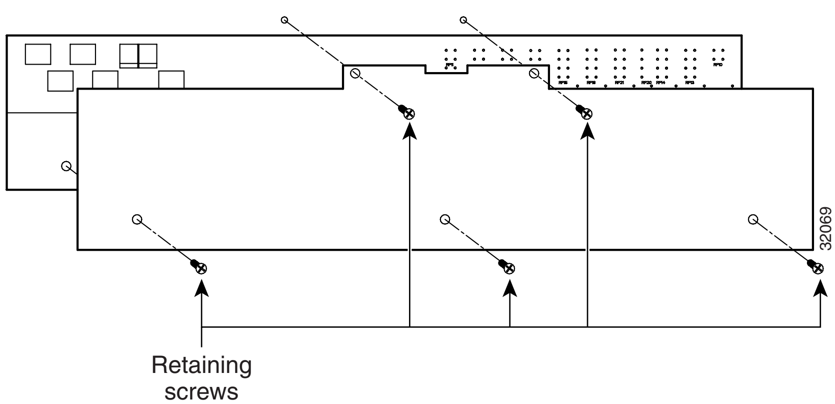
Figure 1-8 Backplane covers



1.4.1 Lower Backplane Cover

The lower section of the ONS 15454 backplane is covered by a clear plastic protector, which is held in place by five 6-32 x 1/2 inch screws. Remove the lower backplane cover to access the alarm interface panel (AIP), alarm pin field, frame ground, and power terminals.

Figure 1-9 Removing the lower backplane cover



1.4.2 Rear Cover

The ONS 15454 has an optional clear plastic rear cover. This clear plastic cover provides additional protection for the cables and connectors on the backplane (Figure 1-10). The rear cover screw locations are shown in Figure 1-11. You can also install the optional spacers if more space is needed between the cables and rear cover (Figure 1-12).

Figure 1-10 Clear rear cover

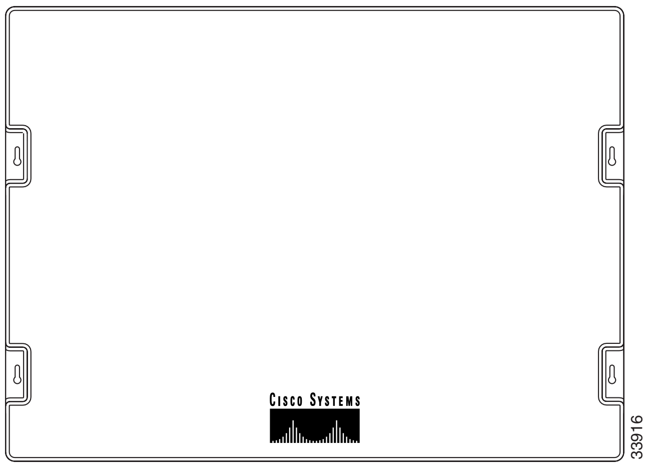


Figure 1-11 Backplane attachment for cover

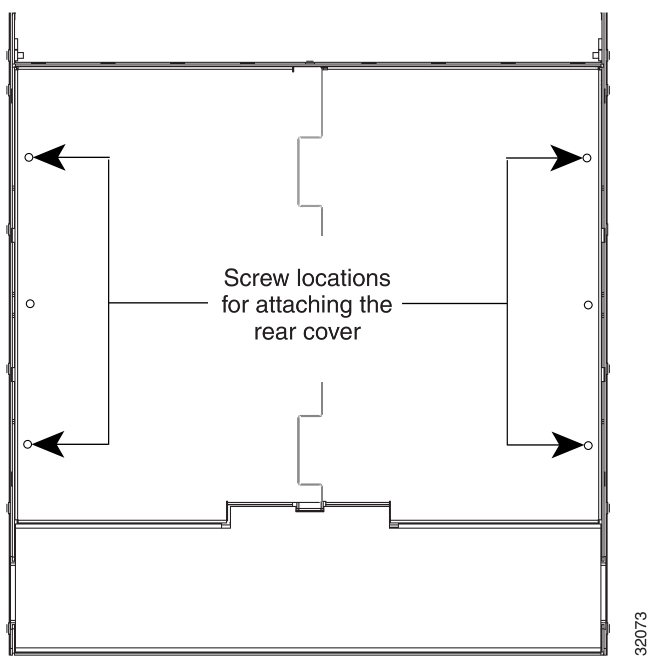
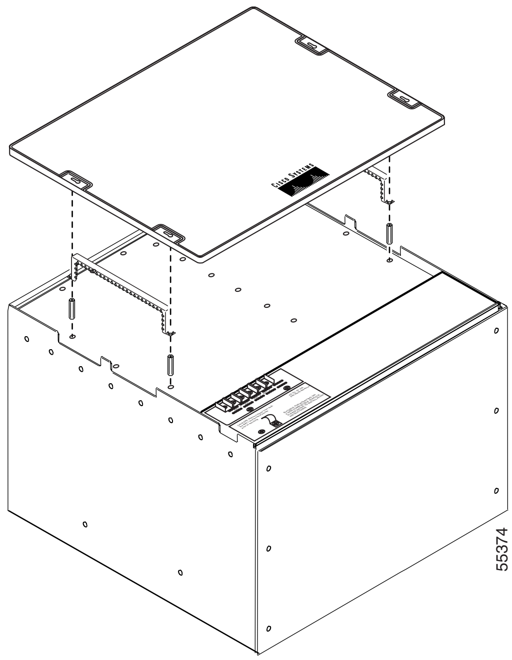


Figure 1-12 Installing the plastic rear cover with spacers



1.4.3 Alarm Interface Panel

The AIP is located above the alarm pin field on the lower section of the backplane. The AIP provides surge protection for the ONS 15454. It also provides an interface from the backplane to the fan-tray assembly and LCD. The AIP plugs into the backplane using a 96-pin DIN connector and is held in place with two retaining screws. The panel has a non-volatile memory chip that stores the unique node address (MAC address).

Note The 5-amp AIP (73-7665-XX) is required when installing the new fan-tray assembly (15454-FTA3), which comes preinstalled on the shelf assembly (15454-SA-ANSI).

Note The MAC address identifies the nodes that support circuits. It allows CTC to determine circuit sources, destinations, and spans. The Timing Communication and Control+ (TCC+) cards in the ONS 15454 also read the MAC address to store the node database.

Note A blown fuse on the AIP board can cause the LCD display to go blank.

1.4.4 Alarm Interface Panel Replacement

If the alarm interface panel (AIP) fails, a MAC Fail alarm displays on the CTC Alarms menu and/or the LCD display on the fan tray will go blank. To perform an in-service replacement of the AIP, you must contact Cisco Technical Assistance Center (TAC) at 877-323-7368.

You can replace the AIP on an in-service system without affecting traffic. The circuit repair feature allows you to repair circuits affected by MAC address changes on a single node at a time. Circuit repair will work when all nodes are running the same software version. Each individual AIP upgrade requires an individual circuit repair; if AIPs are replaced on two nodes, the circuit repair must be performed twice.

Caution Do not use a 2A AIP with a 5A fan-tray assembly; doing so will cause a blown fuse on the AIP.

Note Ensure that all nodes in the affected network are running the same software version before replacing the AIP and repairing circuits. If you need to upgrade nodes to the same software version, no hardware should be changed or circuit repair performed until after the software upgrade is complete.

Note Replace an AIP in a maintenance window. Resetting the active TCC+ can cause a service disruption of less then 50 ms to OC-n or DS-n traffic. Resetting the active TCC+ will cause a service disruption of 3–5 minutes on all Ethernet traffic due to Spanning Tree Reconvergence.

1.5 Fan-Tray Assembly

The fan-tray assembly is located at the bottom of the ONS 15454 front compartment. The fan tray is a removable drawer that holds fans and fan-control circuitry for the ONS 15454. The front door can be left in place or removed before installing the fan-tray assembly. After you install the fan tray, you should only need to access it if a fan failure occurs or you need to replace or clean the fan-tray air filter.

The front of the fan-tray assembly has an LCD screen that provides slot and port-level information for all ONS 15454 card slots, including the number of Critical, Major, and Minor alarms.

The fan-tray assembly features an air filter at the bottom of the tray that you can install and remove by hand. Remove and visually inspect this filter every 30 days and keep spare filters in stock. Refer to the *Cisco ONS 15454 Troubleshooting Guide* for information about cleaning and maintaining the fan-tray air filter.

Note The 15454-SA-ANSI shelf assembly and 15454-FTA3 fan-tray assembly are required with the ONS 15454 XC10G, OC-192, and OC-48 any slot (AS) cards.

Caution Do not operate an ONS 15454 without a fan-tray filter. A fan-tray filter is mandatory.

Caution The 15454-FTA3 fan-tray assembly can only be installed in ONS 15454 Release 3.1 and later shelf assemblies (15454-SA-ANSI, P/N: 800-19857). It includes a pin that does not allow it to be installed in ONS 15454 shelf assemblies released before ONS 15454 Release 3.1 (15454-SA-NEBS3E, 15454-SA-NEBS3, and 15454-SA-R1, P/N: 800-07149). Equipment damage can result from attempting to install the 15454-FTA3 in a non-compatible shelf assembly.

Note The 15454-FTA3 is not I-temp. To obtain an I-temp fan tray, install the 15454-FTA-T fan-tray assembly in an ONS 15454 Release 3.1 shelf assembly (15454-SA-ANSI). However, do not install the ONS 15454 Release 3.1 or later XC10G, OC-192, and OC-48 any slot (AS) cards in the shelf assembly with the 15454-FTA2 fan-tray assembly.

1.5.1 Fan Speed

If one or more fans fail on the fan-tray assembly, replace the entire assembly. You cannot replace individual fans. The red Fan Fail LED on the front of the fan tray illuminates when one or more fans fail. For fan tray replacement instructions, refer to the *Cisco ONS 15454 Troubleshooting Guide*. The red Fan Fail LED clears after you install a working fan tray.

Fan speed is controlled by TCC+ card temperature sensors. The sensors measure the input air temperature at the fan-tray assembly. Fan speed options are low, medium, and high. If the TCC+ card fails, the fans automatically shift to high speed. The temperature measured by the TCC+ sensors is displayed on the LCD screen.

Note Asterisks (*) next to fan tray names mean the power specification shown below is based on a calculation because an actual measurement was not available at the time of publication.

Figure 1-13 Fan Tray Assembly Power Requirements

Fan Tray Assembly	Watts	Amps	BTU/Hr.
FTA2 *	58	1.21	198
FTA3 *	95	1.98	324

1.6 Air Filter

The ONS 15454 contains an air filter; NEBS 3E and later versions of the ONS 15454 use a reusable air filter that is installed either beneath the fan-tray assembly or in the optional external filter brackets. Earlier versions of the ONS 15454 use a disposable air filter that is installed beneath the fan-tray assembly only.

Warning **Do not reach into a vacant slot or chassis while you install or remove a module or a fan. Exposed circuitry could constitute an energy hazard.**

1.6.1 Reusable Air Filter

The reusable filter is made of a gray, open-cell, polyurethane foam that is specially coated to provide fire and fungi resistance. NEBS 3E and later versions of the ONS 15454 use a reusable air filter. Spare filters should be kept in stock.

1.6.2 Disposable Air Filter

The disposable filter is made of spun white polyester that is flame retardant. NEBS 3E and earlier versions of the ONS 15454 use a disposable air filter. This disposable filter is not designed to be cleaned. You can order air filter replacements from Cisco (Cisco P/N: 47-01-00001) or from Universal Air Filter Company, model PE-5:

Universal Air Filter Company (www.uaf.com)
1624 Sauget Industrial Parkway,
Sauget, IL 62206

1.7 Power and Ground Description

Ground the equipment according to Telcordia standards or local practices.

Cisco recommends the following wiring conventions, but customer conventions prevail:

- Red wire for battery connections (-48V DC)
- Black wire for battery return connections (0V DC)

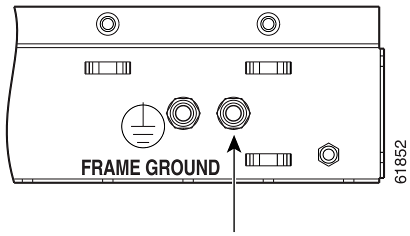
The ONS 15454 has redundant -48V DC #8 power terminals on the shelf assembly backplane. The terminals are labeled BAT1, RET1, BAT2, and RET2 and are located on the lower section of the backplane behind a clear plastic cover.

To install redundant power feeds, use four power cables and one ground cable. For a single power feed, only two power cables (#10 AWG, copper conductor, 194°F [90°C]) and one ground cable (#6 AWG) are required. Use a conductor with low impedance to ensure circuit overcurrent protection. However, the conductor must have the capability to safely conduct any faulty current that might be imposed.

Note If you are installing power on a Release 3.0 ONS 15454 shelf assembly (15454-SA-NEBS3E, 15454-SA-NEBS3, and 15454-SA-R1, P/N: 800-07149), the #12 to #14 AWG power cable and #14 AWG ground cable are required.

The existing ground post is a #10-32 bolt. The nut provided for a field connection is also a #10, with an integral lock washer. The lug must be a dual-hole type and rated to accept the #6 AWG cable. Two posts are provided on the Cisco ONS 15454 to accommodate the dual-hole lug. Figure 1-14 shows the location of the ground posts.

Figure 1-14 Ground posts on the ONS 15454 backplane



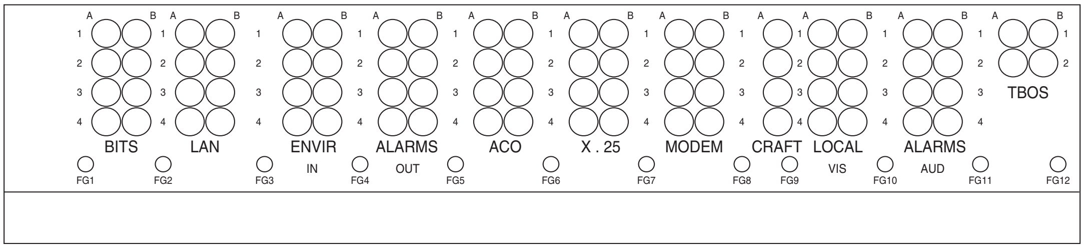
For information about attaching ferrites to power cabling, refer to the "Ferrites" section on page 1-23.

1.8 Alarm, Timing, LAN, and Craft Pin Connections

Caution Always use the supplied ESD wristband when working with a powered ONS 15454. Plug the wristband cable into the ESD jack located on the lower-right outside edge of the shelf assembly.

The ONS 15454 has a backplane pin field located at the bottom of the backplane. The backplane pin field provides 0.045 square inch wire-wrap pins for enabling external alarms, timing input and output, and craft interface terminals. This section describes the backplane pin field and the pin assignments for the field. Figure 1-15 shows the wire-wrap pins on the backplane pin field. Beneath each wire-wrap pin is a frame ground pin. Frame ground pins are labeled FG1, FG2, FG3, etc. Install the ground shield of the cables connected to the backplane to the ground pin that corresponds to the pin field used. Figure 1-15 shows pinouts for the ONS 15454.

Figure 1-15 ONS 15454 backplane pinouts



Field	Pin	Function
BITS	A1	BITS Output 2 negative (-)
	B1	BITS Output 2 positive (+)
	A2	BITS Input 2 negative (-)
	B2	BITS Input 2 positive (+)
	A3	BITS Output 1 negative (-)
	B3	BITS Output 1 positive (+)
	A4	BITS Input 1 negative (-)
	B4	BITS Input 1 positive (+)
LAN	Connecting to a hub, or switch	
	A1	RJ-45 pin 6 RX-
	B1	RJ-45 pin 3 RX+
	A2	RJ-45 pin 2 TX-
	B2	RJ-45 pin 1 TX+
	Connecting to a PC/Workstation or router	
	A1	RJ-45 pin 2 RX-
	B1	RJ-45 pin 1 RX+
	A2	RJ-45 pin 6 TX-
	B2	RJ-45 pin 3 TX+
ENVIR ALARMS IN	A1	Alarm input pair number 1: Reports closure on connected wires.
	B1	
	A2	Alarm input pair number 2: Reports closure on connected wires.
	B2	
	A3	Alarm input pair number 3: Reports closure on connected wires.
	B3	
	A4	Alarm input pair number 4: Reports closure on connected wires.
	B4	

Field	Pin	Function
ENVIR ALARMS OUT N/O	A1	Normally open output pair number 1
	B1	
	A2	Normally open output pair number 2
	B2	
	A3	Normally open output pair number 3
	B3	
	A4	Normally open output pair number 4
	B4	
ACO	A1	Normally open ACO pair
	B1	
CRAFT	A1	Receive (PC pin #2)
	A2	Transmit (PC pin #3)
	A3	Ground (PC pin #5)
	A4	DTR (PC pin #4)
LOCAL ALARMS AUD (Audible) N/O	A1	Alarm output pair number 1: Remote audible alarm.
	B1	
	A2	Alarm output pair number 2: Critical audible alarm.
	B2	
	A3	Alarm output pair number 3: Major audible alarm.
	B3	
	A4	Alarm output pair number 4: Minor audible alarm.
	B4	
LOCAL ALARMS VIS (Visual) N/O	A1	Alarm output pair number 1: Remote visual alarm.
	B1	
	A2	Alarm output pair number 2: Critical visual alarm.
	B2	
	A3	Alarm output pair number 3: Major visual alarm.
	B3	
	A4	Alarm output pair number 4: Minor visual alarm.
	B4	

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Note The X.25, Modem, and TBOS pin fields are not active.

1.8.1 Alarm Contact Installation

The alarm pin field supports up to 17 alarm contacts, including four audible alarms, four visual alarms, one alarm cutoff (ACO), and four user-definable alarm input and output contacts.

Audible alarm contacts are in the LOCAL ALARM AUD pin field and visual contacts are in the LOCAL ALARM VIS pin field. Both of these alarms are in the LOCAL ALARMS category. User-definable contacts are in the ENVIR ALARM IN (external alarm) and ENVIR ALARM OUT (external control) pin fields. These alarms are in the ENVIR ALARMS category; you must have the AIC card installed to use the ENVIR ALARMS. Alarm contacts are Normally Open (N/O), meaning that the system closes the alarm contacts when the corresponding alarm conditions are present. Each alarm contact consists of two wire-wrap pins on the shelf assembly backplane. Visual and audible alarm contacts are classified as Critical, Major, Minor, and Remote. Figure 1-15 on page 1-17 shows alarm pin assignments.

Visual and audible alarms are typically wired to trigger an alarm light at a central alarm collection point when the corresponding contacts are closed. You can use the Alarm Cutoff pins to activate a remote ACO for audible alarms. You can also activate the ACO function by pressing the ACO button on the TCC+ card faceplate. The ACO function clears all audible alarm indications. After clearing the audible alarm indication, the alarm is still present and viewable in the Alarms tab in CTC.

1.8.2 Timing Installation

The ONS 15454 backplane supports two Building Integrated Timing Supply (BITS) clock pin fields. The first four BITS pins, rows 3 and 4, support output and input from the first external timing device. The last four BITS pins, rows 1 and 2, perform the identical functions for the second external timing device. Table 1-1 lists the pin assignments for the BITS timing pin fields.

Table 1-1 External Timing Pin Assignments for BITS

External Device	Contact	Tip & Ring	Function
First external device	A3 (BITS 1 Out)	Primary ring (-)	Output to external device
	B3 (BITS 1 Out)	Primary tip (+)	Output to external device
	A4 (BITS 1 In)	Secondary ring (-)	Input from external device
	B4 (BITS 1 In)	Secondary tip (+)	Input from external device
Second external device	A1 (BITS 2 Out)	Primary ring (-)	Output to external device
	B1 (BITS 2 Out)	Primary tip (+)	Output to external device
	A2 (BITS 2 In)	Secondary ring (-)	Input from external device
	B2 (BITS 2 In	Secondary tip (+)	Input from external device

Note Refer to Telcordia SR-NWT-002224 for rules about provisioning timing references

1.8.3 LAN Installation

Use the LAN pins on the ONS 15454 backplane to connect the ONS 15454 to a workstation or Ethernet LAN, or to a LAN modem for remote access to the node. You can also use the LAN port on the TCC+ faceplate to connect a workstation or to connect the ONS 15454 to the network. Table 1-2 shows the LAN pin assignments.

Before you can connect an ONS 15454 to other ONS 15454s or to a LAN, you must change the default IP address that is shipped with each ONS 15454 (192.1.0.2).

Table 1-2 LAN Pin Assignments

Pin Field	Backplane Pins	RJ-45 Pins
LAN 1 Connecting to data circuit-terminating equipment (DCE*) (a hub or switch)	B2	1
	A2	2
	B1	3
	A1	6
LAN 1 Connecting to data terminal equipment (DTE) (a PC/workstation or router)	B1	1
	A1	2
	B2	3
	A2	6

*The Cisco ONS 15454 is DCE.

1.8.4 TL1 Craft Interface Installation

You can use the craft pins on the ONS 15454 backplane or the RS-232 port on the TCC+ faceplate to create a VT100 emulation window to serve as a TL1 craft interface to the ONS 15454. Use a straight-through cable to connect to the RS-232 port. Table 1-3 shows the pin assignments for the CRAFT pin field.

Note You cannot use the craft backplane pins and the RS-232 port on the TCC+ card simultaneously.

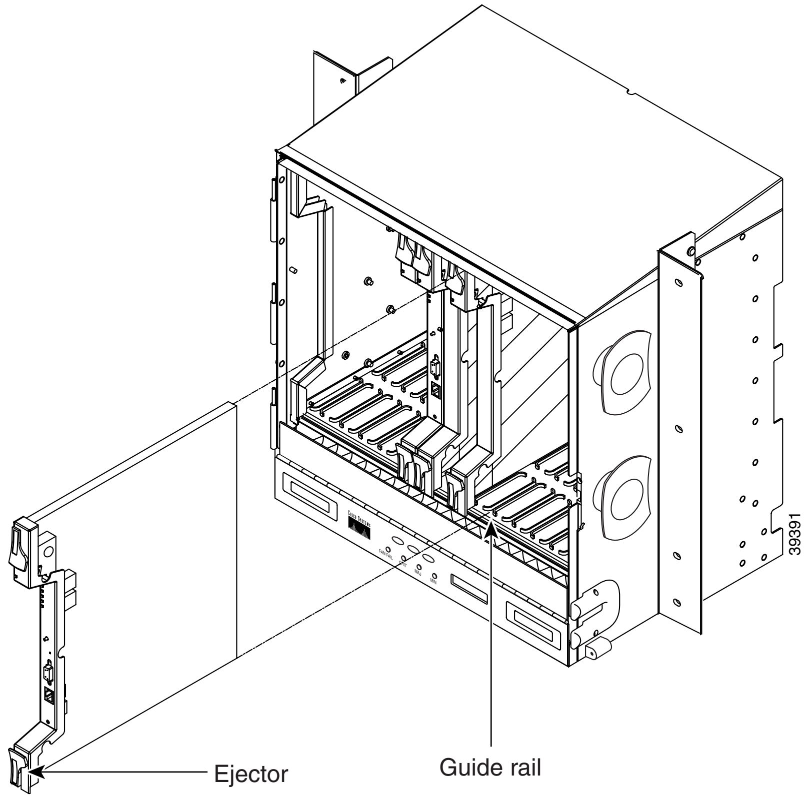
Table 1-3 Craft Interface Pin Assignments

Pin Field	Contact	Function
Craft	A1	Receive
	A2	Transmit
	A3	Ground
	A4	DTR

1.9 Cards and Slots

ONS 15454 cards have electrical plugs at the back that plug into electrical connectors on the shelf assembly backplane. When the ejectors are fully closed, the card plugs into the assembly backplane. Figure 1-16 shows card installation.

Figure 1-16 Installing cards in the ONS 15454



1.9.1 Card Slot Requirements

The ONS 15454 shelf assembly has 17 card slots numbered sequentially from left to right. Slots 1 – 4 and 14 – 17 are multispeed slots. They can host any ONS 15454 card, except the OC48IR 1310, OC48LR 1550, OC48ELR 1550, and OC192LR 1550 cards. Slots 5, 6, 12 and 13 are high-speed slots. They can host all ONS 15454 cards, except the OC12/STM4-4 card. You can install the OC48 IR/STM16 SH AS 1310 and the OC48 LR/STM16 LH AS 1550 cards in any multispeed or high-speed card slot.

Slots 7 and 11 are dedicated to TCC+ cards. Slots 8 and 10 are dedicated to cross-connect (XC, XCVT, XC10G) cards. Slot 9 is reserved for the optional Alarm Interface Controller (AIC) card. Slots 3 and 15 can also host DS1N-14 and DS3N-12 cards that are used in 1:N protection.

Caution Do not operate the ONS 15454 with a single TCC+ card or a single XC/XCVT/XC10G card installed. Always operate the shelf assembly with one working and one protect card of the same type.

Shelf assembly slots have symbols indicating the type of cards that you can install in them. Each ONS 15454 card has a corresponding symbol. The symbol on the card must match the symbol on the slot.

Table 1-4 shows the slot and card symbol definitions.

Table 1-4 Slot and Card Symbols

Symbol Color/Shape	Definition
Orange/Circle	Multispeed slot (all traffic cards except the OC48IR 1310, OC48LR 1550, and OC192 LR 1550 cards). Only install ONS 15454 cards with a circle symbol on the faceplate.
Blue/Triangle	High-speed slot (all traffic cards including the OC48IR 1310, OC48LR 1550, and OC192LR 1550 cards, except the OC12/STM4-4 card). Only install ONS 15454 cards with circle or a triangle symbol on the faceplate.
Purple/Square	TCC+ slot. Only install ONS 15454 cards with a square symbol on the faceplate.
Green/Cross	Cross-connect (XC/XCVT/XC10G) slot. Only install ONS 15454 cards with a cross symbol on the faceplate.
Red/P	Protection slot in 1:N protection schemes.
Red/Diamond	AIC Slot. Only install ONS 15454 cards with a diamond symbol on the faceplate.
Gold/Star	Multispeed slot (OC12/STM4-4 card). Only install ONS 15454 cards with a star symbol on the faceplate.

Table 1-5 lists the number of ports, line rates, connector options, and connector locations for ONS 15454 optical and electrical cards.

Table 1-5 Card Ports, Line Rates, and Connectors

Card	Ports	Line Rate per Port	Connector Types	Connector Location
DS1-14	14	1.544 Mbps	SMB w/wire wrap adapter, AMP Champ Connector*	Backplane
DS1N-14	14	1.544 Mbps	SMB w/wire wrap adapter, AMP Champ Connector*	—
DS3-12	12	44.736 Mbps	SMB or BNC*	Backplane
DS3N-12	12	44.736 Mbps	SMB or BNC*	—
DS3-12E	12	44.736 Mbps	SMB or BNC*	Backplane
DS3N-12E	12	44.736 Mbps	SMB or BNC*	—
DS3XM-6	6	44.736 Mbps	SMB or BNC*	Backplane
EC1-12	12	51.84 Mbps	SMB or BNC*	Backplane
E100T-12	12	100 Mbps	RJ-45	Faceplate
E1000-2	2	1 Gbps	SC (GBIC)	Faceplate
E100T-G	12	100 Mbps	RJ-45	Faceplate
E1000-2-G	2	1 Gbps	SC (GBIC)	Faceplate
G1000-4	4	1 Gbps	SC (GBIC)	Faceplate

Table 1-5 Card Ports, Line Rates, and Connectors (continued)

Card	Ports	Line Rate per Port	Connector Types	Connector Location
OC-3 IR	4	155.52 Mbps (STS-3)	SC	Faceplate
OC-12/STM4-4 (IR/LR)	4	622.08 Mbps (STS-12)	SC	Faceplate
OC-12 (IR/LR)	1	622.08 Mbps (STS-12)	SC	Faceplate
OC-48 (IR/LR/ELR)	1	2488.32 Mbps (STS-48)	SC	Faceplate
OC-48 any slot (IR/LR)	1	2488.32 Mbps (STS-48)	SC	Faceplate
OC-192 (LR)	1	9.95 Gbps (STS-192)	SC	Faceplate

* When used as a protect card, the card does not have a physical external connection. The protect card connects to the working card(s) through the backplane and becomes active when the working card fails. The protect card then uses the physical connection of the failed card.

1.9.2 Card Replacement

To replace an ONS 15454 card with another card of the same type, you do not need to make any changes to the database; remove the old card and replace it with a new card. To replace a card with a card of a different type, physically remove the card and replace it with the new card, then delete the original card from CTC.

Caution Removing any active card from the ONS 15454 can result in traffic interruption. Use caution when replacing cards and verify that only inactive or standby cards are being replaced. If the active card needs to be replaced, switch it to standby prior to removing the card from the node.

Note An improper removal (IMPROPRMVL) alarm is raised whenever a card pull is performed, unless the card is deleted in CTC first. The alarm will clear after the card replacement is complete.

Note In a UPSR, pulling the active XC/XCVT/XC10G without a lockout will cause UPSR circuits to switch.

Warning **Do not reach into a vacant slot or chassis while you install or remove a module or a fan. Exposed circuitry could constitute an energy hazard.**

1.10 Ferrites

Place third-party ferrites on certain cables to dampen electromagnetic interference (EMI) from the ONS 15454. Ferrites must be added to meet the requirements of GR 1089. Refer to the ferrite manufacturer documentation for proper use and installation of the ferrites. Ferrite placements on the ONS 15454 can include power cables, AMP Champ connectors, baluns, BNC/SMB connectors, and the wire-wrap pin field.

1.11 Software and Hardware Compatibility

Table 1-6 provides a matrix showing software and hardware compatibility for ONS 15454 Releases 2.0, 2.1, 2.2.0, 3.0, 3.1, 3.2, and 3.3.

Table 1-6 ONS 15454 Software and Hardware Compatibility

Hardware	2.00.0x (2.0)	2.10.0x (2.1)	2.20.0x (2.2.0)	3.00.0x (3.0)	3.10.0x (3.1)	3.20.0x (3.2)	3.30.0x (3.3)
TCC	Required	Required	Fully Compatible	Not Supported	Not Supported	Not Supported	Not Supported
TCC+	Not Supported	Not Supported	Fully Compatible	Required	Required	Required	Required
XC	Fully Compatible	Fully Compatible	Fully Compatible	See Note	See Note	See Note	See Note
Note In Software R3.0 and higher, VT 1.5 provisioning is not supported.							
XCVT	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
XC10G	Not Supported	Not Supported	Not Supported	Not Supported	Fully Compatible	Fully Compatible	Fully Compatible
AIC	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
EC1-12	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
DS1-14	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
DS1N-14	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
DS3-12	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
DS3N-12	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
DS3-12E	See Note 2	See Note 2	See Note 2	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
DS3N-12E	See Note 2	See Note 2	See Note 2	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
Note In Software R2.0 – 2.2, extended features are not supported.							

Table 1-6 ONS 15454 Software and Hardware Compatibility (continued)

Hardware	2.00.0x (2.0)	2.10.0x (2.1)	2.20.0x (2.2.0)	3.00.0x (3.0)	3.10.0x (3.1)	3.20.0x (3.2)	3.30.0x (3.3)
DS3XM-6	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
OC3 IR 4 1310	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
OC12/STM 4-4	Not Supported	Not Supported	Not Supported	Not Supported	Not Supported	Not Supported	Fully Compatible
OC12 IR 1310	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
OC12 LR 1310	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
OC12 LR 1550	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
OC48 IR 1310	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
OC48 LR 1550	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
OC48 ELR DWDM	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
OC48 IR/STM16 SH AS 1310	See Note	See Note	See Note	See Note	Fully Compatible	Fully Compatible	Fully Compatible
OC48 LR/STM16 LH AS 1550	See Note	See Note	See Note 3	See Note	Fully Compatible	Fully Compatible	Fully Compatible
Note Use the XC10G card, the TCC+ card, and Software R3.1 or higher to enable the any slot function on the OC48 IR/STM16 SH AS 1310 and OC48 LR/STM16 LH AS 1550 cards.							
OC192 LR/STM64 LH 1550	Not Supported	Not Supported	Not Supported	Not Supported	Fully Compatible	Fully Compatible	Fully Compatible
E100T-12	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	See Note	See Note	See Note
E1000-2	Not Supported	Not Supported	Fully Compatible	Fully Compatible	See Note	See Note	See Note
Note In Software R3.0 and higher, the E100T-12 and E1000-2 cards are compatible only with the XCVT card.							
E100T-G	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible
E1000-2-G	Not Supported	Not Supported	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible	Fully Compatible

Table 1-6 ONS 15454 Software and Hardware Compatibility (continued)

Hardware	2.00.0x (2.0)	2.10.0x (2.1)	2.20.0x (2.2.0)	3.00.0x (3.0)	3.10.0x (3.1)	3.20.0x (3.2)	3.30.0x (3.3)
G1000-4	Not Supported	Not Supported	Not Supported	Not Supported	See Note	See Note	See Note

Note The G1000-4 card requires the XC10G card to operate. The G1000-4 card is not compatible with XC or XCVT cards.

If an upgrade is required for compatibility, call the Cisco Technical Assistance Center at 1-877-323-7368.

Common Control Cards

This chapter describes Cisco ONS 15454 common control card functions. For installation and card turn-up procedures, refer to the *Cisco ONS 15454 Procedure Guide*.

Chapter topics include:

2.1 Card Overview

The card overview section summarizes card functions, power consumption, temperature ranges, and compatibility.

Note Each card is marked with a symbol that corresponds to a slot (or slots) on the ONS 15454 shelf assembly. The cards are then installed into slots displaying the same symbols. See the "Card Slot Requirements" section on page 1-20 for a list of slots and symbols.

2.1.1 Common Control Cards

Table 2-1 lists five common control cards for the Cisco ONS 15454 and summarizes card functions.

Table 2-1 Common Control Card Functions

Card	Description	For Additional Information…
TCC+	The TCC+ is the main processing center for the ONS 15454 and provides system initialization, provisioning, alarm reporting, maintenance, and diagnostics.	See the "TCC+ Card" section on page 2-9
XC	The XC card is the central element for switching; it establishes connections and performs time division switching (TDS).	See the "XC Cross-Connect Card" section on page 2-12
XCVT	The XCVT card is the central element for switching; it establishes connections and performs time division switching (TDS). The XCVT can manage STS and VT circuits up to 48c.	See the "XCVT Cross-Connect Card" section on page 2-14
XC10G	The XC10G card is the central element for switching; it establishes connections and performs time division switching (TDS). The XC10G can manage STS and VT circuits up to 192c. The XC10G allows up to four times the bandwidth of current XC and XCVT cards.	See the "XC10G Cross-Connect Card" section on page 2-18
AIC	The AIC card provides customer-defined (environmental) alarms with its additional input/output alarm contact closures.	See the "Alarm Interface Controller Card" section on page 2-23

2.1.2 Card and Power Requirements

Table 2-2 lists power requirements for individual cards.

Note Asterisks (*) next to card or fan tray names mean the power specification shown below is based on a calculation because an actual measurement was not available at the time of publication.

Table 2-2 Individual Card Power Requirements

Card Type	Card Name	Watts	Amps	BTU/Hr.
Control Cards	TCC+	9.82	0.20	33.53
	XC	13	0.28	46
	XCVT	34.40	0.72	117.46
	XC10G	54	1.12	184.38
	AIC	6.01	0.12	20.52

Table 2-2 Individual Card Power Requirements (continued)

Card Type	Card Name	Watts	Amps	BTU/Hr.
Electrical Cards	EC1-12	36.60	0.76	124.97
	DS1-14	12.60	0.26	43.02
	DS1N-14	12.60	0.26	43.02
	DS3-12	38.20	0.79	130.43
	DS3N-12	38.20	0.79	130.43
	DS3-12E	26.80	0.56	91.51
	DS3N-12E	26.80	0.56	91.51
	DS3XM-6 Transmux	20	0.42	68
Optical Cards				
	OC3 IR 4/ STM1 SH 1310	19.20	0.40	65.56
	OC12 IR/ STM4 SH 1310	10.90	0.23	37.22
	OC12 LR/ STM4 LH 1310	12	0.25	41
	OC12 LR/ STM4 LH 1550	9.28	0.19	31.68
	OC12 IR/STM4 SH 1310-4	28	0.58	100
	OC48 IR 1310	32.20	0.67	109.94
	OC48 LR 1550	26.80	0.56	91.50
	OC48 IR/ STM16 SH AS 1310	37.20	0.77	127.01
	OC48 LR/ STM16 LH AS 1550	37.20	0.77	127.01
	OC48 ELR/ STM16 EH 100 GHz	31.20	0.65	106.53
	OC48 ELR 200 GHz	31.20	0.65	106.53
	OC192 LR/ STM64 LH 1550	72.20	1.50	246.52
Ethernet Cards	E100T-12	65	1.35	221.93
	E1000-2	53.50	1.11	182.67
	E100T-G	65	1.35	221.93
	E1000-2-G	53.50	1.11	182.67
	G1000-4	63.00	1.31	215.11

2.1.3 Card Temperature Ranges

Table 2-3 shows C-Temp and I-Temp compliant cards and their product names.

Note The I-Temp symbol is displayed on the faceplate of an I-Temp compliant card. A card without this symbol is C-Temp compliant.

Table 2-3 Card Temperature Ranges and Product Names for the ONS 15454

Card	C-Temp Product Name (0 to +55 degrees Celsius)	I-Temp Product Name (-40 to +65 degrees Celsius)
TCC+	15454-TCC+	15454-TCC+T
XC	15454-XC	15454-XC-T
XCVT	15454-XC-VT	15454-XC-VT-T
XC10G	15454-XC-10G	—
AIC	15454-AIC	15454-AIC-T
EC1-12	15454-EC1-12	15454-EC1-12-T
DS1-14	15454-DS1-14	15454-DS1-14-T
DS1N-14	15454-DS1N-14	15454-DS1N-14-T
DS3-12	15454-DS3-12	15454-DS3-12-T
DS3N-12	15454-DS3N-12	15454-DS3N-12-T
DS3-12E	—	15454-DS3-12E-T
DS3N-12E	—	15454-DS3N-12E-T
DS3XM-6 (Transmux)	15454-DS3XM-6	15454-DS3XM-6-T
OC3 IR 4/STM1 SH 1310	15454-OC34IR1310	15454-OC34I13-T
OC12 IR/STM4 SH 1310	15454-OC121IR1310	15454-OC121I13-T
OC12 LR/STM4 LH 1310	15454-OC121LR1310	15454-OC121L13-T
OC12 LR/STM4 LH 1550	15454-OC121LR1550	15454-OC121L15-T
OC12 IR/STM4 SH 1310-4	15454-OC12IR-4	—
OC48 IR 1310	15454-OC481IR1310	—
OC48 LR 1550	15454-OC481LR1550	—
OC48 IR/STM16 SH AS 1310	15454-OC481IR1310A	—
OC48 LR/STM16 LH AS 1550	15454-OC481LR1550A	—
OC192 LR/STM64 LH 1550	15454-OC192LR1550	—
E100T-12	15454-E100T	—
E1000-2	15454-E1000-2	—
E100T-G	15454-E100T-G	—
E1000-2-G	15454-E1000-2-G	—
G1000-4	15454-G1000-4	—

Table 2-3 Card Temperature Ranges and Product Names for the ONS 15454 (continued)

Card	C-Temp Product Name (0 to +55 degrees Celsius)	I-Temp Product Name (-40 to +65 degrees Celsius)
OC48 ELR/STM16 EH 100 GHz	15454-OC48E-1-28.7	—
	15454-OC48E-1-30.3	
	15454-OC48E-1-31.1	
	15454-OC48E-1-31.9	
	15454-OC48E-1-32.6	
	15454-OC48E-1-33.4	
	15454-OC48E-1-34.2	
	15454-OC48E-1-35.0	
	15454-OC48E-1-35.8	
	15454-OC48E-1-36.6	
	15454-OC48E-1-38.1	
	15454-OC48E-1-38.9	
	15454-OC48E-1-39.7	
	15454-OC48E-1-40.5	
	15454-OC48E-1-41.3	
	15454-OC48E-1-42.1	
	15454-OC48E-1-42.9	
	15454-OC48E-1-43.7	
	15454-OC48E-1-44.5	
	15454-OC48E-1-46.1	
	15454-OC48E-1-46.9	
	15454-OC48E-1-47.7	
	15454-OC48E-1-48.5	
	15454-OC48E-1-49.3	
	15454-OC48E-1-50.1	

Table 2-3 Card Temperature Ranges and Product Names for the ONS 15454 (continued)

Card	C-Temp Product Name (0 to +55 degrees Celsius)	I-Temp Product Name (-40 to +65 degrees Celsius)
OC48 ELR/STM16 EH 100 GHz (continued)	15454-OC48E-1-50.9	—
	15454-OC48E-1-51.7	
	15454-OC48E-1-52.5	
	15454-OC48E-1-54.1	
	15454-OC48E-1-54.9	
	15454-OC48E-1-55.7	
	15454-OC48E-1-56.5	
	15454-OC48E-1-57.3	
	15454-OC48E-1-58.1	
	15454-OC48E-1-58.9	
	15454-OC48E-1-59.7	
	15454-OC48E-1-60.6	
OC48 ELR/STM16 EH 200 GHz	15454-OC48E-30.33	—
	15454-OC48E-31.90	
	15454-OC48E-33.47	
	15454-OC48E-35.04	
	15454-OC48E-36.61	
	15454-OC48E-38.19	
	15454-OC48E-39.77	
	15454-OC48E-31.35	
	15454-OC48E-42.94	
	15454-OC48E-47.72	
	15454-OC48E-49.32	
	15454-OC48E-50.92	
	15454-OC48E-52.52	
	15454-OC48E-54.13	
	15454-OC48E-55.75	
	15454-OC48E-57.36	
	15454-OC48E-58.98	
	15454-OC48E-60.61	

2.1.4 Card Compatibility

The tables below list ONS 15454 cards, compatible software versions, and compatible cross-connect cards. Read each card description for detailed information about the card. In the tables below, **Yes** means cards are compatible with the listed software versions and cross-connect cards. Table cells with dashes mean cards are not compatible with the listed software versions or cross-connect cards.

Table 2-4 Common-Control Card Software and Hardware Compatibility for the ONS 15454

Cards	Software R2.2.1	Software R2.2.2	Software R3.0.1	Software R3.1	Software R3.2	Software R3.3	XC Card	XCVT Card	XC10G Card
TCC+	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
XC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—
XCVT	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—
XC10G	—	—	—	Yes	Yes	Yes	—	—	Yes[1]
AIC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

1. To enable OC-192 and OC-48 any slot card operation, use the XC10G card, the TCC+ card, Software R3.1 or higher, and the new 15454-SA-ANSI shelf assembly. Do not pair an XC or XCVT with an XC10G.

Table 2-5 Electrical Card Software and Cross-Connect Card Compatibility for the ONS 15454

Electrical Cards	Software R2.2.1	Software R2.2.2	Software R3.0.1	Software R3.1	Software R3.2	Software R3.3	XC Card	XCVT Card	XC10G Card
EC1-12	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DS1-14	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DS1N-14	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DS3-12	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DS3N-12	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DS3-12E	—	Yes[1]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DS3N-12E	—	Yes[1]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DS3XM-6 (Transmux)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

1. Use Software R3.0 or higher to enable all enhanced performance monitoring functions on the DS-3E cards. With Software R2.2.2, the DS-3E cards operate as the older DS-3 cards without enhanced performance monitoring.

Table 2-6 Optical Card Software and Cross-Connect Card Compatibility for the ONS 15454

Optical Cards	Software R2.2.1	Software R2.2.2	Software R3.0.1	Software R3.1	Software R3.2	Software R3.3	XC Card	XCVT Card	XC10G Card
OC3 IR 4 1310	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OC12 IR 1310	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OC12 LR 1310	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OC12 LR 1550	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OC3 IR 4/STM1 SH 1310	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OC12 IR/STM4 SH 1310	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 2-6 Optical Card Software and Cross-Connect Card Compatibility for the ONS 15454 (continued)

Optical Cards	Software R2.2.1	Software R2.2.2	Software R3.0.1	Software R3.1	Software R3.2	Software R3.3	XC Card	XCVT Card	XC10G Card
OC12 LR/STM4 LH 1310	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OC12 LR/STM4 LH 1550	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OC12 IR/STM4 SH 1310-4	No	No	No	No	No	Yes	No	No	Yes
OC48 IR 1310	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OC48 LR 1550	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OC48 IR/STM16 SH AS 1310	—	—	—	Yes[1]	Yes	Yes	—	—	Yes[1]
OC48 LR/STM16 LH AS 1550	—	—	—	Yes[1]	Yes	Yes	—	—	Yes[1]
OC48 ELR/STM16 EH 100 GHz	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OC48 ELR 200 GHz	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OC192 LR/STM64 LH 1550	—	—	—	Yes[1]	Yes	Yes	—	—	Yes[1]

1. Use the XC10G card, the TCC+ card, Software R3.1 or higher and the new 15454-SA-ANSI shelf assembly to enable the OC48 IR/STM16 SH AS 1310, OC48 LR/STM16 LH AS 1550, and the OC192 LR/STM64 LH 1550 cards.

Table 2-7 Ethernet Card Software and Cross-Connect Card Compatibility for the ONS 15454

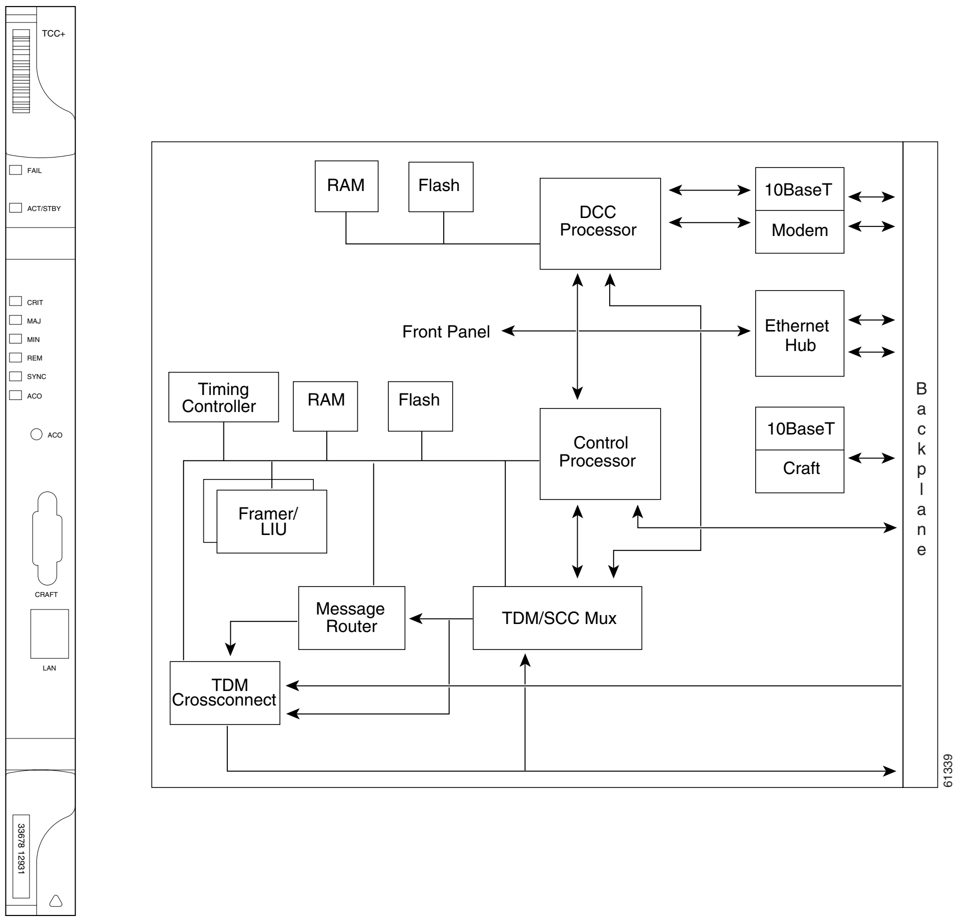
Ethernet Cards	Software R2.2.1	Software R2.2.2	Software R3.0.1	Software R3.1	Software R3.2	Software R3.3	XC Card	XCVT Card	XC10G Card
E100T-12	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—
E1000-2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—
E100T-G	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes[1]
E1000-2-G	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes[1]
G1000-4	No	No	No	No	Yes	Yes	Yes	Yes	Yes[1]

1. To use Ethernet cards with the XC10G, select either the E100T-G card, the E1000-2-G card, or the G1000-4 card. Do not use the E100T-12 card or E1000-2 card with the XC10G.

2.2 TCC+ Card

The TCC+ performs system initialization, provisioning, alarm reporting, maintenance, diagnostics, IP address detection/resolution, SONET Data Communications Channel (DCC) termination, and system fault detection for the ONS 15454. The TCC+ also ensures that the system maintains Telcordia timing requirements. Figure 2-1 shows the TCC+ faceplate and a block diagram of the card.

Figure 2-1 TCC+ faceplate and block diagram



The node database, IP address, and system software are stored in TCC+ non-volatile memory, which allows quick recovery in the event of a power or card failure.

The TCC+ supports multichannel, high-level data link control (HDLC) processing for the DCC. Up to 48 DCCs can be routed over the Serial Communication Interface (SCI) and terminated at the TCC+. The TCC+ selects and processes ten DCCs to facilitate remote system management interfaces.

The TCC+ performs all system-timing functions for each ONS 15454. The TCC+ monitors the recovered clocks from each traffic card and two DS-1 (BITS) interfaces for frequency accuracy. The TCC+ selects a recovered clock, a BITS, or an internal Stratum 3 reference as the system-timing reference. You can provision any of the clock inputs as primary or secondary timing sources. A slow-reference tracking loop allows the TCC+ to synchronize with the recovered clock, which provides holdover if the reference is lost.

Install TCC+ cards in Slots 7 and 11 for redundancy. If the active TCC+ fails, traffic switches to the protect TCC+. All TCC+ protection switches conform to protection switching standards of less than 50 ms.

The TCC+ features an RJ-45 10Base-T LAN port and an RS-232 DB9 type craft interface for user interfaces. The TL1 craft port runs at 9600 bps.

Caution Do not operate the ONS 15454 with only one TCC+ card. Two TCC+ cards must always be installed.

2.2.1 TCC+ Card-Level Indicators

The TCC+ faceplate has eight LEDs. The first two LEDs are card-level indicators.

Table 2-8 TCC+ Card-Level Indicators

Card-Level LEDs	Definition
Red FAIL LED	Indicates a TCC+ hardware problem. Replace the unit if the FAIL LED persists.
ACT/STBY LED **Green (Active)** **Amber (Standby)**	The ACT/STBY (Active/Standby) LED indicates that the TCC+ is active (green) or in standby (amber). The ACT/STBY LED also provides the timing reference and shelf control. When the TCC+ is writing to the Active or Standby TCC+, its Active or Standby LED will blink. To avoid memory corruption, only remove the TCC+ when it is in standby and when the LED is not blinking.

2.2.2 Network-Level Indicators

The TCC+ faceplate has eight LEDs. Six LEDs are network-level indicators.

Table 2-9 TCC+ System-Level Indicators

System-Level LEDs	Definition
Red CRIT LED	Indicates a critical alarm in the network at the local node
Red MAJ LED	Indicates a major alarm in the network at the local node
Amber MIN LED	Indicates a minor alarm in the network at the local node
Red REM LED	Provides first-level alarm isolation. The REM LED turns red when an alarm is present in one or several of the remote nodes.
Green SYNC LED	Indicates that node timing is synchronized to an external reference
Green ACO LED	After pressing the alarm cutoff (ACO) button, the green ACO LED illuminates. The ACO button opens the audible closure on the backplane. The ACO state is stopped if a new alarm occurs. After the originating alarm is cleared, the ACO LED and audible alarm control are reset.

2.2.3 TCC+ Specifications

- CTC Software
  - Interface: 10 Base-T LAN
  - Backplane access: wire wrap
- TL1 Craft Interface
  - Speed: 9600 baud
  - Front panel access: RS-232 DB9 type connector
- Synchronization
  - Stratum 3, per Telcordia GR-253-CORE
  - Free running access: accuracy 4.6 ppm
  - Holdover Stability: 3.7 x10^{-7} ppm/day including temperature (<255 slips in first 24 hours)
  - Reference: External BITS, line, internal
- Environmental
  - Operating Temperature:

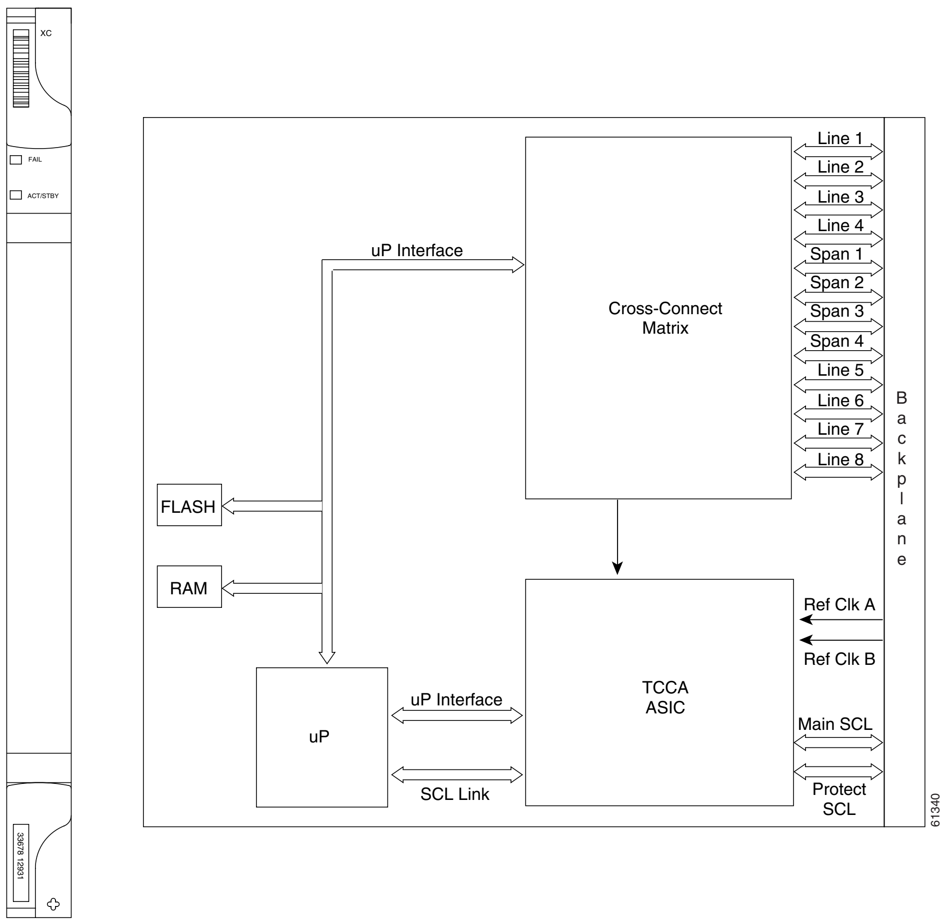
    C-Temp (15454-TCC+): 0 to +55 degrees Celsius

    I-Temp (15454-TCC+T): -40 to +65 degrees Celsius
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 9.82 W, 0.20 amps, 33.53 BTU/Hr.
- Dimensions
  - Height: 12.650 in., Width: 0.716 in., Depth: 9.000 in.
  - Card Weight: 1.5 lbs, 0.7 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950

2.3 XC Cross-Connect Card

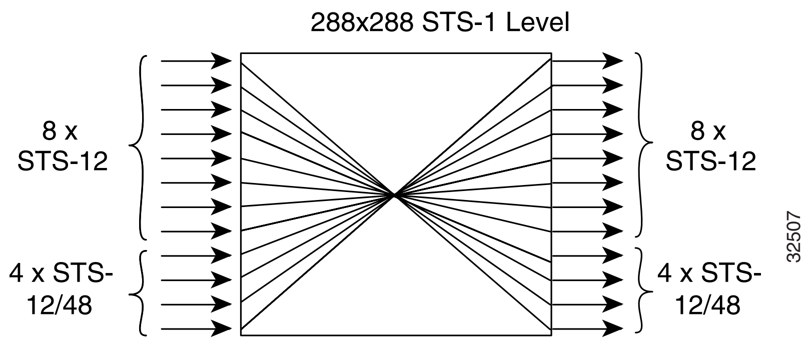
The cross-connect card is the central element for ONS 15454 switching. Available cross-connects are the XC, XCVT, and XC10G. The XC establishes connections and performs time division switching (TDS) at the STS-1 level between ONS 15454 traffic cards. The XC card faceplate and block diagram are shown in Figure 2-2. The cross-connect matrix is shown in Figure 2-3 on page 2-13.

Figure 2-2 XC card faceplate and block diagram



The switch matrix on the XC card consists of 288 bidirectional ports. When creating bidirectional STS-1 cross-connects, each cross-connect uses two STS-1 ports. This results in 144 bidirectional STS-1 cross-connects. The switch matrix is fully crosspoint, non-blocking, and broadcast supporting. (Any STS-1 on any port can be connected to any other port, meaning that the STS cross-connections are non blocking.) This allows network operators to concentrate or groom low-speed traffic from line cards onto high-speed transport spans and to drop low-speed traffic from transport spans onto line cards.

Figure 2-3 XC cross-connect matrix



The XC card has 12 input ports and 12 output ports. Four input and output ports operate at either STS-12 or STS-48 rates. The remaining eight input and output ports operate at the STS-12 rate. An STS-1 on any of the input ports can be mapped to an STS-1 output port, thus providing full STS-1 time slot assignments (TSA).

The XC card works with the TCC+ card to maintain connections and set up cross-connects within the ONS 15454. Either the XC, XCVT, or XC10G is required to operate the ONS 15454. You establish cross-connect and provisioning information through CTC. The TCC+ establishes the proper internal cross-connect information and relays the setup information to the cross-connect card.

Caution Do not operate the ONS 15454 with only one XC, XCVT, or XC10G card. Two cross connect cards of the same type (either two XC, two XCVT, or two XC10G cards) must always be installed.

For simplex operation, you can install a single XC card in Slots 8 or 10. A second XC should be added for redundancy. The card has no external interfaces. All cross-connect card interfaces are provided through the ONS 15454 backplane.

2.3.1 XC Card-Level Indicators

The XC card faceplate has two card-level LEDs.

Table 2-10 XC Card-Level Indicators

Card-Level Indicators	Definition
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. If the FAIL LED persists, replace the card.
ACT/STBY LED **Green (Active)** **Amber (Standby)**	The ACT/STBY LED indicates whether the XC card is active and carrying traffic (green) or in standby mode as a protect card (amber).

2.3.2 XC Specifications

- Cross-Connect
  - Connection Setup Time: 5 ms
  - Latency: 270 ns
- Environmental
  - Operating Temperature:

    C-Temp (15454-XC): 0 to +55 degrees Celsius

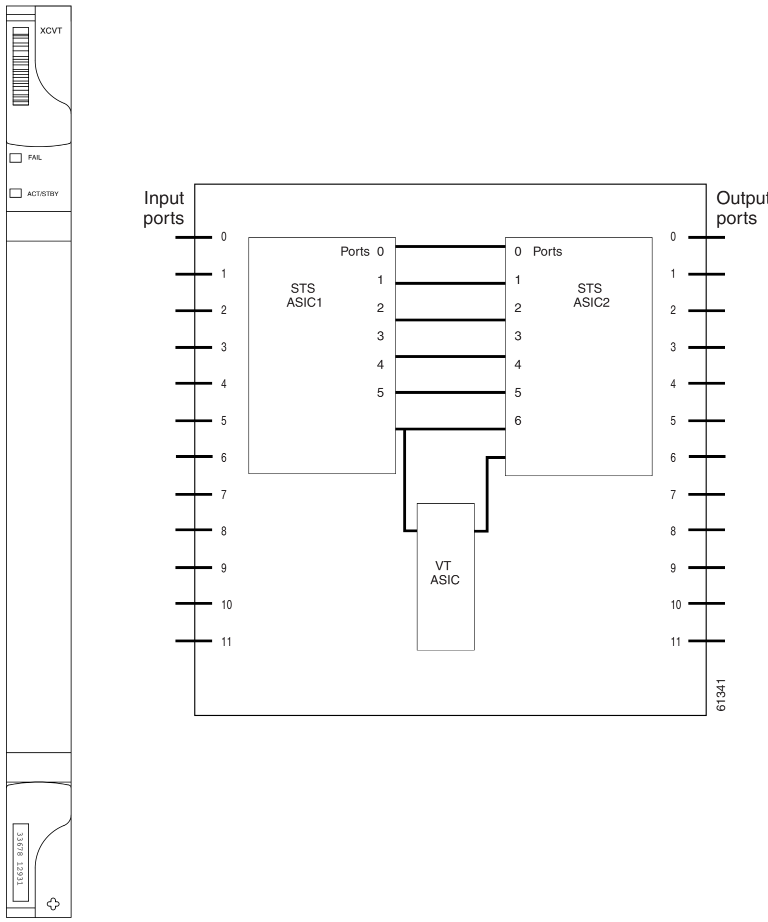
    I-Temp (15454-XC-T): -40 to +65 degrees Celsius
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 13 W, 0.28 amps, 46 BTU/Hr.
- Dimensions
  - Height: 12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 1.5 lbs, 0.7 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950

2.4 XCVT Cross-Connect Card

The XCVT card provides the same STS capability as a standard XC card and also provides VT cross-connection. The XCVT provides non-blocking STS-48 capacity to all of the high-speed slots and non-bidirectional blocking STS-12 capacity to all multispeed slots. Any STS-1 on any port can be connected to any other port, meaning that the STS cross-connections are non blocking.

Figure 2-4 shows the XCVT faceplate and block diagram. Figure 2-5 on page 2-16 shows the cross-connect matrix.

Figure 2-4 XCVT faceplate and block diagram

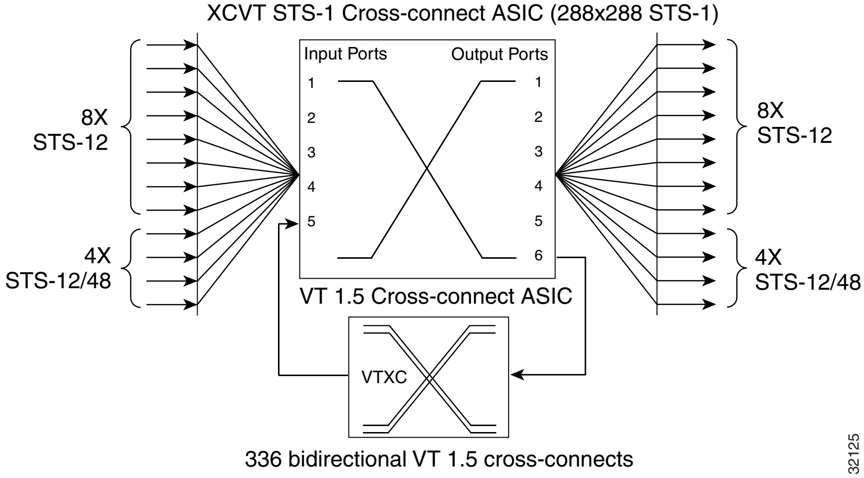


The STS-1 switch matrix on the XCVT card consists of 288 bidirectional ports and adds a VT matrix that can manage up to 336 bidirectional VT1.5 ports or the equivalent of a bidirectional STS-12. The VT1.5-level signals can be cross connected, dropped, or rearranged. The TCC+ assigns bandwidth to each slot on a per STS-1 or per VT1.5 basis. The switch matrices are fully crosspoint and broadcast supporting.

The XCVT card works with the TCC+ card to maintain connections and set up cross-connects within the node. Either the XCVT, XC10G, or XC is required to operate the ONS 15454. You can establish cross-connect (circuit) information through CTC. The TCC+ establishes the proper internal cross-connect information and relays the setup information to the XCVT card.

Caution Do not operate the ONS 15454 with only one XC, XCVT, or XC10G card. Two cross connect cards of the same type (either two XC, two XCVT, or two XC10G cards) must always be installed.

Figure 2-5 XCVT cross-connect matrix



2.4.1 VT Mapping

The VT structure is designed to transport and switch payloads below the DS-3 rate. The ONS 15454 performs Virtual Tributary (VT) mapping according to Telcordia GR-253 standards. Table 2-11 shows the VT numbering scheme for the ONS 15454 as it relates to the Telcordia standard.

Table 2-11 ONS 15454 VT Mapping

ONS 15454 VT Number	Telcordia Group/VT Number
VT1	Group1/VT1
VT2	Group2/VT1
VT3	Group3/VT1
VT4	Group4/VT1
VT5	Group5/VT1
VT6	Group6/VT1
VT7	Group7/VT1
VT8	Group1/VT2
VT9	Group2/VT2
VT10	Group3/VT2
VT11	Group4/VT2
VT12	Group5/VT2
VT13	Group6/VT2
VT14	Group7/VT2
VT15	Group1/VT3
VT16	Group2/VT3
VT17	Group3/VT3

Table 2-11 ONS 15454 VT Mapping (continued)

ONS 15454 VT Number	Telcordia Group/VT Number
VT18	Group4/VT3
VT19	Group5/VT3
VT20	Group6/VT3
VT21	Group7/VT3
VT22	Group1/VT4
VT23	Group2/VT4
VT24	Group3/VT4
VT25	Group4/VT4
VT26	Group5/VT4
VT27	Group6/VT4
VT28	Group7/VT4

2.4.2 XCVT Hosting DS3XM-6

The XCVT card works with DS3XM-6 (transmux) cards. A single DS3XM-6 can demultiplex (map down to a lower rate) six DS-3 signals into 168 VT1.5s that the XCVT card manages and cross connects. XCVT cards host a maximum of 336 bidirectional VT1.5s. In most network configurations, two DS3XM-6 cards are paired as working and protect cards.

2.4.3 XCVT Card-Level Indicators

The XCVT faceplate has two card-level LEDs.

Table 2-12 XCVT Card-Level Indicators

Card-Level Indicators	Definition
Red FAIL LED	The red FAIL LED indicates that the card’s processor is not ready. Replace the card if the red FAIL LED persists.
ACT/STBY LED **Green (Active)** **Amber (Standby)**	The ACT/STBY (Active/Standby) LED indicates whether the XCVT is active and carrying traffic (green) or in standby mode to the active XCVT card (amber).

2.4.4 XC/XCVT Compatibility

The XCVT card is compatible with the XC cards. The XCVT supports run-time compatibility with the XC cross-connect both within a single node and within a ring of mixed XCVT and XC nodes. However, working and protect cards within a single ONS 15454 must be either two XC cards or two XCVT cards. If an XC card or an XCVT card are used together as a working and protect pair, the XCVT acts as an XC card.

The XC and XCVT are supported in unidirectional path switched ring (UPSR) and bidirectional line switched ring (BLSR) configurations. VT and STS-level cross-connect and protection management are also supported in either type of ring. Nodes that rearrange or drop VTs must use an XCVT. Nodes that only rearrange or drop STSs can use an XC. You do not need to upgrade STS-only nodes to XCVT in a ring that can handle both VT and STS drop/rearrangement. In this scenario, however, the XC must run Software R2.0 or higher.

When upgrading from XC to XCVT cards, the first XCVT card installed acts as an XC card until the second XCVT card is installed.

To create an STS-capable ring that allows VT drops at some nodes, all of the nodes in the ring must first run Software R2.0 or higher. The nodes that allow VT drops must use XCVT, but the nodes that do not allow VT drops can use the XC or XCVT card.

2.4.5 XCVT Card Specifications

- Environmental
  - Operating Temperature:

    C-Temp (15454-XC-VT): 0 to +55 degrees Celsius

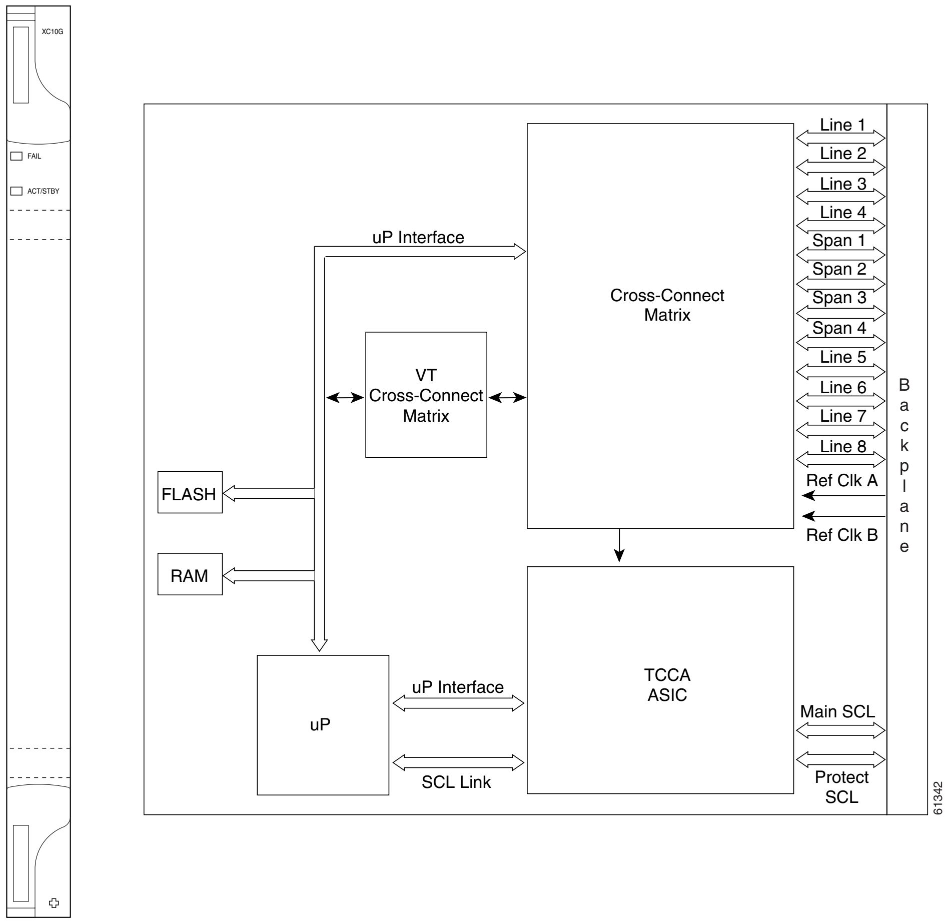
    I-Temp (15454-XC-VT-T): -40 to +65 degrees Celsius
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 34.40 W, 0.72 amps, 117.46 BTU/Hr.
- Dimensions
  - Height: 12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 1.9 lbs, 0.8 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950

2.5 XC10G Cross-Connect Card

The XC10G card cross-connects STS-12, STS-48, and STS-192 signal rates. The XC10G allows up to four times the bandwidth of the XC and XCVT cards. The XC10G provides a maximum of 1152 STS-1 cross-connections. Any STS-1 on any port can be connected to any other port, meaning that the STS cross-connections are non blocking.

Figure 2-6 shows the XC10G faceplate and block diagram. Figure 2-7 on page 2-20 shows the cross-connect matrix.

Figure 2-6 XC10G faceplate and block diagram

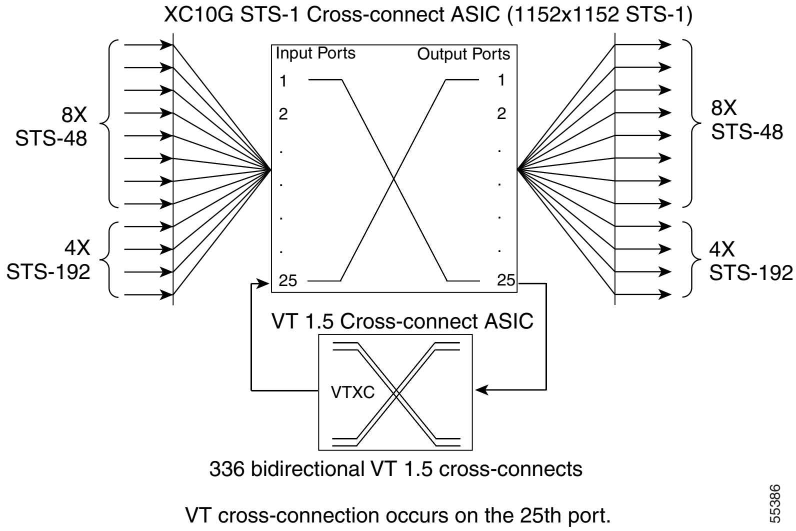


The XC10G card manages up to 336 bidirectional VT1.5 ports and 576 bidirectional STS-1 ports. The TCC+ assigns bandwidth to each slot on a per STS-1 or per VT1.5 basis.

Either the XC10G, XCVT, or XC is required to operate the ONS 15454. You can establish cross-connect (circuit) information through the Cisco Transport Controller (CTC). The TCC+ establishes the proper internal cross-connect information and sends the setup information to the cross-connect card.

Caution Do not operate the ONS 15454 with only one XC, XCVT, or XC10G card. Two cross connect cards of the same type (either two XC, two XCVT, or two XC10G cards) must always be installed.

Figure 2-7 XC10G cross-connect matrix



2.5.1 VT Mapping

The VT structure is designed to transport and switch payloads below the DS-3 rate. The Cisco ONS 15454 performs Virtual Tributary (VT) mapping according to Telcordia GR-253 standards. Table 2-13 shows the VT numbering scheme for the ONS 15454 as it relates to the Telcordia standard.

Table 2-13 ONS 15454 VT Mapping

ONS 15454 VT Number	Telcordia Group/VT Number
VT1	Group1/VT1
VT2	Group2/VT1
VT3	Group3/VT1
VT4	Group4/VT1
VT5	Group5/VT1
VT6	Group6/VT1
VT7	Group7/VT1
VT8	Group1/VT2
VT9	Group2/VT2
VT10	Group3/VT2
VT11	Group4/VT2
VT12	Group5/VT2
VT13	Group6/VT2
VT14	Group7/VT2
VT15	Group1/VT3
VT16	Group2/VT3

Table 2-13 ONS 15454 VT Mapping (continued)

ONS 15454 VT Number	Telcordia Group/VT Number
VT17	Group3/VT3
VT18	Group4/VT3
VT19	Group5/VT3
VT20	Group6/VT3
VT21	Group7/VT3
VT22	Group1/VT4
VT23	Group2/VT4
VT24	Group3/VT4
VT25	Group4/VT4
VT26	Group5/VT4
VT27	Group6/VT4
VT28	Group7/VT4

2.5.2 XC10G Hosting DS3XM-6

The XC10G card works with the DS3XM-6 (transmux) card. A single DS3XM-6 can demultiplex (map down to a lower rate) six DS-3 signals into 168 VT1.5s that the XC10G card manages and cross connects. XC10G cards host a maximum of 336 bidirectional VT1.5 ports. In most network configurations, two DS3XM-6 cards are paired as working and protect cards.

2.5.3 XC10G Card-Level Indicators

The XC10G faceplate has two card-level LEDs.

Table 2-14 XC10G Card-Level Indicators

Card-Level Indicators	Definition
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED illuminates during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.
ACT/STBY LED **Green (Active)** **Amber (Standby)**	The ACT/STBY (Active/Standby) LED indicates whether the XC10G is active and carrying traffic (green) or in standby mode to the active XC10G card (amber).

2.5.4 XC/XCVT/XC10G Compatibility

The XC10G supports the same features as the XC and XCVT cross-connects. The XC10G card is required for OC-192 and OC-48 any-slot operation. Do not use the XCVT or XC cards if you are using the OC-192 card, or if you placed one of the OC-48 any slot cards in a multispeed slot.

Note A configuration mismatch alarm occurs when a XC or XCVT cross-connect card coexists with an OC-192 card placed in the high-speed slot, or with an OC-48 card placed in the multispeed slot.

The TCC+ card, Software R3.1 or higher and the new 15454-SA-ANSI shelf assembly are required for the operation of the XC10G. If you are using Ethernet cards, the E1000-2-G or the E100T-G must be used when the XC10G cross-connect card is in use. Do not pair an XC or XCVT with an XC10G. When upgrading from XC or XCVT to the XC10G card, refer to the *Cisco ONS 15454 Procedure Guide* for more information.

The upgrade procedure from the XC/XCVT cards to the XC10G card only applies to XC/XCVT cards that are installed in the 15454-SA-ANSI (Software R3.1 and later). You cannot perform this upgrade from shelves released prior to software R3.1. The XC10G requires the 15454-SA-ANSI.

2.5.5 XC10G Card Specifications

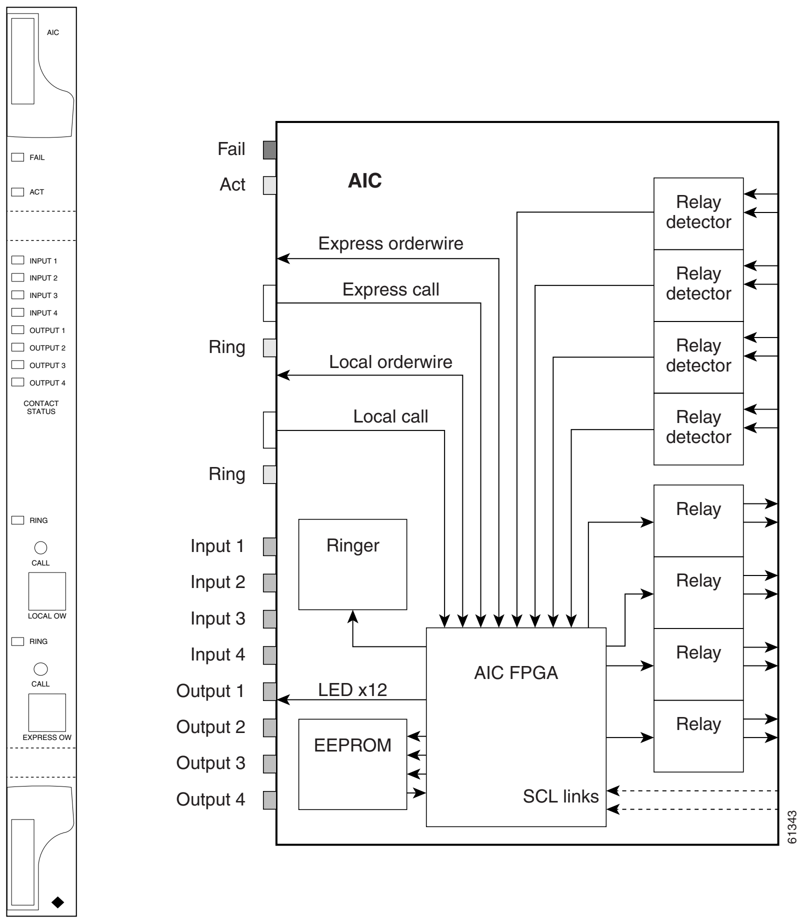
- Environmental
  - Operating Temperature:

    C-Temp (15454-XC-10G): 0 to +55 degrees Celsius
  - Operating Humidity: 5 - 85%, non-condensing
  - Power Consumption: 78.6 W, 1.64 amps, 268.4 BTU/Hr.
- Dimensions
  - Height: 12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 1.5 lbs, 0.6 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950

2.6 Alarm Interface Controller Card

The optional Alarm Interface Controller (AIC) card provides customer-defined alarm input/output (I/O) and supports local and express orderwire. Figure 2-8 shows the AIC faceplate and a block diagram of the card. Figure 2-9 on page 2-25 shows the RJ-11 cable.

Figure 2-8 AIC faceplate and block diagram



2.6.1 User-Defined Alarms

The AIC card provides input/output alarm contact closures. You can define up to four external alarms and four external controls. The physical connections are made using the backplane wire-wrap pins. The alarms are defined using CTC and TL1. For instructions, refer to the *Cisco ONS 15454 Procedure Guide*.

Each alarm contact has a corresponding LED on the front panel of the AIC that indicates the status of the alarm. External alarms (input contacts) are typically used for external sensors such as open doors, temperature sensors, flood sensors, and other environmental conditions. External controls (output contacts) are typically used to drive visual or audible devices such as bells and lights, but they can control other devices such as generators, heaters, and fans.

You can program each of the four input alarm contacts separately. Choices include Alarm on Closure or Alarm on Open, an alarm severity of any level (Critical, Major, Minor, Not Alarmed, Not Reported), a Service Affecting or Non-Service Affecting alarm-service level, and a 63-character alarm description for CTC display in the alarm log. You cannot assign the fan-tray abbreviation for the alarm; the abbreviation reflects the generic name of the input contacts. The alarm condition remains raised until the external input stops driving the contact or you provision the alarm input.

The output contacts can be provisioned to close on a trigger or to close manually. The trigger can be a local alarm severity threshold, a remote alarm severity, or a virtual wire:

- Local NE alarm severity: A hierarchy of non-reported, non-alarmed, minor, major or critical alarm severities that you set to cause output closure. For example, if the trigger is set to minor, a minor alarm or above is the trigger.
- Remote NE alarm severity: Same as the Local NE alarm severity but applies to remote alarms only.
- Virtual wire entities: You can provision any environmental alarm input to raise a signal on any virtual wire on external outputs 1 through 4 when the alarm input is an event. You can provision a signal on any virtual wire as a trigger for an external control output.

You can also program the output alarm contacts (external controls) separately. In addition to provisionable triggers, you can manually force each external output contact to open or close. Manual operation takes precedence over any provisioned triggers that might be present.

2.6.2 Orderwire

Orderwire allows a craftsperson to plug a phoneset into an ONS 15454 and communicate with craftspeople working at other ONS 15454s or other facility equipment. The orderwire is a pulse code modulation (PCM) encoded voice channel that uses E1 or E2 bytes in section/line overhead.

The AIC allows simultaneous use of both local (section overhead signal) and express (line overhead channel) orderwire channels on a SONET ring or particular optics facility. Local orderwire also allows communication at regeneration sites when the regenerator is not a Cisco device.

You can provision orderwire functions with CTC similar to the current provisioning model for DCC channels. In CTC you provision the orderwire communications network during ring turn-up so that all NEs on the ring can reach one another. Orderwire terminations (i.e. the optics facilities that receive and process the orderwire channels) are provisionable. Both express and local orderwire can be configured as on or off on a particular SONET facility. The ONS 15454 supports up to four orderwire channel terminations per shelf. This allows linear, single ring, dual ring, and small hub-and-spoke configurations. Keep in mind that orderwire is not protected in ring topologies such as BLSR and UPSR.

Caution Do not configure orderwire loops. Orderwire loops cause feedback that disables the orderwire channel.

The ONS 15454 implementation of both local and express orderwire is broadcast in nature. The line acts as a party line. There is no signalling for private point-to-point connections. Anyone who picks up the orderwire channel can communicate with all other participants on the connected orderwire subnetwork. The local orderwire party line is separate from the express orderwire party line. Up to four OC-N facilities for each local and express orderwire are provisionable as orderwire paths.

The AIC supports a “call” button on the module front panel which, when pressed, causes all ONS 15454 AICs on the orderwire subnetwork to “ring.” The ringer/buzzer resides on the AIC. There is also a “ring” LED that mimics the AIC ringer. It flashes when any “call” button is pressed on the orderwire subnetwork. The “call” button and ringer/LED allow a remote craftsperson to get the attention of craftspeople across the network.

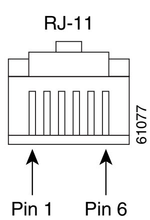
The orderwire ports are standard RJ-11 receptacles. The pins on the orderwire ports correspond to the tip and ring orderwire assignments.

Table 2-15 Orderwire Pin Assignments

RJ-11 Pin Number	Description
1	Four-wire receive ring
2	Four-wire transmit tip
3	Two-wire ring
4	Two-wire tip
5	Four-wire transmit ring
6	Four-wire receive tip

When provisioning the orderwire subnetwork, make sure that an orderwire loop does not exist. Loops cause oscillation and an unusable orderwire channel.

Figure 2-9 RJ-11 cable



2.6.3 AIC Specifications

- Environmental
  - Operating Temperature:

    C-Temp (15454-AIC): 0 to +55 degrees Celsius

    I-Temp (15454-AIC-T): -40 to +65 degrees Celsius
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 6.01 W, 0.12 amps, 20.52 BTU/Hr.
- Dimensions
  - Height: 12.650 in., Width: 0.716 in., Depth: 9.000 in.
  - Card Weight: 1.6 lbs, 0.7 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950

Electrical Cards and Cable

This chapter describes Cisco ONS 15454 electrical card features and functions. For installation and card turn-up procedures, refer to the *Cisco ONS 15454 Procedure Guide*.

Chapter topics include:

3.1 Electrical Card Warnings

Warning **Do not directly touch the backplane with your hand or any metal tool, or you could shock yourself.**

Caution When working with cards, wear the supplied ESD wristband to avoid ESD damage to the card. Plug the wristband cable into the ESD jack located on the lower-right outside edge of the shelf assembly.

Note Each card is marked with a symbol that corresponds to a slot (or slots) on the ONS 15454 shelf assembly. The cards are then installed into slots displaying the same symbols. See the "Card Slot Requirements" section on page 1-20 for a list of slots and symbols.

3.2 EC1-12 Card

The EC1-12 card provides 12 Telcordia-compliant, GR-253 STS-1 electrical ports per card. Each port operates at 51.840 Mbps over a single 75 ohm 728A or equivalent coaxial span.

STS path selection for UNEQ-P, AIS-P, and bit error rate (BER) thresholds is done on the SONET ring interfaces (optical cards) in conjunction with the STS cross-connect. The EC1-12 terminates but does not select the 12 working STS-1 signals from the backplane. The EC1-12 maps each of the 12 received EC1 signals into 12 STS-1s with visibility into the SONET path overhead.

An EC1-12 card can be 1:1 protected with another EC1-12 card but cannot protect more than one EC1-12 card. You must install the EC1-12 in an even-numbered slot to serve as a working card and in an odd-numbered slot to serve as a protect card.

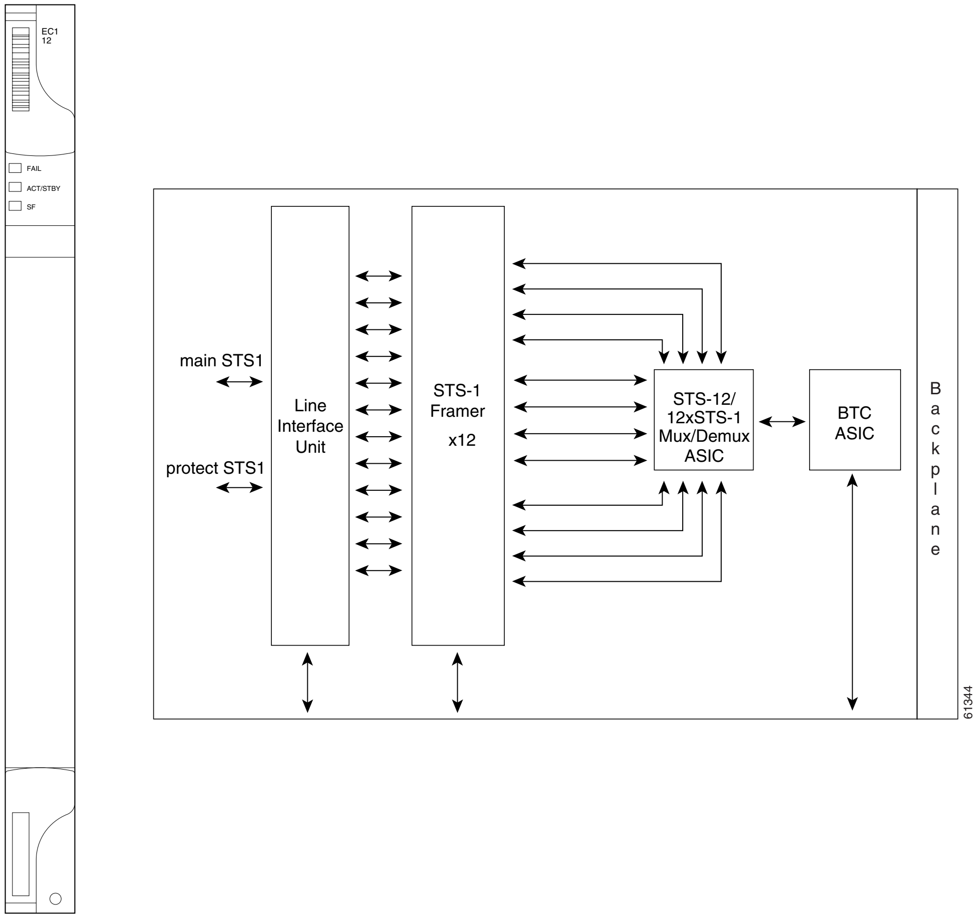
3.2.1 EC1-12 Slots and Connectors

You can install the EC1-12 card in any multispeed or high-speed card slot on the ONS 15454. Each EC1-12 interface features DSX-level (digital signal cross-connect frame) outputs supporting distances up to 450 feet depending on facility conditions.

3.2.2 EC1-12 Faceplate and Block Diagram

Figure 3-1 shows the EC1-12 faceplate and a block diagram of the card.

Figure 3-1 EC1-12 faceplate and block diagram



3.2.3 EC1-12 Hosted by XCVT

All 14 VT1.5 payloads from a EC1-12 card are carried in a single STS-1 to the XC or XCVT card where the payload is further aggregated for efficient STS-1 transport. XCVT cards host a maximum of 336 bidirectional VT1.5s.

3.2.4 EC1-12 Card-Level Indicators

The EC1-12 card faceplate has three card-level LEDs.

Table 3-1 EC1-12 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED signifies that the EC1-12 card's processor is not ready. Replace the unit if the FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the EC1-12 card is operational and ready to carry traffic.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as loss of signal (LOS), loss of frame (LOF) or high bit error rate (BER) on one or more of the card's ports.

3.2.5 EC1-12 Port-Level Indicators

You can obtain the status of the EC1-12 card ports using the LCD screen on the ONS 15454 fan-tray. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. See Alarm Troubleshooting for a complete description of the alarm messages.

3.2.6 EC1-12 Specifications

The EC1-12 card specifications are shown in Table 3-2.

Table 3-2 EC1-12 Card Specifications

Specification Type	Description
EC1-12 Input	Bit Rate: 51.84 Mbps +/- 20 ppm Frame Format: SONET Line Code: B3ZS Termination: Unbalanced coaxial cable Input Impedance: 75 ohms +/-5% Cable Loss: Max 450 ft. 734A, RG-59, 728A/Max 79 ft. RG-179 AIS: TR-TSY-000191-compliant
EC1-12 Output	Bit Rate: 51.84 Mbps +/- 20 ppm Frame Format: SONET Line Code: B3ZS Termination: Unbalanced coaxial cable Input Impedance: 75 ohms +/-5% Cable Loss: Max 450 ft. 734A, RG-59, 728A/Max 79 ft. RG-179 AIS: TR-TSY-000191-compliant Power Level: -1.8 - +5.7 dBm Pulse Shape: ANSI T1.102-1988 Figure 8 Pulse Amplitude: 0.36 - 0.85 V peak to peak Loopback Modes: Terminal and Facility Line Build Out: 0-225 ft.; 226-450 ft.
EC1-12 Electrical Interface	Connectors: BNC or SMB
Operating Temperature	C-Temp (15454-EC1-12): 0 to +55 degrees Celsius I-Temp (15454-EC1-12-T): -40 to +65 degrees Celsius **Note** The I-Temp symbol is displayed on the faceplate of an I-Temp compliant card. A card without this symbol is C-Temp compliant.
Operating Humidity	5 - 95%, non-condensing
Power Consumption	36.60 W, 0.76 amps, 124.97 BTU/Hr.
Dimensions	Height: 12.650 in. Width: 0.716 in. Depth: 9.000 in. Card Weight: 2.0 lbs, 0.9 kg
Compliance	ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950

3.3 DS1-14 and DS1N-14 Cards

The ONS 15454 DS1-14 card provides 14 Telcordia-compliant, GR-499 DS-1 ports. Each port operates at 1.544 Mbps over a 100 ohm twisted-pair copper cable. The DS1-14 card can function as a working or protect card in 1:1 protection schemes and as a working card in 1:N protection schemes.

The DS1-14 card supports 1:1 protection. The DS1-14 can be a working card in a 1:N protection scheme with the proper backplane EIA and wire-wrap or AMP Champ connectors. You can also provision the DS1-14 to monitor for line and frame errors in both directions.

You can group and map DS1-14 card traffic in STS-1 increments to any other card in an ONS 15454 except DS-3 cards. Each DS-1 is asynchronously mapped into a SONET VT1.5 payload and the card carries a DS-1 payload intact in a VT1.5. For performance monitoring purposes, you can gather bidirectional DS-1 frame-level information (loss of frame, parity errors, cyclic redundancy check [CRC] errors, etc.).

3.3.1 DS1N-14 Features and Functions

The DS1N-14 card supports the same features as the DS1-14 card in addition to enhanced protection schemes. The DS1N-14 is capable of 1:N ($N \leq 5$) protection with the proper backplane EIA and wire-wrap or AMP Champ connectors. The DS1N-14 card can function as a working or protect card in 1:1 or 1:N protection schemes.

3.3.2 DS1-14 and DS1N-14 Slots and Connectors

- DS1-14

  You can install the DS1-14 card in any multispeed or high-speed card slot on the ONS 15454. Each DS1-14 port has DSX-level (digital signal cross-connect frame) outputs supporting distances up to 655 feet.

- DS1N-14

  If you use the DS1N-14 as a standard DS-1 card in a 1:1 protection group, you can install the DS1N-14 card in any multispeed or high-speed card slot on the ONS 15454. If you use the card's 1:N functionality, you must install a DS1N-14 card in Slots 3 and 15. Each DS1N-14 port features DSX-level outputs supporting distances up to 655 feet depending on facility conditions.

3.3.3 DS1-14 and DS1N-14 Faceplate and Block Diagram

Figure 3-2 shows the DS1-14 and DS1N-14 faceplates and block diagrams of the cards.

Figure 3-2 DS1-14 faceplate and block diagram

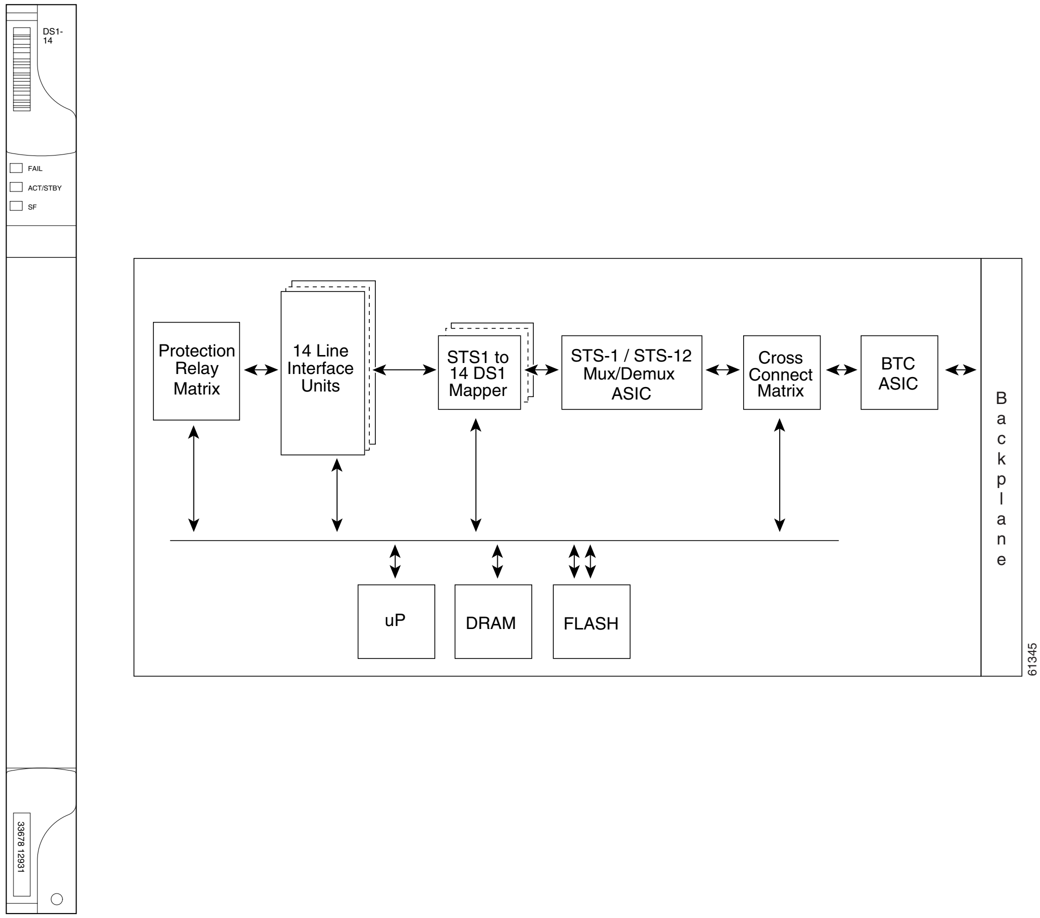
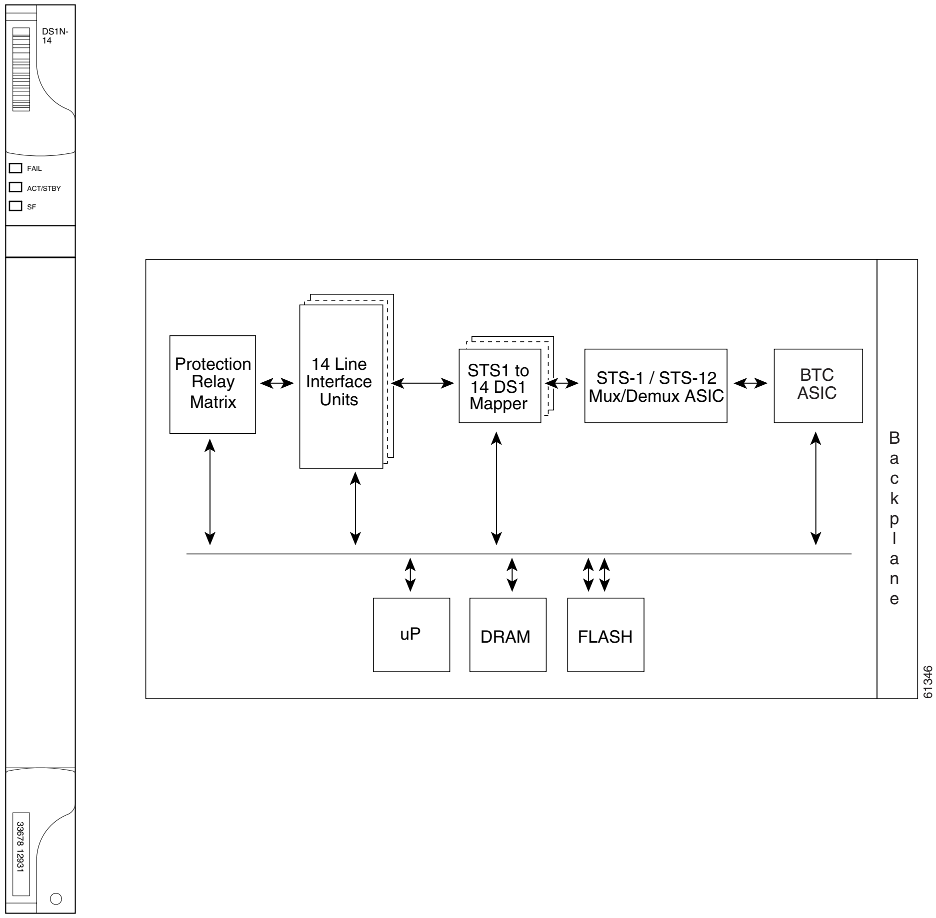


Figure 3-3 shows the DS1N-14 faceplate and a block diagram of the card.

Figure 3-3 DS1N-14 faceplate and block diagram



3.3.4 DS1-14 and DS1N-14 Hosted by the Cross-Connect

All 14 VT1.5 payloads from a DS1-14 card are carried in a single STS-1 to the XCVT or XC10G card where the payload is further aggregated for efficient STS-1 transport. The XC10G and XCVT cards manage up to 336 bidirectional VT1.5 ports.

3.3.5 DS1-14 and DS1N-14 Card-Level Indicators

The DS1-14 and DS1N-14 card faceplate has three LEDs shown in Table 3-3.

Table 3-3 DS1-14 and DS1N-14 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. Replace the card if the red FAIL LED persists.
ACT/STBY LED **Green (Active)** **Amber (Standby)**	The green/amber ACT/STBY LED indicates whether the DS1-14 card is operational and ready to carry traffic (green) or in standby mode (amber).
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF or high BERs on one or more of the card's ports.

3.3.6 DS1-14 and DS1N-14 Port-Level Indicators

You can obtain the status of the DS1-14 and DS1N-14 card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. See Alarm Troubleshooting for a complete description of the alarm messages.

3.3.7 DS1-14 and DS1N-14 Specifications

The DS1-14 and DS1N-14 card specifications are shown in Table 3-4.

Table 3-4 DS1-14 and DS1N-14 Card Specifications

Specification Type	Description
DS1-14/DS1N-14 Input	Bit Rate: 1.544 Mbps +/- 32 ppm Frame Format: Off, SF (D4), ESF Line Code: AMI, B8ZS Termination: Wire-wrap, AMP Champ Input Impedance:100 ohms Cable Loss: Max 655 ft. ABAM #22 AWG AIS: TR-TSY-000191-compliant
DS1-14/DS1N-14 Output	Bit Rate: 1.544 Mbps +/- 32 ppm Frame Format: Off, SF (D4), ESF Line Code: AMI, B8ZS Termination: Wire-wrap, AMP Champ Input Impedance:100 ohms Cable Loss: Max 655 ft. ABAM #22 AWG AIS: TR-TSY-000191-compliant Power Level: 12.5 to 17.9 dBm centered @ 772 KHz, -16.4 to -11.1 dBm centered at 1544 KHz Pulse Shape: GR-499-CORE Figure 9-5 Pulse Amplitude: 2.4- 3.6 V peak-to-peak Loopback Modes: Terminal and Facility
DS1-14/DS1N-14 Electrical Interface	Connectors: BNC or SMB
Surge Protection	GR-1089
Operating Temperature	C-Temp (15454-DS1-14 and 15454-DS1N-14): 0 to +55 degrees Celsius I-Temp (15454-DS1-14-T and 15454-DS1N-14-T): -40 to +65 degrees Celsius **Note** The I-Temp symbol is displayed on the faceplate of an I-Temp compliant card. A card without this symbol is C-Temp compliant.
Operating Humidity	5 - 95%, non-condensing
Power Consumption	12.60 W, 0.26 amps, 43.02 BTU/Hr.
Dimensions	Height: 12.650 in. Width: 0.716 in. Depth: 9.000 in. Card Weight: 1.8 lbs, 0.8 kg
Compliance	ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950

3.4 DS3-12 and DS3N-12 Cards

The ONS 15454 DS3-12 card provides 12 Telcordia-compliant, GR-499 DS-3 ports per card. Each port operates at 44.736 Mbps over a single 75 ohm 728A or equivalent coaxial span. The DS3-12 card operates as a working or protect card in 1:1 protection schemes and as a working card in 1:N protection schemes.

The DS3-12 card supports 1:1 protection with the proper backplane EIA. EIAs are available with BNC or SMB connectors.

Caution When a protection switch moves traffic from the DS3-12 working/active card to the DS3-12 protect/standby card, ports on the now active/standby card cannot be taken out of service. Lost traffic can result if you take a port out of service even if the DS3-12 standby card no longer carries traffic.

3.4.1 DS3N-12 Features and Functions

Other than the protection capabilities, the DS3-12 and DS3N-12 cards are identical. The DS3N-12 can operate as the protect card in a 1:N ($N \leq 5$) DS-3 protection group. It has additional circuitry not present on the basic DS3-12 card that allows it to protect up to five working DS3-12 cards. The basic DS3-12 card can only function as the protect card for one other DS3-12 card.

3.4.2 DS3-12 and DS3N-12 Slots and Connectors

You can install the DS3-12 or DS3N-12 card in any multispeed or high-speed card slot on the ONS 15454. Each DS3-12 or DS3N-12 card port features DSX-level outputs supporting distances up to 450 feet depending on facility conditions. With the proper backplane EIA, the card supports BNC or SMB connectors.

3.4.3 DS3-12 and DS3N-12 Faceplate and Block Diagram

Figure 3-4 shows the DS3-12 faceplates, and a block diagram of the card.

Figure 3-4 DS3-12 faceplate and block diagram

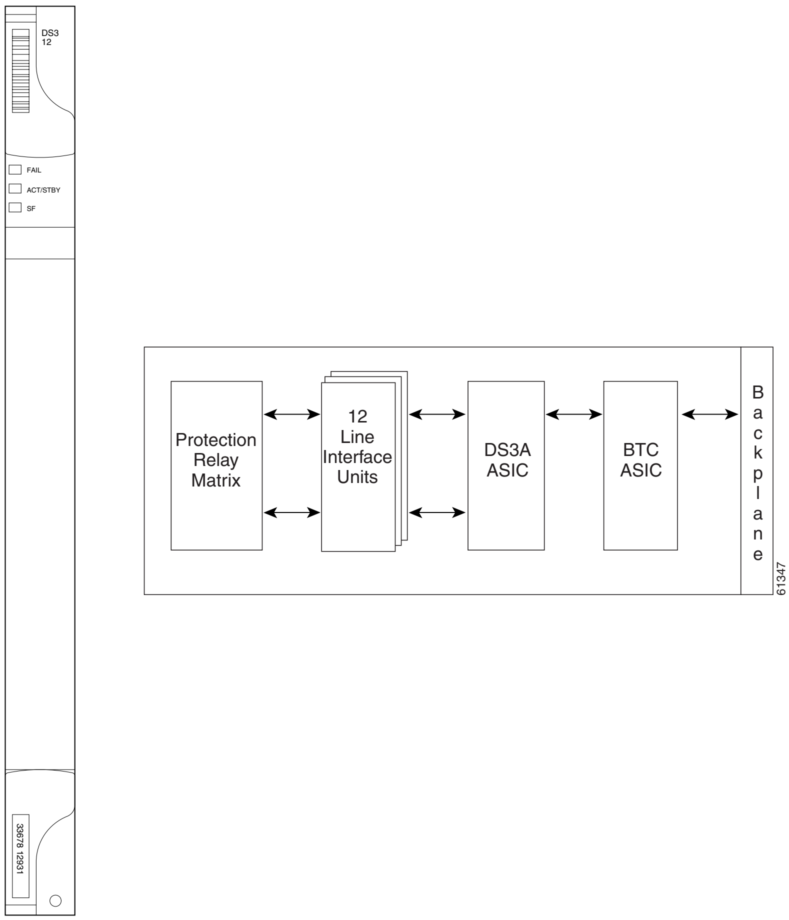
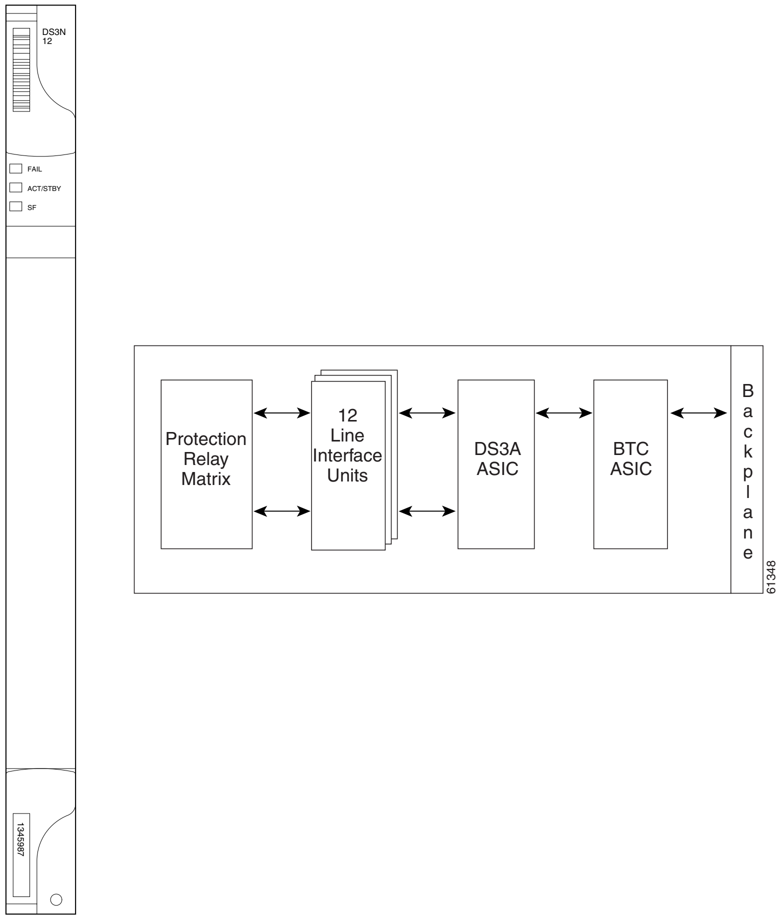


Figure 3-5 shows the DS3N-12 faceplate and a diagram of the card.

Figure 3-5 DS3N-12 faceplate and block diagram



3.4.4 DS3-12 and DS3N-12 Card-Level Indicators

The DS3-12 and DS3N-12 card faceplates have three LEDs shown in Table 3-5.

Table 3-5 DS3-12 and DS3N-12 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. Replace the card if the red FAIL LED persists.
ACT/STBY LED **Green (Active)** **Amber (Standby)**	When the ACTV/STBY LED is green, the DS3-12 card is operational and ready to carry traffic. When the ACTV/STBY LED is amber, the DS3-12 card is operational and in standby (protect) mode.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as port LOS.

3.4.5 DS3-12 and DS3N-12 Port-Level Indicators

You can find the status of the 12 DS3-12 and 12 DS3N-12 card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. See Alarm Troubleshooting for a complete description of the alarm messages.

3.4.6 DS3-12 and DS3N-12 Specifications

The DS3-12 and DS3N-12 card specifications are shown in Table 3-6.

Table 3-6 DS3-12 and DS3N-12 Card Specifications

Specification Type	Description
DS3-12/DS3N-12 Input	Bit Rate: 44.736 Mbps +/- 20 ppm Frame Format: DS-3 ANSI T1.107-1988 Line Code: B3ZS Termination: Unbalanced coaxial cable Input Impedance: 75 ohms +/-5% Cable Loss: Max 450 ft. 734A, RG-59, 728A/Max 79 ft. RG-179 AIS: TR-TSY-000191-compliant
DS3-12/DS3N-12 Output	Bit Rate: 44.736 Mbps +/- 20 ppm Frame Format: DS-3 ANSI T1.107-1988 Line Code: B3ZS Termination: Unbalanced coaxial cable Input Impedance: 75 ohms +/-5% Cable Loss: Max 450 ft. 734A, RG-59, 728A/Max 79 ft. RG-179 AIS: TR-TSY-000191-compliant Power Level: -1.8 - +5.7 dBm Pulse Shape: ANSI T1.102-1988 Figure 8 Pulse Amplitude: 0.36 - 0.85 V peak-to-peak Loopback Modes: Terminal and Facility Line Build Out: 0-225 ft.; 226-450 ft.
DS3-12/DS3N-12 Electrical Interface	Connectors: BNC or SMB
Surge Protection	GR-1089
Operating Temperature	C-Temp (15454-DS3-12 and 15454-DS3N-12): 0 to +55 degrees Celsius I-Temp (15454-DS3-12-T and 15454-DS3N-12-T): -40 to +65 degrees Celsius **Note** The I-Temp symbol is displayed on the faceplate of an I-Temp compliant card. A card without this symbol is C-Temp compliant.

Table 3-6 DS3-12 and DS3N-12 Card Specifications (continued)

Specification Type	Description
Operating Humidity	5 - 95%, non-condensing
Power Consumption	38.20 W, 0.79 amps, 130.43 BTU/Hr.
Dimensions	Height: 12.650 in. Width: 0.716 in. Depth: 9.000 in. DS3-12: Card Weight: 1.7 lbs, 0.7 kg DS3N-12: Card Weight: 1.8 lbs, 0.8 kg
Compliance	ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950

3.5 DS3-12E and DS3N-12E Cards

The ONS 15454 DS3-12E card provides 12 Telcordia-compliant ports per card. Each port operates at 44.736 Mbps over a single 75 ohm 728A or equivalent coaxial span. The DS3-12E card provides enhanced performance monitoring functions. The DS3-12E can detect several different errored logic bits within a DS-3 frame. This function allows the ONS 15454 to identify a degrading DS-3 facility caused by upstream electronics (DS-3 Framer). In addition, DS3 frame format auto detection and J1 path trace are supported. By monitoring additional overhead in the DS-3 frame, subtle network degradations can be detected.

The following list summarizes DS3-12E card features:

- Provisionable framing format M23, C-bit or unframed
- Autorecognition and provisioning of incoming framing
- P-bit monitoring
- C-bit parity monitoring
- X-bit monitoring
- M-bit monitoring
- F-bit monitoring
- Far-end block errors (FEBE) monitoring
- Far-end alarm and control (FEAC) status and loop code detection
- Path trace byte support with TIM-P alarm generation

The DS3-12E supports a 1:1 protection scheme, meaning it can operate as the protect card for one other DS3-12E card.

3.5.1 DS3N-12E Features and Functions

The DS3N-12E can operate as the protect card in a 1:N (N≤5) DS-3 protection group. It has additional circuitry not present on the basic DS3-12E card that allows it to protect up to five working DS3-12E cards. The basic DS3-12E card can only function as the protect card for one other DS3-12E card.

3.5.2 DS3-12E and DS3N-12E Slots and Connectors

You can install the DS3-12E and DS3N-12E cards in any multispeed or high-speed card slot on the ONS 15454. Each DS3-12E and DS3N-12E port features DSX-level outputs supporting distances up to 450 feet. With the proper backplane EIA, the card supports BNC or SMB connectors.

3.5.3 Faceplate and Block Diagram

Figure 3-6 DS3-12E faceplate and block diagram

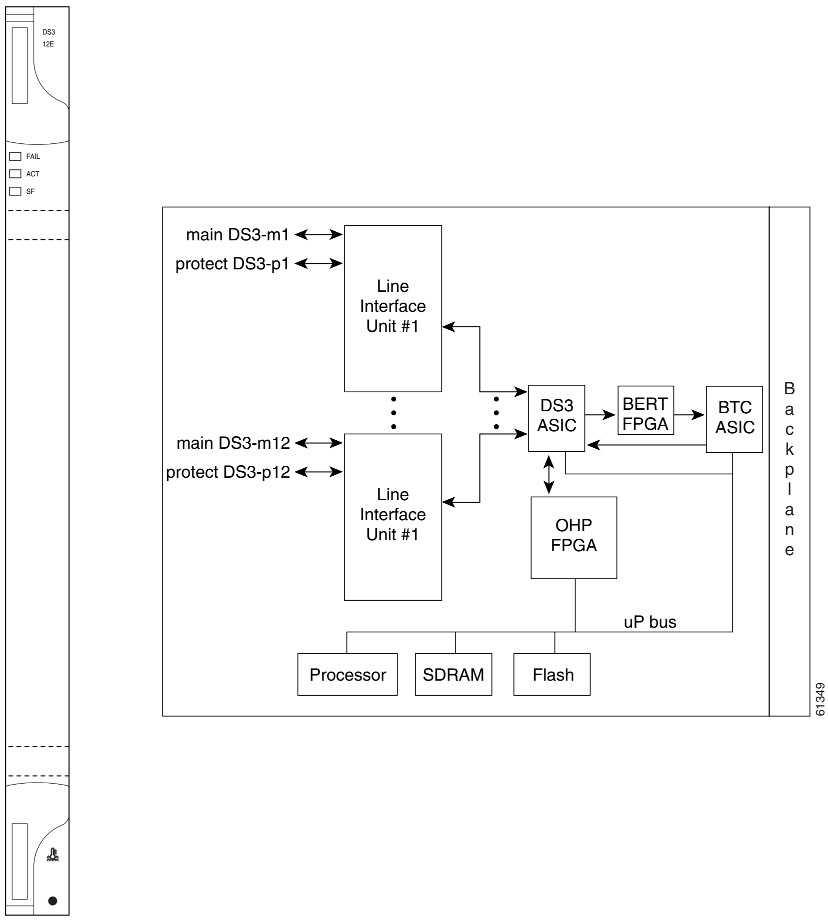
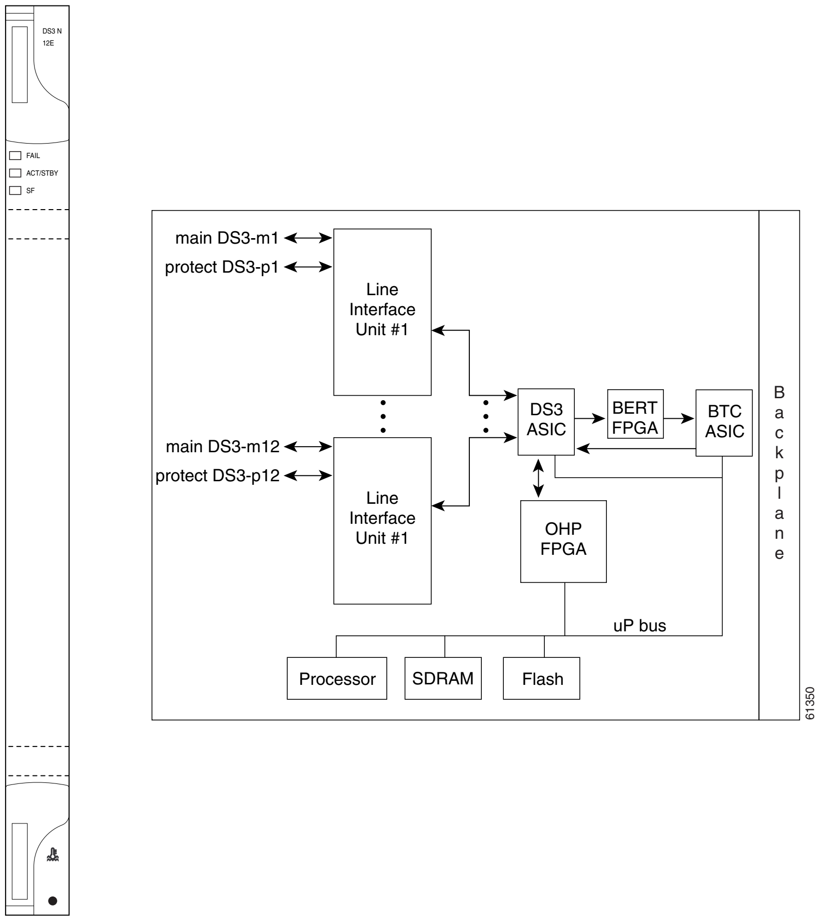


Figure 3-7 shows the DS3N-12E faceplate and a diagram of the card.

Figure 3-7 DS3N-12E faceplate and block diagram



3.5.4 DS3-12E and DS3N-12E Card-Level Indicators

The DS3-12E and DS3-12E card faceplate has three LEDs shown in Table 3-7.

Table 3-7 DS3-12E and DS3N-12E Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. Replace the card if the red FAIL LED persists.
ACT/STBY LED **Green (Active)** **Amber (Standby)**	When the ACTV/STBY LED is green, the DS3-12E card is operational and ready to carry traffic. When the ACTV/STBY LED is amber, the DS3-12E card is operational and in standby (protect) mode.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as port LOS, AIS, etc.

3.5.5 DS3-12E and DS3N-12E Port-Level Indicators

You can find the status of the DS3-12E and DS3N-12E card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to quickly view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. See *Alarm Troubleshooting* for a complete description of the alarm messages.

3.5.6 DS3-12E and DS3N-12E Specifications

The DS3-12E and DS3N-12E card specifications are shown in Table 3-8.

Table 3-8 DS3-12E and DS3N-12E Card Specifications

Specification Type	Description
DS3-12E/DS3N-12E Input	Bit Rate: 44.736 Mbps +/- 20 ppm Frame Format: DS-3 ANSI T1.107-1988 Line Code: B3ZS Termination: Unbalanced coaxial cable Input Impedance: 75 ohms +/-5% Cable Loss: Max 450 ft. 734A, RG-59, 728A/Max 79 ft. RG-179 AIS: TR-TSY-000191-compliant
DS3-12E/DS3N-12E Output	Bit Rate: 44.736 Mbps +/- 20 ppm Frame Format: DS-3 ANSI T1.107-1988 Line Code: B3ZS Termination: Unbalanced coaxial cable Input Impedance: 75 ohms +/-5% Cable Loss: Max 450 ft. 734A, RG-59, 728A/Max 79 ft. RG-179 AIS: TR-TSY-000191-compliant Power Level: -1.8 - +5.7 dBm (The power level is for a signal of all ones and is measured at a center frequency of 22.368 MHz (+/-KHz) bandwidth.) Pulse Shape: ANSI T1.102-1988 Figure 8 Pulse Amplitude: 0.36 - 0.85 V peak-to-peak Loopback Modes: Terminal and Facility Line Build Out: 0-225 ft.; 226-450 ft.
DS3-12E/DS3N-12E Electrical Interface	Connectors: BNC or SMB
Surge Protection	GR-1089
Operating Temperature	I-Temp (15454-DS3-12E-T and 15454-DS3N-12E-T): -40 to +65 degrees Celsius **Note** The I-Temp symbol is displayed on the faceplate of an I-Temp compliant card. A card without this symbol is C-Temp compliant.
Operating Humidity	5 - 95%, non-condensing

Table 3-8 DS3-12E and DS3N-12E Card Specifications (continued)

Specification Type	Description
Power Consumption	26.80 W, 0.56 amps, 91.51 BTU/Hr.
Dimensions	Height: 12.650 in. Width: 0.716 in. Depth: 9.000 in. Depth with backplane connector: 9.250 in. DS3-12E Card Weight: 1.8 lbs, 0.8 kg DS3N-12E Card Weight: 1.9 lbs, 0.8 kg
Compliance	ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950

3.6 DS3XM-6 Card

The DS3XM-6 card, commonly referred to as a transmux card, provides six Telcordia-compliant, GR-499-CORE M13 multiplexing functions. The DS3XM-6 converts six framed DS-3 network connections to 28x6 or 168 VT1.5s. You cannot create circuits from a DS3XM-6 card to a DS-3 card. DS3XM-6 cards operate at the VT1.5 level.

3.6.1 DS3XM-6 Slots and Connectors

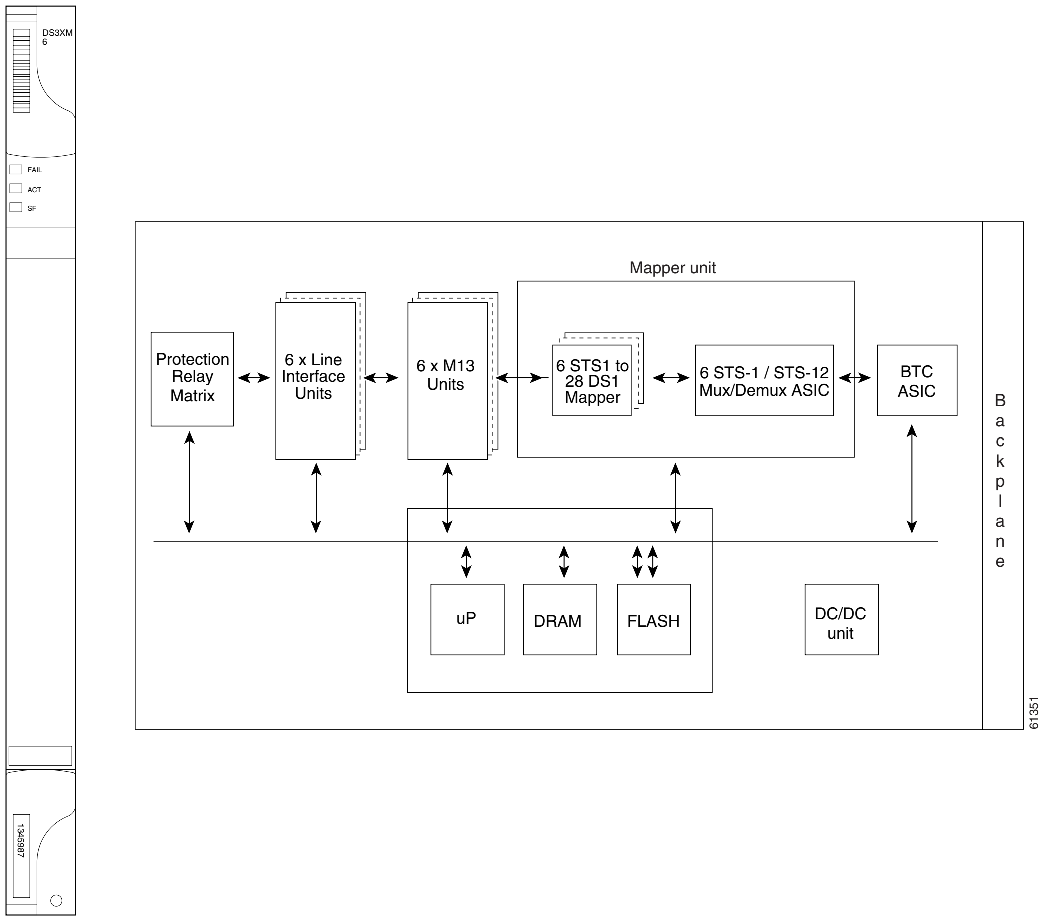
The DS3XM-6 card supports 1:1 protection with the proper backplane EIA. EIAs are available with BNC or SMB connectors.

You can install the DS3XM-6 in any multispeed or high-speed card slot. Each DS3XM-6 port features DSX-level outputs supporting distances up to 450 feet depending on facility conditions.

3.6.2 DS3XM-6 Faceplate and Block Diagram

Figure 3-8 shows the DS3XM-6 faceplate and a block diagram of the card.

Figure 3-8 DS3XM-6 faceplate and block diagram



3.6.3 DS3XM-6 Hosted By XCVT

The DS3XM-6 card works in conjunction with the XCVT card. A single DS3XM-6 can demultiplex (map down to a lower rate) six DS-3 signals into 168 VT1.5s that the XCVT card then manages and cross connects. XCVT cards host a maximum of 336 bidirectional VT1.5s or two DS3XM-6 cards. In most network configurations two DS3XM-6 cards are paired together as working and protect cards.

3.6.4 DS3XM-6 Card-Level Indicators

The DS3XM-6 card faceplate has three LEDs.

Table 3-9 DS3XM-6 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. Replace the card if the red FAIL LED persists.
ACT/STBY LED **Green (Active)** **Amber (Standby)**	When the ACTV/STBY LED is green, the DS3XM-6 card is operational and ready to carry traffic. When the ACTV/STBY LED is amber, the DS3XM-6 card is operational and in standby in a 1:1 protection group.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BER on one or more of the card's ports.

3.6.5 DS3XM-6 Port-Level Indicators

You can find the status of the six DS3XM-6 card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to quickly view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. See *Alarm Troubleshooting* for a complete description of the alarm messages.

3.6.6 DS3XM-6 Specifications

The DS3XC-6 card specifications are shown in Table 3-10.

Table 3-10 DS3XM-6 Card Specifications

Specification Type	Description
DS3XM-6 Input	Bit Rate: 44.736 Mbps +/- 20 ppm Frame Format: DS-3 ANSI T1.107-1988 Line Code: B3ZS Termination: Unbalanced coaxial cable Input Impedance: 75 ohms +/-5% Cable Loss: Max 450 ft. 734A, RG-59, 728A/Max 79 ft. RG-179 AIS: TR-TSY-000191-compliant
DS3XM-6 Output	Bit Rate: 44.736 Mbps +/- 20 ppm Frame Format: DS-3 ANSI T1.107-1988 Line Code: B3ZS Termination: Unbalanced coaxial cable Input Impedance: 75 ohms +/-5% Cable Loss: Max 450 ft. 734A, RG-59, 728A/Max 79 ft. RG-179 AIS: TR-TSY-000191-compliant Power Level: -1.8 - +5.7 dBm Pulse Shape: ANSI T1.102-1988 Figure 8 Pulse Amplitude: 0.36 - 0.85 V peak-to-peak Loopback Modes: Terminal and Facility Line Build Out: 0-225 ft.; 226-450 ft.
DS3XM-6 Electrical Interface	Connectors: BNC or SMB
Surge Protection	GR-1089
Operating Temperature	C-Temp (15454-DS3XM-6): 0 to +55 degrees Celsius I-Temp (15454-DS3XM-6-T): -40 to +65 degrees Celsius **Note** The I-Temp symbol is displayed on the faceplate of an I-Temp compliant card. A card without this symbol is C-Temp compliant.
Operating Humidity	5 - 95%, non-condensing
Power Consumption	20 W, 0.42 amps, 68 BTU/Hr.
Dimensions	Height: 12.650 in. Width: 0.716 in. Depth: 9.000 in. Card Weight: 1.8 lbs, 0.8 kg
Compliance	ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950

3.7 Electrical Card Comparisons

Table 3-11 Electrical Card Power Requirements

Card Type	Card Name	Watts	Amps	BTU/Hr.
Electrical Cards	EC1-12	36.60	0.76	124.97
	DS1-14	12.60	0.26	43.02
	DS1N-14	12.60	0.26	43.02
	DS3-12	38.20	0.79	130.43
	DS3N-12	38.20	0.79	130.43
	DS3-12E	26.80	0.56	91.51
	DS3N-12E	26.80	0.56	91.51
	DS3XM-6 Transmux *	20	0.42	68

Table 3-12 Electrical Card Temperature Ranges

Card	C-Temp Product Name (0 to +55 degrees Celsius)	I-Temp Product Name (-40 to +65 degrees Celsius)
EC1-12	15454-EC1-12	15454-EC1-12-T
DS1-14	15454-DS1-14	15454-DS1-14-T
DS1N-14	15454-DS1N-14	15454-DS1N-14-T
DS3-12	15454-DS3-12	15454-DS3-12-T
DS3N-12	15454-DS3N-12	15454-DS3N-12-T
DS3-12E	—	15454-DS3-12E-T
DS3N-12E	—	15454-DS3N-12E-T
DS3XM-6 (Transmux)	15454-DS3XM-6	15454-DS3XM-6-T

3.8 Electrical Interface Assemblies

Optional EIA backplane covers are typically pre-installed when ordered with the ONS 15454. EIAs must be ordered when using DS-1, DS-3, DS3XM-6, or EC-1 cards. A minimum amount of assembly may be required when EIAs are ordered separately from the ONS 15454. Four different EIA backplane covers are available for the ONS 15454: BNC, High-Density BNC, SMB, and AMP Champ. This section describes each EIA in detail. If the shelf was not shipped with the correct EIA interface, you must order and install the correct EIA.

EIAs are attached to the shelf assembly backplane to provide electrical interface cable connections. EIAs are available with SMB and BNC connectors for DS-3 or EC-1 cards. EIAs are available with AMP Champ connectors for DS-1 cards. You must use SMB EIAs for DS-1 twisted-pair cable installation. You can install EIAs on one or both sides of the ONS 15454 backplane in any combination (in other words, AMP Champ on Side A and BNC on Side B or High-Density BNC on side A and SMB on side B, and so forth).

EIAs have two sides. As you face the rear of the ONS 15454 shelf assembly, the right-hand side is the A side and the left-hand side is the B side. You can install EIAs on one or both sides of the ONS 15454 backplane in any combination. For example, you can use an AMP Champ EIA on side A and a BNC EIA on side B. The top of the EIA connector columns are labelled with the corresponding slot number, and EIA connector pairs are marked Tx and Rx to correspond to transmit and receive cables. EIAs come pre-installed on the ONS 15454 when ordered with the node.

If you are installing EIAs after the shelf assembly is installed, plug the EIA into the backplane. The EIA has six electrical connectors that plug into six corresponding backplane connectors. The EIA backplane must replace the standard sheet metal cover to provide access to the coaxial cable connectors. The EIA sheet metal covers use the same screw holes as the solid backplane panels, but they have 12 additional 6-32 x 1/2 inch phillips screw holes so you can screw down the cover and the board using standoffs on the EIA board. This section describes each EIA.

Table 3-13 gives the product numbers and common names for EIAs.

Table 3-13 EIA Configurations

EIA Type	Cards Supported	A Side Hosts	A Side Columns Map to	A Side Product Number	B Side Hosts	B Side Columns Map to	B Side Product Number
BNC	DS-3 DS3XM-6 EC-1	24 pairs of BNC connectors	Slot 2 Slot 4	15454-EIA-BNC-A24	24 pairs of BNC connectors	Slot 14 Slot 16	15454-EIA-BNC-B24
High-Density BNC	DS-3 DS3XM-6 EC-1	48 pairs of BNC connectors	Slot 1 Slot 2 Slot 4 Slot 5	15454-EIA-BNC-A48	48 pairs of BNC connectors	Slot 13 Slot 14 Slot 16 Slot 17	15454-EIA-BNC-B48
SMB	DS-1 DS-3 EC-1 DS3XM-6	84 pairs of SMB connectors	Slot 1 Slot 2 Slot 3 Slot 4 Slot 5 Slot 6	15454-EIA-SMB-A84	84 pairs of SMB connectors	Slot 12 Slot 13 Slot 14 Slot 15 Slot 16 Slot 17	15454-EIA-SMB-B84
AMP Champ	DS-1	6 AMP Champ connectors	Slot 1 Slot 2 Slot 3 Slot 4 Slot 5 Slot 6	15454-EIA-AMP-A84	6 AMP Champ connectors	Slot 12 Slot 13 Slot 14 Slot 15 Slot 16 Slot 17	15454-EIA-AMP-B84

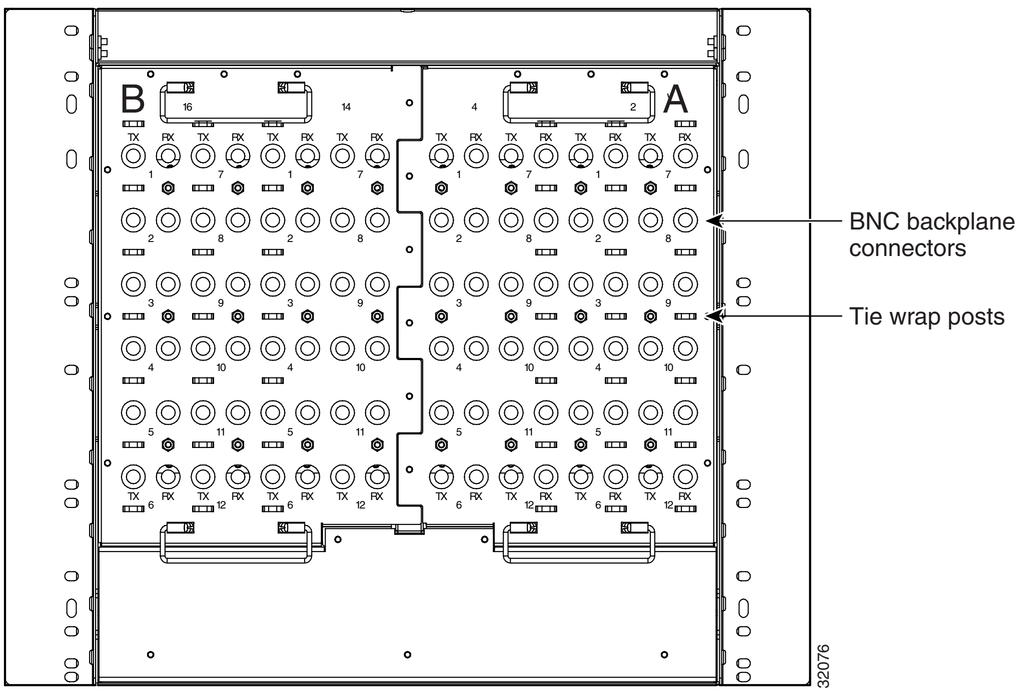
3.8.1 BNC EIA

The ONS 15454 BNC EIA supports 24 DS-3 circuits on each side of the ONS 15454 (24 transmit and 24 receive connectors). If you install BNC EIAs on both sides of the shelf assembly, the ONS 15454 hosts up to 48 circuits. The BNC connectors on the EIA supports Trompeter UCBJ224 (75 Ohm) 4 leg connectors (King or ITT are also compatible). Right-angle mating connectors for the connecting cable are AMP 413588-2 (75 Ohm) connectors. If preferred, you can also use a straight connector of the same type. Use RG-59/U cable to connect to the ONS 15454 BNC EIA. These cables are recommended to connect to a patch panel and are designed for long runs of up to 450 feet. You can use BNC EIAs for DS-3 (including the DS3XM-6) or EC-1 cards.

Figure 3-9 shows the ONS 15454 with pre-installed BNC EIAs.

To install coaxial cable with BNC connectors, refer to the *Cisco ONS 15454 Procedure Guide*.

Figure 3-9 A BNC backplane for use in 1:1 protection schemes



3.8.1.1 BNC Connectors

The EIA side marked "A" has 24 pairs of BNC connectors. The first 12 pairs of BNC connectors correspond to Ports 1–12 for a 12-port card and map to Slot 2 on the shelf assembly. The BNC connector pairs are marked "Tx" and "Rx" to indicate transmit and receive cables for each port. You can install an additional card in Slot 1 as a protect card for the card in Slot 2. The second 12 BNC connector pairs correspond to Ports 1–12 for a 12-port card and map to Slot 4 on the shelf assembly. You can install an additional card in Slot 3 as a protect card for the card in Slot 4. Slots 5 and 6 do not support DS-3 cards when BNC connectors are used.

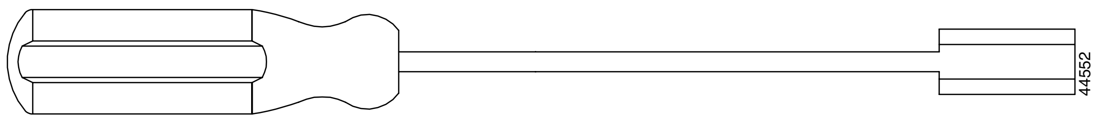
The EIA side marked "B" provides an additional 24 pairs of BNC connectors. The first 12 BNC connector pairs correspond to Ports 1–12 for a 12-port card and map to Slot 14 on the shelf assembly. The BNC connector pairs are marked "Tx" and "Rx" to indicate transmit and receive cables for each port. You can install an additional card in Slot 15 as a protect card for the card in Slot 14. The second 12 BNC connector pairs correspond to Ports 1–12 for a 12-port card and map to Slot 16 on the shelf assembly. You can install an additional card in Slot 17 as a protect card for the card in Slot 16. Slots 12 and 13 do not support DS-3 cards when BNC connectors are used.

When BNC connectors are used with a DS3N-12 card in Slot 3 or 15, the 1:N card protection extends only to the two slots adjacent to the 1:N card due to BNC wiring constraints.

3.8.1.2 BNC Insertion and Removal Tool

Due to the large number of BNC connectors on the High-Density BNC EIA, you might require a special tool for inserting and removing BNC EIAs (Figure 3-10). This tool also helps with ONS 15454 patch panel connections.

Figure 3-10 BNC insertion and removal tool



This tool can be obtained with P/N 227-T1000 from:

Amphenol USA (www.amphenol.com)

One Kennedy Drive

Danbury, CT 06810

Phone: 203-743-9272 Fax: 203-796-2032

This tool can be obtained with P/N RT-1L from:

Trompeter Electronics Inc. (www.trompeter.com)

31186 La Baya Drive

Westlake Village, CA 91362-4047

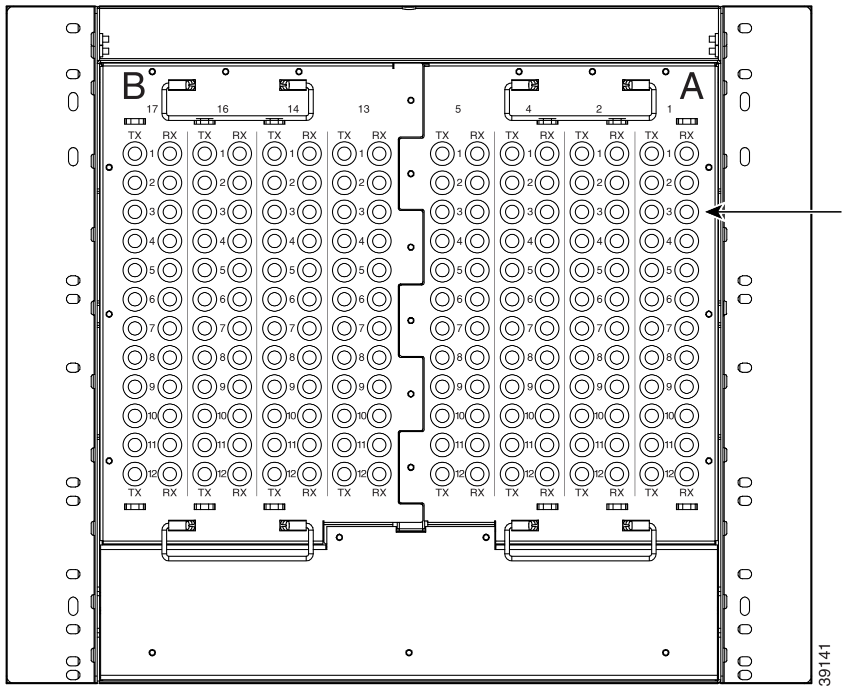
Phone: (800) 982-2629 Fax: (818) 706-1040

3.8.2 High-Density BNC EIA

The ONS 15454 High-Density BNC EIA supports 48 DS-3 circuits on each side of the ONS 15454 (48 transmit and 48 receive connectors). If you install BNC EIAs on both sides of the unit, the ONS 15454 hosts up to 96 circuits. The High-Density BNC EIA supports Trompeter UCBJ224 (75 Ohm) 4 leg connectors (King or ITT are also compatible). Use straight connectors on RG-59/U cable to connect to the High-Density BNC EIA. Cisco recommends these cables for connection to a patch panel; they are designed for long runs of up to 450 feet. You can use High-Density BNC EIAs for DS-3 (including the DS3XM-6) or EC-1 cards. Figure 3-11 shows the ONS 15454 with pre-installed High-Density BNC EIAs.

To install coaxial cable with High-Density BNC connectors, refer to the *Cisco ONS 15454 Procedure Guide*.

Figure 3-11 A High-Density BNC backplane for use in 1:N protection schemes



The EIA side marked "A" hosts 48 pairs of BNC connectors. Each column of connector pairs is numbered and corresponds to the slot of the same number. The first column (12 pairs) of BNC connectors corresponds to Slot 1 on the shelf assembly, the second column to Slot 2, the third column to Slot 4, and the fourth column to Slot 5. The rows of connectors correspond to Ports 1–12 of a 12-port card.

The EIA side marked "B" provides an additional 48 pairs of BNC connectors. The first column (12 pairs) of BNC connectors corresponds to Slot 13 on the shelf assembly, the second column to Slot 14, the third column to Slot 16, and the fourth column to Slot 17. The rows of connectors correspond to Ports 1–12 of a 12-port card. The BNC connector pairs are marked "Tx" and "Rx" to indicate transmit and receive cables for each port. The High-Density BNC EIA supports both 1:1 and 1:N protection across all slots.

3.8.3 SMB EIA

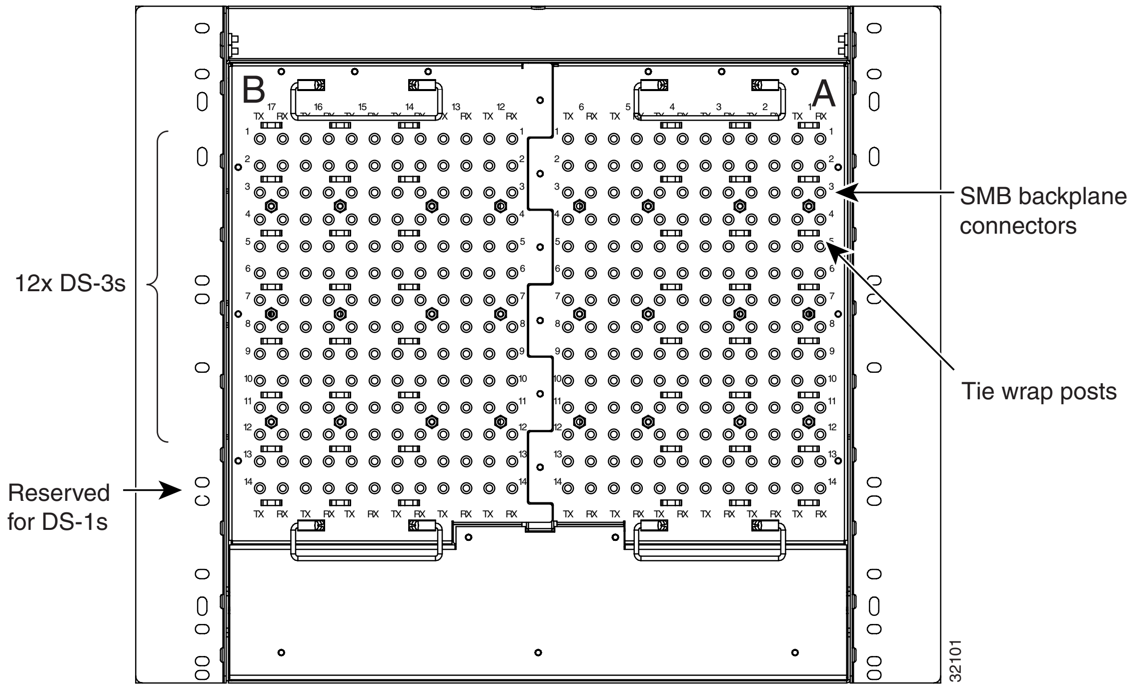
The ONS 15454 SMB EIA supports AMP 415484-1 75 Ohm 4 leg connectors. Right-angle mating connectors for the connecting cable are AMP 415484-2 (75 Ohm) connectors. Use RG-179/U cable to connect to the ONS 15454 EIA. Cisco recommends these cables for connection to a patch panel; they are not designed for long runs (over 50 feet). Range does not affect loopback testing.

You can use SMB EIAs with DS-1, DS-3 (including the DS3XM-6), and EC-1 cards. If you use DS-1 cards, use the DS-1 electrical interface adapter to terminate the twisted pair DS-1 cable from the backplane (see the "Electrical Interface Adapters" section on page 3-32). SMB EIAs support 14 ports per slot when used with a DS-1 card, 12 ports per slot when used with a DS-3 or EC-1 card, and 6 ports per slot when used with a DS3XM-6 card.

Figure 3-12 shows the ONS 15454 with pre-installed SMB EIAs and the sheet metal cover and screw locations for the EIA. The SMB backplane cover is similar to the BNC cover. The SMB connectors on the EIA are AMP 415504-3 (75 Ohm) 4 leg connectors.

To install SMB connectors, refer to the *Cisco ONS 15454 Procedure Guide*.

Figure 3-12 An SMB EIA backplane



The SMB EIA has 84 transmit and 84 receive connectors on each side of the ONS 15454 for a total of 168 SMB connectors (84 circuits).

The EIA side marked "A" hosts 84 SMB connectors in six columns of 14 connectors. The "A" side columns are numbered 1–6 and correspond to Slots 1–6 on the shelf assembly. The EIA side marked "B" hosts an additional 84 SMB connectors in six columns of 14 connectors. The "B" side columns are numbered 12–17 and correspond to Slots 12–17 on the shelf assembly. The connector rows are numbered 1–14 and correspond to the 14 ports on a DS-1 card.

For DS-3 or EC-1, the EIA supports 72 transmit and 72 receive connectors, for a total of 144 SMB connectors (72 circuits). If you use a DS-3 or EC-1 card, only Ports 1–12 are active. If you use a DS3XM-6 card, only Ports 1 – 6 are active. The SMB connector pairs are marked "Tx" and "Rx" to identify transmit and receive cables for each port. If you use SMB connectors, you can install DS-1, DS-3, or EC-1 cards in any multispeed slot.

3.8.4 AMP Champ EIA

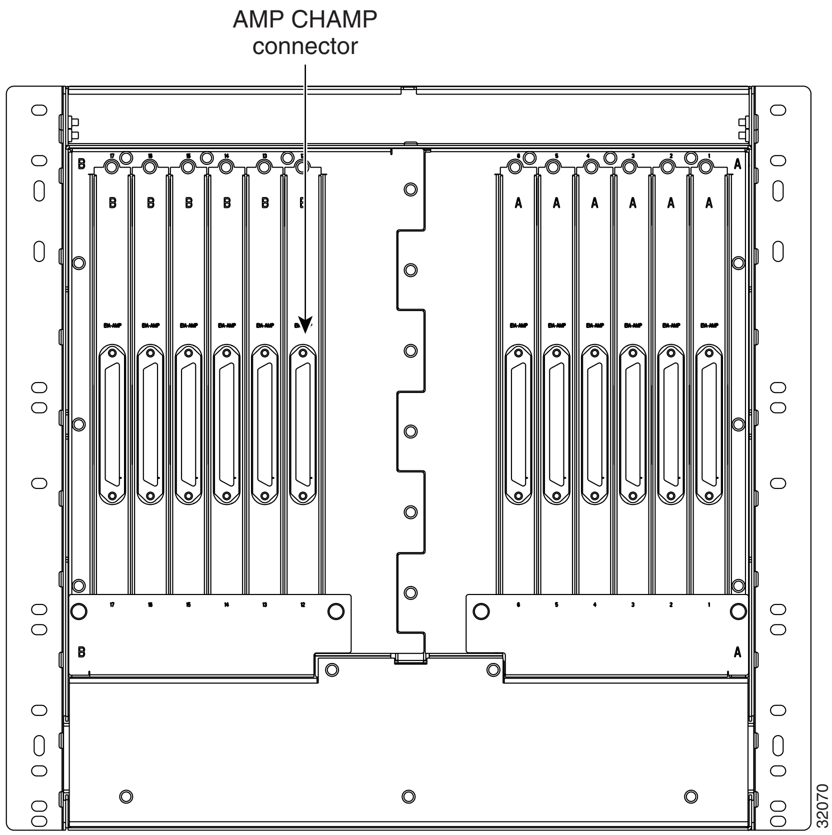
The ONS 15454 AMP Champ EIA supports 64-pin (32 pair) AMP Champ connectors for each slot on both sides of the shelf assembly where the EIA is installed. Cisco AMP Champ connectors are female AMP # 552246-1 with AMP # 552562-2 bail locks. Each AMP Champ connector supports 14 DS-1 ports. You can use AMP Champ EIAs with DS-1 cards only. Figure 3-13 shows the ONS 15454 with pre-installed AMP Champ EIAs and the corresponding sheet metal cover and screw locations for the EIA.

To install AMP Champ connector DS-1 cables, you must use 64-pin bundled cable connectors with a 64-pin male AMP Champ connector. You need an AMP Champ connector #552276-1 for the receptacle side and #1-552496-1 (for cable diameter .475in.–.540in) or #2-552496-1 (for cable diameter

.540in.–.605in.) for the right-angle shell housing (or their functional equivalent). The corresponding 64-pin female AMP Champ connector on the AMP Champ EIA supports one receive and one transmit for each DS-1 port for the corresponding card slot.

Because each DS1-14 card supports 14 DS-1 ports, only 56 pins (28 pairs) of the 64-pin connector are used. Prepare one 56-wire cable for each DS-1 facility installed. Table 3-14 shows the pin assignments for the AMP Champ connectors on the ONS 15454 AMP Champ EIA.

Figure 3-13 An AMP EIA Champ backplane



The EIA side marked "A" hosts six AMP Champ connectors. The connectors are numbered 1–6 for the corresponding slots on the shelf assembly. Each AMP Champ connector on the backplane supports 14 DS-1 ports for a DS1-14 card, and each connector features 28 live pairs—one transmit pair and one receive pair—for each DS-1 port.

The EIA side marked "B" hosts six AMP Champ connectors. The connectors are labeled 12–17 for the corresponding slots on the shelf assembly. Each AMP Champ connector on the backplane supports 14 DS-1 ports for a DS1-14 card, and each connector features 28 live pairs—one transmit pair and one receive pair—for each DS-1 port.

Note EIAs are hot-swappable. You do not need to disconnect power to install or remove EIAs.

Caution Always use an electrostatic discharge (ESD) wristband when working with a powered ONS 15454. Plug the wristband cable into the ESD jack located on the lower-right outside edge of the shelf assembly.

Table 3-14 Pin Assignments for AMP Champ Connectors (Shaded Area Corresponds to White/Orange Binder Group)

Signal/Wire	Pin	Pin	Signal/Wire	Signal/Wire	Pin	Pin	Signal/Wire
Tx Tip 1 white/blue	1	33	Tx Ring 1 blue/white	Rx Tip 1 yellow/orange	17	49	Rx Ring 1 orange/yellow
Tx Tip 2 white/orange	2	34	Tx Ring 2 orange/white	Rx Tip 2 yellow/green	18	50	Rx Ring 2 green/yellow
Tx Tip 3 white/green	3	35	Tx Ring 3 green/white	Rx Tip 3 yellow/brown	19	51	Rx Ring 3 brown/yellow
Tx Tip 4 white/brown	4	36	Tx Ring 4 brown/white	Rx Tip 4 yellow/slate	20	52	Rx Ring 4 slate/yellow
Tx Tip 5 white/slate	5	37	Tx Ring 5 slate/white	Rx Tip 5 violet/blue	21	53	Rx Ring 5 blue/violet
Tx Tip 6 red/blue	6	38	Tx Ring 6 blue/red	Rx Tip 6 violet/orange	22	54	Rx Ring 6 orange/violet
Tx Tip 7 red/orange	7	39	Tx Ring 7 orange/red	Rx Tip 7 violet/green	23	55	Rx Ring 7 green/violet
Tx Tip 8 red/green	8	40	Tx Ring 8 green/red	Rx Tip 8 violet/brown	24	56	Rx Ring 8 brown/violet
Tx Tip 9 red/brown	9	41	Tx Ring 9 brown/red	Rx Tip 9 violet/slate	25	57	Rx Ring 9 slate/violet
Tx Tip 10 red/slate	10	42	Tx Ring 10 slate/red	Rx Tip 10 white/blue	26	58	Rx Ring 10 blue/white
Tx Tip 11 black/blue	11	43	Tx Ring 11 blue/black	Rx Tip 11 white/orange	27	59	Rx Ring 11 orange/white
Tx Tip 12 black/orange	12	44	Tx Ring 12 orange/black	Rx Tip 12 white/green	28	60	Rx Ring 12 green/white
Tx Tip 13 black/green	13	45	Tx Ring 13 green/black	Rx Tip 13 white/brown	29	61	Rx Ring 13 brown/white
Tx Tip 14 black/brown	14	46	Tx Ring 14 brown/black	Rx Tip 14 white/slate	30	62	Rx Ring 14 slate/white
Tx Spare0+ N/A	15	47	Tx Spare0- N/A	Rx Spare0+ N/A	31	63	Rx Spare0- N/A
Tx Spare1+ N/A	16	48	Tx Spare1- N/A	Rx Spare1+ N/A	32	64	Rx Spare1- N/A

Table 3-15 shows the pin assignments for the AMP Champ connectors on the ONS 15454 AMP Champ EIA for a shielded DS1 cable.

Table 3-15 Pin Assignments for AMP Champ Connectors (shielded DS1 cable)

64-Pin Blue Bundle				64-Pin Orange Bundle			
Signal/Wire	**Pin**	**Pin**	**Signal/Wire**	**Signal/Wire**	**Pin**	**Pin**	**Signal/Wire**
Tx Tip 1 white/blue	1	33	Tx Ring 1 blue/white	Rx Tip 1 white/blue	17	49	Rx Ring 1 blue/white
Tx Tip 2 white/orange	2	34	Tx Ring 2 orange/white	Rx Tip 2 white/orange	18	50	Rx Ring 2 orange/white
Tx Tip 3 white/green	3	35	Tx Ring 3 green/white	Rx Tip 3 white/green	19	51	Rx Ring 3 green/white
Tx Tip 4 white/brown	4	36	Tx Ring 4 brown/white	Rx Tip 4 white/brown	20	52	Rx Ring 4 brown/white
Tx Tip 5 white/slate	5	37	Tx Ring 5 slate/white	Rx Tip 5 white/slate	21	53	Rx Ring 5 slate/white
Tx Tip 6 red/blue	6	38	Tx Ring 6 blue/red	Rx Tip 6 red/blue	22	54	Rx Ring 6 blue/red
Tx Tip 7 red/orange	7	39	Tx Ring 7 orange/red	Rx Tip 7 red/orange	23	55	Rx Ring 7 orange/red
Tx Tip 8 red/green	8	40	Tx Ring 8 green/red	Rx Tip 8 red/green	24	56	Rx Ring 8 green/red
Tx Tip 9 red/brown	9	41	Tx Ring 9 brown/red	Rx Tip 9 red/brown	25	57	Rx Ring 9 brown/red
Tx Tip 10 red/slate	10	42	Tx Ring 10 slate/red	Rx Tip 10 red/slate	26	58	Rx Ring 10 slate/red
Tx Tip 11 black/blue	11	43	Tx Ring 11 blue/black	Rx Tip 11 black/blue	27	59	Rx Ring 11 blue/black
Tx Tip 12 black/orange	12	44	Tx Ring 12 orange/black	Rx Tip 12 black/orange	28	60	Rx Ring 12 orange/black
Tx Tip 13 black/green	13	45	Tx Ring 13 green/black	Rx Tip 13 black/green	29	61	Rx Ring 13 green/black
Tx Tip 14 black/brown	14	46	Tx Ring 14 brown/black	Rx Tip 14 black/brown	30	62	Rx Ring 14 brown/black
Tx Tip 15 black/slate	15	47	Tx Tip 15 slate/black	Rx Tip 15 black/slate	31	63	Rx Tip 15 slate/black
Tx Tip 16 yellow/blue	16	48	Tx Tip 16 blue/yellow	Rx Tip 16 yellow/blue	32	64	Rx Tip 16 blue/yellow

When using DS-1 AMP Champ cables, you must equip the ONS 15454 with an AMP Champ connector EIA on each side of the backplane where DS-1 cables will terminate. Each AMP Champ connector on the EIA corresponds to a slot in the shelf assembly and is numbered accordingly. The AMP Champ connectors have screw-down tooling at each end of the connector.

3.8.5 EIA Replacement

The replacement procedure is the same for all the EIA types. However, installing the AMP Champ EIA requires the additional step of attaching the fastening plate to the bottom of the connector row. Before you attach a new EIA, you must remove the backplane cover or EIA already attached to the ONS 15454.

3.9 Coaxial Cable

Caution Always use the supplied ESD wristband when working with a powered ONS 15454. Plug the wristband cable into the ESD jack located on the lower-right outside edge of the shelf assembly.

When using ONS 15454 DS-3 electrical cables, the cables must terminate on an EIA installed on the ONS 15454 backplane. All DS-3 cables connected to the ONS 15454 DS-3 card must terminate with coaxial cables using the desired connector type to connect to the specified EIA.

The electromagnetic compatibility (EMC) performance of the system depends on good-quality DS-3 coaxial cables, such as Shuner Type G 03233 D, or the equivalent.

3.10 DS-1 Cable

DS-1s support AMP Champ connector cabling and twisted-pair wire-wrap cabling. Twisted-pair wire-wrap cables require SMB EIAs.

3.10.1 Twisted Pair Wire-Wrap Cables

Installing twisted-pair, wire-wrap DS-1 cables requires separate pairs of grounded twisted-pair cables for receive (in) and transmit (out). Prepare four cables, two for receive and two for transmit, for each DS-1 facility to be installed.

Caution Always use the supplied ESD wristband when working with a powered ONS 15454. Plug the wristband cable into the ESD jack located on the lower-right outside edge of the shelf assembly.

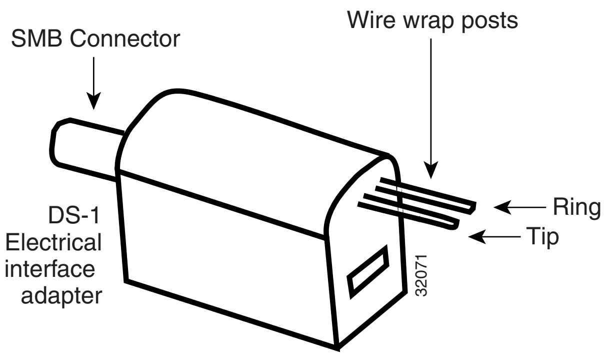
If you use DS-1 electrical twisted-pair cables, equip the ONS 15454 with an SMB EIA on each side of the backplane where DS-1 cables will terminate. You must install special DS-1 electrical interface adapters, commonly referred to as a balun, on every transmit and receive connector for each DS-1 termination.

3.10.2 Electrical Interface Adapters

Note DS-1 electrical interface adapters project an additional 1.72 inches from the ONS 15454 backplane.

If you install DS-1 cards in the ONS 15454, you must fit the corresponding transmit and receive SMB connectors on the EIA with a DS-1 electrical interface adapter. You can install the adapter on the SMB connector for the port. The adaptor has wire-wrap posts for DS-1 transmit and receive cables. Figure 3-14 shows the DS-1 electrical interface adapter.

Figure 3-14 DS-1 electrical interface adapter (balun)



Each DS-1 electrical interface adapter has a female SMB connector on one end and a pair of .045 inch square wire-wrap posts on the other end. The wire-wrap posts are .200 inches apart.

Caution Always use the supplied ESD wristband when working with a powered ONS 15454. Plug the wristband cable into the ESD jack located on the lower-right outside edge of the shelf assembly.

3.11 Cable Routing and Management

The ONS 15454 cable management facilities include the following:

- A cable-routing channel that runs the width of the shelf assembly
- Plastic horseshoe-shaped fiber guides at each side opening of the cable-routing channel that ensure the proper bend radius is maintained in the fibers

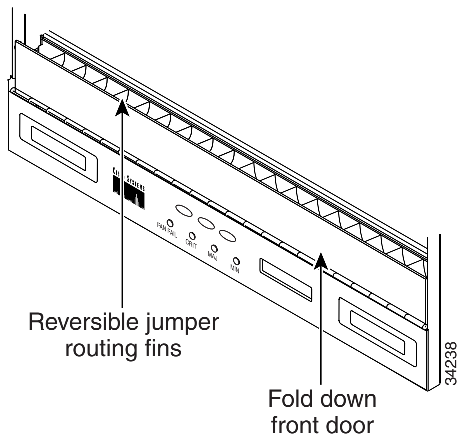
Note You can remove the fiber guide if necessary to create a larger opening (if you need to route CAT-5 Ethernet cables out the side, for example). To remove the fiber guide, take out the three screws that anchor it to the side of the shelf assembly.

- A fold-down door that provides access to the cable-management tray
- Cable tie-wrap facilities on EIAs that secure cables to the cover panel
- Reversible jumper routing fins that enable you to route cables out either side by positioning the fins as desired
- Jumper slack storage reels (2) on each side panel that reduce the amount of slack in cables that are connected to other devices

Note To remove the jumper slack storage reels, take out the screw in the center of each reel.

Figure 3-15 shows the cable management facilities that you can access through the fold-down front door, including the cable-routing channel and the jumper routing fins.

Figure 3-15 Managing cables on the front panel



3.11.1 Coaxial Cable Management

Coaxial cables connect to EIAs on the ONS 15454 backplane using cable connectors. EIAs feature cable-management eyelets for tie wrapping or lacing cables to the cover panel.

3.11.2 DS-1 Twisted-Pair Cable Management

Connect twisted pair/DS-1cables to SMB EIAs on the ONS 15454 backplane using cable connectors and DS-1 electrical interface adapters (baluns).

3.11.3 AMP Champ Cable Management

EIAs have cable management eyelets to tiewrap or lace cables to the cover panel. Tie wrap or lace the AMP Champ cables according to local site practice and route the cables. If you configure the ONS 15454 for a 23-inch rack, two additional inches of cable management area is available on each side of the shelf assembly.

Optical Cards

This chapter describes Cisco ONS 15454 card features and functions. For installation and card turn-up procedures, see the *Cisco ONS 15454 Procedure Guide*.

Chapter topics include:

4.1 Card Overview

The optical card overview section summarizes card functions, power consumption, temperature ranges, and compatibility.

Note Each card is marked with a symbol that corresponds to a slot (or slots) on the ONS 15454 shelf assembly. The cards are then installed into slots displaying the same symbols. See the "Card Slot Requirements" section on page 1-20 for a list of slots and symbols.

4.1.1 Optical Cards

Table 4-1 lists the Cisco ONS 15454 optical cards.

Table 4-1 Optical Cards for the ONS 15454

Card	Port Description	For Additional Information...
OC3 IR 4 SH 1310	The OC3 IR 4 1310 card provides four intermediate or short-range OC-3 ports. **Note** The OC3 IR 4 SH 1310 and OC3 IR 4/STM1 SH 1310 cards are functionally the same.	See the "OC3 IR 4/STM1 SH 1310 Card" section on page 4-7
OC12 IR 1310	The OC12 IR 1310 card provides one intermediate or short-range OC-12 port. **Note** The OC12 IR 1310 and OC12/STM4 SH 1310 cards are functionally the same.	See the "OC12 IR/STM4 SH 1310 Card" section on page 4-9
OC12 LR 1310	The OC12 LR 1310 card provides one long-range OC-12 port and operates at 1310 nm. **Note** The OC12 LR 1310 and OC12 LR/STM4 LH 1310 cards are functionally the same.	See the "OC12 LR/STM4 LH 1310 Card" section on page 4-12
OC12 LR 1550	The OC12 LR 1550 card provides one long-range OC-12 port and operates at 1550 nm. **Note** The OC12 LR 1550 and OC12 LR/STM4 LH 1550 cards are functionally the same.	See the "OC12 LR/STM4 LH 1550 Card" section on page 4-15
OC3 IR 4/ STM1 SH 1310	The OC3 IR 4/STM1 SH 1310 card provides four intermediate or short-range OC-3 ports.	See the "OC3 IR 4/STM1 SH 1310 Card" section on page 4-7
OC12 IR/STM4 SH 1310	The OC12 IR/STM4 SH 1310 card provides one intermediate or short-range OC-12 port.	See the "OC12 IR/STM4 SH 1310 Card" section on page 4-9
OC12 LR/ STM4 LH 1310	The OC12 LR/STM4 LH 1310 card provides one long-range OC-12 port and operates at 1310 nm.	See the "OC12 LR/STM4 LH 1310 Card" section on page 4-12
OC12 LR/ STM4 LH 1550	The OC12 LR/STM4 LH 1550 card provides one long-range OC-12 port and operates at 1550 nm.	See the "OC12 LR/STM4 LH 1550 Card" section on page 4-15
OC12/ STM4-4	The OC12/STM4-4 card provides four intermediate or short-range OC-12/STM-4 ports.	See the "OC12/STM4-4 Card" section on page 4-18
OC48 IR 1310	The OC48 IR 1310 card provides one intermediate-range OC-48 port and operates at 1310 nm. This card functions in slots 5, 6, 12, or 13 only.	See the "OC48 IR 1310 Card" section on page 4-21
OC48 LR 1550	The OC48 LR 1550 card provides one long-range OC-48 port and operates at 1550 nm. This card functions in slots 5, 6, 12, or 13 only.	See the "OC48 LR 1550 Card" section on page 4-24
OC48 IR/ STM16 SH AS 1310	The OC48 IR/STM16 SH AS 1310 card provides one intermediate-range OC-48 port and operates in any multispeed or high-speed card slot.	See the "OC48 IR/STM16 SH AS 1310 Card" section on page 4-27
OC48 LR/ STM16 LH AS 1550	The OC48 LR/STM16 LH AS 1550 card provides one long-range OC-48 port and operates in any multispeed or high-speed card slot.	See the "OC48 LR/STM16 LH AS 1550 Card" section on page 4-30

Table 4-1 Optical Cards for the ONS 15454 (continued)

Card	Port Description	For Additional Information...
OC48 ELR/ STM16 EH 100 GHz	Thirty-seven distinct OC48 ITU 100 GHz dense wavelength division multiplexing (DWDM) cards provide the ONS 15454 DWDM channel plan.	See the "OC48 ELR/STM16 EH 100 GHz Cards" section on page 4-33
OC48 ELR 200 GHz	Eighteen distinct OC48 ITU 200GHz DWDM cards provide the ONS 15454 DWDM channel plan.	See the "OC48 ELR 200 GHz Cards" section on page 4-37
OC192 LR/ STM64 LH 1550	The OC192 LR/STM64 LH 1550 card provides one long-range OC-192 port and operates at 1550 nm.	See the "OC192 LR/STM64 LH 1550 Card" section on page 4-40

4.1.2 Card Power Requirements

Table 4-2 lists power requirements for individual cards.

Note Asterisks (*) next to card or fan tray names mean the power specification shown below is based on a calculation because an actual measurement was not available at the time of publication.

Table 4-2 Individual Card Power Requirements

Card Name	Watts	Amps	BTU/Hr.
OC3 IR 4 SH 1310	19.20	0.40	65.56
OC12 IR 1310	10.90	0.23	37.22
OC12 LR 1310	10.90	0.23	37.22
OC12 LR 1550	9.28	0.19	31.68
OC3 IR 4/ STM1 SH 1310	19.20	0.40	65.56
OC12 IR/ STM4 SH 1310	10.90	0.23	37.22
OC12 LR/ STM4 LH 1310 *	12	0.25	41
OC12 LR/ STM4 LH 1550	9.28	0.19	31.68
OC12-4IR/STM4-4*	28	0.58	100
OC48 IR 1310	32.20	0.67	109.94
OC48 LR 1550	26.80	0.56	91.50
OC48 IR/ STM16 SH AS 1310	37.20	0.77	127.01
OC48 LR/ STM16 LH AS 1550	37.20	0.77	127.01
OC48 ELR/ STM16 EH 100 GHz	31.20	0.65	106.53
OC48 ELR 200 GHz	31.20	0.65	106.53
OC192 LR/ STM64 LH 1550	72.20	1.50	246.52

4.1.3 Card Temperature Ranges

Table 4-3 shows C-Temp and I-Temp compliant cards and their product names.

Note The I-Temp symbol is displayed on the faceplate of an I-Temp compliant card. A card without this symbol is C-Temp compliant.

Table 4-3 Optical Card Temperature Ranges and Product Names for the ONS 15454

Card	C-Temp Product Name (0 to +55 degrees Celsius)	I-Temp Product Name (-40 to +65 degrees Celsius)
OC3 IR 4/STM1 SH 1310	15454-OC34IR1310	15454-OC34I13-T
OC12 IR/STM4 SH 1310	15454-OC121IR1310	15454-OC121I13-T
OC12 LR/STM4 LH 1310	15454-OC121LR1310	15454-OC121L13-T
OC12 LR/STM4 LH 1550	15454-OC121LR1550	15454-OC121L15-T
OC12 IR/STM4 SH 1310-4	15454-OC12IR1310-4	—
OC48 IR 1310	15454-OC481IR1310	—
OC48 LR 1550	15454-OC481LR1550	—
OC48 IR/STM16 SH AS 1310	15454-OC481IR1310A	—
OC48 LR/STM16 LH AS 1550	15454-OC481LR1550A	—
OC192 LR/STM64 LH 1550	15454-OC192LR1550	—

Table 4-3 Optical Card Temperature Ranges and Product Names for the ONS 15454 (continued)

Card	C-Temp Product Name (0 to +55 degrees Celsius)	I-Temp Product Name (-40 to +65 degrees Celsius)
OC48 ELR/STM16 EH 100 GHz	15454-OC48E-1-28.7	—
	15454-OC48E-1-30.3	
	15454-OC48E-1-31.1	
	15454-OC48E-1-31.9	
	15454-OC48E-1-32.6	
	15454-OC48E-1-33.4	
	15454-OC48E-1-34.2	
	15454-OC48E-1-35.0	
	15454-OC48E-1-35.8	
	15454-OC48E-1-36.6	
	15454-OC48E-1-38.1	
	15454-OC48E-1-38.9	
	15454-OC48E-1-39.7	
	15454-OC48E-1-40.5	
	15454-OC48E-1-41.3	
	15454-OC48E-1-42.1	
	15454-OC48E-1-42.9	
	15454-OC48E-1-43.7	
	15454-OC48E-1-44.5	
	15454-OC48E-1-46.1	
	15454-OC48E-1-46.9	
	15454-OC48E-1-47.7	
	15454-OC48E-1-48.5	
	15454-OC48E-1-49.3	
	15454-OC48E-1-50.1	

Table 4-3 Optical Card Temperature Ranges and Product Names for the ONS 15454 (continued)

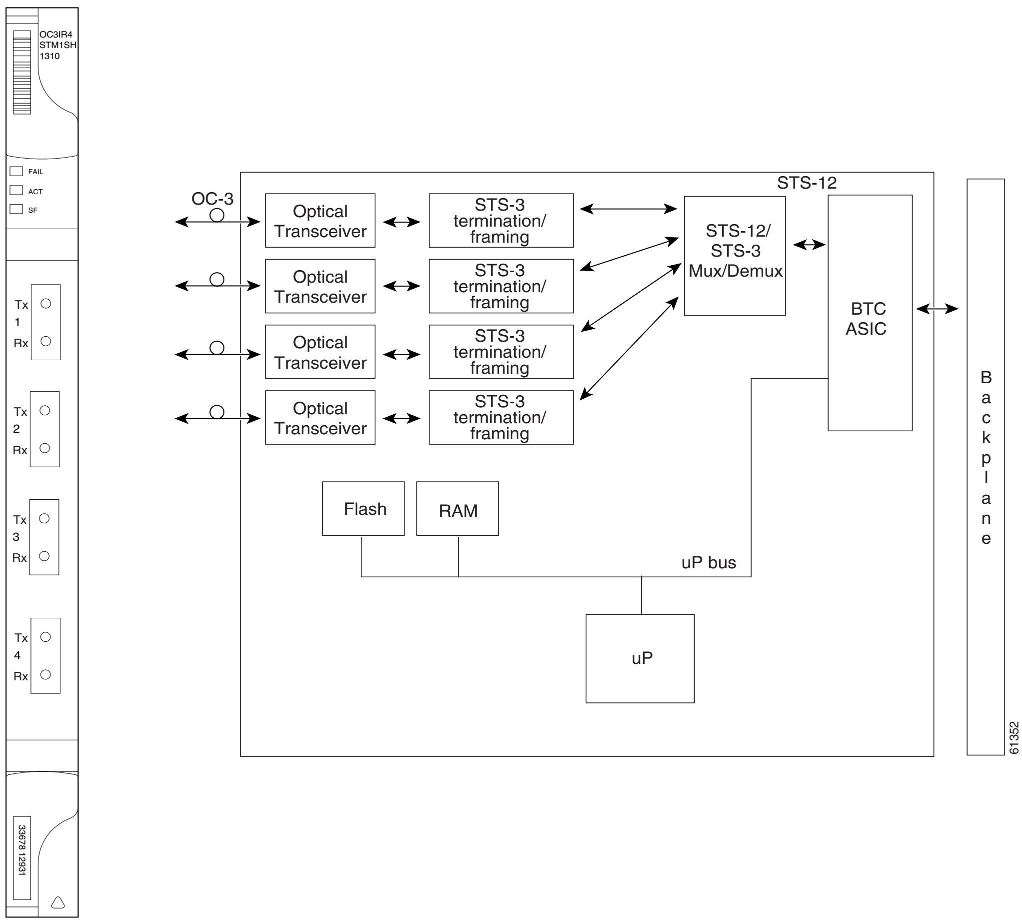
Card	C-Temp Product Name (0 to +55 degrees Celsius)	I-Temp Product Name (-40 to +65 degrees Celsius)
OC48 ELR/STM16 EH 100 GHz (continued)	15454-OC48E-1-50.9	—
	15454-OC48E-1-51.7	
	15454-OC48E-1-52.5	
	15454-OC48E-1-54.1	
	15454-OC48E-1-54.9	
	15454-OC48E-1-55.7	
	15454-OC48E-1-56.5	
	15454-OC48E-1-57.3	
	15454-OC48E-1-58.1	
	15454-OC48E-1-58.9	
	15454-OC48E-1-59.7	
	15454-OC48E-1-60.6	
OC48 ELR/STM16 EH 200 GHz	15454-OC48E-30.33	—
	15454-OC48E-31.90	
	15454-OC48E-33.47	
	15454-OC48E-35.04	
	15454-OC48E-36.61	
	15454-OC48E-38.19	
	15454-OC48E-39.77	
	15454-OC48E-31.35	
	15454-OC48E-42.94	
	15454-OC48E-47.72	
	15454-OC48E-49.32	
	15454-OC48E-50.92	
	15454-OC48E-52.52	
	15454-OC48E-54.13	
	15454-OC48E-55.75	
	15454-OC48E-57.36	
	15454-OC48E-58.98	
	15454-OC48E-60.61	

4.2 OC3 IR 4/STM1 SH 1310 Card

The OC3 IR 4/STM1 SH 1310 card provides four intermediate or short range SONET/SDH OC-3 ports compliant with the International Telecommunication Union's G.707, G.957, and Telcordia's GR-253. Each port operates at 155.52 Mbps over a single-mode fiber span. The card supports VT and non-concatenated or concatenated payloads at the STS-1 or STS-3c signal levels. Figure 4-1 shows the OC3 IR 4/STM1 SH 1310 faceplate and a diagram of the card.

Note The OC3 IR 4 SH 1310 and OC3 IR 4/STM1 SH 1310 cards are functionally the same.

Figure 4-1 OC3 IR 4/STM1 SH 1310 faceplate and block diagram



You can install the OC3 IR 4/STM1 SH 1310 card in any multispeed or high-speed card slot. The card can be provisioned as part of a unidirectional path switched ring (UPSR) or in a linear add-drop multiplexer (ADM) configuration. Each port features a 1310 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses SC connectors.

The OC3 IR 4/STM1 SH 1310 card supports 1+1 unidirectional or bidirectional protection switching. You can provision protection on a per port basis.

The OC3 IR 4/STM1 SH 1310 detects LOS, LOF, Loss of Pointer (LOP), line Alarm Indication Signal (AIS-L), and line Remote Defect Indication (RDI-L) conditions. See Alarm Troubleshooting in the Alarm Troubleshooting and Maintenance Guide for a description of these conditions. The card also counts section and line bit interleaved parity (BIP) errors.

4.2.1 OC3 IR 4/STM1 SH 1310 Card-Level Indicators

The OC3 IR 4/STM1 SH 1310 card has three card-level LED indicators.

Table 4-4 OC3 IR 4/STM1 SH 1310 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OC3 IR 4/STM1 SH 1310 card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, AIS-L or high BER on one or more of the card's ports. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

4.2.2 OC3 IR 4/STM1 SH 1310 Port-Level Indicators

You can find the status of the four card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

Warning **Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments or performance of procedures other than those specified may result in hazardous radiation exposure.**

4.2.3 OC3 IR 4/STM1 SH 1310 Card Specifications

- Line
  - Bit Rate:155.52 Mbps
  - Code: Scrambled NRZ
  - Fiber: 1310 nm single-mode
  - Loopback Modes: Terminal and Facility
  - Connector: SC
  - Compliance: Telcordia SONET, GR-GSY-00253, ITU-T G.707, ITU-T G.957
  - Transmitter
  - Max. Transmitter Output Power: -8 dBm

- Min. Transmitter Output Power: -15 dBm
- Center Wavelength: 1274 nm – 1356 nm
- Nominal Wavelength: 1310 nm
- Transmitter: Fabry Perot laser

- Receiver
  - Max. Receiver Level: -8 dBm
  - Min. Receiver Level: -28 dBm
  - Receiver: InGaAs/InP photo detector
  - Link Loss Budget: 13 dB
- Environmental
  - Operating Temperature:

    C-Temp (15454-OC34IR1310): 0 to +55 degrees Celsius

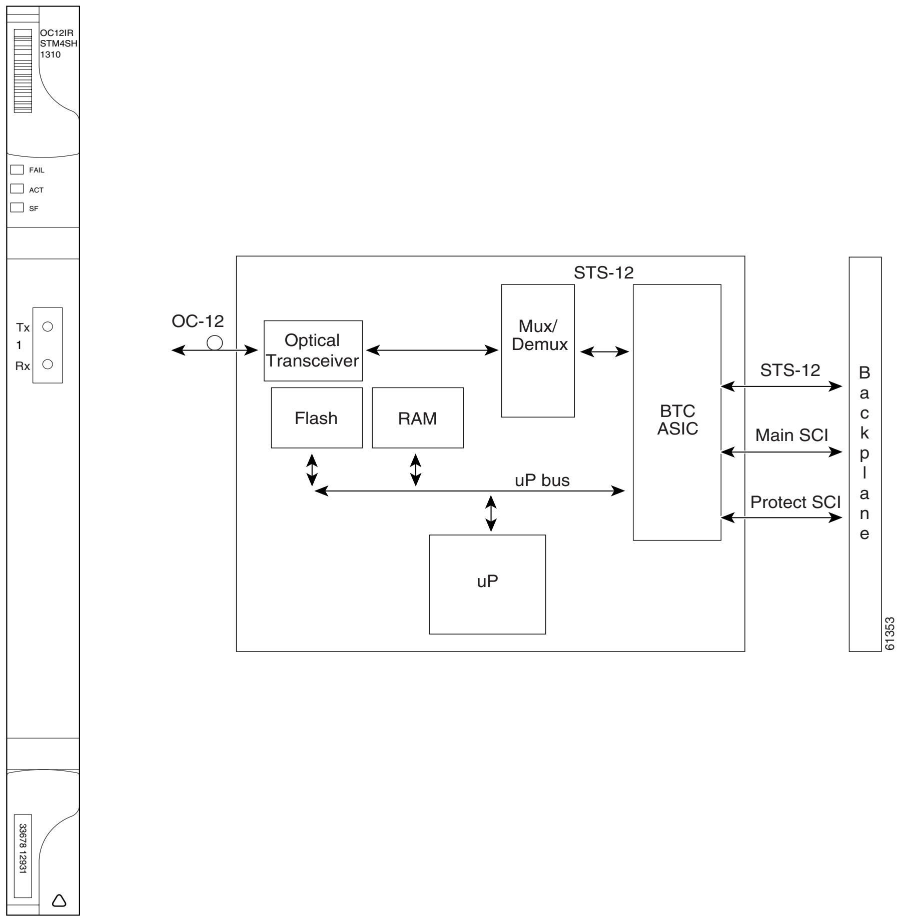
    I-Temp (15454-OC34I13-T): -40 to +65 degrees Celsius
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 19.20 W, 0.40 amps, 65.56 BTU/Hr.
- Dimensions
  - Height: 12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 1.0 lbs, 0.4 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950
  - Eye Safety Compliance: Class I

4.3 OC12 IR/STM4 SH 1310 Card

The OC12 IR/STM4 SH 1310 card provides one intermediate or short range SONET/SDH OC-12 port compliant with the International Telecommunication Union's G.707, G.957, and Telcordia's GR-253. The port operates at 622.08 Mbps over a single-mode fiber span. The card supports VT and non-concatenated or concatenated payloads at STS-1, STS-3c, STS-6c or STS-12c signal levels. Figure 4-2 shows the OC12 IR/STM4 SH 1310 faceplate and a block diagram of the card.

Note The OC12 IR 1310 and OC12/STM4 SH 1310 cards are functionally the same.

Figure 4-2 OC12 IR/STM4 SH 1310 faceplate and block diagram



You can install the OC12 IR/STM4 SH 1310 card in any multispeed or high-speed card slot and provision the card as a drop card or span card in a two-fiber BLSR, UPSR, or in ADM (linear) configurations.

The OC12 IR/STM4 SH 1310 port features a 1310 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The OC12 IR/STM4 SH 1310 uses SC optical connections and supports 1+1 unidirectional and bidirectional protection.

The OC12 IR/STM4 SH 1310 detects LOS, LOF, LOP, AIS-L, and RDI-L conditions. See the *Cisco ONS 15454 Troubleshooting Guide* for a description of these conditions. The card counts section and line BIT errors.

4.3.1 OC12 IR/STM4 SH 1310 Card-Level Indicators

The OC12 IR/STM4 SH 1310 card has three card-level LED indicators.

Table 4-5 OC12 IR/STM4 SH 1310 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OC12 IR/STM4 SH 1310 card is operational and is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, AIS-L or high BERs on the card's port. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

4.3.2 OC12 IR/STM4 SH 1310 Port-Level Indicators

You can find the status of the OC-12 card port using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

Warning **Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments or performance of procedures other than those specified may result in hazardous radiation exposure.**

4.3.3 OC12 IR/STM4 SH 1310 Card Specifications

- Line
  - Bit Rate: 622.08 Mbps
  - Code: Scrambled NRZ
  - Fiber: 1310 nm single-mode
  - Loopback Modes: Terminal and Facility
  - Connectors: SC
  - Compliance: Telcordia SONET, GR-GSY-00253, ITU-T G.707, ITU-T G.957
- Transmitter
  - Max. Transmitter Output Power: -8 dBm
  - Min. Transmitter Output Power: -15 dBm
  - Center Wavelength: 1274 nm – 1356 nm
  - Nominal Wavelength: 1310 nm
  - Transmitter: Fabry Perot laser

- Receiver
  - Max. Receiver Level: -8 dBm
  - Min. Receiver Level: -28 dBm
  - Receiver: InGa As/InP photo detector
  - Link Loss Budget: 13 dB
- Environmental
  - Operating Temperature:

    C-Temp (15454-OC121IR1310): 0 to +55 degrees Celsius

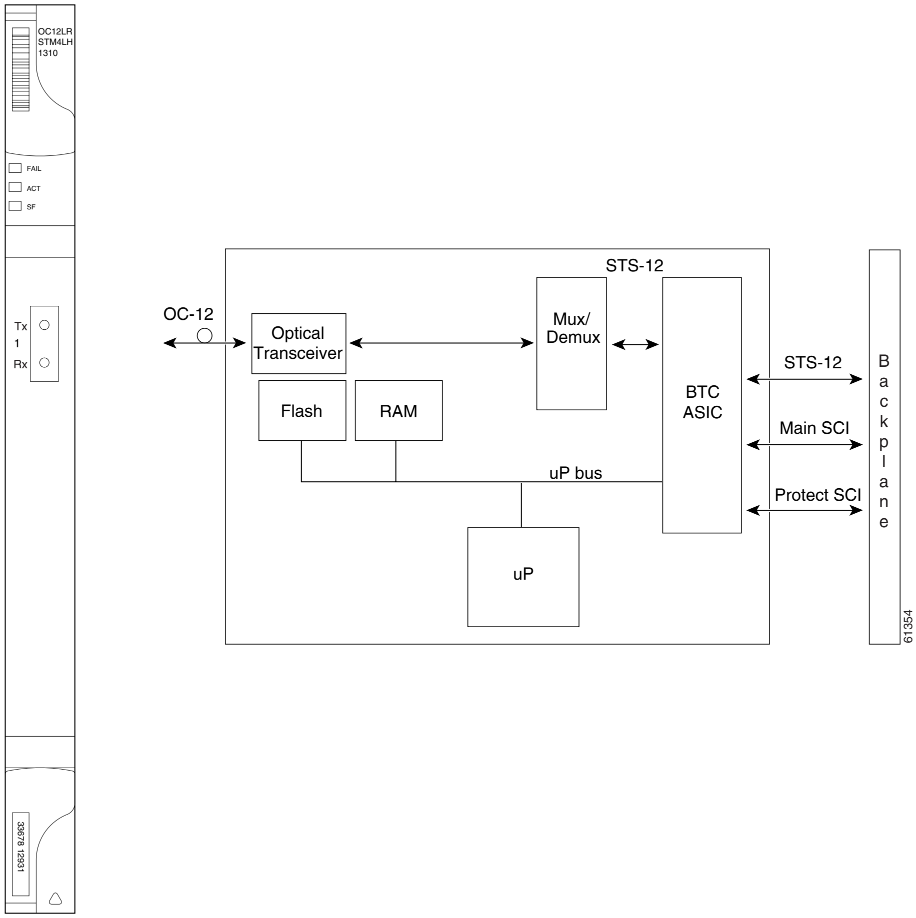
    I-Temp (15454-OC121I13-T): -40 to +65 degrees Celsius
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 10.90 W, 0.23 amps, 37.22 BTU/Hr.
- Dimensions
  - Height: 12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 1.4 lbs, 0.6 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950
  - Eye Safety Compliance: Class I

4.4 OC12 LR/STM4 LH 1310 Card

The OC12 LR/STM4 LH 1310 card provides one long-range, ITU-T G.707, ITU-T G.957, and Telcordia-compliant, GR-253 SONET OC-12 port per card. The port operates at 622.08 Mbps over a single-mode fiber span. The card supports VT and non-concatenated or concatenated payloads at STS-1, STS-3c, STS-6c or STS-12c signal levels. Figure 4-3 shows the OC12 LR/STM4 LH 1310 faceplate and a block diagram of the card.

Note The OC12 LR 1310 and OC12 LR/STM4 LH 1310 cards are functionally the same.

Figure 4-3 OC12 LR/STM4 LH 1310 faceplate and block diagram



You can install the OC12 LR/STM4 LH 1310 card in any multispeed or high-speed card slot and provision the card as a drop card or span card in a two-fiber BLSR (Bidirectional line switched ring), UPSR, or ADM (linear) configuration.

The OC12 LR/STM4 LH 1310 card port features a 1310 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses SC optical connections supporting 1+1 unidirectional and bidirectional protection.

The OC12 LR/STM4 LH 1310 detects LOS, LOF, LOP, AIS-L, and RDI-L conditions. The card also counts section and line BIT errors.

4.4.1 OC12 LR/STM4 LH 1310 Card-Level Indicators

The OC12 LR/STM4 LH 1310 card has three card-level LED indicators.

Table 4-6 OC12 LR/STM4 LH 1310 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OC12 LR/STM4 LH 1310 card is operational and is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, AIS-L or high BERs on the card's port. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

4.4.2 OC12 LR/STM4 LH 1310 Port-Level Indicators

You can find the status of the OC12 LR/STM4 LH 1310 card port using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to quickly view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

Warning **Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments or performance of procedures other than those specified may result in hazardous radiation exposure.**

4.4.3 OC12 LR/STM4 LH 1310 Card Specifications

- Line
  - Bit Rate: 622.08 Mbps
  - Code: Scrambled NRZ
  - Fiber: 1310 nm single-mode
  - Loopback Modes: Terminal and Facility
  - Connectors: SC
  - Compliance: Telcordia SONET, GR-253-CORE, ITU-T G.707, ITU-T G.957
- Transmitter
  - Max. Transmitter Output Power: +2 dBm
  - Min. Transmitter Output Power: -3 dBm
  - Center Wavelength: 1280 nm – 1335 nm
  - Nominal Wavelength: 1310 nm
  - Transmitter: Distributed feedback laser

- Receiver
  - Max. Receiver Level: -8 dBm
  - Min. Receiver Level: -28 dBm
  - Receiver: InGaAs/InP photo detector
  - Link Loss Budget: 25 dB
- Environmental
  - Operating Temperature:

    C-Temp (15454-OC121LR1310): 0 to +55 degrees Celsius

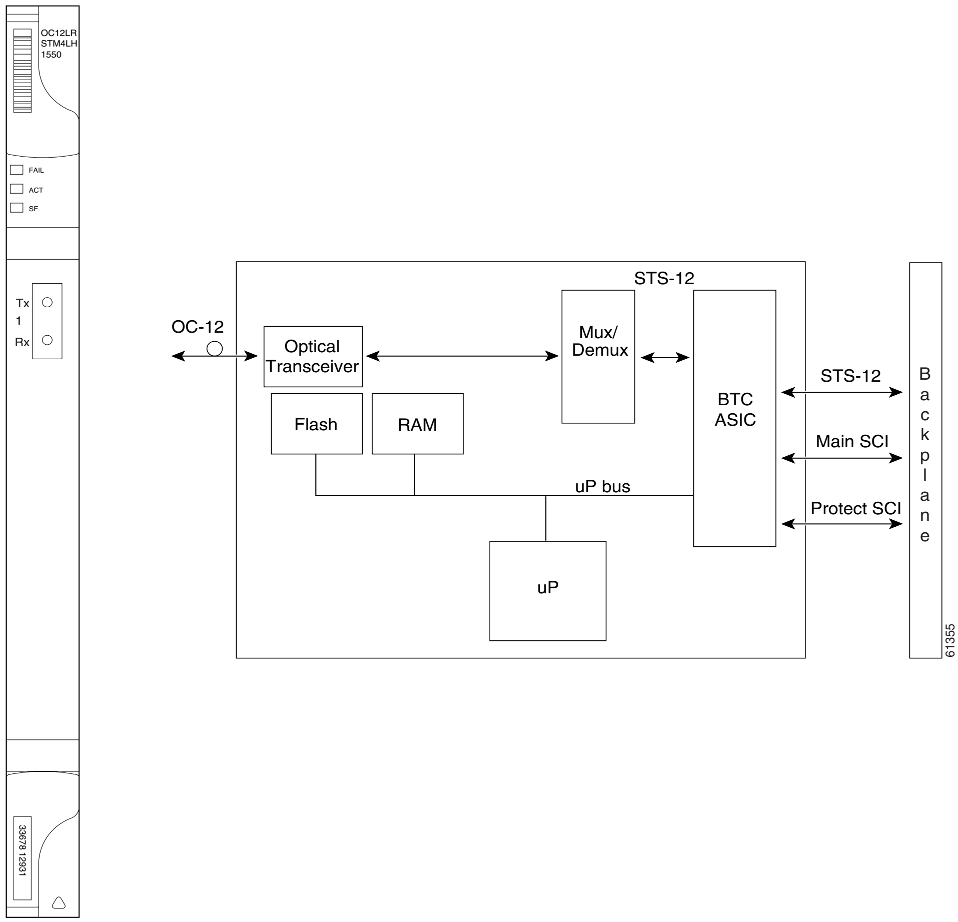
    I-Temp (15454-OC121L13-T): -40 to +65 degrees Celsius
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 9.28 W, 0.25 amps, 41BTU/Hr.
- Dimensions
  - Height: 12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 1.4 lbs, 0.6 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950
  - Eye Safety Compliance: Class I

4.5 OC12 LR/STM4 LH 1550 Card

The OC12 LR/STM4 LH 1550 card provides one long-range SONET/SDH OC-12 port compliant with the International Telecommunication Union’s G.707, G.957, and Telcordia’s GR-253. The port operates at 622.08 Mbps over a single-mode fiber span. The card supports VT and non-concatenated, or concatenated payloads at STS-1, STS-3c, STS-6c, or STS-12c signal levels. Figure 4-4 shows the OC12 LR/STM4 LH 1550 faceplate and a block diagram of the card.

Note The OC12 LR 1550 and OC12 LR/STM4 LH 1550 cards are functionally the same.

Figure 4-4 OC12 LR/STM4 LH 1550 faceplate and block diagram



You can install the OC12 LR/STM4 LH 1550 card in any multispeed card slot. The OC12 LR/STM4 LH 1550 can be provisioned as part of a two-fiber BLSR, UPSR or linear ADM.

The OC12 LR/STM4 LH 1550 uses long-reach optics centered at 1550 nm and contains a transmit and receive connector (labeled) on the card faceplate. The OC12 LR/STM4 LH 1550 uses SC optical connections and supports 1+1 bidirectional or unidirectional protection switching.

The OC12 LR/STM4 LH 1550 detects LOS, LOF, LOP, AIS-L, and RDI-L conditions. The card also counts section and line BIT errors.

4.5.1 OC12 LR/STM4 LH 1550 Card-Level Indicators

The OC12 LR/STM4 LH 1550 card has three card-level LED indicators.

Table 4-7 OC12 LR/STM4 LH 1550 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OC12 LR/STM4 LH 1550 card is operational and ready to carry traffic.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, AIS-L or high BERs on the card's port. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

4.5.2 OC12 LR/STM4 LH 1550 Port-Level Indicators

You can find the status of the OC12 LR/STM4 LH 1550 card port using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

Warning **Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments or performance of procedures other than those specified may result in hazardous radiation exposure.**

4.5.3 OC12 LR/STM4 LH 1550 Card Specifications

- Line
  - Bit Rate: 622.08 Mbps
  - Code: Scrambled NRZ
  - Fiber: 1550 nm single-mode
  - Loopback Modes: Terminal and Facility
  - Connectors: SC
  - Compliance: Telcordia SONET, GR-253-CORE, ITU-T G.707, ITU-T G.957
- Transmitter
  - Max. Transmitter Output Power: +2 dBm
  - Min. Transmitter Output Power: -3 dBm
  - Center Wavelength: 1480 nm – 1580 nm
  - Nominal Wavelength: 1550 nm
  - Transmitter: Distributed feedback laser

- Receiver
  - Max. Receiver Level: -8 dBm
  - Min. Receiver Level: -28 dBm
  - Receiver: InGaAs/InP photo detector
  - Link Loss Budget: 25 dB
- Environmental
  - Operating Temperature:

    C-Temp (15454-OC121LR1550): 0 to +55 degrees Celsius

    I-Temp (15454-OC121L15-T): -40 to +65 degrees Celsius
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 9.28 W, 0.19 amps, 31.68 BTU/Hr.
- Dimensions
  - Height: 12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 1.4 lbs, 0.6 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950
  - Eye Safety Compliance: Class I

4.6 OC12/STM4-4 Card

The OC12/STM4-4 card provides four intermediate or short range SONET/SDH OC-12/STM-4 ports compliant with the International Telecommunication Union's G.707, G.957, and Telcordia's GR-253. Each port operates at 622.08 Mbps over a single-mode fiber span. The card supports VT and non-concatenated or concatenated payloads at the STS-1, STS-3c, STS-6c, or STS-12c signal levels.

The OC12/STM4-4 card supports 1+1 unidirectional or bidirectional protection switching. You can provision protection on a per port basis.

The OC12/STM4-4 detects LOS, LOF, Loss of Pointer (LOP), line Alarm Indication Signal (AIS-L), and line Remote Defect Indication (RDI-L) conditions. The card also counts section and line bit interleaved parity (BIP) errors.

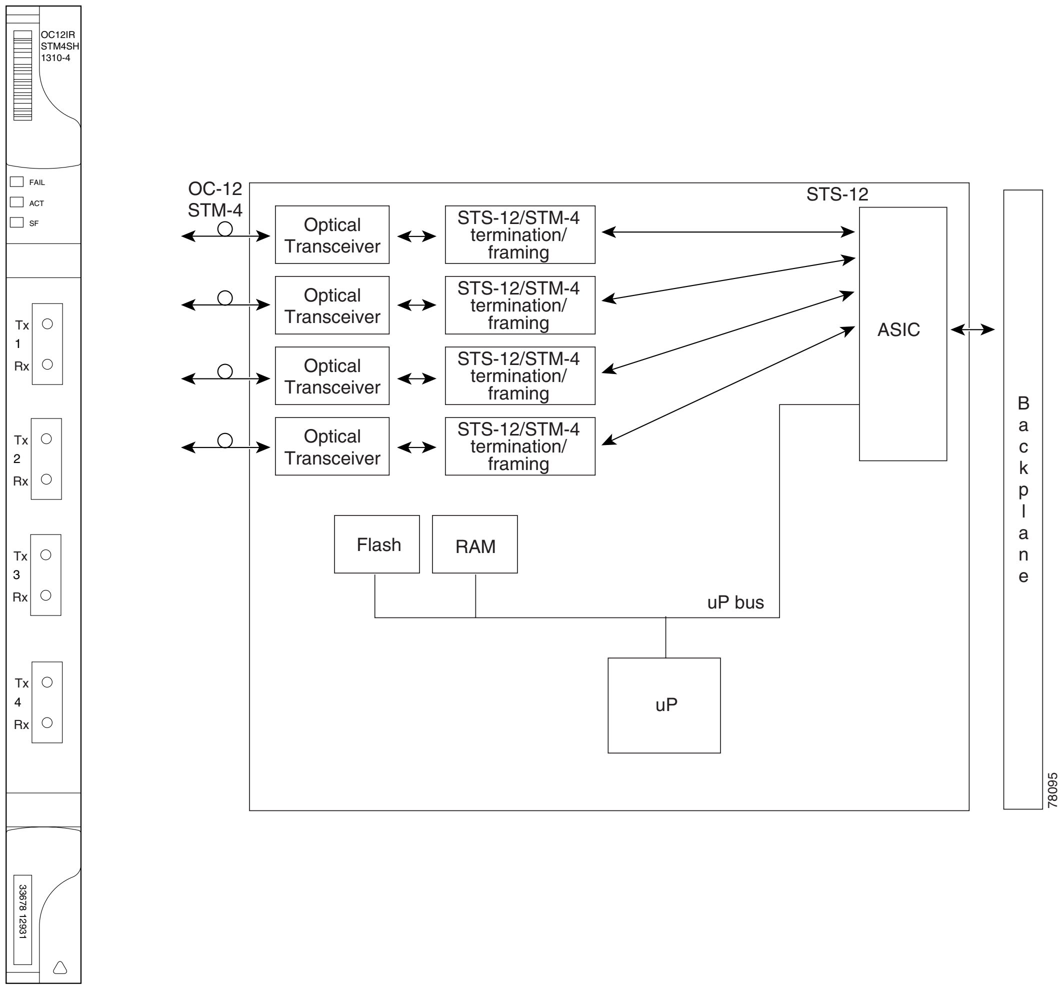
4.6.1 OC12/STM4-4 Slots and Connectors

You can install the OC12/STM4-4 card in any multispeed card slot. The card can be provisioned as part of a unidirectional path switched ring (UPSR) or in a linear add-drop multiplexer (ADM) configuration. Each port features a 1310 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses SC connectors.

4.6.2 OC12/STM4-4 Faceplate and Block Diagram

Figure 4-1 shows the OC12/STM4-4 faceplate and a diagram of the card.

Figure 4-5 OC12/STM4-4 faceplate and block diagram



4.6.3 OC12/STM4-4 Card-Level Indicators

The OC12/STM4-4 card has three card-level LED indicators.

Table 4-8 OC12/STM4-4 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. Replace the card if the red FAIL LED persists.

Table 4-8 OC12/STM4-4 Card-Level Indicators (continued)

Card-Level Indicators	Description
Green ACT LED	The green ACT LED indicates that the OC12/STM4-4 card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, AIS-L or high BER on one or more of the card's ports. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

4.6.4 OC12/STM4-4 Port-Level Indicators

You can find the status of the four card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

Warning **Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments or performance of procedures other than those specified may result in hazardous radiation exposure.**

4.6.5 OC12/STM4-4 Specifications

- Line
  - Bit Rate: 622.08 Mbps
  - Code: Scrambled NRZ
  - Fiber: 1310 nm single-mode
  - Loopback Modes: Terminal and Facility
  - Connector: SC
  - Compliance: Telcordia SONET, GR-GSY-00253, ITU-T G.707, ITU-T G.957
  - Transmitter
  - Max. Transmitter Output Power: -8 dBm
  - Min. Transmitter Output Power: -15 dBm
  - Center Wavelength: 1274 nm – 1356 nm
  - Nominal Wavelength: 1310 nm
  - Transmitter: Fabry Perot laser
- Receiver
  - Max. Receiver Level: -8 dBm
  - Min. Receiver Level: -30 dBm
  - Receiver: InGaAs/InP photo detector
  - Link Loss Budget: 15 dB

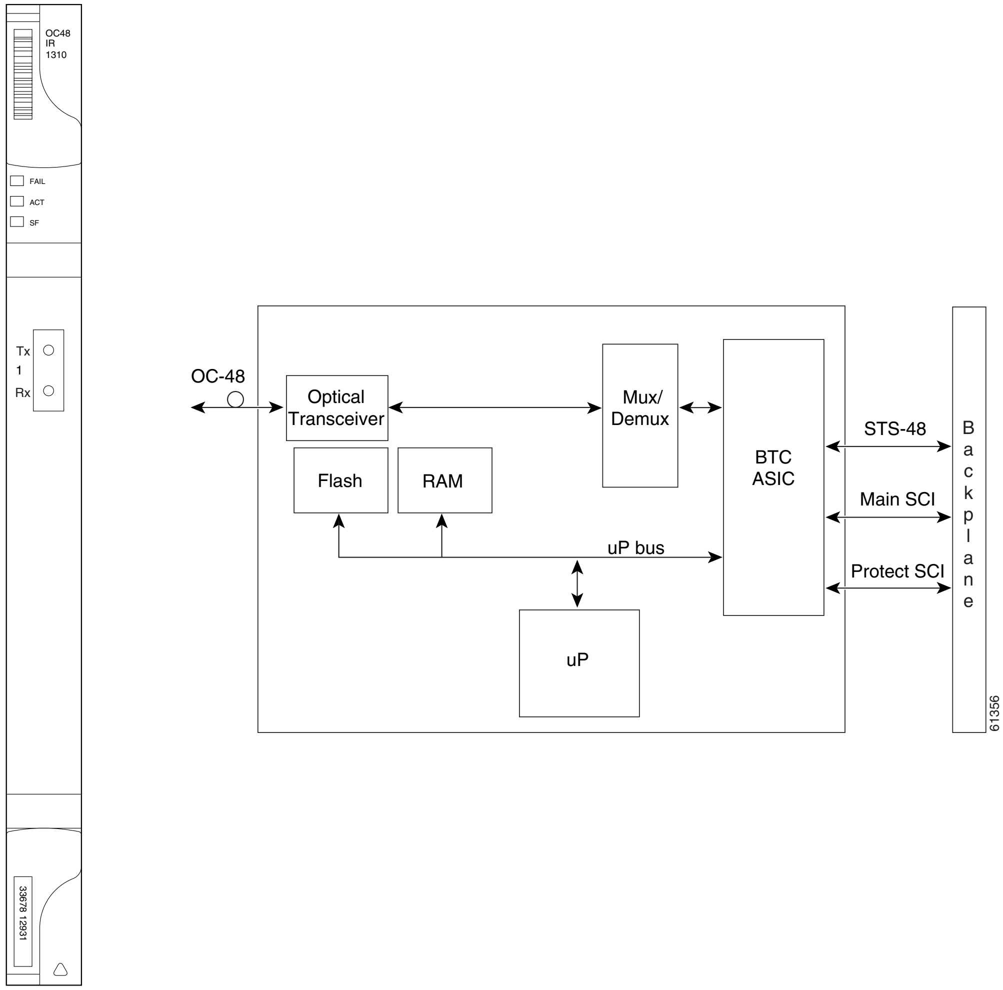
- Operating Temperature
  - C-Temp: 0 to +55 degrees Celsius
- Operating Humidity
  - 5 - 95%, non-condensing
- Power Consumption
  - 28 W, 0.58 amps, 100 BTU/Hr.
- Dimensions
  - Height: 12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 1.0 lbs, 0.4 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950
  - Eye Safety Compliance: Class I

Note Minimum Transmit Power, Minimum Receive Power, and Link Loss Budget may exceed standard specifications.

4.7 OC48 IR 1310 Card

The OC48 IR 1310 card provides one intermediate-range, Telcordia-compliant, GR-253 SONET OC-48 port per card. Each port operates at 2.49 Gbps over a single-mode fiber span. The card supports VT and non-concatenated, or concatenated payloads at STS-1, STS-3c, STS-6c, STS-12c, or STS-48c signal levels. Figure 4-6 shows the OC48 IR 1310 faceplate and a block diagram of the card.

Figure 4-6 OC48 IR 1310 faceplate and block diagram



You can install the OC48 IR 1310 card in any high-speed card slot and provision the card as a drop or span card in a two-fiber or four-fiber BLSR, UPSR, or in an ADM (linear) configuration.

The OC-48 port features a 1310 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The OC48 IR 1310 uses SC connectors. The card supports 1+1 unidirectional and bidirectional protection switching.

The OC48 IR 1310 detects LOS, LOF, LOP, AIS-L, and RDI-L conditions. The card also counts section and line BIT errors.

4.7.1 OC48 IR 1310 Card-Level Indicators

The OC48 IR 1310 card has three card-level LED indicators.

Table 4-9 OC48 IR 1310 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OC48 IR 1310 card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, AIS-L or high BERs on the card's port. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

4.7.2 OC48 IR 1310 Port-Level Indicators

You can find the status of the OC48 IR 1310 card port using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

Warning **Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments or performance of procedures other than those specified may result in hazardous radiation exposure.**

4.7.3 OC48 IR 1310 Card Specifications

- Line
  - Bit Rate: 2.49 Gbps
  - Code: Scrambled NRZ
  - Fiber: 1310 nm single-mode
  - Loopback Modes: Terminal and Facility
  - Connectors: SC
  - Compliance: Telcordia SONET, GR-GSY-00253
- Transmitter
  - Max. Transmitter Output Power: 0 dBm
  - Min. Transmitter Output Power: -5 dBm
  - Center Wavelength: 1280 nm – 1350 nm
  - Nominal Wavelength: 1310 nm

    Transmitter: Uncooled direct modulated DFB

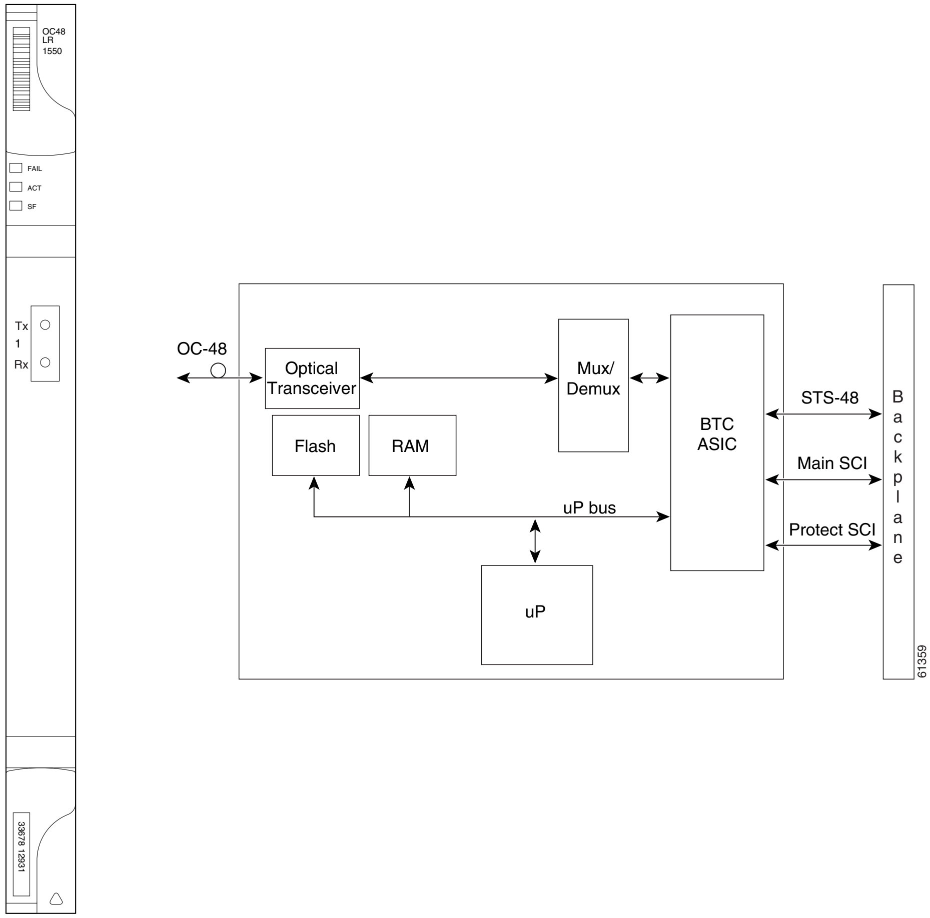
- Receiver
  - Max. Receiver Level: 0 dBm
  - Min. Receiver Level: -18 dBm
  - Receiver: InGaAs InP photo detector
  - Link Loss Budget: 13 dB min.
- Environmental
  - Operating Temperature:

    C-Temp (15454-OC481IR1310): 0 to +55 degrees Celsius
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 32.20 W, 0.67 amps, 109.94 BTU/Hr.
- Dimensions
  - Height: 12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 1.8 lbs, 0.8 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950
  - Eye Safety Compliance: Class I

4.8 OC48 LR 1550 Card

The OC48 LR 1550 card provides one long-range, Telcordia-compliant, GR-253 SONET OC-48 port per card. Each port operates at 2.49 Gbps over a single-mode fiber span. The card supports VT, non-concatenated or concatenated payloads at STS-1, STS-3c, STS-6c STS-12c or STS-48c signal levels. Figure 4-7 shows the OC48 LR 1550 faceplate and a block diagram of the card.

Figure 4-7 OC48 LR 1550 faceplate and block diagram



You can install OC48 LR 1550 cards in any high-speed slot on the ONS 15454 and provision the card as a drop or span card in a two-fiber or four-fiber BLSR, UPSR, or in an ADM (linear) configuration.

The OC48 LR 1550 port features a 1550 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses SC connectors, and it supports 1+1 unidirectional and bidirectional protection switching.

The OC48 LR 1550 detects LOS, LOF, LOP, AIS-L, and RDI-L conditions. The card also counts section and line BIT errors.

4.8.1 OC48 LR 1550 Card-Level Indicators

The OC48 LR 1550 card has three card-level LED indicators.

Table 4-10 OC48 LR 1550 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OC48 LR 1550 card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF or high BERs on the card's port. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

4.8.2 OC48 LR 1550 Port-Level Indicators

You can find the status of the OC48 LR 1550 card port using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

Warning **Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments or performance of procedures other than those specified may result in hazardous radiation exposure.**

4.8.3 OC48 LR 1550 Card Specifications

- Line
  - Bit Rate: 2.49 Gbps
  - Code: Scrambled NRZ
  - Fiber: 1550 nm single-mode
  - Loopback Modes: Terminal and Facility
  - Connectors: SC
  - Compliance: Telcordia SONET, GR-GSY-00253
- Transmitter
  - Max. Transmitter Output Power: +3 dBm
  - Min. Transmitter Output Power: -2 dBm
  - Center Wavelength: 1520 nm – 1580 nm
  - Nominal Wavelength: 1550 nm
  - Transmitter: Distributed feedback laser

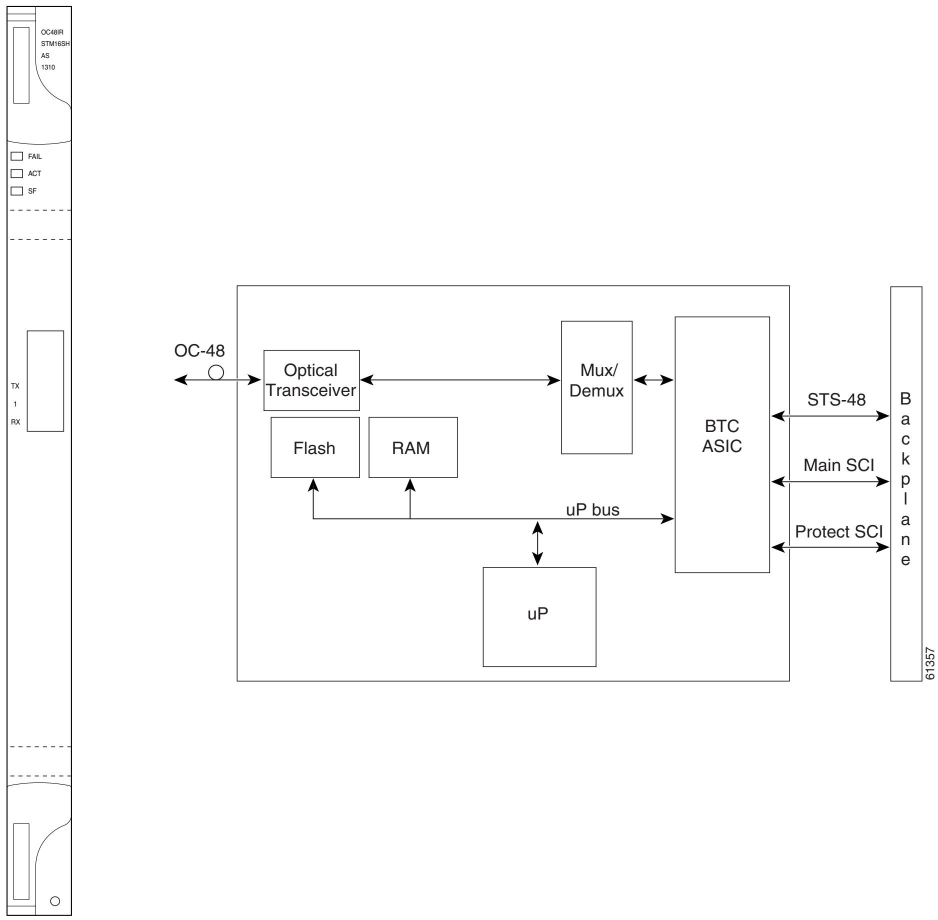
- Receiver
  - Max. Receiver Level: -8 dBm
  - Min. Receiver Level: -28 dBm
  - Receiver: InGaAs APD photo detector
  - Link Loss Budget: 26 dB min., with 1 dB dispersion penalty
- Environmental
  - Operating Temperature:

    C-Temp (15454-OC481LR1550): 0 to +55 degrees Celsius
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 26.80 W, 0.56 amps, 91.50 BTU/Hr.
- Dimensions
  - Height:12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 1.8 lbs, 0.8 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950
  - Eye Safety Compliance: Class I

4.9 OC48 IR/STM16 SH AS 1310 Card

The OC48 IR/STM16 SH AS 1310 card provides one intermediate-range SONET/SDH OC-48 port compliant with the International Telecommunication Union's G.707, G.957, and Telcordia's GR-253. The port operates at 2.49 Gbps over a single-mode fiber span. The card supports VT and non-concatenated or concatenated payloads at STS-1, STS-3c, STS-6c, STS-12c, or STS-48c signal levels. Figure 4-8 shows the OC48 IR/STM16 SH AS 1310 faceplate and a block diagram of the card.

Figure 4-8 OC48 IR/STM16 SH AS 1310 faceplate and block diagram



You can install the OC48 IR/STM16 SH AS 1310 card in any multispeed or high-speed card slot on the ONS 15454 and provision the card as a drop or span card in a two-fiber or four-fiber BLSR, UPSR, or in an ADM (linear) configuration.

The OC-48 port features a 1310 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The OC48 IR/STM16 SH AS 1310 uses SC connectors. The card supports 1+1 unidirectional and bidirectional protection switching.

The OC48 IR/STM16 SH AS 1310 detects LOS, LOF, LOP, AIS-L, and RDI-L conditions. The card also counts section and line BIT errors.

4.9.1 OC48 IR/STM16 SH AS 1310 Card-Level Indicators

The OC48 IR/STM16 SH AS 1310 card has three card-level LED indicators.

Table 4-11 OC48 IR/STM16 SH AS 1310 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OC48 IR/STM16 SH AS 1310 card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, AIS-L or high BERs on the card's port. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

4.9.2 OC48 IR/STM16 SH AS 1310 Port-Level Indicators

You can find the status of the OC48 IR/STM16 SH AS 1310 card port using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

Warning **Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments or performance of procedures other than those specified may result in hazardous radiation exposure.**

4.9.3 OC48 IR/STM16 SH AS 1310 Compatibility

Use the XC10G card, the TCC+ card, the new 15454-SA-ANSI shelf assembly, and Software R3.1 or higher to enable the OC48 IR/STM16 SH AS 1310 card. The OC48 IR/STM16 SH AS 1310 card uses the BTC backplane interface to provide recognition in both the high-speed and multispeed slots.

4.9.4 OC48 IR/STM16 SH AS 1310 Card Specifications

- Line
  - Bit Rate: 2.49 Gbps
  - Code: Scrambled NRZ
  - Fiber: 1310 nm Single Mode
  - Loopback Modes: Terminal and Facility
  - Connectors: SC
  - Compliance: Telcordia SONET, GR-GSY-00253, ITU-T G.707, ITU-T G.957

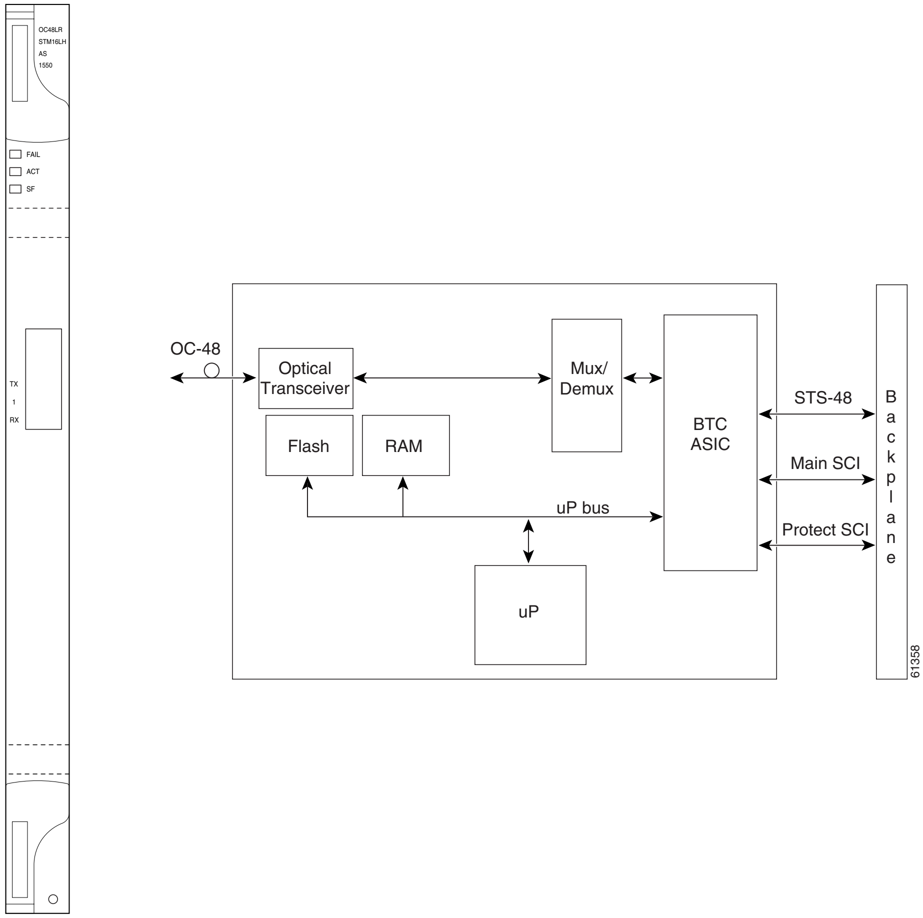
- Transmitter
  - Max. Transmitter Output Power: 0 dBm
  - Min. Transmitter Output Power: -5 dBm
  - Center Wavelength: 1280 nm – 1350 nm
  - Nominal Wavelength: 1310nm
  - Transmitter: Distributed feedback laser
- Receiver
  - Max. Receiver Level: 0 dBm
  - Min. Receiver Level: -18 dBm
  - Receiver: InGaAs InP photo detector
  - Link Loss Budget: 13 dB min.
- Environmental
  - Operating Temperature:

    C-Temp (15454-OC481IR1310A): 0 to +55 degrees Celsius
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 37.20 W, 0.77 amps, 127.01 BTU/Hr.
- Dimensions
  - Height: 12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 2.2 lbs, 0.9 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950
  - Eye Safety Compliance: Class I

4.10 OC48 LR/STM16 LH AS 1550 Card

The OC48 LR/STM16 LH AS 1550 card provides one long-range SONET/SDH OC-48 port compliant with the International Telecommunication Union’s G.707, G.957, and Telcordia’s GR-253. Each port operates at 2.49 Gbps over a single-mode fiber span. The card supports VT and non-concatenated or concatenated payloads at STS-1, STS-3c, STS-6c, STS-12c, or STS-48c signal levels. Figure 4-9 shows the OC48 LR/STM16 LH AS 1550 faceplate and a block diagram of the card.

Figure 4-9 OC48 LR/STM16 LH AS 1550 faceplate and block diagram



You can install OC48 LR/STM16 LH AS 1550 cards in any multispeed or high-speed slot on the ONS 15454 and provision the card as a drop or span card in a two-fiber or four-fiber BLSR, UPSR, or in an ADM (linear) configuration.

The OC48 LR/STM16 LH AS 1550 port features a 1550 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses SC connectors, and it supports 1+1 unidirectional and bidirectional protection switching.

The OC48 LR/STM16 LH AS 1550 detects LOS, LOF, LOP, AIS-L, and RDI-L conditions. The card also counts section and line BIT errors.

4.10.1 OC48 LR/STM16 LH AS 1550 Card-Level Indicators

The OC48 LR/STM16 LH AS 1550 card has three card-level LED indicators.

Table 4-12 OC48 LR/STM16 LH AS 1550 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OC48 LR/STM16 LH AS 1550 card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF or high BERs on the card's port. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

4.10.2 OC48 LR/STM16 LH AS 1550 Port-Level Indicators

You can find the status of the OC48 LR/STM16 LH AS 1550 card port using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

Warning **Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments or performance of procedures other than those specified may result in hazardous radiation exposure.**

4.10.3 OC48 LR/STM16 LH AS 1550 Compatibility

Use the XC10G card, the TCC+ card, the new 15454-SA-ANSI shelf assembly, and Software R3.1 or higher to enable the OC48 LR/STM16 LH AS 1550 card. The OC48 LR/STM16 LH AS 1550 card uses the BTC backplane interface to provide recognition in both the high-speed and multispeed slots.

4.10.4 OC48 LR/STM16 LH AS 1550 Card Specifications

- Line
  - Bit Rate: 2.49 Gbps
  - Code: Scrambled NRZ
  - Fiber: 1550 nm Single Mode
  - Loopback Modes: Terminal and Facility
  - Connectors: SC
  - Compliance: Telcordia SONET, GR-GSY-00253, ITU-T G.707, ITU-T G.957

- Transmitter
  - Max. Transmitter Output Power: +3 dBm
  - Min. Transmitter Output Power: -2 dBm
  - Center Wavelength: 1520 nm – 1580 nm
  - Nominal Wavelength: 1550 nm
  - Transmitter: Distributed feedback laser
- Receiver
  - Max. Receiver Level: -8 dBm
  - Min. Receiver Level: -28 dBm
  - Receiver: InGaAs APD photo detector
  - Link Loss Budget: 26 dB min., with 1 dB dispersion penalty
- Environmental
  - Operating Temperature:

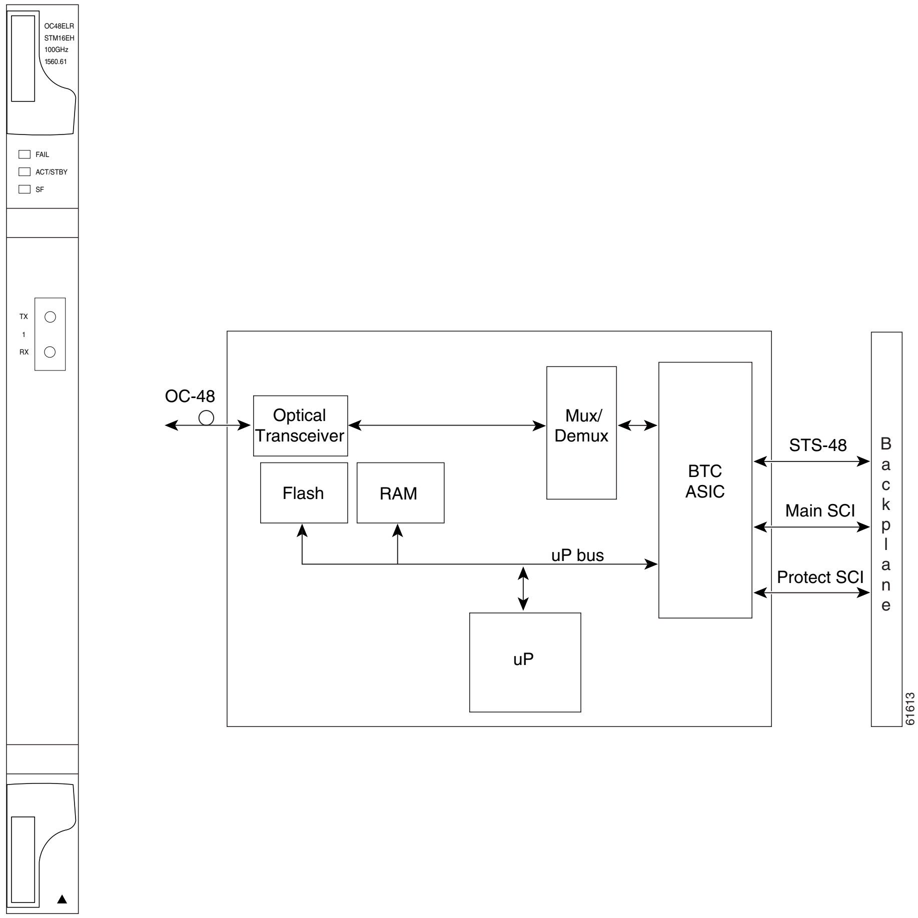
    C-Temp (15454-OC481LR1550A): 0 to +55 degrees Celsius
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 37.20 W, 0.77 amps, 127.01 BTU/Hr.
- Dimensions
  - Height:12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 2.2 lbs, 0.9 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950
  - Eye Safety Compliance: Class I

4.11 OC48 ELR/STM16 EH 100 GHz Cards

Thirty-seven distinct OC48 ITU 100GHz dense wavelength division multiplexing (DWDM) cards provide the ONS 15454 DWDM channel plan. Each OC-48 DWDM card has one SONET OC-48/SDH STM-16 port that complies with Telcordia, GR-253 SONET, and the International Telecommunication Union's ITU-T G.692, and ITU-T G.958.

The port operates at 2.49 Gbps over a single-mode fiber span. The card carries VT, concatenated, and non-concatenated payloads at STS-1, STS-3c, STS-6c, STS-12c, or STS-48c signal levels. Figure 4-10 shows the OC48 ELR/STM16 EH 100 GHz faceplate and a block diagram of the card.

Figure 4-10 OC48 ELR/STM16 EH 100 GHz faceplate and block diagram



Nineteen of the cards operate in the blue band with spacing of 100 GHz on the ITU grid standard G.692 and Telcordia GR-2918-CORE, issue 2 (1528.77 nm, 1530.33 nm, 1531.12 nm, 1531.90 nm, 1532.68 nm, 1533.47 nm, 1534.25 nm, 1535.04 nm, 1535.82 nm, 1536.61 nm, 1538.19 nm, 1538.98 nm, 1539.77 nm, 1540.56 nm, 1541.35 nm, 1542.14 nm, 1542.94 nm, 1543.73 nm, 1544.53 nm).

The other eighteen cards operate in the red band with spacing of 100 GHz on the ITU grid (1546.12 nm, 1546.92 nm, 1547.72 nm, 1548.51 nm,1549.32 nm, 1550.12 nm, 1550.92 nm, 1551.72 nm, 1552.52 nm, 1554.13 nm, 1554.94 nm, 1555.75 nm, 1556.55 nm, 1557.36 nm, 1558.17 nm, 1558.98 nm, 1559.79 nm, 1560.61 nm). These cards are also designed to interoperate with the Cisco ONS 15216 DWDM solution.

You can install the OC48 ELR/STM16 EH 100 GHz cards in any high-speed slot and provision the card as a drop or span card in a two-fiber or four-fiber BLSR, UPSR, or in an ADM (linear) configuration. Each OC48 ELR/STM16 EH 100 GHz card uses extended long reach optics operating individually within the ITU-T 100 GHz grid. The OC-48 DWDM cards are intended to be used in applications with long unregenerated spans of up to 200 km (with mid-span amplification). These transmission distances are achieved through the use of inexpensive optical amplifiers (flat gain amplifiers) such as Cisco ONS 15216 erbium-doped fiber amplifiers (EDFAs).

Maximum system reach in filterless applications is 26 dB without the use of optical amplifiers or regenerators. However, system reach also depends on the condition of the facilities, number of splices and connectors, and other performance-affecting factors. When used in combination with ONS 15216 100 GHz filters, the link budget is reduced by the insertion loss of the filters plus an additional 2dB power penalty. The OC-48 ELR DWDM cards wavelength stability is +/- 0.12 nm for the life of the product and over the full range of operating temperatures. Each interface contains a transmitter and receiver.

The OC-48 ELR cards detect loss of signal (LOS), loss of frame (LOF), loss of pointer (LOP), and line-layer alarm indication signal (AIS-L) conditions. The cards also count section and line BIT errors.

4.11.1 OC48 ELR 100 GHz Card-Level Indicators

The OC48 ELR/STM16 EH 100 GHz cards have three card-level LED indicators.

Table 4-13 OC48 ELR/STM16 EH 100 GHz Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OC48 ELR card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF or high BERs on the card's port. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

4.11.2 OC48 ELR 100 GHz Port-Level Indicators

You can find the status of the OC48 ELR card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to quickly view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

Warning **Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments or performance of procedures other than those specified may result in hazardous radiation exposure.**

4.11.3 OC48 ELR 100 GHz Compatibility

The OC48 ELR/STM16 EH 100 GHz card requires a cross-connect (XC) card, cross-connect virtual tributary (XCVT) card, or an XC10G for proper operation.

4.11.4 OC48 ELR 100 GHz Card Specifications

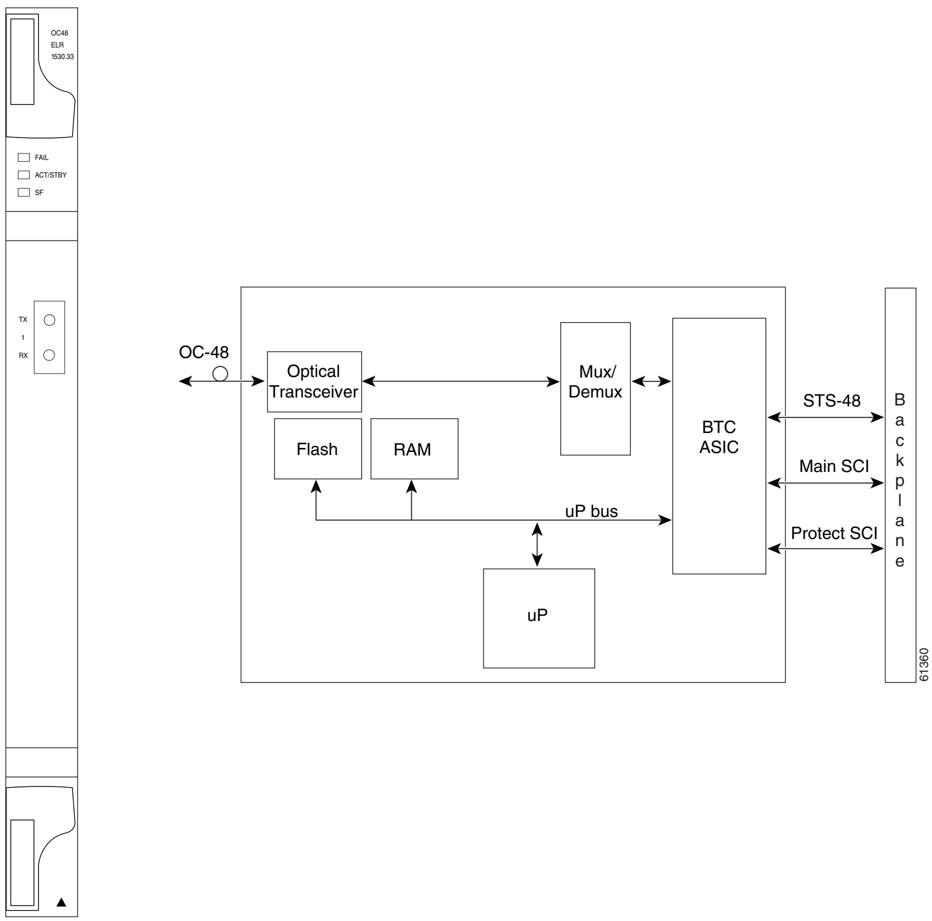
- Line
  - Bit Rate: 2.49 Gbps
  - Code: Scrambled NRZ
  - Fiber: 1550 nm single-mode
  - Loopback Modes: Terminal and Facility
  - Connectors: SC
  - Compliance: Telcordia SONET, GR-GSY-00253, ITU-T G.692, ITU-T G.958
- Transmitter
  - Max. Transmitter Output Power: 0 dBm
  - Min. Transmitter Output Power: -2 dBm
  - Center Wavelength: ±.12 nm
  - Transmitter: Electro-absorption laser
- Receiver
  - Max. Receiver Level: -9 dBm
  - Min. Receiver Level: -27 dBm at 1E-12 BER
  - Receiver: InGaAs APD photo detector
  - Link Loss Budget: 25 dB min. at BER=10E-12, (not including the power dispersion penalty)
  - Dispersion Penalty: 2dB for a dispersion of up to 5400 ps/nm
- Environmental
  - Operating Temperature:

    C-Temp: 0 to +55 degrees Celsius (For product names, see Card Temperature Ranges, page 4-4)
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 31.20 W, 0.65 amps, 106.53 BTU/Hr.
- Dimensions
  - Height:12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 2.4 lbs, 1.1 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950
  - Eye Safety Compliance: Class I

4.12 OC48 ELR 200 GHz Cards

Eighteen distinct OC48 ITU 200GHz dense wavelength division multiplexing (DWDM) cards provide the ONS 15454 DWDM channel plan. Each OC-48 DWDM card provides one Telcordia-compliant, GR-253 SONET OC-48 port. The port operates at 2.49 Gbps over a single-mode fiber span. The card carries VT, concatenated, and non-concatenated payloads at STS-1, STS-3c, STS-6c, STS-12c, or STS-48c signal levels. Figure 4-10 shows the OC48 ELR DWDM faceplate and a block diagram of the card.

Figure 4-11 OC48 ELR 200 GHz faceplate and block diagram



Nine of the cards operate in the blue band with spacing of 200 GHz on the ITU grid (1530.33 nm, 1531.90 nm, 1533.47 nm, 1535.04 nm, 1536.61 nm, 1538.19 nm, 1539.77 nm, 1541.35 nm, 1542.94 nm).

The other nine cards operate in the red band with spacing of 200 GHz on the ITU grid (1547.72 nm, 1549.32 nm, 1550.92 nm, 1552.52 nm, 1554.13 nm, 1555.75 nm, 1557.36 nm, 1558.98 nm, 1560.61 nm). These cards are also designed to interoperate with the Cisco ONS 15216 DWDM solution.

You can install the OC48 ELR 200 GHz cards in any high-speed slot and provision the card as a drop or span card in a two-fiber or four-fiber BLSR, UPSR, or in an ADM (linear) configuration. Each OC48 ELR DWDM card uses extended long reach optics operating individually within the ITU-T 200 GHz grid. The OC48 DWDM cards are intended to be used in applications with long unregenerated spans of up to 200 km (with mid-span amplification). These transmission distances are achieved through the use of inexpensive optical amplifiers (flat gain amplifiers) such as erbium doped fiber amplifiers (EDFAs). Using co-located amplification, distances up to 200 km can be achieved for a single channel (160 km for 8 channels).

Maximum system reach in filterless applications is 24 dB or approximately 80 km without the use of optical amplifiers or regenerators. However, system reach also depends on the condition of the facilities, number of splices and connectors or other performance-affecting factors. The OC48 ELR DWDM cards feature wavelength stability of +/- 0.25 nm. Each interface contains a transmitter and receiver.

The OC48 ELR DWDM cards are the first in a family of cards meant to support extended long reach applications in conjunction with optical amplification. Using electro-absorption technology, the OC48 DWDM cards provide a solution at the lower-extended long reach distances.

The OC48 LR 1550 interface features a 1550 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses SC connectors and supports 1+1 unidirectional and bidirectional protection switching.

The OC48 ELR cards detect LOS, LOF, LOP, AIS-L, and RDI-L conditions. The cards also count section and line BIT errors.

To enable APS, the OC48 ELR cards extract the K1 and K2 bytes from the SONET overhead. The DCC bytes are forwarded to the TCC+ card; the TCC+ terminates the DCC.

4.12.1 OC48 ELR 200 GHz Card-Level Indicators

The OC48 ELR cards have three card-level LED indicators.

Table 4-14 OC48 ELR 200 GHz Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card’s processor is not ready. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OC48 ELR card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF or high BERs on the card’s port. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

4.12.2 OC48 ELR 200 GHz Port-Level Indicators

You can find the status of the OC48 ELR card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to quickly view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

Warning **Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments or performance of procedures other than those specified may result in hazardous radiation exposure.**

4.12.3 OC48 ELR 200 GHz Compatibility

The OC48 ELR/STM16 EH 200 GHz card requires an XC card, XCVT card, or XC10G card for proper operation.

4.12.4 OC48 ELR 200 GHz Card Specifications

- Line
  - Bit Rate: 2.49 Gbps
  - Code: Scrambled NRZ
  - Fiber: 1550 nm single-mode
  - Loopback Modes: Terminal and Facility
  - Connectors: SC
  - Compliance: Telcordia SONET, GR-GSY-00253, ITU-T G692, ITU-T G958
- Transmitter
  - Max. Transmitter Output Power: 0 dBm
  - Min. Transmitter Output Power: -2 dBm
  - Center Wavelength: ±.25 nm
  - Transmitter: Electro-absorption laser
- Receiver
  - Max. Receiver Level: -8 dBm
  - Min. Receiver Level: -28 dBm
  - Receiver: InGaAs APD photo detector
  - Link Loss Budget: 26 dB min., with 1 dB dispersion penalty
- Environmental
  - Operating Temperature:

    C-Temp: 0 to +55 degrees Celsius
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 31.20 W, 0.65 amps, 106.53 BTU/Hr.
- Dimensions
  - Height:12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 2.9 lbs, 1.3 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950
  - Eye Safety Compliance: Class I

4.13 OC192 LR/STM64 LH 1550 Card

The OC192 LR/STM64 LH 1550 card provides one long-range SONET/SDH OC-192 port compliant with the International Telecommunication Union's G.707, G.957, and Telcordia's GR-1377 and GR-253. The card port operates at 9.96 Gbps over unamplified distances up to 80 km with different types of fiber such as C-SMF or dispersion compensated fiber limited by loss and/or dispersion. The card supports VT and non-concatenated or concatenated payloads.

Figure 4-12 shows the OC192 LR/STM64 LH 1550 faceplate and a block diagram of the card. Figure 4-13 on page 4-41 shows an enlarged view of the faceplate warning.

Figure 4-12 OC192 LR/STM64 LH 1550 faceplate and block diagram

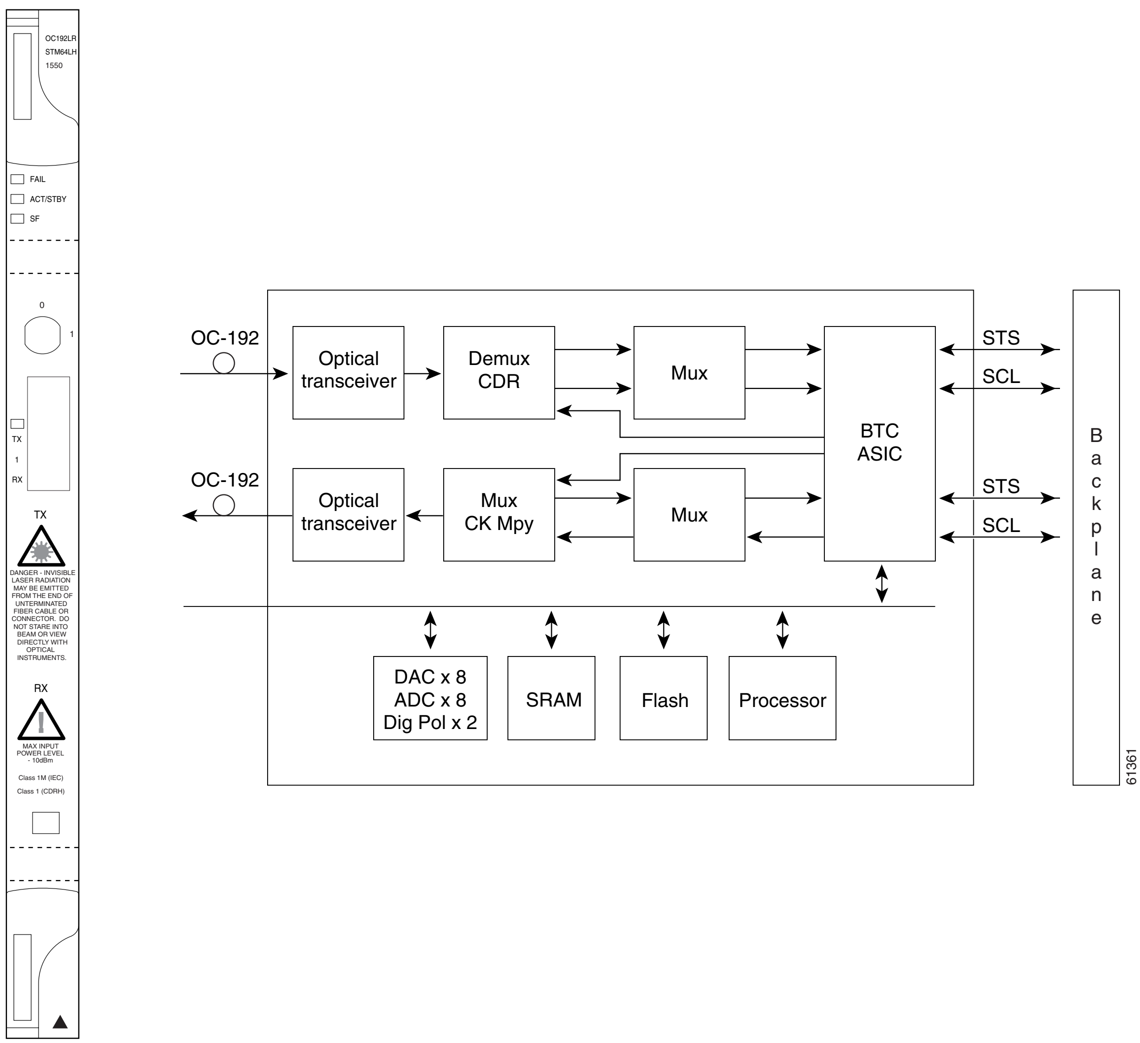
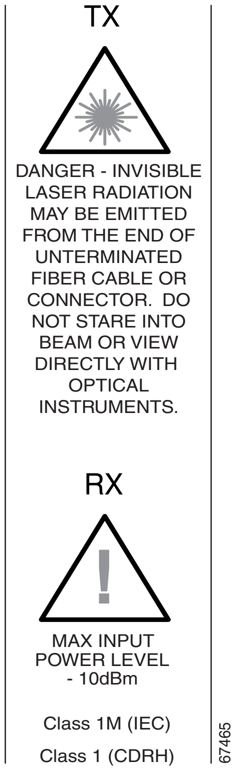


Figure 4-13 Enlarged section of the OC192 LR/STM64 LH 1550 faceplate



Caution You must use a 19 to 24 dB (20 recommended) fiber attenuator when connecting a fiber loopback to an OC192 LR/STM64 LH 1550 card. Never connect a direct fiber loopback. Using fiber loopbacks causes irreparable damage to the OC-192 card. A Tx to Rx connection that is not attenuated will damage the receiver.

You can install OC192 LR/STM64 LH 1550 cards in any high-speed slot on the ONS 15454 and provision the card as a drop or span card in a two-fiber or four-fiber BLSR, UPSR, or in an ADM (linear) configuration.

The OC-192 card port features a 1550 nm laser and contains a transmit and receive connector (labeled) on the card faceplate.

Warning **On the OC-192 card, the laser is on when the card is booted and the safety key is in the on position (labeled 1). The port does not have to be in service for the laser to be on. The laser is off when the safety key is off (labeled 0).**

The card uses a dual SC connector for optical cable termination. The card supports 1+1 unidirectional and bidirectional facility protection. It also supports 1:1 protection in four-fiber bidirectional line switched ring applications where both span switching and ring switching may occur.

The OC192 LR/STM64 LH 1550 card detects SF, LOS, or LOF conditions on the optical facility. The card also counts section and line BIT errors from B1 and B2 byte registers in the section and line overhead.

4.13.1 OC192 LR/STM64 LH 1550 Card-Level Indicators

The OC192 LR/STM64 LH 1550 card has three card-level LED indicators.

Table 4-15 OC192 LR/STM64 LH 1550 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. Replace the card if the red FAIL LED persists.
ACT/STBY LED **Green (Active)** **Yellow (Standby)**	When the ACTV/STBY LED is green, the OC-192 card is operational and ready to carry traffic. When the ACTV/STBY LED is amber, the OC-192 card is operational and in standby (protect) mode.
Yellow SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF or high BERs on the card's port. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

4.13.2 OC192 LR/STM64 LH 1550 Port-Level Indicators

You can find the status of the OC192 LR/STM64 LH 1550 card port using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of the port or card slot; the screen displays the number and severity of alarms for a given port or slot.

Warning **Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments or performance of procedures other than those specified may result in hazardous radiation exposure.**

4.13.3 OC192 LR/STM64 LH 1550 Compatibility

Use the XC10G card, the TCC+ card, the new 15454-SA-ANSI shelf assembly, and Software R3.1 or higher to enable the OC192 LR/STM64 LH 1550 card.

4.13.4 OC192 LR/STM64 LH 1550 Card Specifications

- Line
  - Bit Rate: 9.96 Gbps
  - Code: Scrambled NRZ
  - Fiber: 1550 nm Single Mode

- Loopback Modes: Terminal and Facility

Note You must use a 19 to 24 dB (20 recommended) fiber attenuator when connecting a fiber loopback to an OC192 LR/STM64 LH 1550 card. Never connect a direct fiber loopback.

  - Connectors: SC
  - Compliance: Telcordia SONET, GR-GSY-00253, ITU-T G.707, ITU-T G.957
- Transmitter
  - Max. Transmitter Output Power: +10 dBm
  - Min. Transmitter Output Power: +7 dBm
  - Center Wavelength: 1530 nm – 1565 nm
  - Nominal Wavelength: 1550 nm
  - Transmitter: LN (Lithium Niobate) external modulator transmitter
- Receiver
  - Max. Receiver Level: -10 dBm
  - Min. Receiver Level: -19 dBm
  - Receiver: APD/TIA
  - Link Loss Budget: 24 dB min., with no dispersion or 22 dB optical path loss at BER = 1- exp (-12) including dispersion
- Environmental
  - Operating Temperature:

    C-Temp (15454-OC192LR1550): 0 to +55 degrees Celsius
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 72.20 W, 1.50 amps, 246.52 BTU/Hr.
- Dimensions
  - Height:12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 3.1 lbs, 1.3 kg
- Compliance
  - ONS 15454 OC192/STM64 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950
  - Eye Safety Compliance: Class I (21 CFR 1040.10 and 1040.11) and Class 1M (IEC 60825-12001-01) laser products

Ethernet Cards

The Cisco ONS 15454 integrates Ethernet into a SONET time-division multiplexing (TDM) platform. This chapter describes the G series Ethernet card and E series Ethernet cards. For Ethernet application information, see Chapter 12, "Ethernet Operation." For installation and card turn-up procedures, refer to the *Cisco ONS 15454 Procedure Guide*.

Chapter topics include:

5.1 Card Overview

The card overview section summarizes card functions, power consumption, temperature ranges, and compatibility.

Note Each card is marked with a symbol that corresponds to a slot (or slots) on the ONS 15454 shelf assembly. The cards are then installed into slots displaying the same symbols. See the *Cisco ONS 15454 Procedure Guide* for a list of slots and symbols.

5.1.1 Ethernet Cards

Table 5-1 lists the Cisco ONS 15454 Ethernet cards.

Table 5-1 Ethernet Cards for the ONS 15454

Card	Port Description	For Additional Information...
E100T-12	The E100T-12 card provides 12 switched, autosensing, 10/100 Base-T Ethernet ports.	See the "E100T-12 Card" section on page 5-3
E1000-2	The E1000-2 card provides two ports of IEEE-compliant, 1000 Mbps ports.	See the "E1000-2 Card" section on page 5-8
E100T-G	The E100T-G card provides 12 switched, autosensing, 10/100 Base-T Ethernet ports and is compatible with the XC10G card.	See the "E100T-G Card" section on page 5-6
E1000-2-G	The E1000-2-G card provides two ports of IEEE-compliant, 1000 Mbps ports and is compatible with the XC10G card.	See the "E1000-2-G Card" section on page 5-11
G1000-4	The G1000-4 card provides four ports of IEEE-compliant, 1000 Mbps ports and is compatible with the XC10G card.	See the "G1000-4 Card" section on page 5-14

5.1.2 Card and Fan-Tray Assembly Power Requirements

Table 5-2 lists power requirements for individual cards.

Note Asterisks (*) next to card or fan tray names mean the power specification shown below is based on a calculation because an actual measurement was not available at the time of publication.

Table 5-2 Individual Card Power Requirements

Card Type	Card Name	Watts	Amps	BTU/Hr.
Ethernet Cards	E100T-12	65	1.35	221.93
	E1000-2	53.50	1.11	182.67
	E100T-G	65	1.35	221.93
	E1000-2-G	53.50	1.11	182.67
	G1000-4	63.00	1.31	215.11

5.1.3 Card Temperature Ranges

Table 5-3 shows C-Temp and I-Temp compliant cards and their product names.

Note The I-Temp symbol is displayed on the faceplate of an I-Temp compliant card. A card without this symbol is C-Temp compliant.

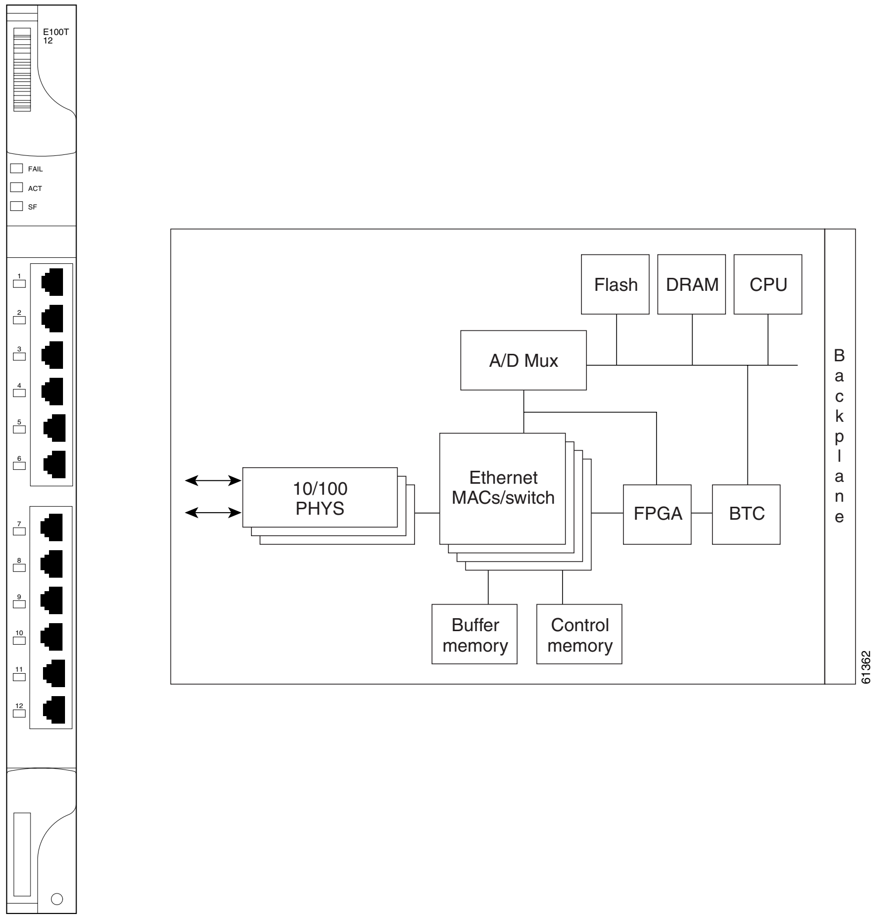
Table 5-3 Ethernet Card Temperature Ranges and Product Names for the ONS 15454

Card	C-Temp Product Name (0 to +55 degrees Celsius)	I-Temp Product Name (-40 to +65 degrees Celsius)
E100T-12	15454-E100T	—
E1000-2	15454-E1000-2	—
E100T-G	15454-E100T-G	—
E1000-2-G	15454-E1000-2-G	—
G1000-4	15454-G1000-4	—

5.2 E100T-12 Card

Do not use the E100T-12 when the XC10G cross-connect card is in use. The ONS 15454 uses E100T-12 cards for Ethernet (10 Mbps) and Fast Ethernet (100 Mbps). Each card provides 12 switched, IEEE 802.3-compliant, 10/100 Base-T Ethernet ports that can independently detect the speed of an attached device (auto-sense) and automatically connect at the appropriate speed. The ports auto-configure to operate at either half or full duplex and determine whether to enable or disable flow control. You can also configure Ethernet ports manually. Figure 5-1 shows the faceplate and a block diagram of the card.

Figure 5-1 E100T-12 faceplate and block diagram



The E100T-12 Ethernet card provides high-throughput, low-latency packet switching of Ethernet traffic across a SONET network while providing a greater degree of reliability through SONET "self-healing" protection services. This Ethernet capability enables network operators to provide multiple 10/100 Mbps access drops for high-capacity customer LAN interconnects, Internet traffic, and cable modem traffic aggregation. It enables the efficient transport and co-existence of traditional TDM traffic with packet-switched data traffic.

Each E100T-12 card supports standards-based, wire-speed, layer 2 Ethernet switching between its Ethernet interfaces. The 802.1Q tag logically isolates traffic (typically subscribers). 802.1Q also supports multiple classes of service.

You can install the E100T-12 card in any multispeed slot. Multiple Ethernet cards installed in an ONS 15454 can act independently or as a single Ethernet switch. You can create logical SONET ports by provisioning a number of STS channels to the packet switch entity within the ONS 15454. Logical ports can be created with a bandwidth granularity of STS-1. The ONS 15454 supports STS-1, STS-3c, STS-6c, or STS-12c circuit sizes.

Note When making an STS-12c Ethernet circuit, the E100 or E1000 cards must be configured as single-card EtherSwitch.

5.2.1 E100T-12 Card-Level Indicators

The E100T-12 card faceplate has two card-level LED indicators.

Table 5-4 E100T-12 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready or catastrophic software failure occurred on the E100T-12 card. As part of the boot sequence, the FAIL LED is turned on until the software deems the card operational.
Green ACT LED	A green ACT LED provides the operational status of the E100T-12. When the ACT LED is green it indicates that the E100T-12 card is active and the software is operational.
SF LED	Not used

5.2.2 E100T-12 Port-Level Indicators

The E100T-12 card also has 12 pairs of LEDs (one pair for each port) to indicate port conditions. You can find the status of the E100T-12 card port using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

Table 5-5 E100T-12 Port-Level Indicators

LED State	Description
Amber	Transmitting and Receiving
Solid Green	Idle and Link Integrity
Green Light Off	Inactive Connection or Unidirectional Traffic

5.2.3 E100T-12 Compatibility

Do not use the E100T-12 card with the XC10G card. If you want to use the XC10G card, the E100T-G is compatible with the XC10G.

5.2.4 E100T-12 Card Specifications

- Environmental
  - Operating Temperature:

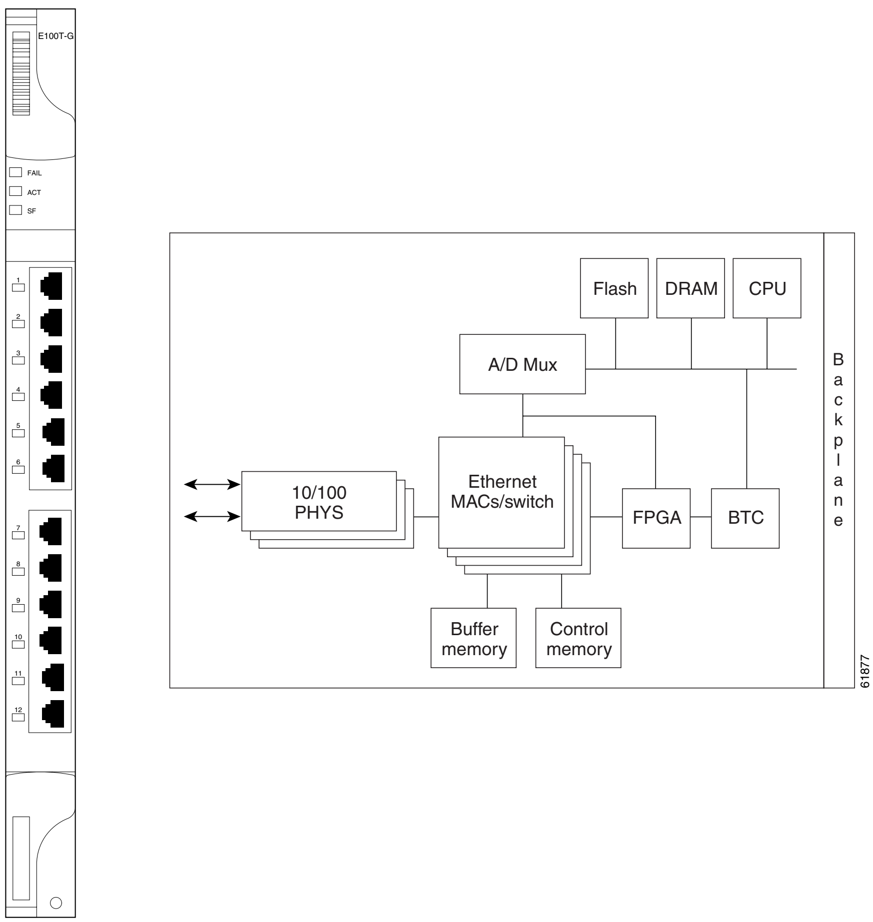
    C-Temp (15454-E100T): 0 to +55 degrees Celsius
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 65 W, 1.35 amps, 221.93 BTU/Hr.
- Dimensions
  - Height: 12.650 in.

  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 2.3 lbs, 1.0 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950

5.3 E100T-G Card

Use the E100T-G when the XC10G cross-connect card is in use. The ONS 15454 uses E100T-G cards for Ethernet (10 Mbps) and Fast Ethernet (100 Mbps). Each card provides 12 switched, IEEE 802.3-compliant, 10/100 Base-T Ethernet ports that can independently detect the speed of an attached device (auto-sense) and automatically connect at the appropriate speed. The ports auto-configure to operate at either half or full duplex and determine whether to enable or disable flow control. You can also configure Ethernet ports manually. Figure 5-2 shows the faceplate and a block diagram of the card.

Figure 5-2 E100T-G faceplate and block diagram



The E100T-G Ethernet card provides high-throughput, low-latency packet switching of Ethernet traffic across a SONET network while providing a greater degree of reliability through SONET “self-healing” protection services. This Ethernet capability enables network operators to provide multiple 10/100 Mbps access drops for high-capacity customer LAN interconnects, Internet traffic, and cable modem traffic aggregation. It enables the efficient transport and co-existence of traditional TDM traffic with packet-switched data traffic.

Each E100T-G card supports standards-based, wire-speed, layer 2 Ethernet switching between its Ethernet interfaces. The 802.1Q tag logically isolates traffic (typically subscribers). 802.1Q also supports multiple classes of service.

You can install the E100T-G card in any multispeed slot. Multiple Ethernet cards installed in an ONS 15454 can act independently or as a single Ethernet switch. You can create logical SONET ports by provisioning a number of STS channels to the packet switch entity within the ONS 15454. Logical ports can be created with a bandwidth granularity of STS-1. The ONS 15454 supports STS-1, STS-3c, STS-6c, or STS-12c circuit sizes.

Note When making an STS-12c Ethernet circuit, the E100 or E1000 cards must be configured as single-card EtherSwitch.

5.3.1 E100T-G Card-Level Indicators

The E100T-G card faceplate has two card-level LED indicators.

Table 5-6 E100T-G Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card’s processor is not ready or catastrophic software failure occurred on the E100T-G card. As part of the boot sequence, the FAIL LED is turned on until the software deems the card operational.
Green ACT LED	A green ACT LED provides the operational status of the E100T-G. When the ACT LED is green it indicates that the E100T-G card is active and the software is operational.
SF LED	Not used

5.3.2 E100T-G Port-Level Indicators

The E100T-G card also has 12 pairs of LEDs (one pair for each port) to indicate port conditions. You can find the status of the E100T-G card port using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

Table 5-7 E100T-G Port-Level Indicators

LED State	Description
Yellow (A)	Port is active (Transmitting and/or Receiving data). By default, indicates the transmitter is active but can be software controlled to indicate link status, duplex status, or receiver active.
Solid Green (L)	Link is established. By default, indicates the link for this port is up, but can be software controlled to indicate duplex status, operating speed, or collision

5.3.3 E100T-G Compatibility

Use the E100T-G when the XC10G cross-connect card is in use.

5.3.4 E100T-G Card Specifications

- Environmental
  - Operating Temperature:

    C-Temp (15454-E100T-G): 0 to +55 degrees Celsius
  - Operating Humidity: 5 - 95%, non-condensing
  - Power Consumption: 65 W, 1.35 amps, 221.93 BTU/Hr.
- Dimensions
  - Height: 12.650 in, Width: 0.716 in., Depth: 9.000 in.
  - Card Weight: 2.3 lbs, 1.0 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950

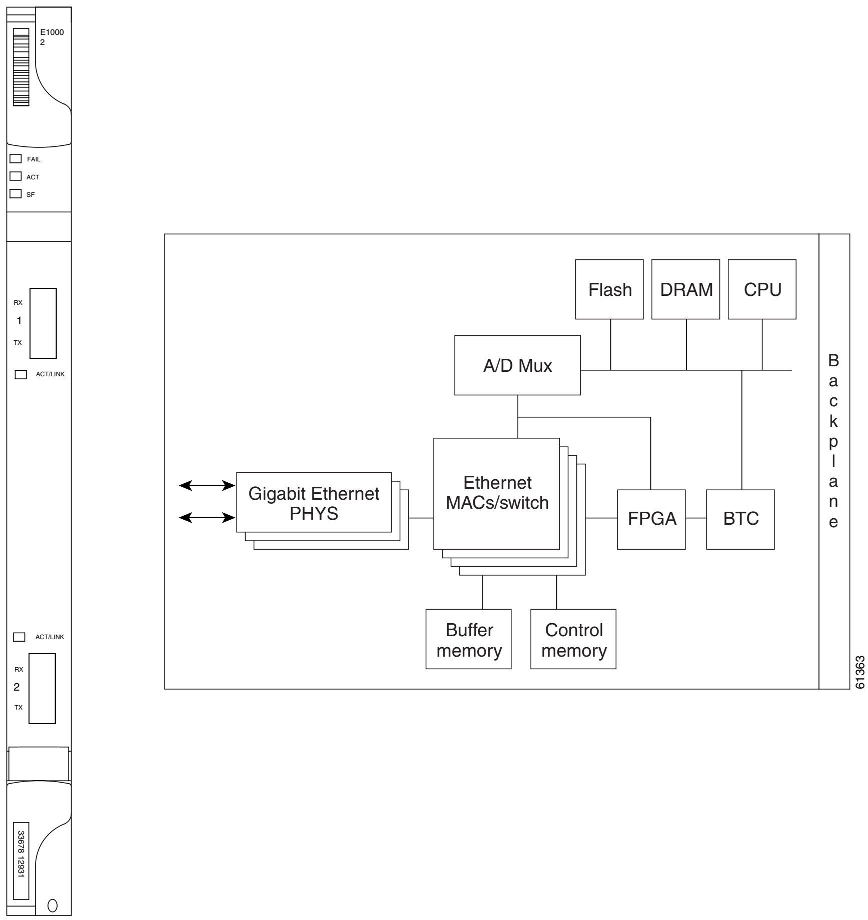
5.4 E1000-2 Card

Do not use the E1000-2 when the XC10G cross-connect card is in use. The ONS 15454 uses E1000-2 cards for Gigabit Ethernet (1000 Mbps). The E1000-2 card provides two IEEE-compliant, 1000 Mbps ports for high-capacity customer LAN interconnections. Each port supports full-duplex operation. Figure 5-3 shows the card faceplate and a block diagram of the card.

The E1000-2 card uses standard Cisco gigabit interface converter (GBIC) modular receptacles for the optical ports. GBICs are hot-swappable input/output devices that plug into a Gigabit Ethernet port to link the port to the fiber-optic network. Cisco provides two GBIC models: one for short-reach applications and one for long-reach applications. The short-reach model connects to multimode fiber and the long-reach model requires single-mode fiber.

For Software R2.2.0 and later, both GBIC modules are offered as separate orderable products: an IEEE 1000Base-SX compliant, 850 nm optical module and an IEEE 1000Base-LX-compliant, 1300 nm optical module, the 850 nm SX optics are designed for multimode fiber and distances of up to 220 meters on 62.5 micron fiber and up to 550 meters on 50 micron fiber. For more information see the *Cisco ONS 15454 Procedure Guide*.

Figure 5-3 E1000-2 faceplate and block diagram



The E1000-2 Gigabit Ethernet card provides high-throughput, low-latency packet switching of Ethernet traffic across a SONET network while providing a greater degree of reliability through SONET “self-healing” protection services. This enables network operators to provide multiple 1000 Mbps access drops for high-capacity customer LAN interconnects. It enables efficient transport and co-existence of traditional TDM traffic with packet-switched data traffic.

Each E1000-2 card supports standards-based, layer 2 Ethernet switching between its Ethernet interfaces and SONET interfaces on the ONS 15454. The 802.1Q VLAN tag logically isolates traffic (typically subscribers). The E1000-2 supports two 802.1Q.

You can install the E1000-2 card into any multispeed slot. Multiple Ethernet cards installed in an ONS 15454 can act together as a single switching entity or as an independent single switch supporting a variety of SONET port configurations.

You can create logical SONET ports by provisioning STS channels to the packet switch entity within the ONS 15454. Logical ports can be created with a bandwidth granularity of STS-1. The ONS 15454 supports STS-1, STS-3c, STS-6c, or STS-12c circuit sizes.

Note When making an STS-12c Ethernet circuit, the E100 or E1000 cards must be configured as single-card EtherSwitch.

5.4.1 E1000-2 Card-Level Indicators

The E1000-2 card faceplate has two card-level LED indicators.

Table 5-8 E1000-2 Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready or catastrophic software failure occurred on the E1000-2 card. As part of the boot sequence, the FAIL LED is turned on until the software deems the card operational.
Green ACT LED	A green ACT LED provides the operational status of the E1000-2. When the ACT LED is green it indicates that the E1000-2 card is active and the software is operational.
SF LED	Not used

5.4.2 E1000-2 Port-Level Indicators

The E1000-2 card also has one bicolor LED per port. When the green LINK LED is on, carrier is detected, meaning an active network cable is installed. When the green LINK LED is off, an active network cable is not plugged into the port, or the card is carrying unidirectional traffic. The amber port ACT LED flashes at a rate proportional to the level of traffic being received and transmitted over the port.

Table 5-9 E1000-2 Port-Level Indicators

LED State	Description
Amber	Transmitting and Receiving
Solid Green	Idle and Link Integrity
Green Light Off	Inactive Connection or Unidirectional Traffic

5.4.3 E1000-2 Compatibility

Do not use the E1000-2 card with the XC10G card. If you want to use the XC10G card, the E1000-2-G is compatible with the XC10G.

5.4.4 E1000-2 Card Specifications

- Environmental
  - Operating Temperature:
    C-Temp (15454-E1000-2): 0 to +55 degrees Celsius
  - Operating Humidity: 5- 95%, non-condensing
  - Power Consumption: 53.50 W, 1.11 amps, 182.67 BTU/Hr.
- Dimensions
  - Height: 12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 2.1 lbs, 0.9 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950
  - Eye Safety Compliance: Class I (21 CFR 1040.10 and 1040.11) and Class 1M (IEC 60825-1 2001-01) laser products

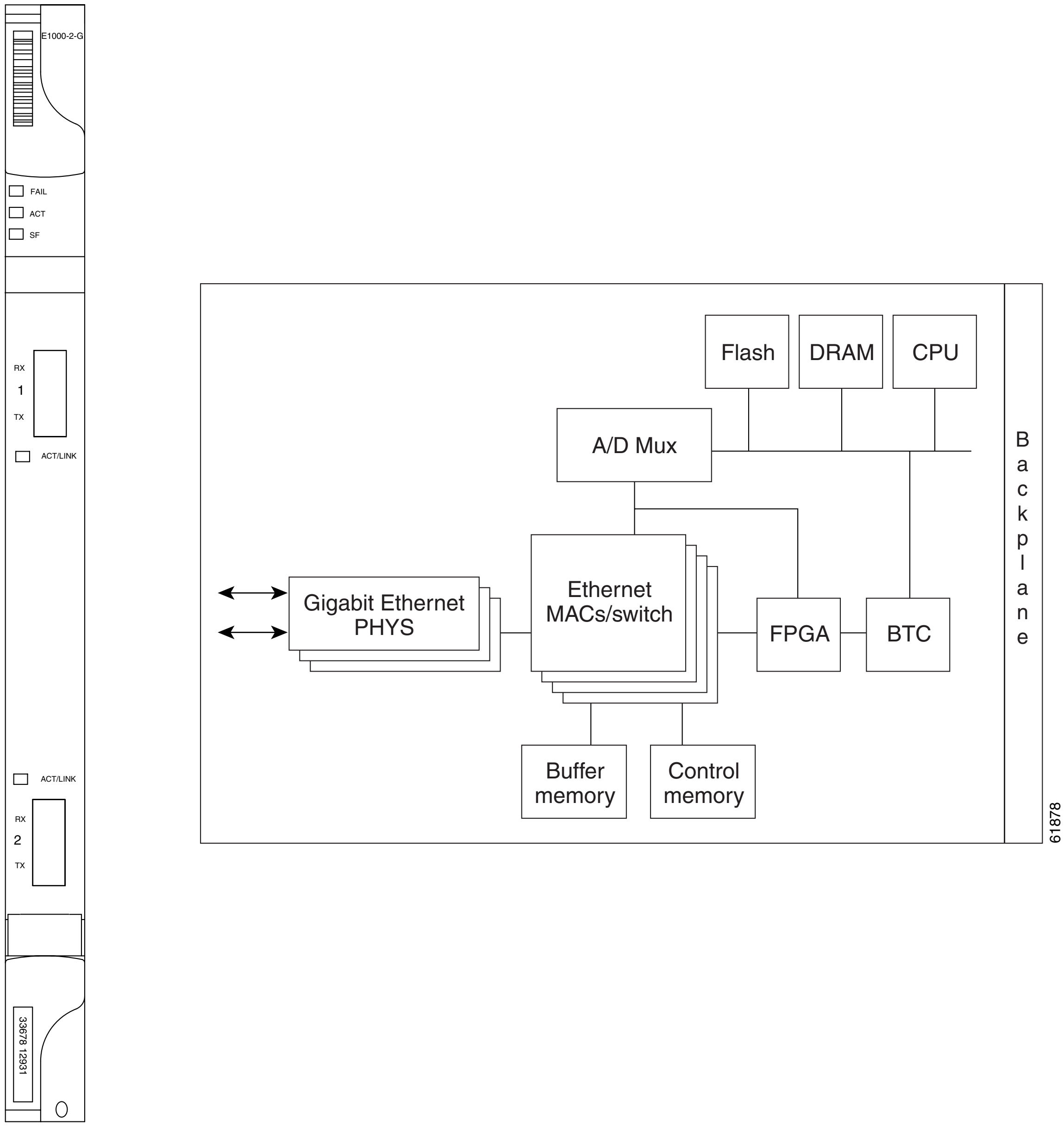
5.5 E1000-2-G Card

Use the E1000-2-G when the XC10G cross-connect card is in use. The ONS 15454 uses E1000-2-G cards for Gigabit Ethernet (1000 Mbps). The E1000-2-G card provides two IEEE-compliant, 1000 Mbps ports for high-capacity customer LAN interconnections. Each port supports full-duplex operation. Figure 5-4 shows the card faceplate and a block diagram of the card.

The E1000-2-G card uses standard Cisco gigabit interface converter (GBIC) modular receptacles for the optical ports. GBICs are hot-swappable input/output devices that plug into a Gigabit Ethernet port to link the port to the fiber-optic network. Cisco provides two GBIC models: one for short-reach applications and one for long-reach applications. The short-reach model connects to multimode fiber and the long-reach model requires single-mode fiber.

For Software R2.2.0 and later, both GBIC modules are offered as separate orderable products: an IEEE 1000Base-SX compliant, 850 nm optical module and an IEEE 1000Base-LX-compliant, 1300 nm optical module, the 850 nm SX optics are designed for multimode fiber and distances of up to 220 meters on 62.5 micron fiber and up to 550 meters on 50 micron fiber. For more information see the *Cisco ONS 15454 Procedure Guide.*

Figure 5-4 E1000-2-G faceplate and block diagram



The E1000-2-G Gigabit Ethernet card provides high-throughput, low-latency packet switching of Ethernet traffic across a SONET network while providing a greater degree of reliability through SONET “self-healing” protection services. This enables network operators to provide multiple 1000 Mbps access drops for high-capacity customer LAN interconnects. It enables efficient transport and co-existence of traditional TDM traffic with packet-switched data traffic.

Each E1000-2-G card supports standards-based, layer 2 Ethernet switching between its Ethernet interfaces and SONET interfaces on the ONS 15454. The 802.1Q VLAN tag logically isolates traffic (typically subscribers). The E1000-2-G supports two 802.1Q.

You can install the E1000-2-G card into any multispeed slot. Multiple Ethernet cards installed in an ONS 15454 can act together as a single switching entity or as an independent single switch supporting a variety of SONET port configurations.

You can create logical SONET ports by provisioning STS channels to the packet switch entity within the ONS 15454. Logical ports can be created with a bandwidth granularity of STS-1. The ONS 15454 supports STS-1, STS-3c, STS-6c, or STS-12c circuit sizes.

Note When making an STS-12c Ethernet circuit, the E100 or E1000 cards must be configured as a Single-card EtherSwitch.

5.5.1 E1000-2-G Card-Level Indicators

The E1000-2-G card faceplate has two card-level LED indicators.

Table 5-10 E1000-2-G Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready or catastrophic software failure occurred on the E1000-2-G card. As part of the boot sequence, the FAIL LED is turned on until the software deems the card operational.
Green ACT LED	A green ACT LED provides the operational status of the E1000-2-G. When the ACT LED is green it indicates that the E1000-2-G card is active and the software is operational.
SF LED	Not used

5.5.2 E1000-2-G Port-Level Indicators

The E1000-2-G card also has one bicolor LED per port. When the green LINK LED is on, carrier is detected, meaning an active network cable is installed. When the green LINK LED is off, an active network cable is not plugged into the port, or the card is carrying unidirectional traffic. The amber port ACT LED flashes at a rate proportional to the level of traffic being received and transmitted over the port.

Table 5-11 E1000-2-G Port-Level Indicators

LED State	Description
Amber	Transmitting and Receiving
Solid Green	Idle and Link Integrity
Green Light Off	Inactive Connection or Unidirectional Traffic

5.5.3 E1000-2-G Compatibility

Use the E1000-2-G when the XC10G cross-connect card is in use.

5.5.4 E1000-2-G Card Specifications

- Environmental
  - Operating Temperature:

    C-Temp (15454-E1000-2-G): 0 to +55 degrees Celsius
  - Operating Humidity: 5- 95%, non-condensing
  - Power Consumption: 53.50 W, 1.11 amps, 182.67 BTU/Hr.
- Dimensions
  - Height: 12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 2.1 lbs, 0.9 kg
- Compliance
  - ONS 15454 cards, when installed in a system, comply with these standards: Safety: UL 1950, CSA C22.2 No. 950, EN 60950, IEC 60950
  - Eye Safety Compliance: Class I (21 CFR 1040.10 and 1040.11) and Class 1M (IEC 60825-1 2001-01) laser products

5.6 G1000-4 Card

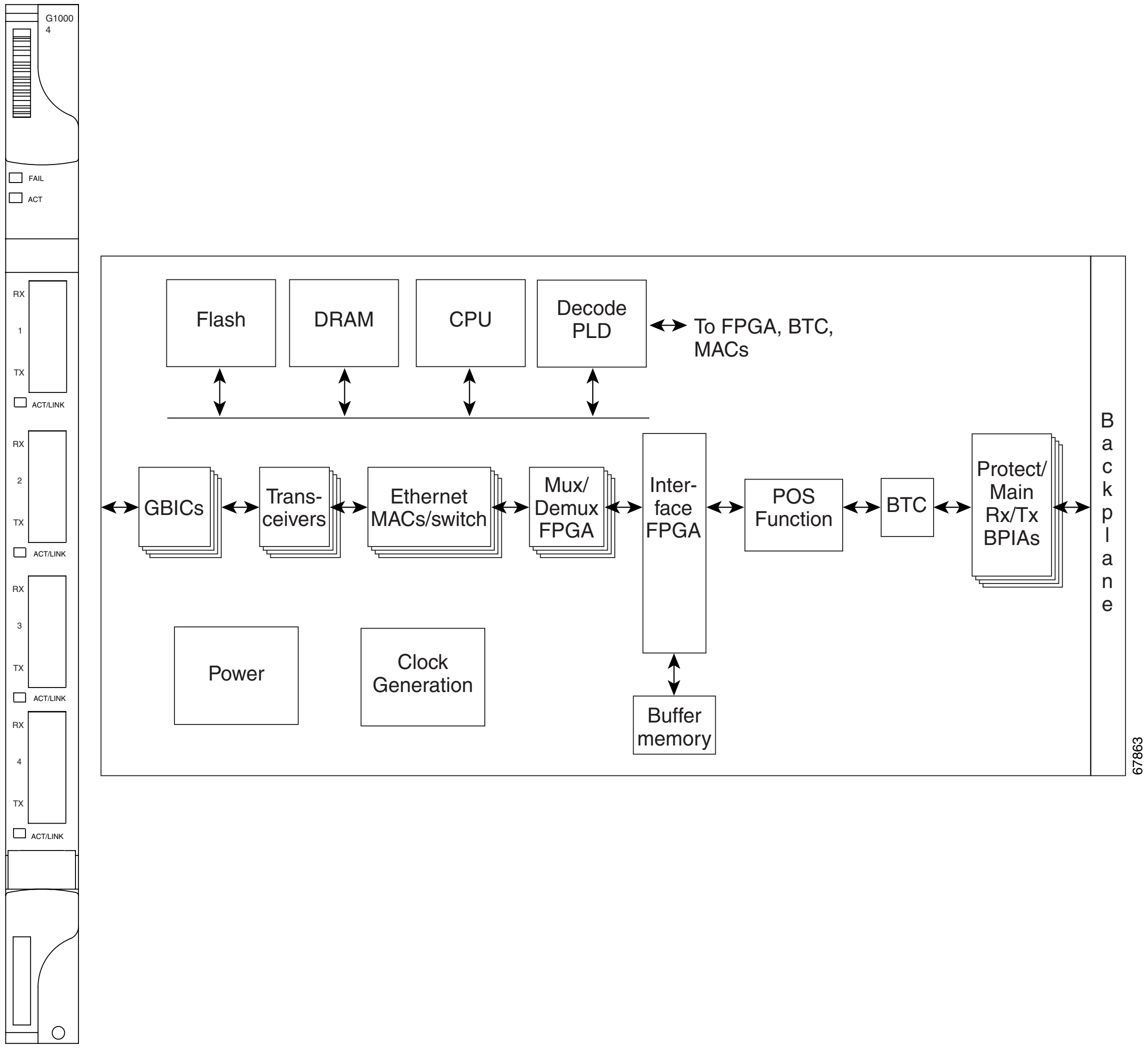
Use the G1000-4 card when the XC10G card is in use. The ONS 15454 uses G1000-4 cards for Gigabit Ethernet (1000 Mbps). The G1000-4 card provides four ports of IEEE-compliant, 1000 Mbps interfaces. Each port supports full-duplex operation for a maximum bandwidth of OC-48 on each card. The G1000-4 card uses GBIC modular receptacles for the optical interfaces.

Two GBIC modules are offered as separate orderable products for maximum customer flexibility:

- an IEEE 1000Base-SX compliant, 850 nm optical module;
- an IEEE 1000Base-LX-compliant, 1300 nm optical module.
- an IEEE 1000Base-ZX-complaint, 1550 nm optical module.

The 850 nm SX optics are designed for multimode fiber and distances of up to 220 meters on 62.5 micron fiber and up to 550 meters on 50 micron fiber. The 1300 nm LX optics are designed for single-mode fiber and distances of up to ten kilometers. The 1550 nm ZX optics are designed for single-mode fiber and distances of up to eighty kilometers. Figure 5-5 shows the card faceplate and the block diagram of the card.

Figure 5-5 G1000-4 faceplate and block diagram



The G1000-4 Gigabit Ethernet card provides high-throughput, low latency transport of Ethernet encapsulated traffic (IP and other layer 2 or layer 3 protocols) across a SONET network. Carrier-class Ethernet transport is achieved by hitless (< 50 msec) performance in the event of any failures or protection switches (such as 1+1 APS, UPSR, or BLSR). Full provisioning support is possible via CTC, TL1, or CTM.

You can install the G1000-4 card into any multispeed slot for a total shelf capacity of 48 Gigabit Ethernet ports.

Note The practical G1000-4 port per shelf limit is 40, because at least 2 slots are typically filled by OC-N cards such as the OC-192.

The circuit sizes supported are STS-1, STS-3c, STS-6c, STS-9c, STS-24c, STS-48c.

5.6.1 G1000-4 Card-Level Indicators

The G1000-4 card faceplate has two card-level LED indicators.

Table 5-12 G1000-4 Card-Level Indicators

Card-Level LEDs	Description
FAIL LED (red)	The red FAIL LED indicates the card's processor is not ready or a catastrophic software failure occurred on the G1000-4 card. As part of the boot sequence, the FAIL LED is turned on, and it turns off when the software is deemed operational.
ACT LED (green)	A green ACT LED provides the operational status of the G1000-4. When the ACT LED is green it indicates that the G1000-4 card is active and the software is operational.

5.6.2 G1000-4 Port-Level Indicators

The G1000-4 card also has one bicolor LED per port. The following table describes the status that each color represents.

Table 5-13 G1000-4 Port-Level Indicators

Port-Level LED	Description
Off	No link exists to the Ethernet port.
Steady Amber	A link exists to the Ethernet port, but traffic flow is inhibited. For example, an unconfigured circuit, an error on line, or a non-enabled port may inhibit traffic flow.
Solid Green	A link exists to the Ethernet port, but no traffic is carried on the port.
Flashing Green	A link exists to the Ethernet port, and traffic is carried on the port. The LED flash rate reflects the traffic rate for the port.

5.6.3 G1000-4 Compatibility

The G1000-4 card requires Cisco ONS 15454 Release 3.2 or later system software and XC10G cross-connect cards.

5.6.4 G1000-4 Card Specifications

- Environmental
  - Operating Temperature:
    C-Temp (15454-G1000-4): 0 to +55 degrees Celsius
  - Operating Humidity: 5- 95%, non-condensing
  - Power Consumption: 63.00 W, 1.31 amps, 215.11 BTU/Hr.
- Dimensions
  - Height: 12.650 in.
  - Width: 0.716 in.
  - Depth: 9.000 in.
  - Card Weight: 2.1 lbs, 0.9 kg

CHAPTER 6

Card Protection

This chapter explains the Cisco ONS 15454 card protection configurations. To provision card protection, refer to the *Cisco ONS 15454 Procedure Guide*.

Chapter topics include:

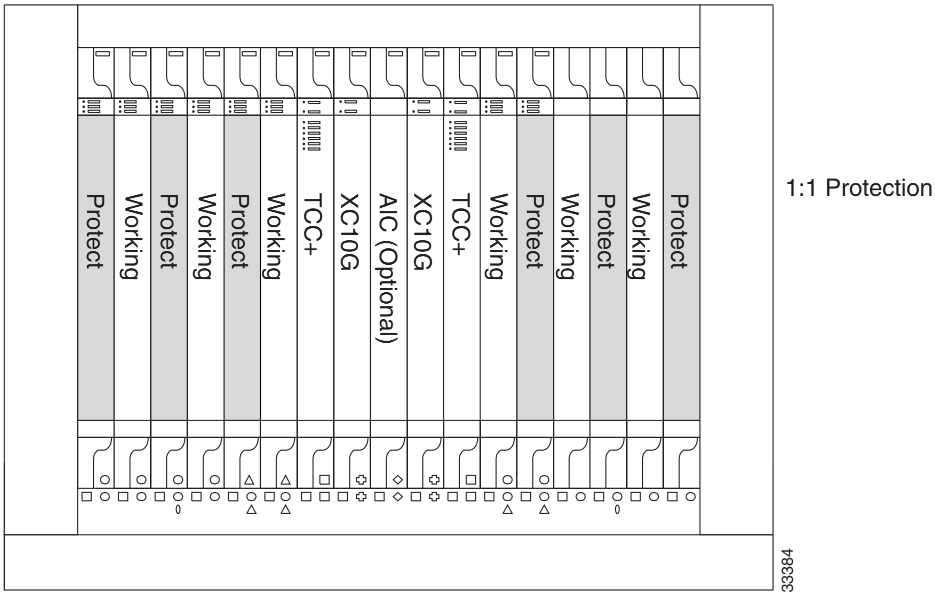
6.1 Electrical Card Protection

The ONS 15454 provides a variety of electrical card protection methods. This section describes the protection options. Figure 6-1 shows a 1:1 protection scheme and Figure 6-2 on page 6-3 shows a 1:N protection scheme.

6.1.1 Protection, 1:1

In 1:1 protection, a working card is paired with a protect card of the same type. If the working card fails, the traffic from the working card switches to the protect card. When the failure on the working card is resolved, traffic automatically reverts to the working card. Figure 6-1 shows the ONS 15454 in a 1:1 protection configuration. Each working card in an even-numbered slot is paired with a protect card in an odd-numbered slot: Slot 1 is protecting Slot 2, Slot 3 is protecting Slot 4, Slot 5 is protecting Slot 6, Slot 17 is protecting Slot 16, Slot 15 is protecting Slot 14, and Slot 13 is protecting Slot 12. The following electrical cards use a 1:1 protection scheme: EC1-12, DS1-14, DS3-12 and DS3-12E.

Figure 6-1 ONS 15454 cards in a 1:1 protection configuration

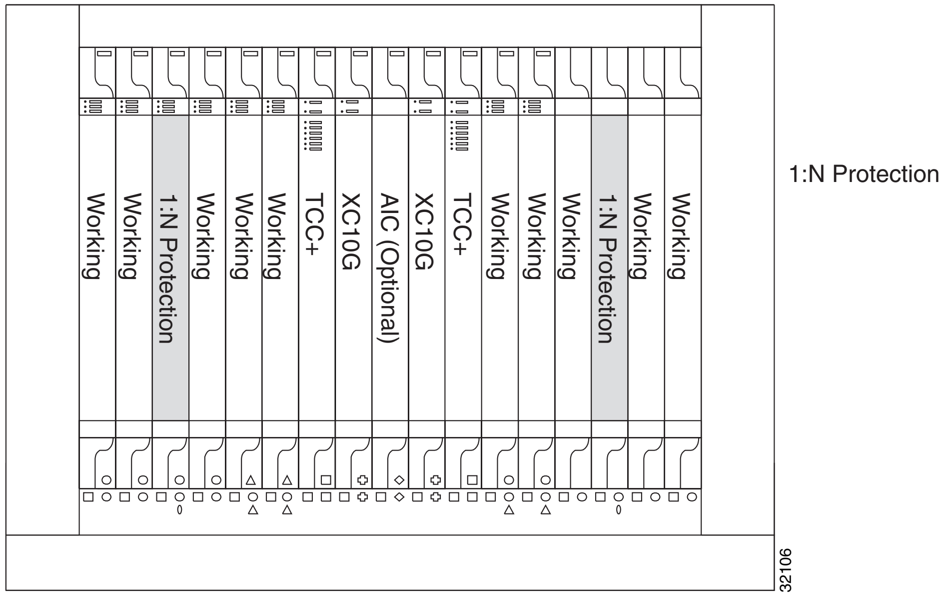


6.1.2 Protection, 1:N

1:N protection allows a single card to protect up to five working cards of the same DS-N level. A DS1N-14 card protects DS1-14 cards, a DS3N-12 card protects DS3-12 cards, and DS3N-12E cards protect DS3-12E cards. The standard DS1-14, DS3-12, and DS3-12E cards provide 1:1 protection only. Currently, 1:N protection operates only at the DS-1 and DS-3 levels. 1:N cards have added circuitry to act as the protection card in a 1:N protection group. Otherwise, the card is identical to the standard card and can serve as a normal working card.

The physical DS-1 or DS-3 interfaces on the ONS 15454 backplane use the working card until the working card fails. When the node detects this failure, the protection card takes over the physical DS-1 or DS-3 electrical interfaces through the relays and signal bridging on the backplane. Figure 6-2 shows the ONS 15454 in a 1:N protection configuration. Each side of the shelf assembly has only one card protecting all of the cards on that side.

Figure 6-2 ONS 15454 cards in a 1:N protection configuration



6.1.2.1 Revertive Switching

1:N protection supports revertive switching. Revertive switching sends the electrical interfaces (traffic) back to the original working card after the card comes back online. Detecting an active working card triggers the reversion process. There is a variable time period for the lag between detection and reversion, called the revertive delay, which you can set using the ONS 15454 software, Cisco Transport Controller (CTC). To set the revertive delay, refer to the *Cisco ONS 15454 Procedure Guide*. All cards in a protection group share the same reversion settings. 1:N protection groups default to automatic reversion.

6.1.2.2 Protection Guidelines, 1:N

Several rules apply to 1:N protection groups in the ONS 15454:

- Working and protect card groups must reside in the same card bank (A or B)
- The 1:N protect card must reside in Slot 3 for side A and Slot 15 for side B
- Working cards may sit on either or both sides of the protect card

The ONS 15454 supports 1:N equipment protection for all add-drop multiplexer configurations (ring, linear, and terminal), as specified by Telcordia GR-253-CORE.

The ONS 15454 automatically detects and identifies a 1:N protection card when the card is installed in Slot 3 or Slot 15. However, the slot containing the 1:N card in a protection group must be manually provisioned as a protect slot because by default all cards are working cards.

For detailed procedures on setting up DS-1 and DS-3 protection groups, refer to the *Cisco ONS 15454 Procedure Guide*.

6.2 Electrical Card Protection and the Backplane

Protection schemes for electrical cards differ slightly depending on the Electrical Interface Assembly (EIA) type used on the ONS 15454 backplane. The difference is due to the varying connector size. For example, because BNC connectors are larger, fewer DS3-12 cards can be supported when using a BNC connector.

Note For EIA descriptions and installation, refer to the Cisco ONS 15454 Procedure Guide.

Caution **When a protection switch moves traffic from the DS3-12 working/active card to the DS3-12 protect/standby card, ports on the new active/standby card cannot be taken out of service as long as traffic is switched. Lost traffic can result when a port is taken out of service even if the DS3-12 standby card no longer carries traffic.**

6.2.1 Standard BNC Protection

When you use BNC connectors, the ONS 15454 supports 1:1 protection or 1:N protection for a total of four working DS-3 electrical cards. If you are using EC-1 electrical cards with the BNC EIA, the ONS 15454 supports 1:1 protection and a total of four working cards. Slots 2, 4, 14, and 16 are designated working slots. These slots are mapped to a set of 12 BNC connectors on the EIA. These slots can be used without protection for unprotected DS-3 access.

With 1:N or 1:1 protection, Slots 1, 3, 15 and 17 are designated for protection when BNC connectors are used. With 1:N protection, Slots 3 and 15 are also designated for protection when BNC connectors are used. Slots 5, 6, 12, and 13 do not support DS3-12 cards when you use the regular BNC EIA.

6.2.2 High-Density BNC Protection

When you use the High-Density BNC EIA, the ONS 15454 supports 1:1 protection or 1:N protection for eight total working DS-3 electrical cards. If you are using EC-1 electrical cards with the High-Density BNC EIA, the ONS 15454 supports 1:1 protection and a total of eight working cards. Slots 1, 2, 4, 5, 13, 14, 16, and 17 are designated working slots.

These slots are mapped to a set of 12 BNC type connectors on the EIA. You can use these slots without protection for unprotected DS-3 or EC-1 access. Slots 3 and 15 are designated for 1:N protection slots when you use BNC connectors with the High-Density BNC EIA. Slots 6 and 12 do not support DS-3 or EC-1 cards when you use the High-Density BNC EIA.

6.2.3 SMB Protection

When you use SMB connectors, the ONS 15454 supports 1:1 or 1:N protection for the DS-1 and the DS-3 electrical cards. If you are using EC-1 cards with the SMB EIA, the ONS 15454 supports 1:1 protection. Working and protection electrical cards are defined by card slot pairs (the same card type is used for working and protect modules; the protection of the card is defined by the slot where it is housed). Each slot maps to a set of 12 or 14 SMB connectors on the EIA depending on the number of ports on the corresponding card. Any slot can be used without protection for unprotected DS-1, DS-3, or EC-1 access.

The DS1N-14 card can be a working or protect card in 1:1 or 1:N protection schemes. When used with 1:N protection, the DS1N-14 card can protect up to five DS1-14 plug-ins using the SMB connectors with the DS-1 electrical interface adapters (baluns).

6.2.4 AMP Champ Protection

When you use AMP Champ connectors, the ONS 15454 supports 1:1 or 1:N protection for the DS-1 cards. The DS1N-14 card can be a working or protect card in 1:1 or 1:N protection schemes. When used with 1:N protection, the DS1N-14 card can protect up to five DS1-14 plug-ins using the AMP Champ EIA.

6.3 Optical Card Protection

With 1+1 port-to-port protection, any number of ports on the protect card can be assigned to protect the corresponding ports on the working card. The working and protect cards do not have to be placed side by side in the node. A working card must be paired with a protect card of the same type, for example, an OC-3 card should be paired with another OC-3 card. The protection takes place on the port level, any number of ports on the protect card can be assigned to protect the corresponding ports on the working card.

For example, on a four-port card, you can assign one port as a protection port on the protect card (protecting the corresponding port on the working card) and leave three ports unprotected. Conversely, you can assign three ports as protection ports and leave one port unprotected.

Note Currently, the OC-3 card is the only multiple port optical card. You cannot make protection groups on the same multiport card.

With 1:1 or 1:N protection (electrical cards), the protect card must protect an entire slot. In other words, all the ports on the protect card will be used in the protection scheme.

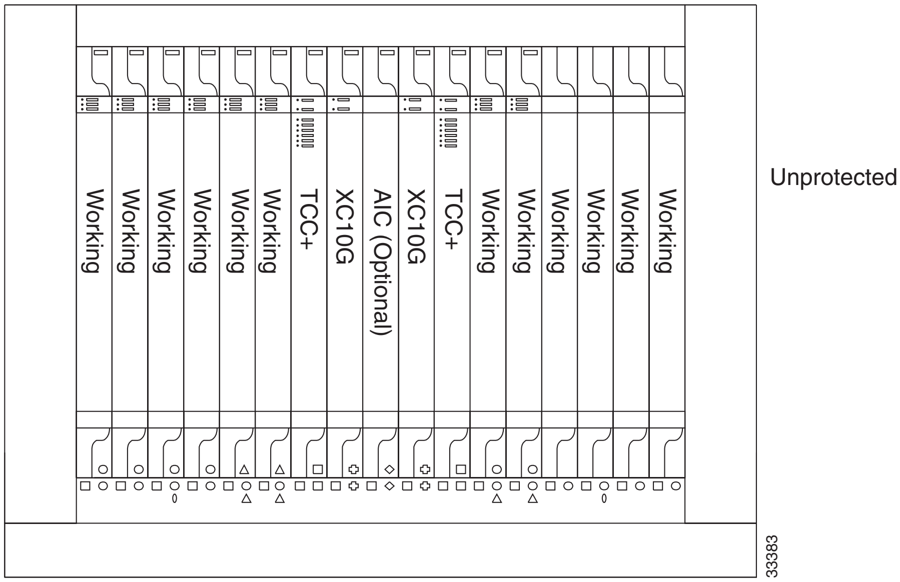
1+1 span protection can be either revertive or non-revertive. With non-revertive 1+1 protection, when a failure occurs and the signal switches from the working card to the protect card, the signal stays switched to the protect card until it is manually switched back. Revertive 1+1 protection automatically switches the signal back to the working card when the working card comes back online.

You create and modify protection schemes using CTC software. For more information, refer to the *Cisco ONS 15454 Procedure Guide*.

6.4 Unprotected Cards

Unprotected cards are not included in a protection scheme; therefore, a card failure or a signal error results in lost data. Because no bandwidth lies in reserve for protection, unprotected schemes maximize the available ONS 15454 bandwidth. Figure 6-3 shows the ONS 15454 in an unprotected configuration. All cards are in a working state.

Figure 6-3 ONS 15454 in an unprotected configuration



6.5 Inhibiting Protection Group Switching

Protection group switching allows you to prohibit traffic from switching to a specified card using the Maintenance > Protection tabs. Protection group switching can be accomplished by applying a Lock On or a Lock Out to a specified card. When the Lock On state is applied to a specified working or protect card, any traffic which is currently on that card will remain on that card and will be unable to switch to the opposite card. When the Lock Out state is applied to a specified working or protect card, any traffic which is currently on that card will be switched to the opposite card. A combination of Lock On and Lock Out is allowed in 1:1 and 1:N protection; for example, a Lock On on the working card and a Lock Out on the protect card. For procedures, refer to the Maintenance chapter in the *Cisco ONS 15454 Procedure Guide.*

Note A non-alarmed event (INHSW) is raised when a card is placed in a Lock On or Lock Out state.

Cisco Transport Controller Operation

This chapter describes Cisco Transport Controller (CTC), the Cisco ONS 15454's software interface that is stored on the TCC+ card and downloaded to your workstation each time you log into the ONS 15454. For CTC set up and log-in information, refer to the *Cisco ONS 15454 Procedure Guide*.

Chapter topics include:

7.1 CTC Software Versions

ONS 15454 provisioning and administration is performed using the Cisco Transport Controller software. CTC is a Java application that is installed in two locations:

- ONS 15454 Timing Communications and Control card (TCC+)
- PCs and UNIX workstations that connect to the ONS 15454

7.1.1 CTC Software Installed on the TCC+

CTC software is pre-loaded on the ONS 15454 TCC+ cards; therefore, you do not need to install software on the TCC+. When a new CTC software version is released, follow procedures in the *Cisco ONS 15454 Software Upgrade Guide Release 3.3* to upgrade the ONS 15454 software on the TCC+.

When you upgrade CTC software, the TCC+ stores the older CTC version as the protect CTC version, and the newer CTC release becomes the working version. You can view the software versions that are installed on an ONS 15454 by selecting the Maintenance > Software tabs in node view. Select the tabs in network view to display the software versions installed on all the network nodes.

Figure 7-1 CTC software versions displayed in node view

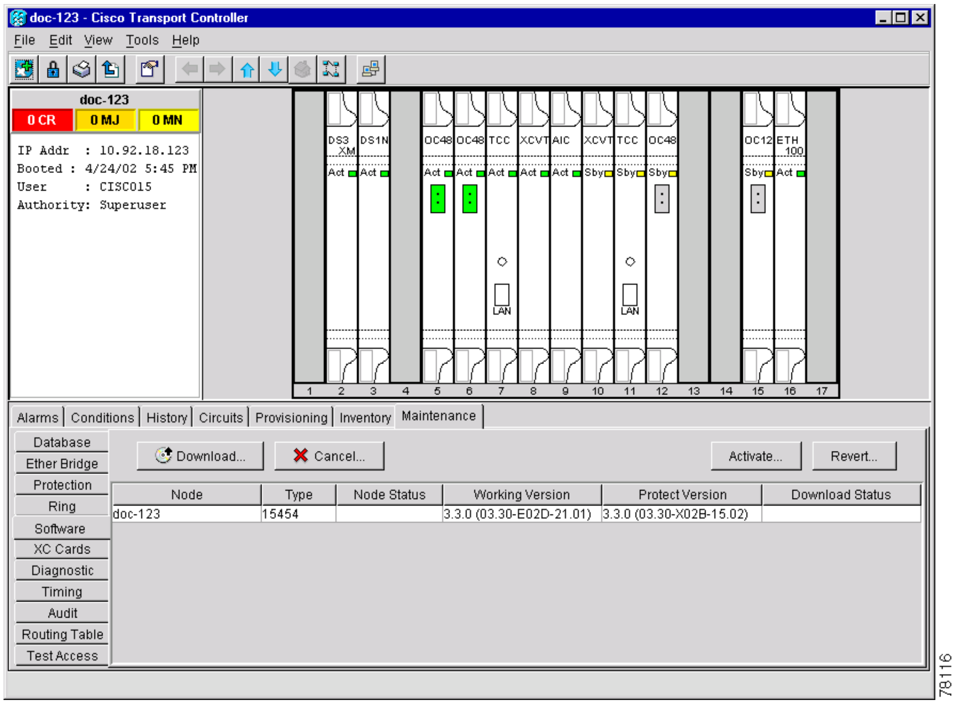
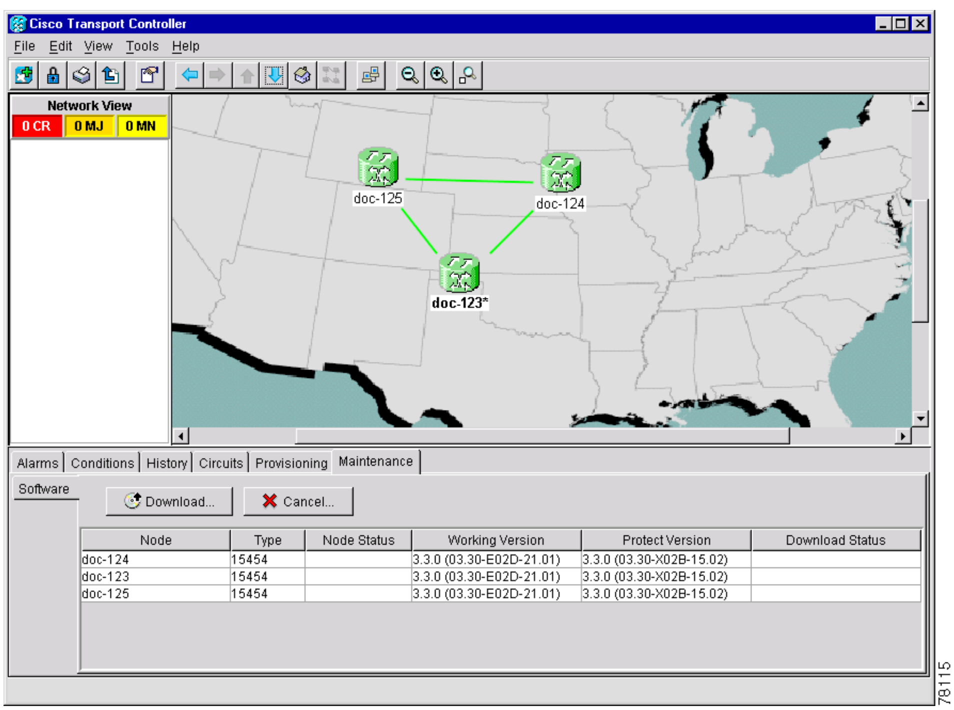


Figure 7-2 CTC software versions in displayed network view



7.1.2 CTC Software Installed on the PC or UNIX Workstation

CTC software is downloaded from the TCC+ and installed on your computer automatically after you connect to the ONS 15454. Downloading the CTC software files automatically ensures your computer is running the same CTC software version as the TCC+ you are accessing. The computer CTC software files are stored in the temporary directory designated by your computer's operating system. If the files are deleted, they are downloaded the next time you connect to an ONS 15454. Downloading the files takes 1-2 minutes.

7.2 CTC Installation Overview

To connect to an ONS 15454 using CTC, you enter the ONS 15454 IP address in the URL field of a web browser, such as Netscape Navigator or Microsoft Internet Explorer. After connecting to an ONS 15454, the following occurs automatically:

1. A CTC launcher applet is downloaded from the TCC+ to your computer.
2. The launcher determines whether your computer has a CTC release matching the release on the ONS 15454 TCC+.
3. If the computer does not have CTC installed, or if the installed release is older than the TCC+ version, the launcher downloads the CTC program files from the TCC+.
4. The launcher starts CTC. The CTC session is separate from the web browser session, so the web browser is no longer needed. If you log into an ONS 15454 that is connected to ONS 15454s with older versions of CTC, or to Cisco ONS 15327s, CTC "element" files are downloaded automatically to enable you to interact with those nodes. You cannot interact with nodes on the network that have a software version later than the node that you are logged into. Therefore, always log into nodes having the latest software release.

Each ONS 15454 can handle up to four network-level CTC sessions (the login node and its DCC-connected nodes) and one node-level session (login node only) at one time. CTC performance may vary, depending upon the volume of activity in each session.

Note You can also use TL1 commands to communicate with the Cisco ONS 15454 through VT100 terminals and VT100 emulation software, or you can Telnet to an ONS 15454 using TL1 port 3083. See the *Cisco ONS 15454 and Cisco ONS 15327 TL1 Command Guide* for a comprehensive list of TL1 commands.

7.3 Computer Requirements

To use CTC in ONS 15454 Release 3.3, your computer must have a web browser with the correct Java Runtime Environment (JRE) installed. The correct JRE for each CTC software release is included on the Cisco ONS 15454 software CD. If you are running multiple CTC software releases on a network, the JRE installed on the computer must be compatible with the different software releases. Table 7-1 on page 7-4 shows JRE compatibility with ONS software releases.

Table 7-1 JRE Compatibility

ONS Software Release	JRE 1.2.2 Compatible	JRE 1.3 Compatible
ONS 15454 Release 2.2.1 and earlier	Yes	No
ONS 15454 Release 2.2.2	Yes	Yes
ONS 15454 Release 3.0	Yes	Yes
ONS 15454 Release 3.1	Yes	Yes
ONS 15454 Release 3.2	Yes	Yes
ONS 15454 Release 3.3	Yes	Yes

Requirements for PCs and UNIX workstations are provided in Table 7-2. A modified java.policy file must also be installed. In addition to Netscape Communicator and the JRE, also included on the ONS 15454 software CD and the ONS 15454 documentation CD are the Java plug-in and modified java.policy file.

Table 7-2 Computer Requirements for CTC

Area	Requirements	Notes
Processor	Pentium II 300 MHz, UltraSPARC, or equivalent	300 Mhz is the recommended processor speed. You can use computers with less processor speed; however, you may experience longer response times and slower performance.
RAM	128 MB	
Hard drive	2 GB recommended; 50 MB space must be available	
Operating System	• PC: Windows 95, Windows 98, Windows NT 4.0, or Windows 2000 • Workstation: Solaris 2.6	
Web browser	• PC: Netscape Navigator 4.51 or higher, or Netscape Communicator 4.61 or higher, or Internet Explorer 4.0 (service pack 2) or higher • Workstation: Netscape Navigator 4.73 or higher	Netscape Communicator 4.73 (Windows) and 4.76 (UNIX) are installed by the CTC Installation Wizard included on the Cisco ONS 15454 software and documentation CDs.

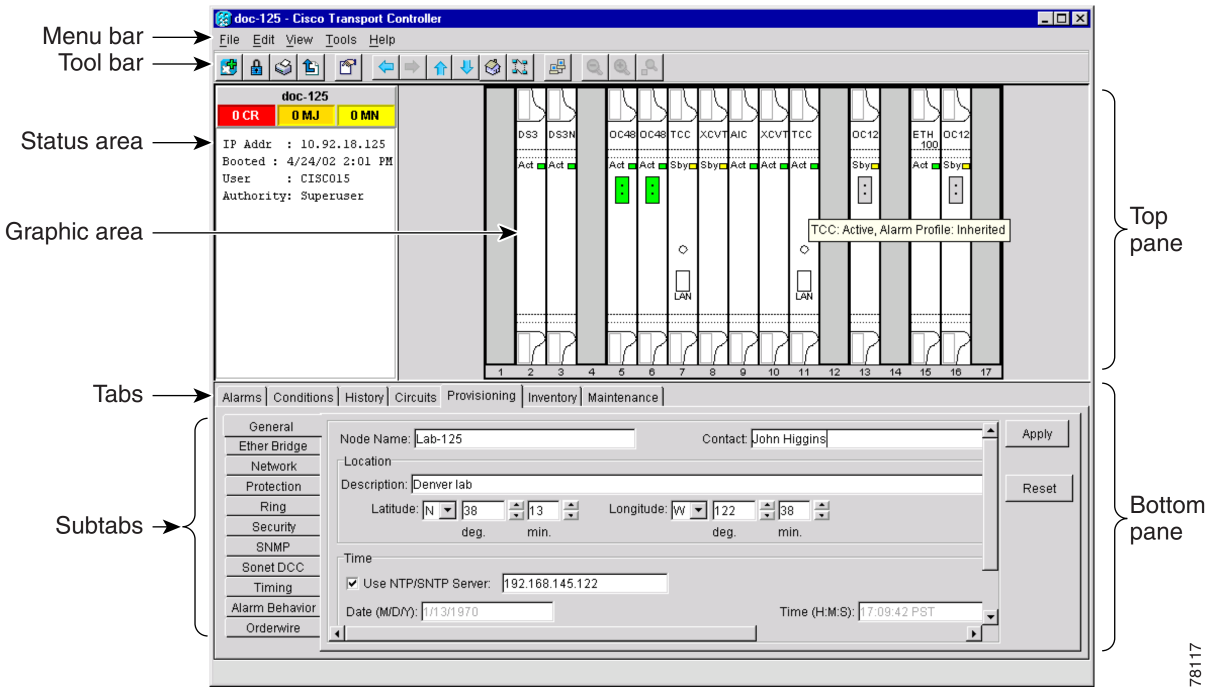
Table 7-2 Computer Requirements for CTC (continued)

Area	Requirements	Notes
Java Runtime Environment	JRE 1.3.1_02	JRE 1.3.1_02 is installed by the CTC Installation Wizard included on the Cisco ONS 15454 software and documentation CDs. If you will connect to an ONS 15454 running Release 2.2.1, you must uninstall JRE 1.3.1 and install JRE 1.2.2_05, then reinstall JRE 1.3.1_02 when you connect to an ONS 15454 running Release 3.3.
Java.policy file	A java.policy file modified for CTC	The java.policy file is modified by the CTC Installation Wizard included on the Cisco ONS 15454 software and documentation CDs.
Cable	User-supplied Category 5 straight-through cable with RJ-45 connectors on each end to connect the computer to the ONS 15454 directly or though a LAN.	

7.4 The CTC Window

The CTC window (screen) displays after you log into an ONS 15454 (Figure 7-3). The window includes a menu bar, toolbar, and a top and bottom pane. The top pane displays status information about the selected objects and a graphic of the current view. The bottom pane displays tabs and subtabs, which you use to view ONS 15454 information and perform ONS 15454 provisioning and maintenance. From this window you can display three ONS 15454 views: network, node, and card.

Figure 7-3 CTC window elements in the node view (default login view)



7.4.1 Node View

The CTC node view, shown in Figure 7-3, is the first view displayed after you log into an ONS 15454. The login node is the first node displayed, and it is the "home view" for the session. Node view allows you to view and manage one ONS 15454 node. The status area shows the node name, IP address, session boot date and time, number of critical (CR), major (MJ), and minor (MN) alarms, the name of the current logged-in user, and security level of the user.

7.4.1.1 CTC Card Colors

The graphic area of the CTC window depicts the ONS 15454 shelf assembly. The colors of the cards in the graphic reflect the real-time status of the physical card and slot (Table 7-3).

Table 7-3 Node View Card Colors

Card Color	Status
Grey	Slot is not provisioned; no card is installed
Violet	Slot is provisioned; no card is installed
White	Slot is provisioned; a functioning card is installed
Yellow	Slot is provisioned; a minor alarm condition exists
Orange	Slot is provisioned; a major alarm condition exists
Red	Slot is provisioned; a critical alarm exists

7.4.1.2 Node View Card Shortcuts

If you move your mouse over cards in the graphic, popups display additional information about the card including the card type, card status (active or standby), the number of critical, major, and minor alarms (if any), and the alarm profile used by the card. Right-clicking a card reveals a shortcut menu, which you can use to open, reset, or delete a card. Right-click a slot (grey) to pre-provision a card (i.e., provision a slot before installing the card).

7.4.1.3 Node View Tabs

Table 7-4 lists the tabs and subtabs available in the node view.

Table 7-4 Node View Tabs and Subtabs

Tab	Description	Subtabs
Alarms	Lists current alarms (CR, MJ, MN) for the node and updates them in real-time	none
Conditions	Displays a list of standing conditions on the node.	none
History	Provides a history of node alarms including date, type, and severity of each alarm. The Session subtab displays alarms and events for the current session. The Node subtab displays alarms and events retrieved from a fixed-size log on the node.	Session, Node
Circuits	Create, delete, edit, and map circuits	none
Provisioning	Provision the ONS 15454 node	General, Ether Bridge, Network, Protection, Ring, Security, SNMP, Sonet DCC, Timing, Alarming, Orderwire
Inventory	Provides inventory information (part number, serial number, CLEI codes) for cards installed in the node. Allows you to delete and reset cards.	none
Maintenance	Perform maintenance tasks for the node	Database, Ether Bridge, Protection, Ring, Software, XC cards, Diagnostic, Timing, Audit, Routing Table, Test Access

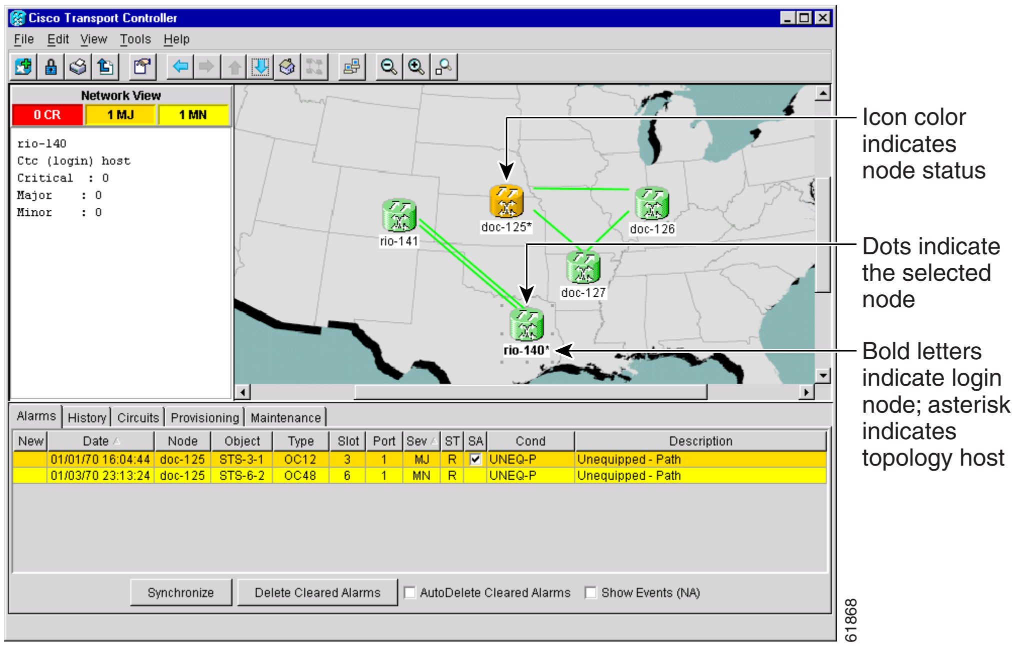
7.4.2 Network View

Network view (Figure 7-4) allows you to view and manage ONS 15454s that have DCC connections to the node that you logged into and any login node groups you may have selected.

Note Nodes with DCC connections to the login node will not display if you select Exclude Dynamically Discovered Nodes on the Login dialog box.

The graphic area displays a background image with colored ONS 15454 icons. The icon colors indicate the node status (Table 7-5). Green lines show DCC connections between the nodes. Selecting a node or span in the graphic area displays information about the node and span in the status area.

Figure 7-4 A four-node network displayed in CTC network view



The node colors displayed in network view indicate the status of the node.

Table 7-5 Node Status Shown in Network View

Color	Alarm Status
Green	No alarms
Yellow	Minor alarms
Orange	Major alarms
Red	Critical alarms
Grey with node name	Node is initializing
Grey with IP address	Node is initializing, or a problem exists with IP routing from node to CTC

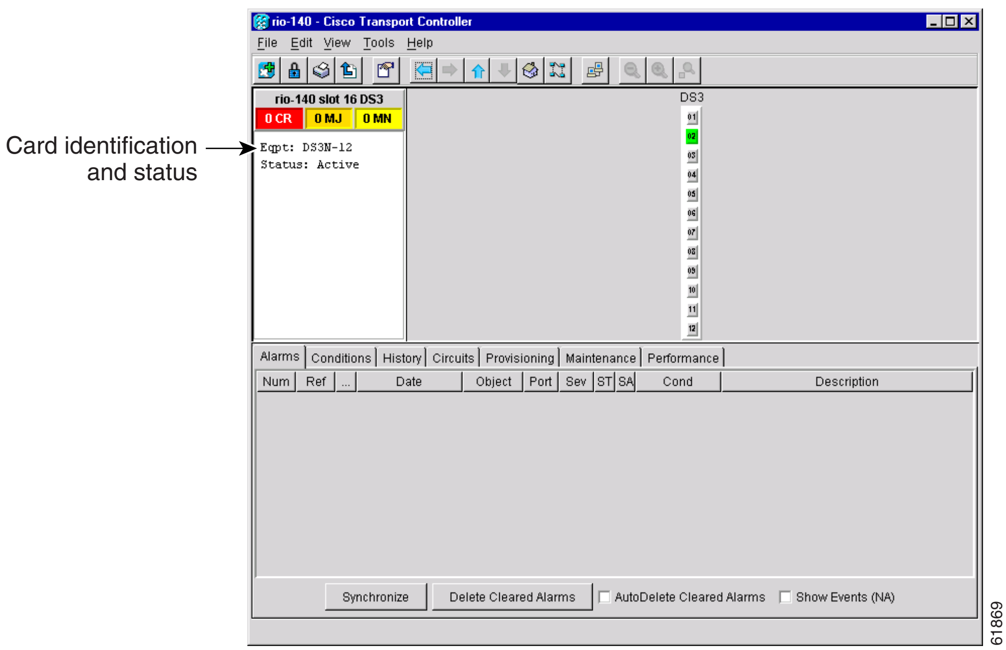
7.4.3 Card View

Card view displays information about individual ONS 15454 cards and is the window where you perform card-specific maintenance and provisioning (Figure 7-5). A graphic of the selected card is shown in the graphic area. The status area displays the node name, slot, number of alarms, card type, equipment type, and either the card status (active or standby) or port status (IS [in service] or OOS [out of service]). The information that is displayed and the actions you can perform depend on the card.

Note CTC displays a card view for all ONS 15454 cards except the TCC+, XC, XCVT, and XC10G cards.

Card view provides access to the following tabs: Alarms, History, Circuits, Provisioning, Maintenance, Performance, and Conditions. (The Performance tab is not displayed for the AIC card.) The subtabs, fields, and information displayed under each tab depend on the card type selected.

Figure 7-5 CTC card view showing an DS3N-12 card



7.5 TCC+ Reset

You can reset the ONS 15454 TCC+ cards by using the Cisco Transport Controller (CTC) software, or by physically reseating a TCC+ card (card pull). Resetting the TCC+ using CTC reboots the TCC+ and reloads the operating system and the application software. Additionally, a card pull reset temporarily removes power from the TCC+ and clears all buffer memory.

You can apply a CTC reset to either an active or standby TCC+ without affecting traffic, but you should only perform a card pull on a standby TCC+. If you need to perform a card pull on an active TCC+, put the TCC+ into standby mode first by performing a reset using CTC on the card.

Note When a software-initiated reset is performed on an active TCC card or TCC+, the AIC card goes through an initialization process and also resets. The AIC card reset is normal and will happen each time an active TCC card goes through a software-initiated reset.

7.6 The TCC+ Database

When dual TCC+ cards are installed in the ONS 15454, each TCC+ card hosts a separate database; therefore, the protect card's database is available if the database on the working TCC+ fails. You can also store a back-up version of the database on the workstation running CTC. This operation should be part of a regular ONS 15454 maintenance program at approximately weekly intervals, and should also be completed when preparing an ONS 15454 for a pending natural disaster, such as a flood or fire.

Note The following parameters are not backed up and restored: node name, IP address, mask and gateway, and IIOP port. If you change the node name and then restore a backed up database with a different node name, the circuits will map to the new node name. Cisco recommends keeping a record of the old and new node names.

7.7 Reverting to an Earlier Software Load

Prior to Release 2.2.1, the ONS 15454 could not revert to an earlier software database without deleting the current database and losing both cross-connect and DCC connectivity. The revert would result in a loss of traffic until the user manually restored the previous database or recreated the existing circuits and provisioning.

Reverting to a 2.2.1 or later load will switch to the older software load and its attendant database without affecting traffic or DCC connectivity. This feature requires dual TCC+ cards and CTC software Release 2.2.1 or later as the protect version.

When you click the Activate button after a software upgrade, the TCC+ copies the current working database and saves it in a reserved location in the TCC+ flash memory. If you later need to revert to the original working software load from the protect software load, the saved database installs automatically. You do not need to restore the database manually or recreate circuits.

Tip The revert feature is useful if a maintenance window closes while you are upgrading CTC software. You can revert to the standby software load without losing traffic. When the next maintenance window opens, complete the upgrade and activate the new software load.

Note A revert to a maintenance release software load will use the current active database; therefore, no provisioning is lost. All other reverts do restore the database. (A maintenance release has a three-digit release number, e.g. 2.2.2).

Circuits created and provisioning performed after a software load is activated (upgraded to a higher software release) will not reinstate with a revert. The database configuration at the time of activation is reinstated after a revert. This does not apply to maintenance reverts (e.g. 2.2.2 to 2.2.1), because maintenance releases use the same database.

Security and Timing

This chapter provides information about Cisco ONS 15454 users and SONET timing. To provision security and timing, refer to the *Cisco ONS 15454 Procedure Guide*.

Chapter topics include:

- Users and Security, page 8-1
- Node Timing, page 8-3

8.1 Users and Security

The CISCO15 user provided with each ONS 15454 can be used to set up other ONS 15454 users. You can add up to 500 users to one ONS 15454. Each ONS 15454 user can be assigned one of the following security levels:

- *Retrieve* users can retrieve and view CTC information but cannot set or modify parameters.
- *Maintenance* users can access only the ONS 15454 maintenance options.
- *Provisioning* users can access provisioning and maintenance options.
- *Superusers* can perform all of the functions of the other security levels as well as set names, passwords, and security levels for other users.

Table 8-1 shows the actions that each user can perform in node view.

Table 8-1 ONS 15454 Security Levels—Node View

CTC Tab	Subtab	Actions	Retrieve	Maintenance	Provisioning	Superuser
Alarms	n/a	Synchronize alarms	X	X	X	X
Conditions	n/a	Retrieve	X	X	X	X
History	Session	Read only				
	Node	Retrieve Alarms/Events	X	X	X	X
Circuits	n/a	Create/Delete/Edit/ Upgrade			X	X
		Path Selector Switching		X	X	X
		Search	X	X	X	X
		Switch retrieval	X	X	X	X
Provisioning	General	Edit				X

Table 8-1 ONS 15454 Security Levels—Node View (continued)

CTC Tab	Subtab	Actions	Retrieve	Maintenance	Provisioning	Superuser
	EtherBridge	Spanning Trees: Edit			X	X
		Thresholds: Create/Delete			X	X
	Network	All				X
	Protection	Create/Delete/Edit			X	X
		Browse groups	X	X	X	X
	Ring	All (BLSR)			X	X
	Security	Create/Delete				X
		Change password	same user	same user	same user	all users
	SNMP	Create/Delete/Edit				X
		Browse trap destinations	X	X	X	X
	Sonet DCC	Create/Delete				X
	Timing	Edit			X	X
	Alarming	Edit			X	X
Inventory	n/a	Delete			X	X
		Reset		X	X	X
Maintenance	Database	Backup/Restore				X
	EtherBridge	Spanning Tree Retrieve	X	X	X	X
		Spanning Tree Clear/Clear all		X	X	X
		MAC Table Retrieve	X	X	X	X
		MAC Table Clear/Clear all		X	X	X
		Trunk Utilization Refresh	X	X	X	X
	Protection	Switch/lock out operations		X	X	X
	Ring	BLSR maintenance		X	X	X
	Software	Download/Upgrade/ Activate/Revert				X
	XC Cards	Protection switches		X	X	X
	Diagnostic	Retrieve/Lamp test		X	X	X
	Timing	Edit		X	X	X
	Audit	Retrieve	X	X	X	X
	Routing Table	Read only				
	Test Access	Read only				

Each ONS 15454 user has a specified amount of time that he or she can leave the system idle before the CTC window is locked. The lockouts prevent unauthorized users from making changes. Higher-level users have shorter idle times, as shown in Table 8-2.

Table 8-2 ONS 15454 User Idle Times

Security Level	Idle Time
Superuser	15 minutes
Provisioning	30 minutes
Maintenance	60 minutes
Retrieve	Unlimited

You can perform ONS 15454 user management tasks from network or node view. In network view, you can add, edit, or delete users from multiple nodes at one time. If you perform user management tasks in node view, you can only add, edit, or delete users from that node.

Note You must add the same user name and password to each node the user will access.

8.2 Node Timing

SONET timing parameters must be set for each ONS 15454. Each ONS 15454 independently accepts its timing reference from one of three sources:

- The BITS (Building Integrated Timing Supply) pins on the ONS 15454 backplane
- An OC-N card installed in the ONS 15454. The card is connected to a node that receives timing through a BITS source.
- The internal ST3 clock on the TCC+ card

You can set ONS 15454 timing to one of three modes: external, line, or mixed. If timing is coming from the BITS pins, set ONS 15454 timing to external. If the timing comes from an OC-N card, set the timing to line. In typical ONS 15454 networks:

- One node is set to external. The external node derives its timing from a BITS source wired to the BITS backplane pins. The BITS source, in turn, derives its timing from a Primary Reference Source (PRS) such as a Stratum 1 clock or GPS signal.
- The other nodes are set to line. The line nodes derive timing from the externally-timed node through the OC-N trunk cards.

You can set three timing references for each ONS 15454. The first two references are typically two BITS-level sources, or two line-level sources optically connected to a node with a BITS source. The third reference is the internal clock provided on every ONS 15454 TCC+ card. This clock is a Stratum 3 (ST3). If an ONS 15454 becomes isolated, timing is maintained at the ST3 level.

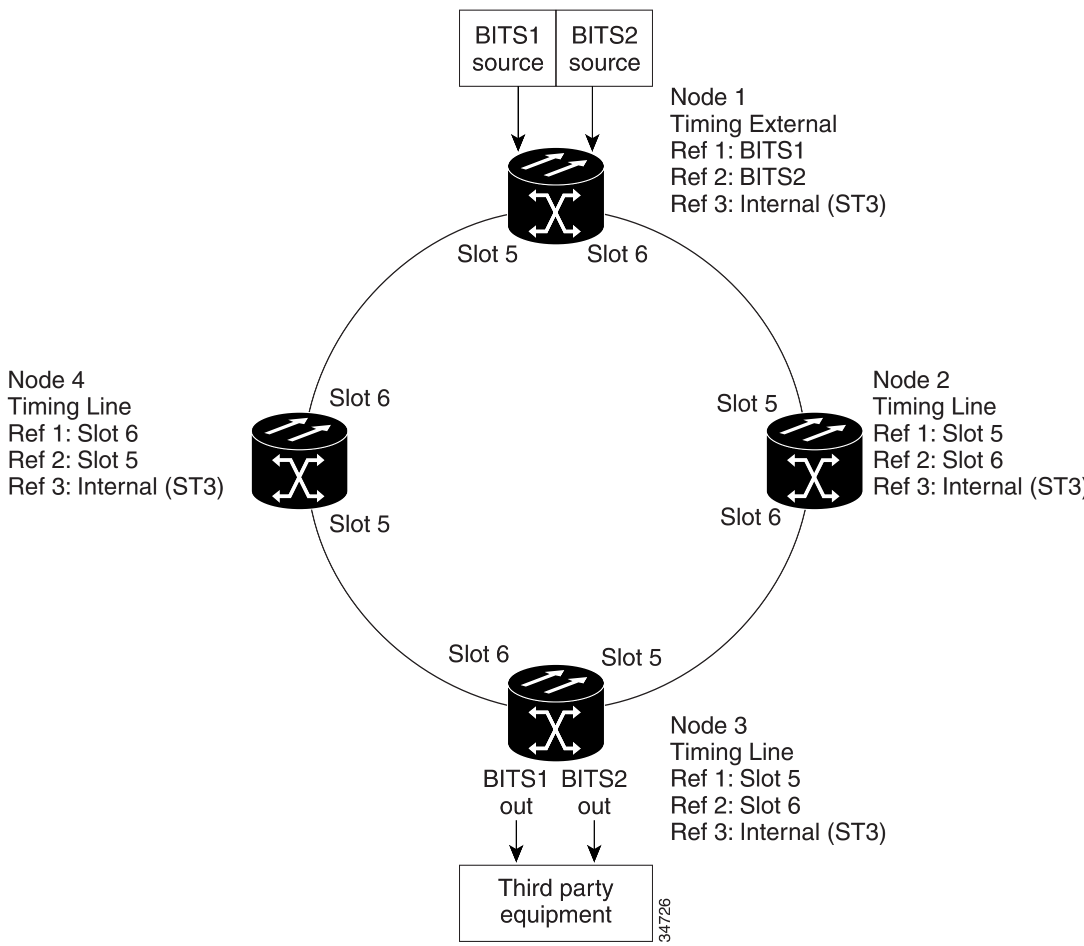
Caution Mixed timing allows you to select both external and line timing sources. However, Cisco does not recommend its use because it can create timing loops. Use this mode with caution.

8.2.1 Network Timing Example

Figure 8-1 shows an ONS 15454 network timing setup example. Node 1 is set to external timing. Two timing references are set to BITS. These are Stratum 1 timing sources wired to the BITS input pins on the Node 1 backplane. The third reference is set to internal clock. The BITS output pins on the backplane of Node 3 are used to provide timing to outside equipment, such as a Digital Access Line Access Multiplexer.

In the example, Slots 5 and 6 contain the trunk cards. Timing at Nodes 2, 3, and 4 is set to line, and the timing references are set to the trunk cards based on distance from the BITS source. Reference 1 is set to the trunk card closest to the BITS source. At Node 2, Reference 1 is Slot 5 because it is connected to Node 1. At Node 4, Reference 1 is set to Slot 6 because it is connected to Node 1. At Node 3, Reference 1 could be either trunk card because they are equal distance from Node 1.

Figure 8-1 An ONS 15454 timing example



8.2.2 Synchronization Status Messaging

Synchronization Status Messaging (SSM) is a SONET protocol that communicates information about the quality of the timing source. SSM messages are carried on the S1 byte of the SONET Line layer. They enable SONET devices to automatically select the highest quality timing reference and to avoid timing loops.

SSM messages are either Generation 1 or Generation 2. Generation 1 is the first and most widely deployed SSM message set. Generation 2 is a newer version. If you enable SSM for the ONS 15454, consult your timing reference documentation to determine which message set to use. Table 8-3 and Table 8-4 show the Generation 1 and Generation 2 message sets.

Table 8-3 SSM Generation 1 Message Set

Message	Quality	Description
PRS	1	Primary reference source – Stratum 1
STU	2	Sync traceability unknown
ST2	3	Stratum 2
ST3	4	Stratum 3
SMC	5	SONET minimum clock
ST4	6	Stratum 4
DUS	7	Do not use for timing synchronization
RES		Reserved; quality level set by user

Table 8-4 SSM Generation 2 Message Set

Message	Quality	Description
PRS	1	Primary reference source - Stratum 1
STU	2	Sync traceability unknown
ST2	3	Stratum 2
TNC	4	Transit node clock
ST3E	5	Stratum 3E
ST3	6	Stratum 3
SMC	7	SONET minimum clock
ST4	8	Stratum 4
DUS	9	Do not use for timing synchronization
RES		Reserved; quality level set by user

SONET Topologies

This chapter explains Cisco ONS 15454 SONET topologies. To provision topologies, refer to the *Cisco ONS 15454 Procedure Guide*.

Chapter topics include:

Table 9-1 shows the SONET rings that can be created on each ONS 15454 node.

Table 9-1 ONS 15454 Rings

Ring Type	Maximum per node
All rings	5
BLSRs	2
2-Fiber BLSR	2
4-Fiber BLSR	1
UPSR	4

9.1 Bidirectional Line Switched Rings

The ONS 15454 can support two concurrent BLSRs in one of the following configurations:

- Two, two-fiber BLSRs, or
- One two-fiber and one four-fiber BLSR.

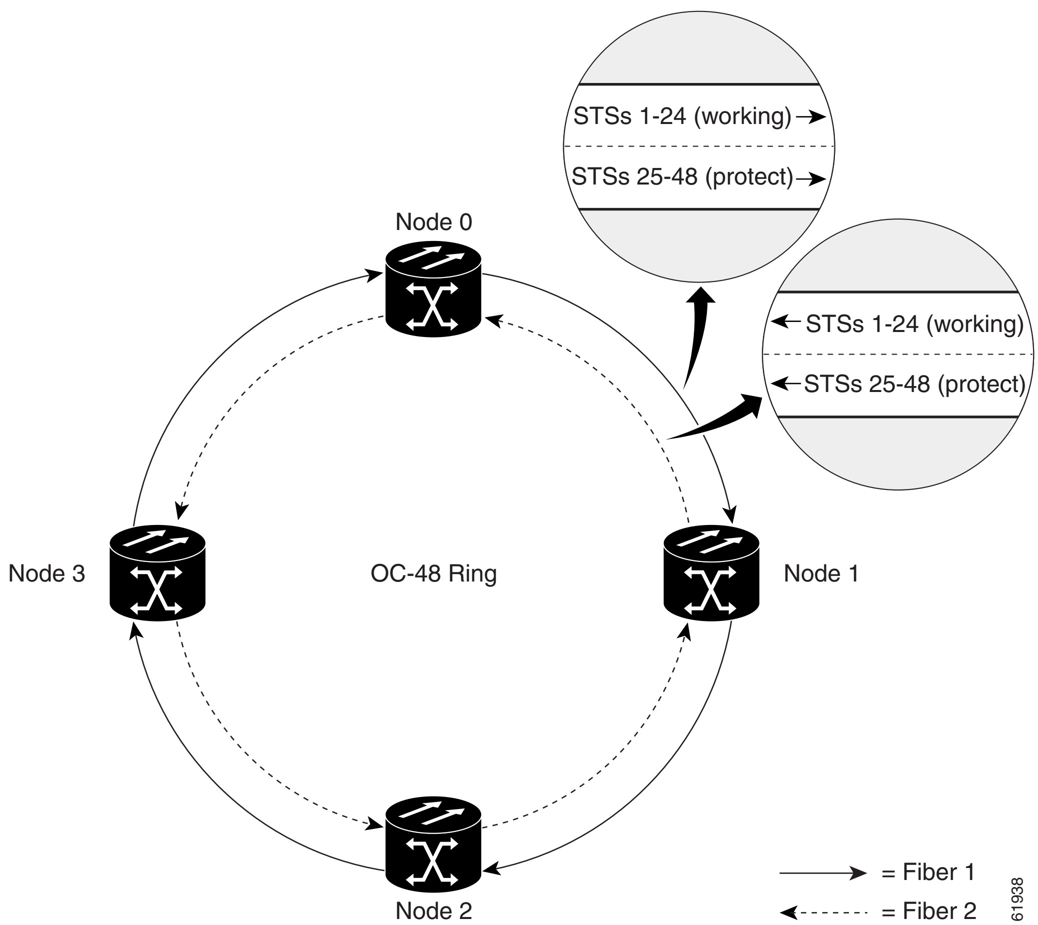
Each BLSR can have up to 32 ONS 15454s. Because the working and protect bandwidths must be equal, you can create only OC-12 (two-fiber only), OC-48, or OC-192 BLSRs.

Note For best performance, BLSRs should have one LAN connection for every ten nodes in the BLSR.

9.1.1 Two-Fiber BLSRs

In two-fiber BLSRs, each fiber is divided into working and protect bandwidths. For example, in an OC-48 BLSR (Figure 9-1), STSs 1 – 24 carry the working traffic, and STSs 25 – 48 are reserved for protection. Working traffic (STSs 1 – 24) travels in one direction on one fiber and in the opposite direction on the second fiber. The Cisco Transport Controller (CTC) circuit routing routines calculate the "shortest path" for circuits based on many factors, including requirements set by the circuit provisioner, traffic patterns, and distance. For example, in Figure 9-1, circuits going from Node 0 to Node 1 typically will travel on Fiber 1, unless that fiber is full, in which case circuits will be routed on Fiber 2 through Node 3 and Node 2. Traffic from Node 0 to Node 2 (or Node 1 to Node 3), may be routed on either fiber, depending on circuit provisioning requirements and traffic loads.

Figure 9-1 A four-node, two-fiber BLSR



The SONET K1 and K2 bytes carry the information that governs BLSR protection switches. Each BLSR node monitors the K bytes to determine when to switch the SONET signal to an alternate physical path. The K bytes communicate failure conditions and actions taken between nodes in the ring.

If a break occurs on one fiber, working traffic targeted for a node beyond the break switches to the protect bandwidth on the second fiber. The traffic travels in reverse direction on the protect bandwidth until it reaches its destination node. At that point, traffic is switched back to the working bandwidth.

Figure 9-2 shows a sample traffic pattern on a four-node, two-fiber BLSR.

Figure 9-2 Four-node, two-fiber BLSR sample traffic pattern

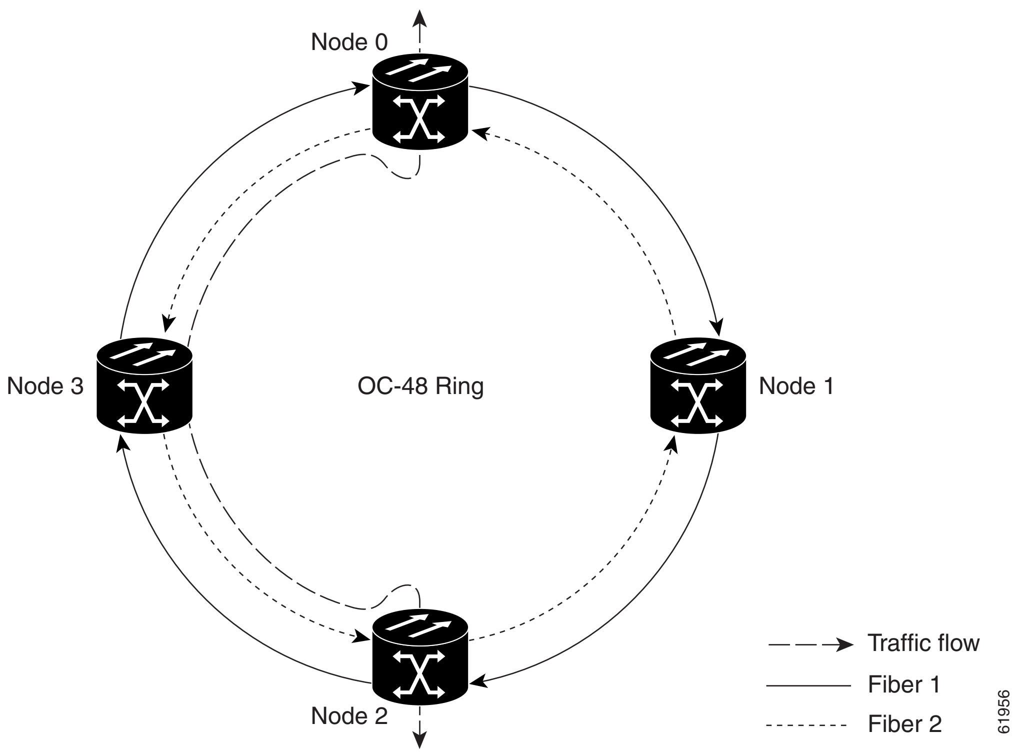
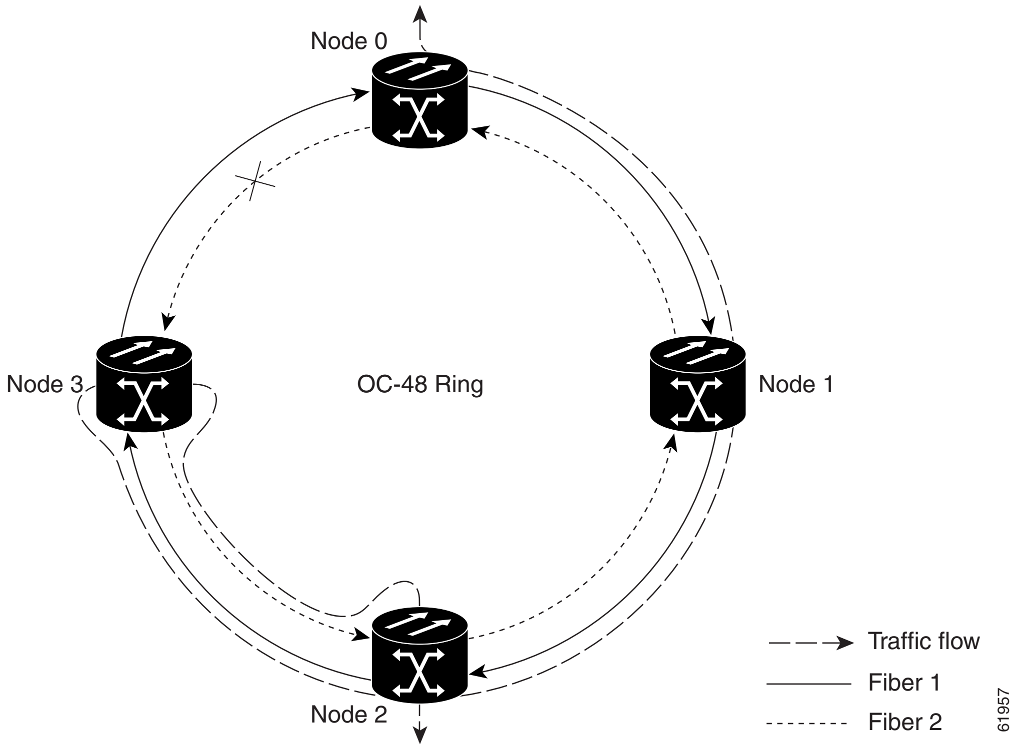


Figure 9-3 shows how traffic is rerouted following a line break between Node 0 and Node 3.

- All circuits originating on Node 0 carried to Node 2 on Fiber 2 are switched to the protect bandwidth of Fiber 1. For example, a circuit carried on STS-1 on Fiber 2 is switched to STS-25 on Fiber 1. A circuit carried on STS-2 on Fiber 2 is switched to STS-26 on Fiber 1. Fiber 1 carries the circuit to Node 3 (the original routing destination). Node 3 switches the circuit back to STS-1 on Fiber 2 where it is routed to Node 2 on STS-1.
- Circuits originating on Node 2 that were normally carried to Node 0 on Fiber 1 are switched to the protect bandwidth of Fiber 2 at Node 3. For example, a circuit carried on STS-2 on Fiber 1 is switched to STS-26 on Fiber 2. Fiber 2 carries the circuit to Node 0 where the circuit is switched back to STS-2 on Fiber 1 and then dropped to its destination.

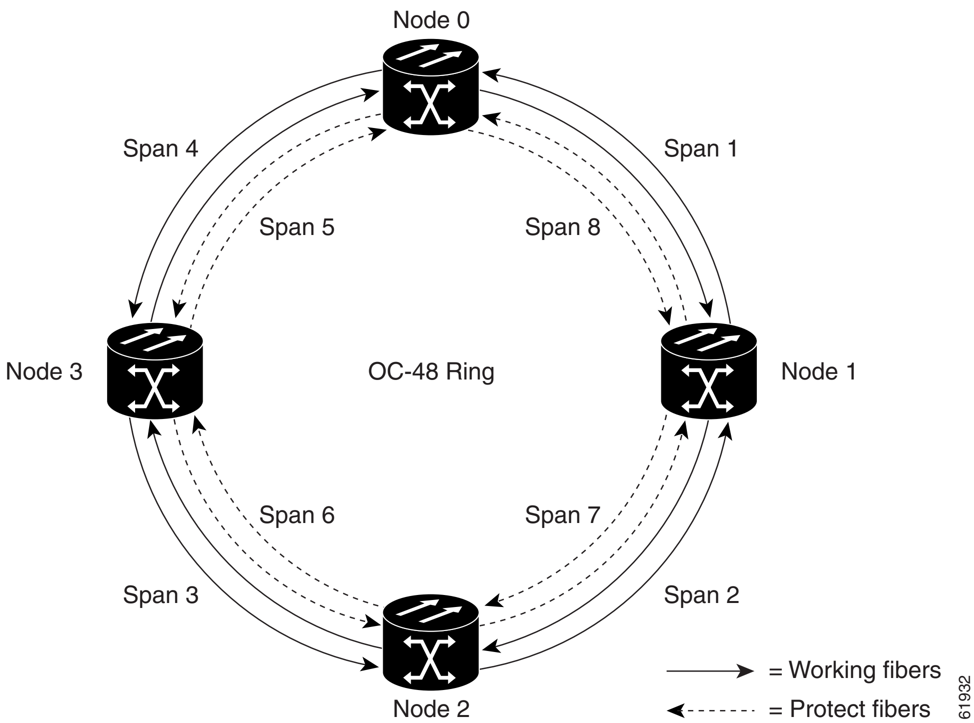
Figure 9-3 Four-node, two-fiber BLSR traffic pattern following line break



9.1.2 Four-Fiber BLSRs

Four-fiber BLSRs double the bandwidth of two-fiber BLSRs. Because they allow span switching as well as ring switching, four-fiber BLSRs increase the reliability and flexibility of traffic protection. Two fibers are allocated for working traffic and two fibers for protection, as shown in Figure 9-4. To implement a four-fiber BLSR, you must install four OC-48 or OC-48AS cards, or four OC-192 cards at each BLSR node.

Figure 9-4 A four-node, four-fiber BLSR



Four-fiber BLSRs provide span and ring switching:

- Span switching (Figure 9-5) occurs when a working span fails. Traffic switches to the protect fibers between the nodes (Node 0 and Node 1 in the Figure 9-5 example) and then returns to the working fibers. Multiple span switches can occur at the same time.
- Ring switching (Figure 9-6) occurs when a span switch cannot recover traffic, such as when both the working and protect fibers fail on the same span. In a ring switch, traffic is routed to the protect fibers throughout the full ring.

Figure 9-5 A four-fiber BLSR span switch

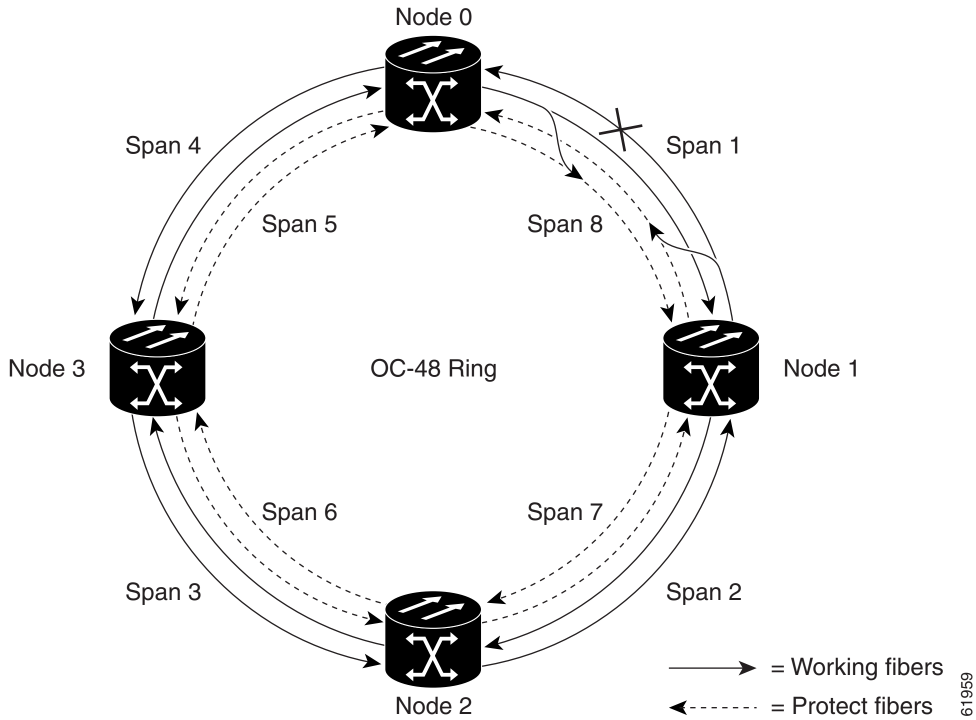
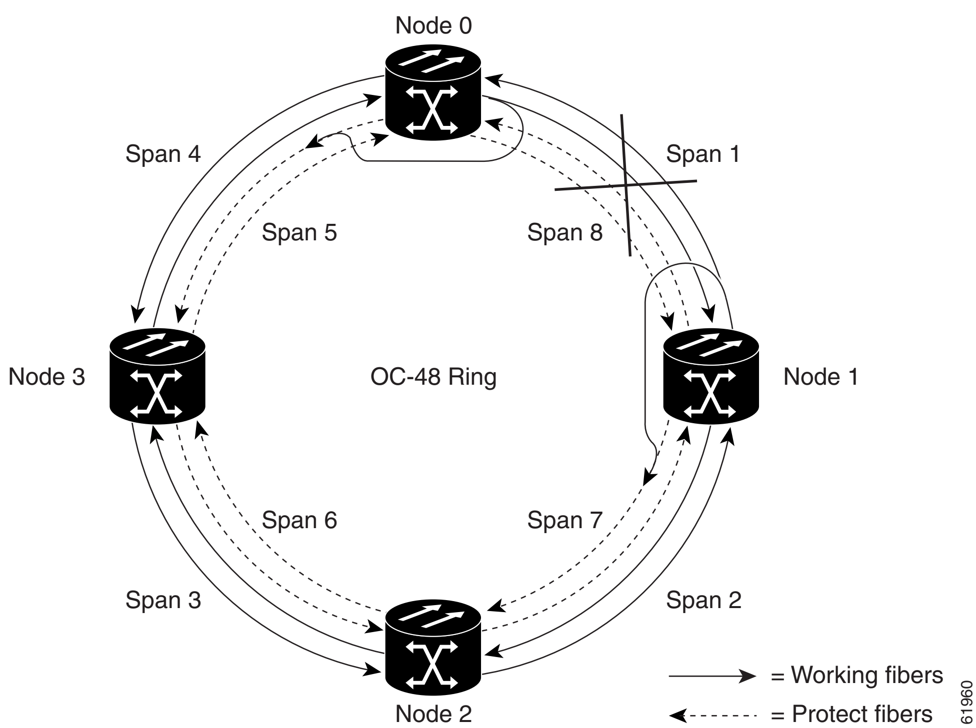


Figure 9-6 A four-fiber BLSR ring switch



9.1.3 BLSR Bandwidth

BLSR nodes can terminate traffic that is fed from either side of the ring. Therefore, BLSRs are suited for distributed node-to-node traffic applications such as interoffice networks and access networks.

BLSRs allow bandwidth to be reused around the ring and can carry more traffic than a network with traffic flowing through one central hub. BLSRs can also carry more traffic than a UPSR operating at the same OC-N rate. Table 9-2 shows the bidirectional bandwidth capacities of two-fiber BLSRs. The capacity is the OC-N rate divided by two, multiplied by the number of nodes in the ring minus the number of pass-through STS-1 circuits. Table 9-3 shows the bidirectional bandwidth capacities of four-fiber BLSRs.

Table 9-2 Two-Fiber BLSR Capacity

OC Rate	Working Bandwidth	Protection Bandwidth	Ring Capacity
OC-12	STS1-6	STS 7-12	6 x N[1] - PT[2]
OC-48	STS 1-24	STS 25-48	24 x N - PT
OC-192	STS 1-96	STS 97-192	96 x N - PT

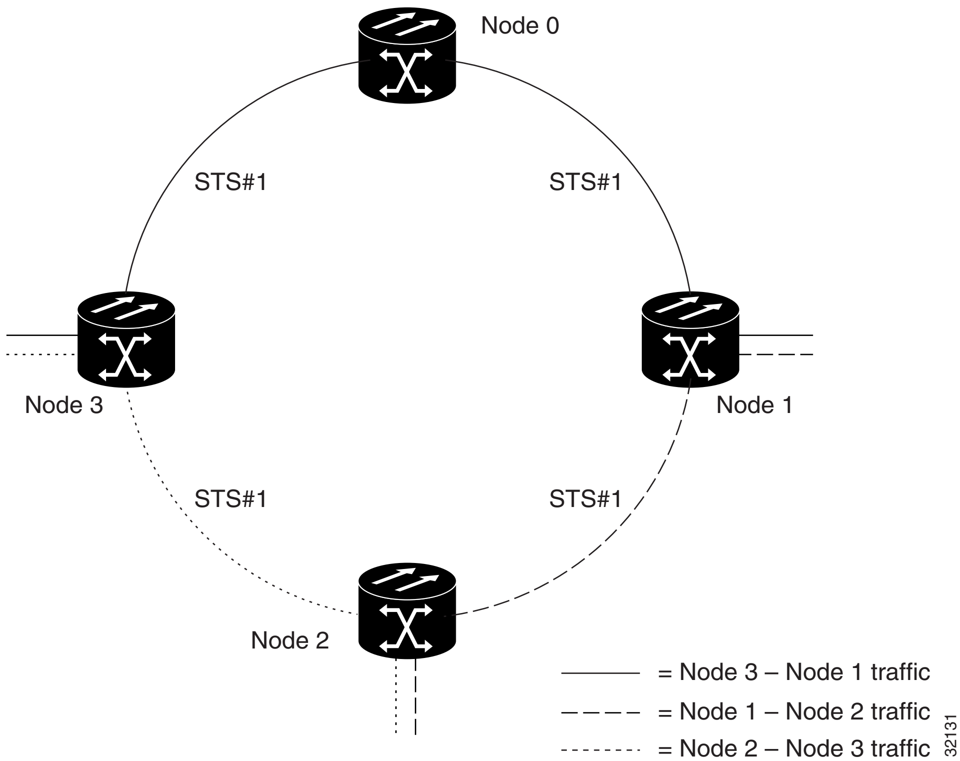
1. N equals the number of ONS 15454 nodes configured as BLSR nodes.
2. PT equals the number of STS-1 circuits passed through ONS 15454 nodes in the ring (capacity can vary depending on the traffic pattern).

Table 9-3 Four-Fiber BLSR Capacity

OC Rate	Working Bandwidth	Protection Bandwidth	Ring Capacity
OC-48	STS 1-48 (Fiber 1)	STS 1-48 (Fiber 2)	48 x N - PT
OC-192	STS 1-192 (Fiber 1)	STS 1-192 (Fiber 2)	192 x N - PT

Figure 9-7 shows an example of BLSR bandwidth reuse. The same STS carries three different traffic sets simultaneously on different spans on the ring: one set from Node 3 to Node 1, one from Node 1 to Node 2, and another from Node 2 to Node 3.

Figure 9-7 BLSR bandwidth reuse



9.1.4 Sample BLSR Application

Figure 9-8 shows a sample two-fiber BLSR implementation. A regional long-distance network connects to other carriers at Node 0. Traffic is delivered to the service provider's major hubs.

- Carrier 1 delivers six DS-3s over two OC-3 spans to Node 0. Carrier 2 provides twelve DS-3s directly. Node 0 receives the signals and delivers them around the ring to the appropriate node.
- The ring also brings 14 DS-1s back from each remote site to Node 0. Intermediate nodes serve these shorter regional connections.
- The ONS 15454 OC-3 card supports a total of four OC-3 ports so that two additional OC-3 spans can be added at little cost.

Figure 9-8 A five-node BLSR

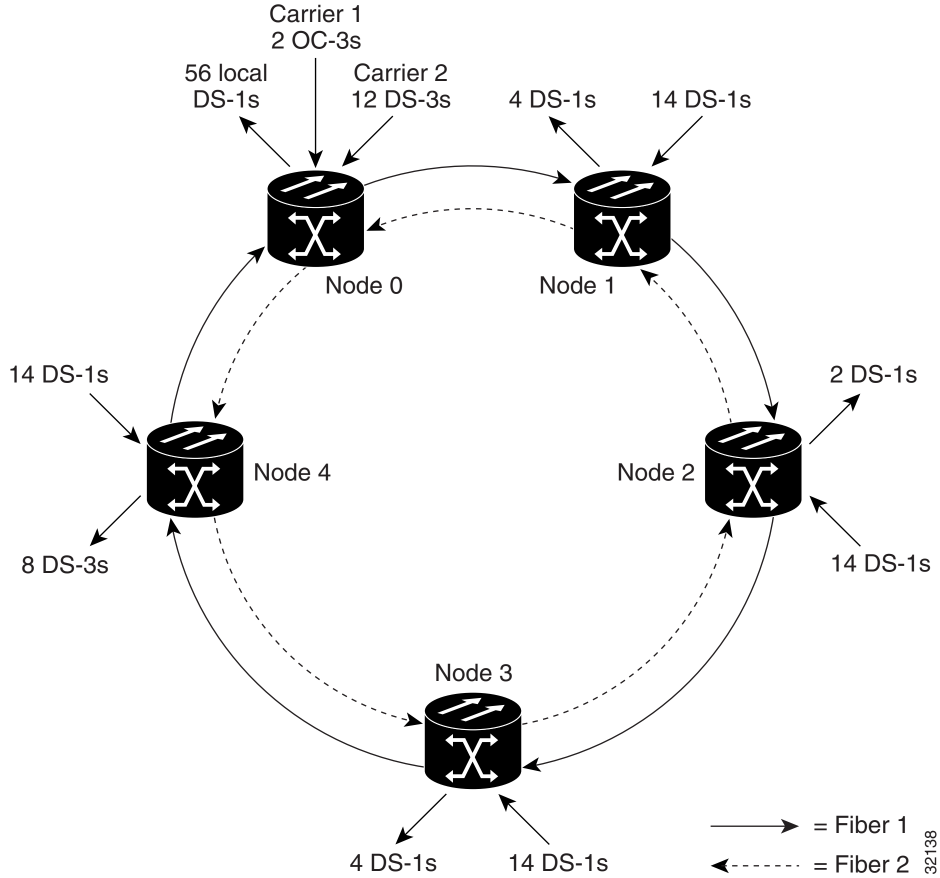


Figure 9-9 shows the shelf assembly layout for Node 0, which has one free slot. Figure 9-10 shows the shelf assembly layout for the remaining sites in the ring. In this BLSR configuration, an additional eight DS-3s at Node IDs 1 and 3 can be activated. An additional four DS-3s can be added at Node ID 4, and ten DS-3s can be added at Node ID 2. Each site has free slots for future traffic needs.

Figure 9-9 Shelf assembly layout for Node 0 in Figure 9-8

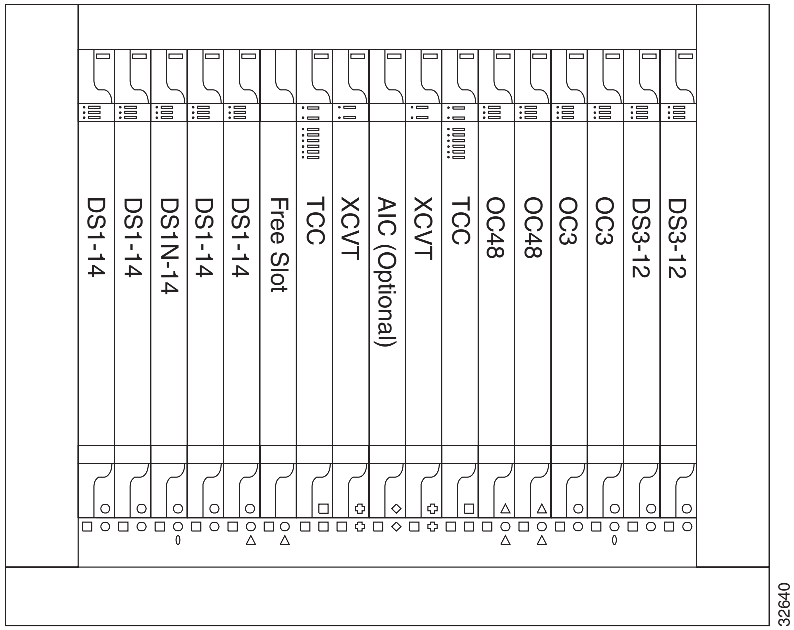
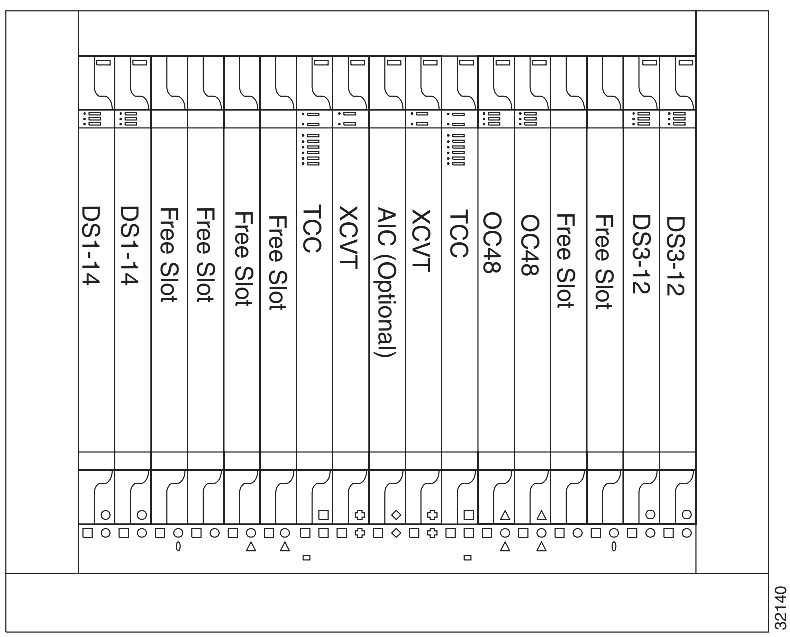


Figure 9-10 Shelf assembly layout for Nodes 1 – 4 in Figure 9-8



9.1.5 BLSR Fiber Connections

Plan your fiber connections and use the same plan for all BLSR nodes. For example, make the east port the farthest slot to the right and the west port the farthest left. Plug fiber connected to an east port at one node into the west port on an adjacent node. Figure 9-11 shows fiber connections for a two-fiber BLSR with trunk cards in Slot 5 (west) and Slot 12 (east).

Note Always plug the transmit (Tx) connector of an OC-N card at one node into the receive (Rx) connector of an OC-N card at the adjacent node. Cards will display an SF LED if Tx and Rx connections are mismatched.

For four-fiber BLSRs, use the same east—west connection pattern for the working and protect fibers. Do not mix working and protect card connections. The BLSR will not function if working and protect cards are interconnected. Figure 9-12 shows fiber connections for a four-fiber BLSR. Slot 5 (west) and Slot 12 (east) carry the working traffic. Slot 6 (west) and Slot 13 (east) carry the protect traffic.

Figure 9-11 Connecting fiber to a four-node, two-fiber BLSR

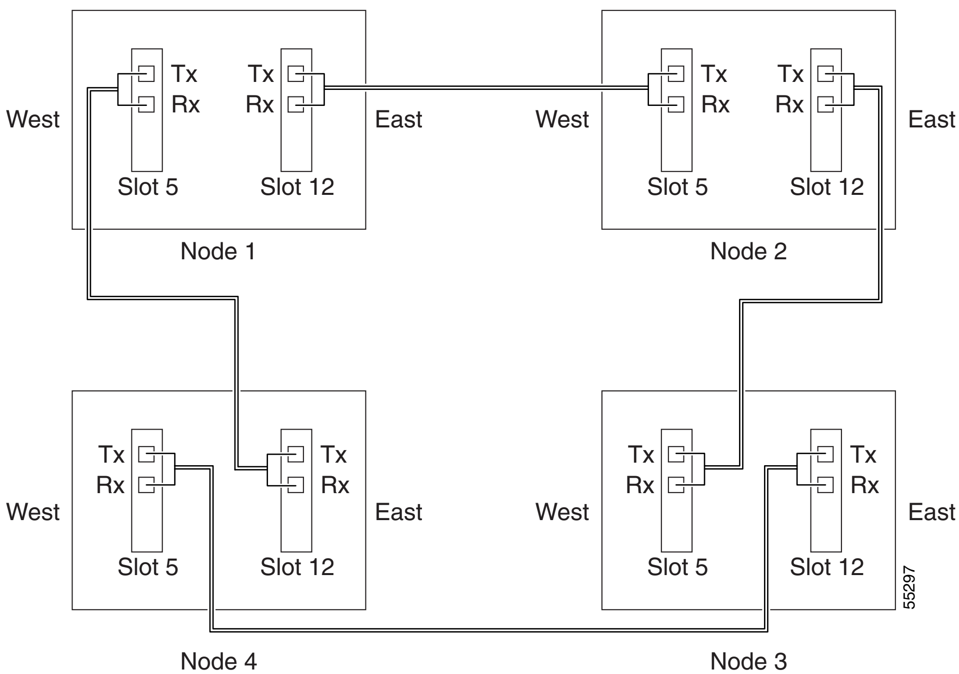
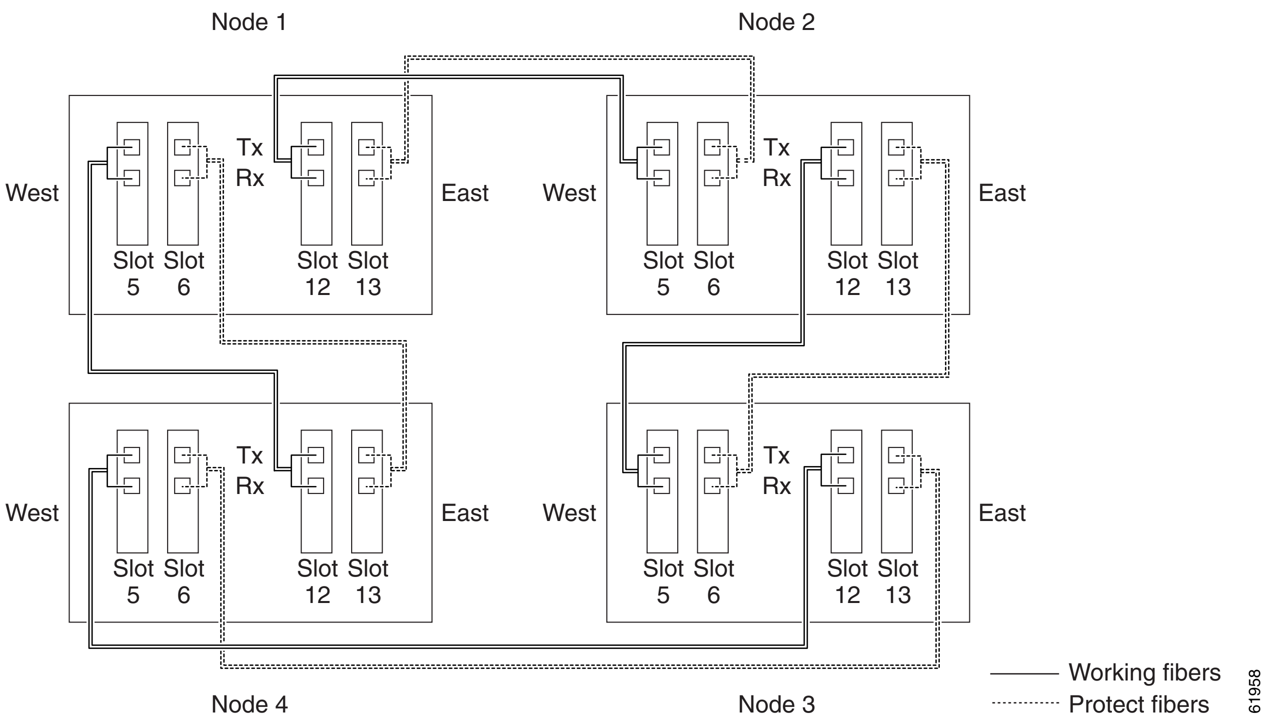


Figure 9-12 Connecting fiber to a four-node, four-fiber BLSR



9.1.6 Two-Fiber BLSR to Four-Fiber BLSR Upgrade

Two-fiber OC-48 or OC-192 BLSRs can be upgraded to four-fiber BLSRs. To upgrade, you install two OC-48 or OC-192 cards at each two-fiber BLSR node, then log into CTC and upgrade each node from two-fiber to four-fiber. The fibers that were divided into working and protect bandwidths for the two-fiber BLSR are now fully allocated for working BLSR traffic.

9.2 Unidirectional Path Switched Rings

UPSRs provide duplicate fiber paths around the ring. Working traffic flows in one direction and protection traffic flows in the opposite direction. If a problem occurs in the working traffic path, the receiving node switches to the path coming from the opposite direction.

CTC automates ring configuration. UPSR traffic is defined within the ONS 15454 on a circuit-by-circuit basis. If a path-protected circuit is not defined within a 1+1 or BLSR line protection scheme and path protection is available and specified, CTC uses UPSR as the default.

Figure 9-13 shows a basic UPSR configuration. If Node ID 0 sends a signal to Node ID 2, the working signal travels on the working traffic path through Node ID 1. The same signal is also sent on the protect traffic path through Node ID 3. If a fiber break occurs (Figure 9-14), Node ID 2 switches its active receiver to the protect signal coming through Node ID 3.

Because each traffic path is transported around the entire ring, UPSRs are best suited for networks where traffic concentrates at one or two locations and is not widely distributed. UPSR capacity is equal to its bit rate. Services can originate and terminate on the same UPSR, or they can be passed to an adjacent access or interoffice ring for transport to the service-terminating location.

Figure 9-13 A basic four-node UPSR

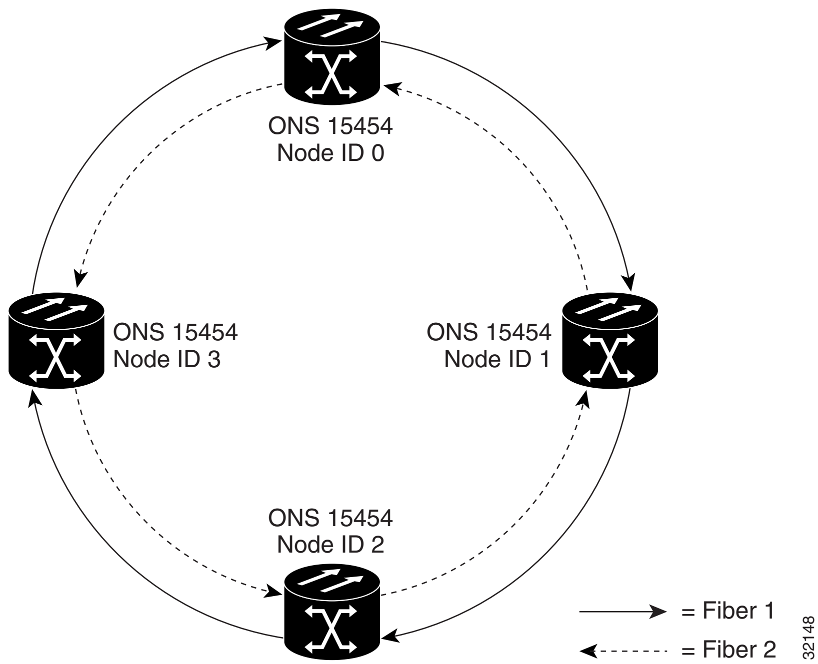


Figure 9-14 A UPSR with a fiber break

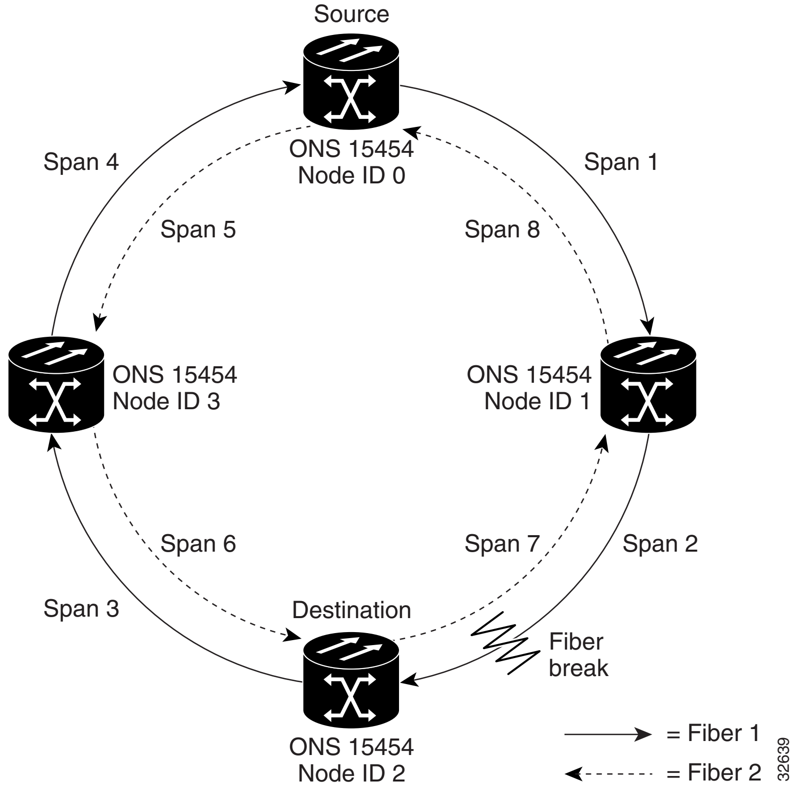
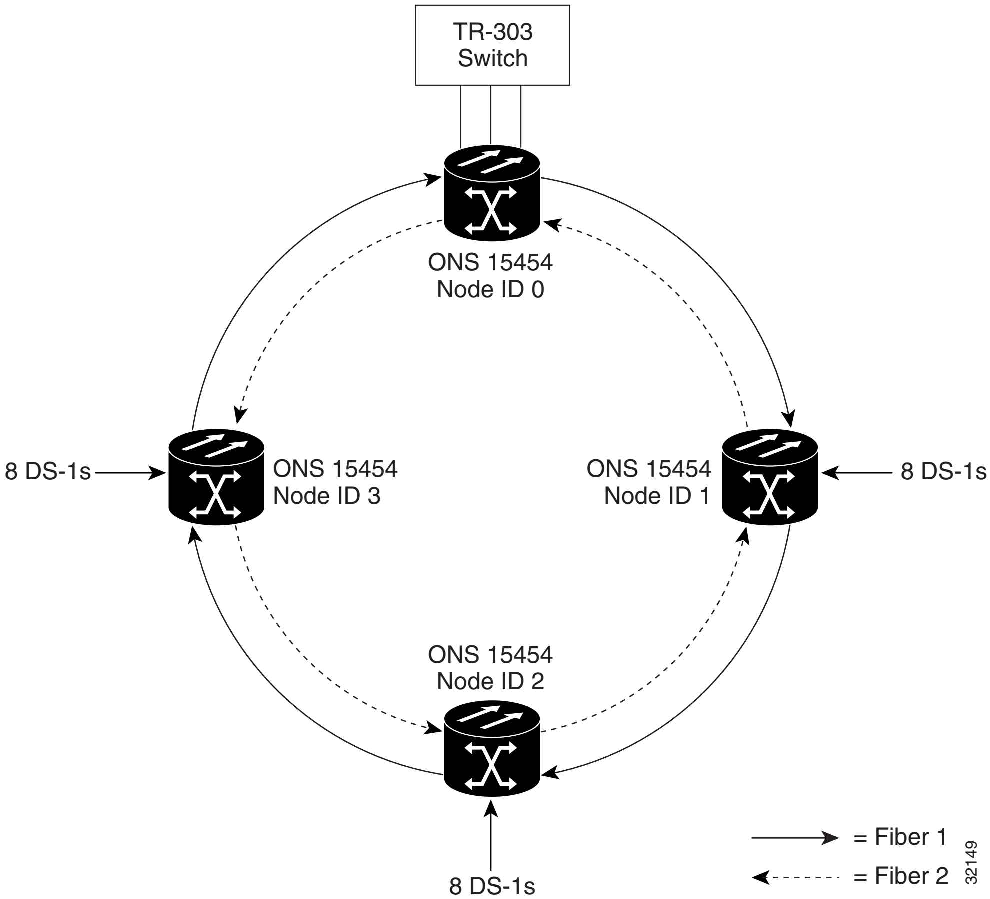


Figure 9-15 shows a common UPSR application. OC-3 optics provide remote switch connectivity to a host TR-303 switch. In the example, each remote switch requires eight DS-1s to return to the host switch. Figure 9-16 and Figure 9-17 show the shelf layout for each site.

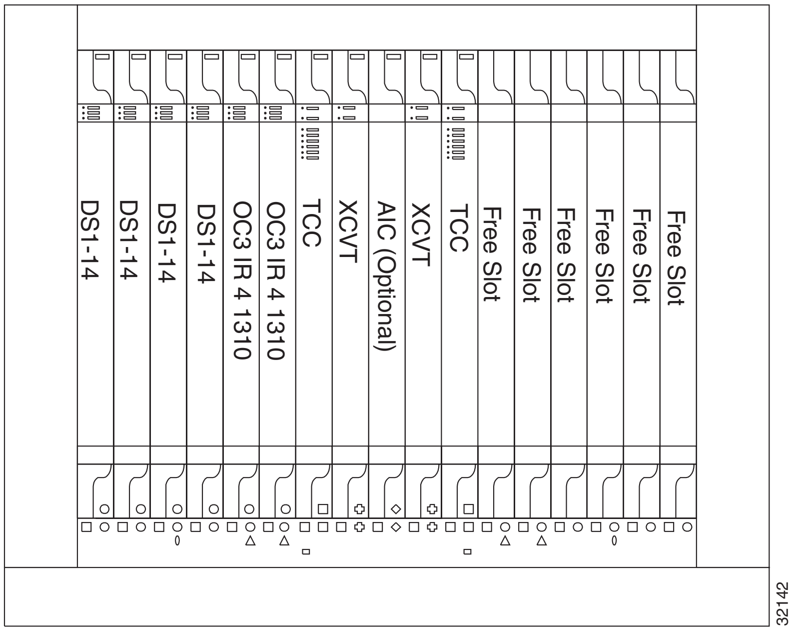
Figure 9-15 An OC-3 UPSR



Node ID 0 has four DS1-14 cards to provide 56 active DS-1 ports. The other sites only require two DS1-14 cards to handle the eight DS-1s to and from the remote switch. You can use the other half of each ONS 15454 shelf assembly to provide support for a second or third ring to other existing or planned remote sites.

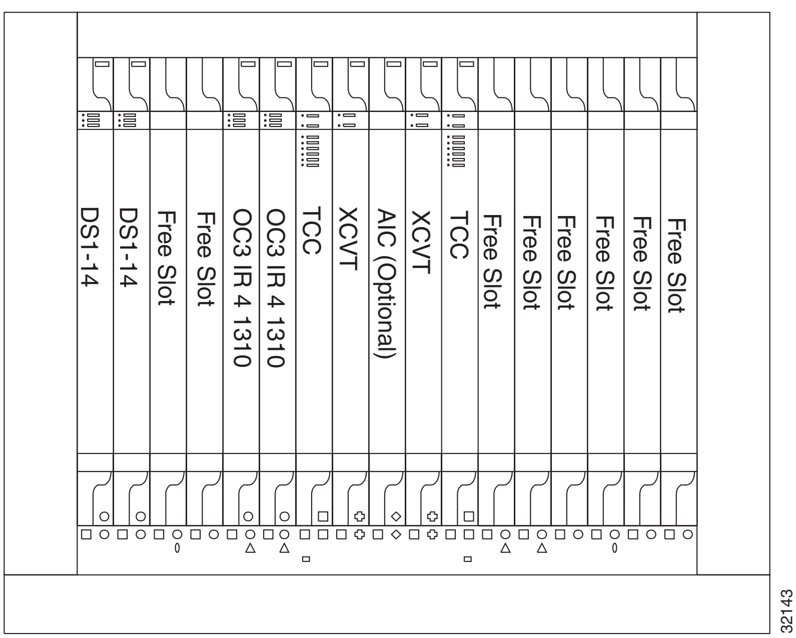
In this sample OC-3 UPSR, Node ID 0 contains four DS1-14 cards and two OC3 IR 4 1310 cards. Six free slots also exist in this setup and can be provisioned with cards or left empty. Figure 9-16 shows the shelf setup for these cards.

Figure 9-16 Layout of Node ID 0 in the OC-3 UPSR example (Figure 5-15)



In the Figure 9-15 on page 9-15 example, Nodes IDs 1 - 3 each contain two DS1-14 cards and two OC3 4 IR 1310 cards. Eight free slots exist. They can be provisioned with other cards or left empty. Figure 9-17 shows the shelf assembly setup for this configuration sample.

Figure 9-17 Layout of Node IDs 1 – 3 in the OC-3 UPSR example (Figure 5-15)



9.3 Subtending Rings

The ONS 15454 supports up to ten SONET DCCs. Therefore, one ONS 15454 node can terminate and groom any one of the following ring combinations:

- 5 UPSRs, or
- 4 UPSRs and 1 BLSR, or
- 3 UPSRs and 2 BLSRs

Subtending rings from an ONS 15454 reduces the number of nodes and cards required and reduces external shelf-to-shelf cabling. Figure 9-18 shows an ONS 15454 with multiple subtending rings.

Figure 9-18 An ONS 15454 with multiple subtending rings

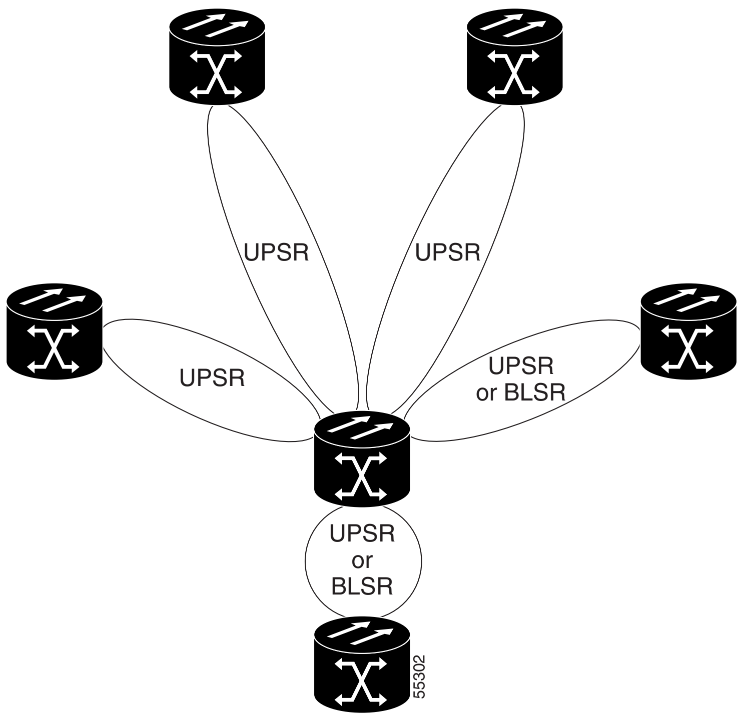
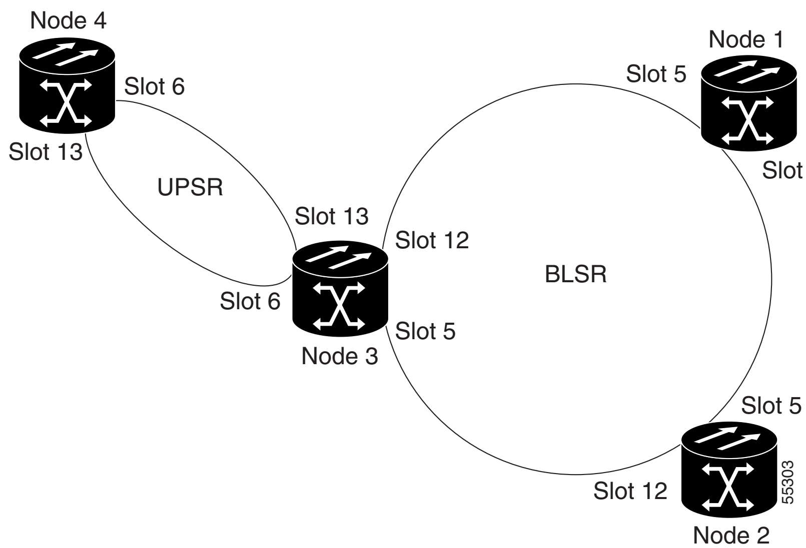


Figure 9-19 shows a UPSR subtending from a BLSR. In this example, Node 3 is the only node serving both the BLSR and UPSR. OC-N cards in Slots 5 and 12 serve the BLSR, and OC-N cards in Slots 6 and 13 serve the UPSR.

Figure 9-19 A UPSR subtending from a BLSR

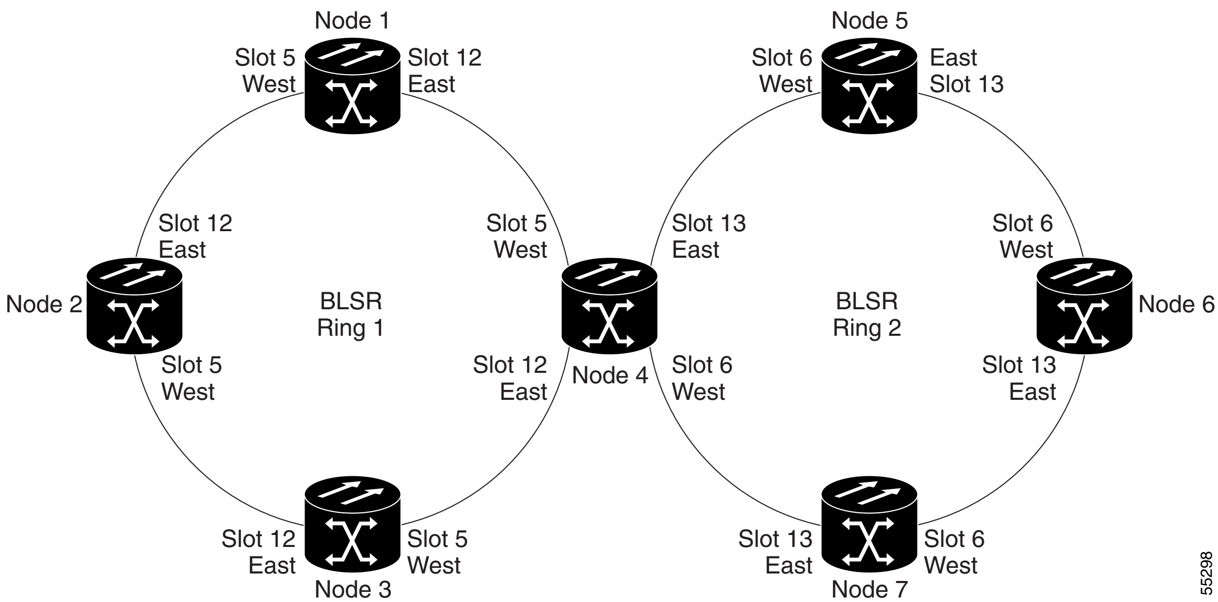


The ONS 15454 can support two BLSRs on the same node. This capability allows you to deploy an ONS 15454 in applications requiring SONET DCSs (digital cross connect systems) or multiple SONET ADMs (add/drop multiplexers).

Figure 9-20 shows two BLSRs shared by one ONS 15454. Ring 1 runs on Nodes 1, 2, 3, and 4. Ring 2 runs on Nodes 4, 5, 6, and 7. Two BLSR rings, Ring 1 and Ring 2, are provisioned on Node 4. Ring 1 uses cards in Slots 5 and 12, and Ring 2 uses cards in Slots 6 and 13.

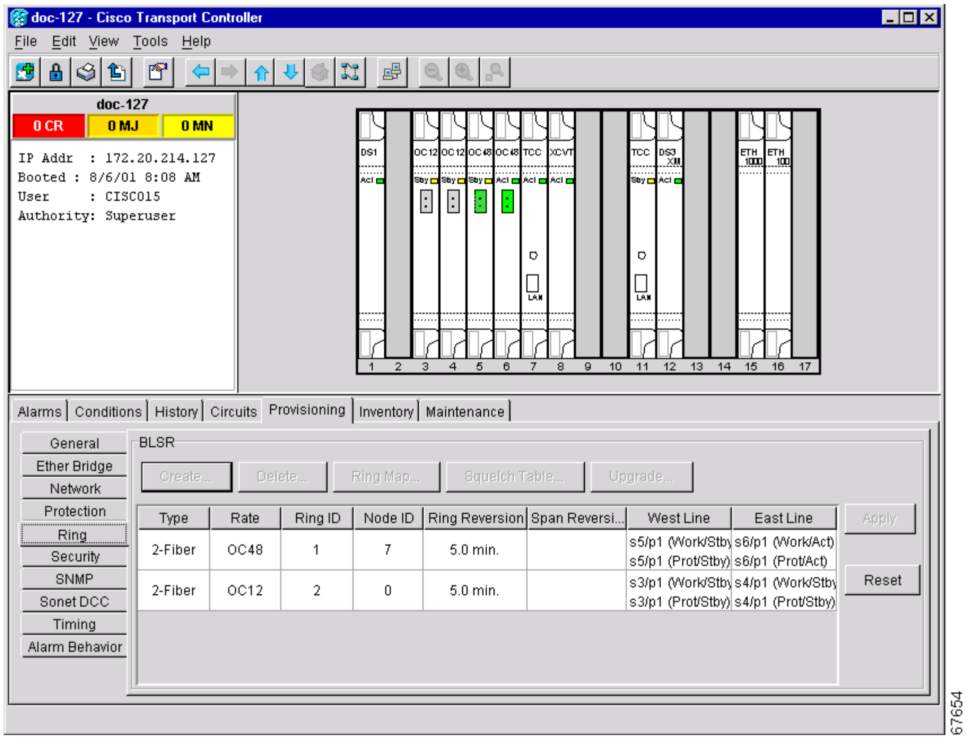
Note Although different node IDs are used for the two BLSRs shown in Figure 9-20, nodes in different BLSRs can use the same node ID.

Figure 9-20 A BLSR subtending from a BLSR



After subtending two BLSRs, you can route circuits from nodes in one ring to nodes in the second ring. For example in Figure 9-20, you can route a circuit from Node 1 to Node 7. The circuit would normally travel from Node 1 to Node 4 to Node 7. If fiber breaks occur, for example between Nodes 1 and 4 and Nodes 4 and 7, traffic is rerouted around each ring: in this example, Nodes 2 and 3 in Ring 1 and Nodes 5 and 6 in Ring 2.

Figure 9-21 Configuring two BLSRs on the same node

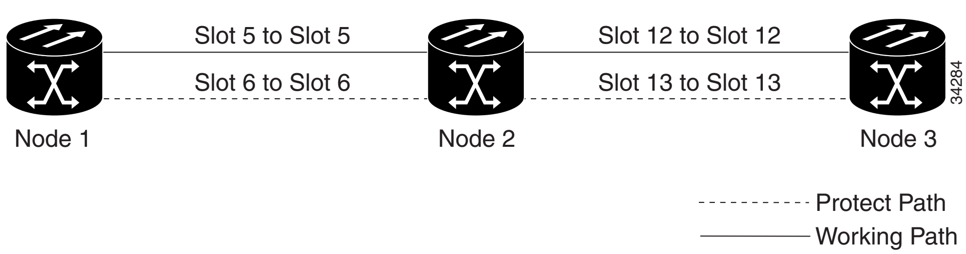


9.4 Linear ADM Configurations

You can configure ONS 15454s as a line of add/drop multiplexers (ADMs) by configuring one set of OC-N cards as the working path and a second set as the protect path. Unlike rings, linear (point-to-point) ADMs require that the OC-N cards at each node be in 1+1 protection to ensure that a break to the working line is automatically routed to the protect line.

Figure 9-22 shows three ONS 15454s in a linear ADM configuration. Working traffic flows from Slot 6/Node 1 to Slot 6/Node 2, and from Slot 12/Node 2 to Slot 12/Node 3. You create the protect path by placing Slot 6 in 1+1 protection with Slot 5 at Nodes 1 and 2, and Slot 12 in 1+1 protection with Slot 13 at Nodes 2 and 3.

Figure 9-22 A linear (point-to-point) ADM configuration



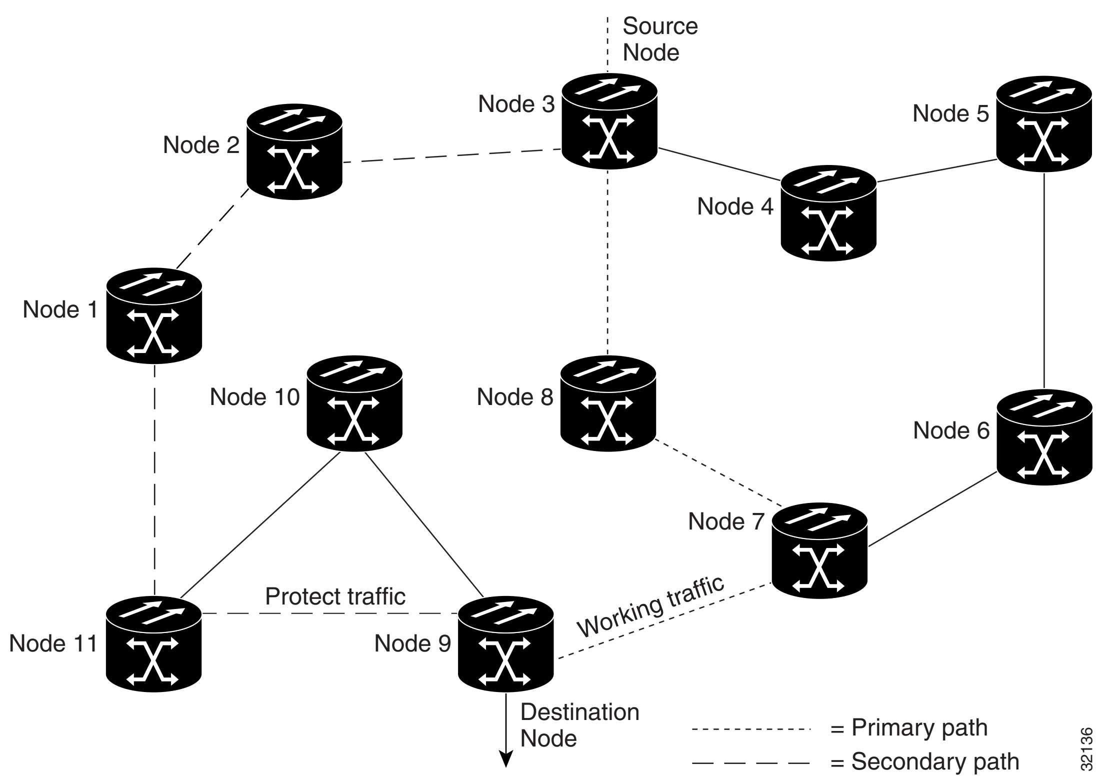
9.5 Path-Protected Mesh Networks

In addition to single BLSRs, UPSRs and ADMs, you can extend ONS 15454 traffic protection by creating path-protected mesh networks (PPMNs). PPMNs include multiple ONS 15454 SONET topologies and extend the protection provided by a single UPSR to the meshed architecture of several interconnecting rings. In a PPMN, circuits travel diverse paths through a network of single or multiple meshed rings. When you create circuits, you can have CTC automatically route circuits across the PPMN, or you can manually route them. You can also choose levels of circuit protection. For example, if you choose full protection, CTC creates an alternate route for the circuit in addition to the main route. The second route follows a unique path through the network between the source and destination and sets up a second set of cross-connections.

For example, in Figure 9-23, a circuit is created from Node 3 to Node 9. CTC determines that the shortest route between the two nodes passes through Node 8 and Node 7, shown by the dotted line, and automatically creates cross-connections at Nodes, 3, 8, 7, and 9 to provide the primary circuit path.

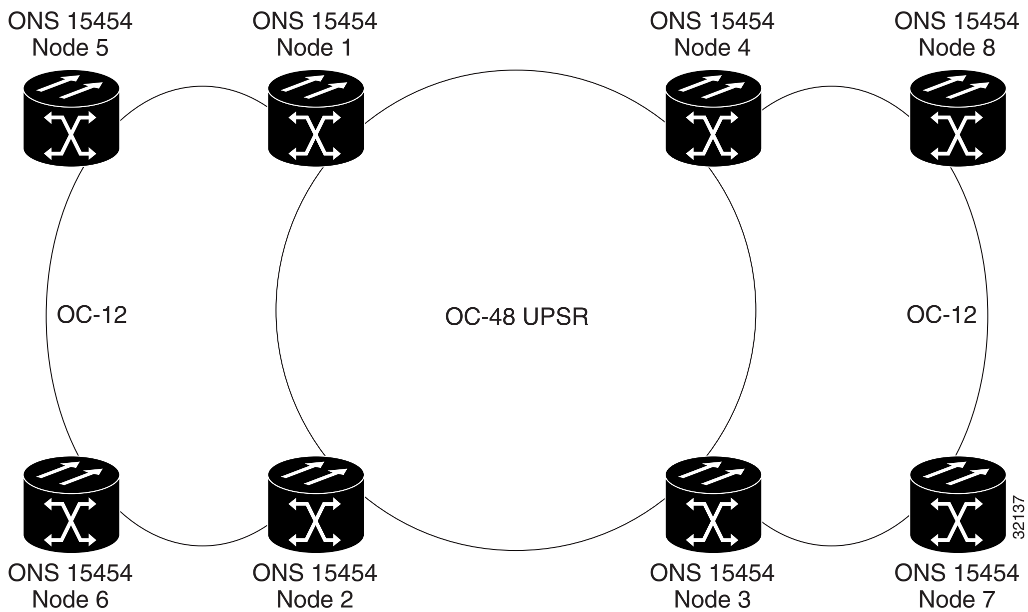
If full protection is selected, CTC creates a second unique route between Nodes 3 and 9 which, in this example, passes through Nodes 2, 1, and 11. Cross-connections are automatically created at Nodes, 3, 2, 1, 11, and 9, shown by the dashed line. If a failure occurs on the primary path, traffic switches to the second circuit path. In this example, Node 9 switches from the traffic coming in from Node 7 to the traffic coming in from Node 11 and service resumes. The switch occurs within 50 ms.

Figure 9-23 A path-protected mesh network



PPMN also allows spans of different SONET line rates to be mixed together in “virtual rings.” Figure 9-24 shows Nodes 1, 2, 3, and 4 in a standard OC-48 ring. Nodes 5, 6, 7, and 8 link to the backbone ring through OC-12 fiber. The “virtual ring” formed by Nodes 5, 6, 7, and 8 uses both OC-48 and OC-12.

Figure 9-24 A PPMN virtual ring

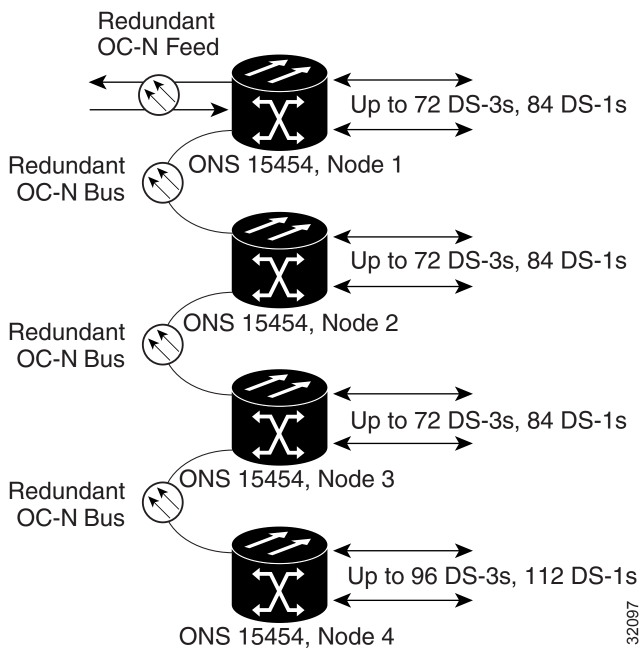


9.6 Four Node Configuration

You can link multiple ONS 15454s using their OC-N cards (i.e., create a fiber-optic bus) to accommodate more access traffic than a single ONS 15454 can support. For example, if you need to drop more than 112 DS-1s or 96 DS-3s (the maximum that can be aggregated in a single node), you can link the nodes but not merge multiple nodes into a single ONS 15454. You can link nodes with OC-12 or OC-48 fiber spans as you would link any other two network nodes. The nodes can be co-located in a facility to aggregate more local traffic.

Figure 9-25 shows a four-shelf node setup. Each shelf assembly is recognized as a separate node in the ONS 15454 software interface (Cisco Transport Controller [CTC]), and traffic is mapped using CTC cross-connect options. In the figure, each node uses redundant fiber-optic cards. Node 1 uses redundant OC-N transport and OC-N bus (connecting) cards for a total of four cards, with eight free slots remaining. Nodes 2 and 3 each use two redundant OC-N bus cards for a total of four cards, with eight free slots remaining. Node 4 uses redundant OC-12 bus cards for a total of two cards, with ten free slots remaining. The four node example presented here is one of many ways to set up a multiple-node configuration.

Figure 9-25 A four-shelf node configuration



9.7 Optical Speed Upgrades

A span is the optical fiber connection between two ONS 15454 nodes. In a span (optical speed) upgrade, the transmission rate of a span is upgraded from a lower to a higher OC-N signal but all other span configuration attributes remain unchanged. With multiple nodes, a span upgrade is a coordinated series of upgrades on all nodes in the ring or protection group in which traffic carried at a lower OC-N rate is transferred to a higher OC-N. You can perform in-service span upgrades for the following ONS 15454 cards:

- OC-12 to four-port OC-12
- OC-12 to OC-48
- OC-12 to OC-192
- OC-48 to OC-192

Use the XC10G card, the TCC+ card, Software R3.1 or later and the new 15454-SA-ANSI shelf assembly to enable the OC48 IR/STM16 SH AS 1310, OC48 LR/STM16 LH AS 1550, and the OC192 LR/STM64 LH 1550 cards.

To perform a span upgrade, the higher-rate optical card must replace the lower-rate card in the same slot. If the upgrade is conducted on spans residing in a BLSR, all spans in the ring must be upgraded. The protection configuration of the original lower-rate optical card (two-fiber BLSR, four-fiber BLSR, UPSR, and 1+1) is retained for the higher-rate optical card.

When performing span upgrades on a large number of nodes, Cisco recommends that you upgrade all spans in a ring consecutively and in the same maintenance window. Until all spans are upgraded, mismatched card types will be present.

Cisco recommends using the Span Upgrade Wizard to perform span upgrades. Although you can also use the manual span upgrade procedures, the manual procedures are mainly provided as error recovery for the wizard. The Span Upgrade Wizard and the Manual Span Upgrade procedures require at least two technicians (one at each end of the span) who can communicate with each other during the upgrade. Upgrading a span is non-service affecting and will cause no more than three switches, each of which is less than 50 ms in duration.

Note Span upgrades do not upgrade SONET topologies, for example, a 1+1 group to a two-fiber BLSR. See the *Cisco ONS 15454 Procedures Guide* for topology upgrade procedures.

9.7.1 Span Upgrade Wizard

The Span Upgrade Wizard automates all steps in the manual span upgrade procedure (BLSR, UPSR, and 1+1). The wizard can upgrade both lines on one side of a four-fiber BLSR or both lines of a 1+1 group; the wizard upgrades UPSRs and two-fiber BLSRs one line at a time. The Span Upgrade Wizard requires that spans have DCC enabled.

The Span Upgrade Wizard provides no way to back out of an upgrade. In the case of an abnormal error, you must exit the wizard and initiate the manual procedure to either continue with the upgrade or back out of it. To continue with the manual procedure, examine the standing conditions and alarms to identify the stage in which the wizard failure occurred.

9.7.2 Manual Span Upgrades

Manual Span Upgrades are mainly provided as error recovery for the Span Upgrade Wizard, but they can be used to perform span upgrades. Downgrading can be performed to back out of a span upgrade. The procedure for downgrading is the same as upgrading except that you choose a lower-rate card type.You cannot downgrade if circuits exist on the STSs that will be removed (the higher STSs). Four manual span upgrade options are available:

- Perform a Manual Span Upgrade on a Two-Fiber BLSR
- Perform a Manual Span Upgrade on a Four-Fiber BLSR
- Perform a Manual Span Upgrade on a UPSR
- Perform a Manual Span Upgrade on a 1+1 Protection Group

CHAPTER 10

IP Networking

This chapter provides seven scenarios showing Cisco ONS 15454s in common IP network configurations. The chapter does not provide a comprehensive explanation of IP networking concepts and procedures. For IPset up instructions, refer to the *Cisco ONS 15454 Procedure Guide*.

Chapter topics include:

Note To set up ONS 15454s within an IP network, you must work with a LAN administrator or other individual at your site who has IP networking training and experience. To learn more about IP networking, many outside resources are available. *IP Routing Fundamentals*, by Mark Sportack (Cisco Press, 1999), provides a comprehensive introduction to routing concepts and protocols in IP networks.

10.1 IP Networking Overview

ONS 15454s can be connected in many different ways within an IP environment:

- They can be connected to LANs through direct connections or a router.
- IP subnetting can create ONS 15454 node groups, which allow you to provision non-DCC connected nodes in a network.
- Different IP functions and protocols can be used to achieve specific network goals. For example, Proxy Address Resolution Protocol (ARP) enables one LAN-connected ONS 15454 to serve as a gateway for ONS 15454s that are not connected to the LAN.
- You can create static routes to enable connections among multiple CTC sessions with ONS 15454s that reside on the same subnet but have different destination IP addresses.
- If ONS 15454s are connected to OSPF networks, ONS 15454 network information is automatically communicated across multiple LANs and WANs.
- The ONS 15454 proxy server can be used to control the visibility and accessibility between CTC computers and ONS 15454 element nodes.

10.2 IP Addressing Scenarios

ONS 15454 IP addressing generally has seven common scenarios or configurations. Use the scenarios as building blocks for more complex network configurations. Table 10-1 provides a general list of items to check when setting up ONS 15454s in IP networks.

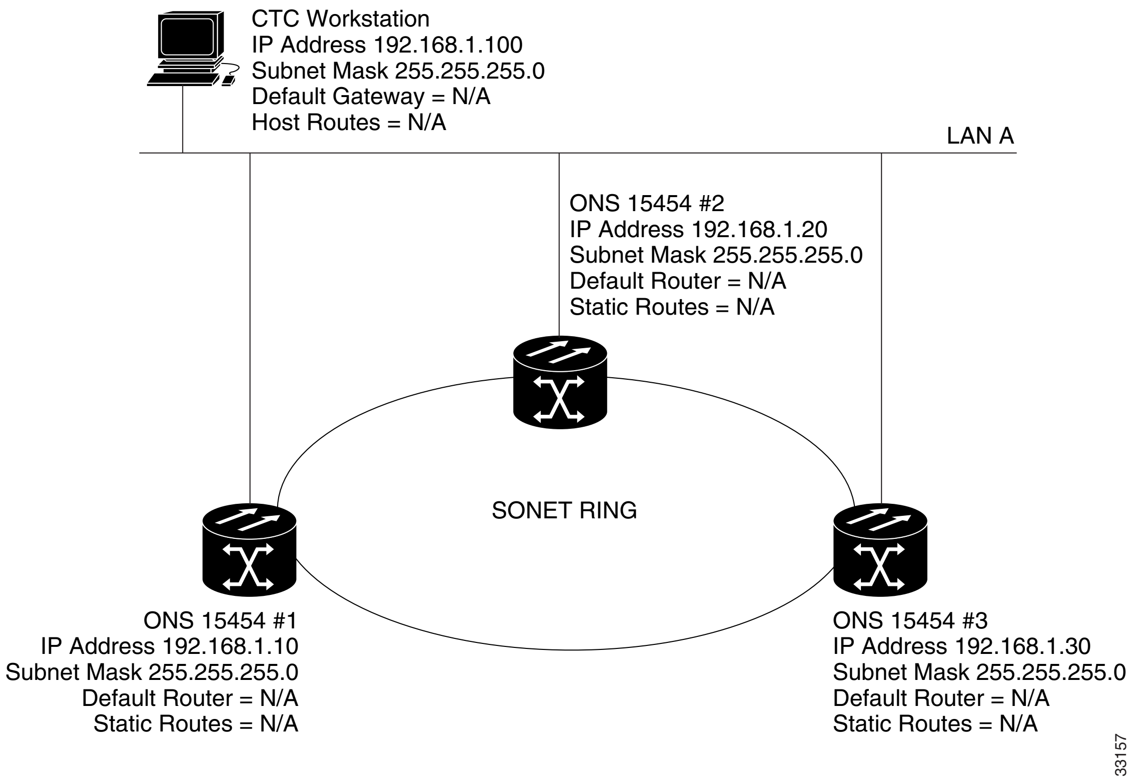
Table 10-1 General ONS 15454 IP Troubleshooting Checklist

Item	What to check
Link integrity	Verify that link integrity exists between: • CTC computer and network hub/switch • ONS 15454s (backplane wire-wrap pins or RJ-45 port) and network hub/switch • Router ports and hub/switch ports
ONS 15454 hub/switch ports	If connectivity problems occur, set the hub or switch port that is connected to the ONS 15454 to 10 Mbps half-duplex.
Ping	Ping the node to test connections between computers and ONS 15454s.
IP addresses/subnet masks	Verify that ONS 15454 IP addresses and subnet masks are set up correctly.
Optical connectivity	Verify that ONS 15454 optical trunk ports are in service; DCC is enabled on each trunk port

10.2.1 Scenario 1: CTC and ONS 15454s on Same Subnet

Scenario 1 shows a basic ONS 15454 LAN configuration (Figure 10-1). The ONS 15454s and CTC computer reside on the same subnet. All ONS 15454s connect to LAN A, and all ONS 15454s have DCC connections.

Figure 10-1 Scenario 1: CTC and ONS 15454s on same subnet

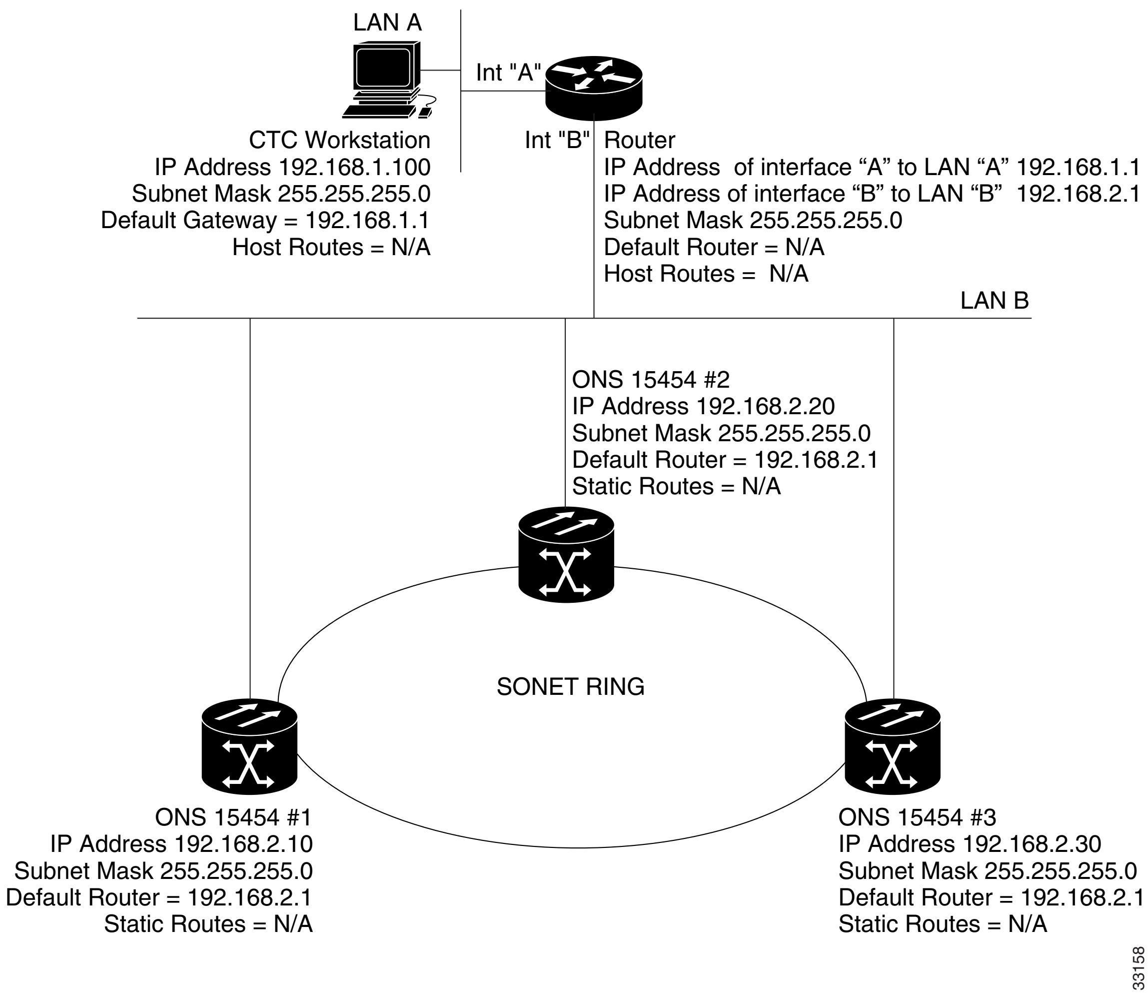


10.2.2 Scenario 2: CTC and ONS 15454s Connected to Router

In Scenario 2 the CTC computer resides on a subnet (192.168.1.0) and attaches to LAN A (Figure 10-2). The ONS 15454s reside on a different subnet (192.168.2.0) and attach to LAN B. A router connects LAN A to LAN B. The IP address of router interface A is set to LAN A (192.168.1.1), and the IP address of router interface B is set to LAN B (192.168.2.1).

On the CTC computer, the default gateway is set to router interface A. If the LAN uses DHCP (Dynamic Host Configuration Protocol), the default gateway and IP address are assigned automatically. In the Figure 10-2 example, a DHCP server is not available.

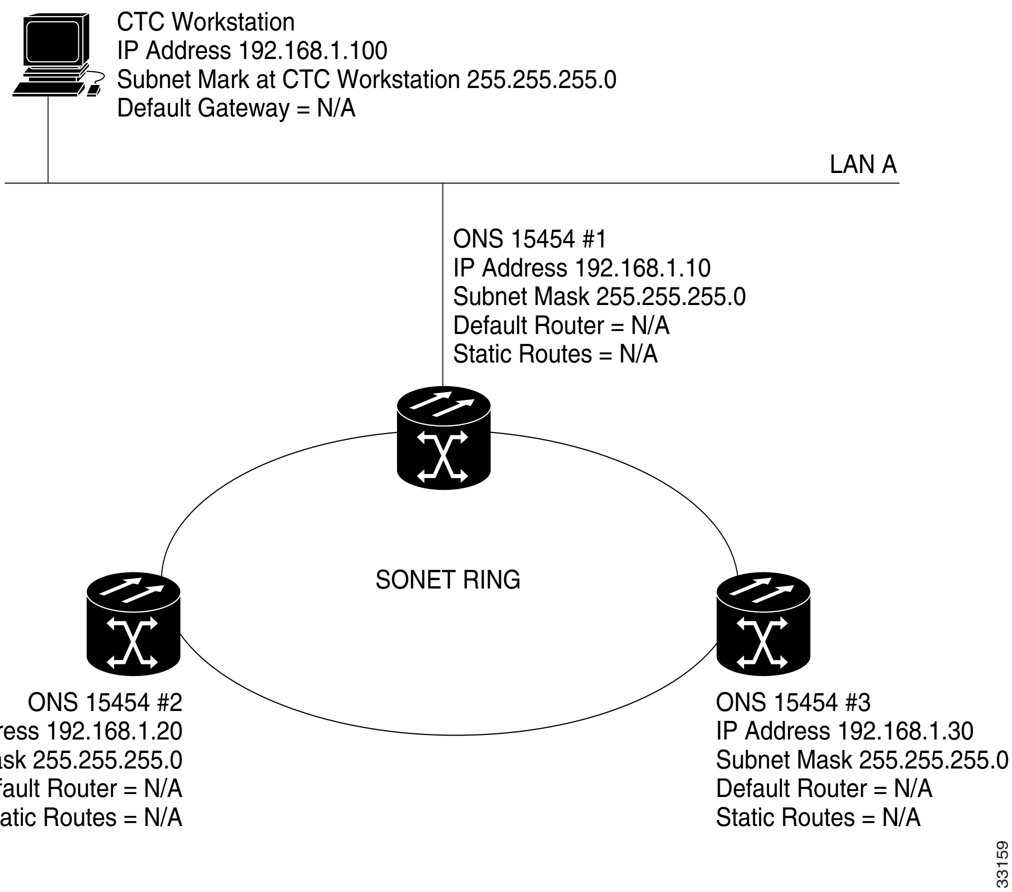
Figure 10-2 Scenario 2: CTC and ONS 15454s connected to router



10.2.3 Scenario 3: Using Proxy ARP to Enable an ONS 15454 Gateway

Scenario 3 is similar to Scenario 1, but only one ONS 15454 (node #1) connects to the LAN (Figure 10-3). Two ONS 15454s (#2 and #3) connect to ONS 15454 #1 through the SONET DCC. Because all three ONS 15454s are on the same subnet, Proxy ARP enables ONS 15454 #1 to serve as a gateway for ONS 15454s #2 and #3.

Figure 10-3 Scenario 3: Using Proxy ARP



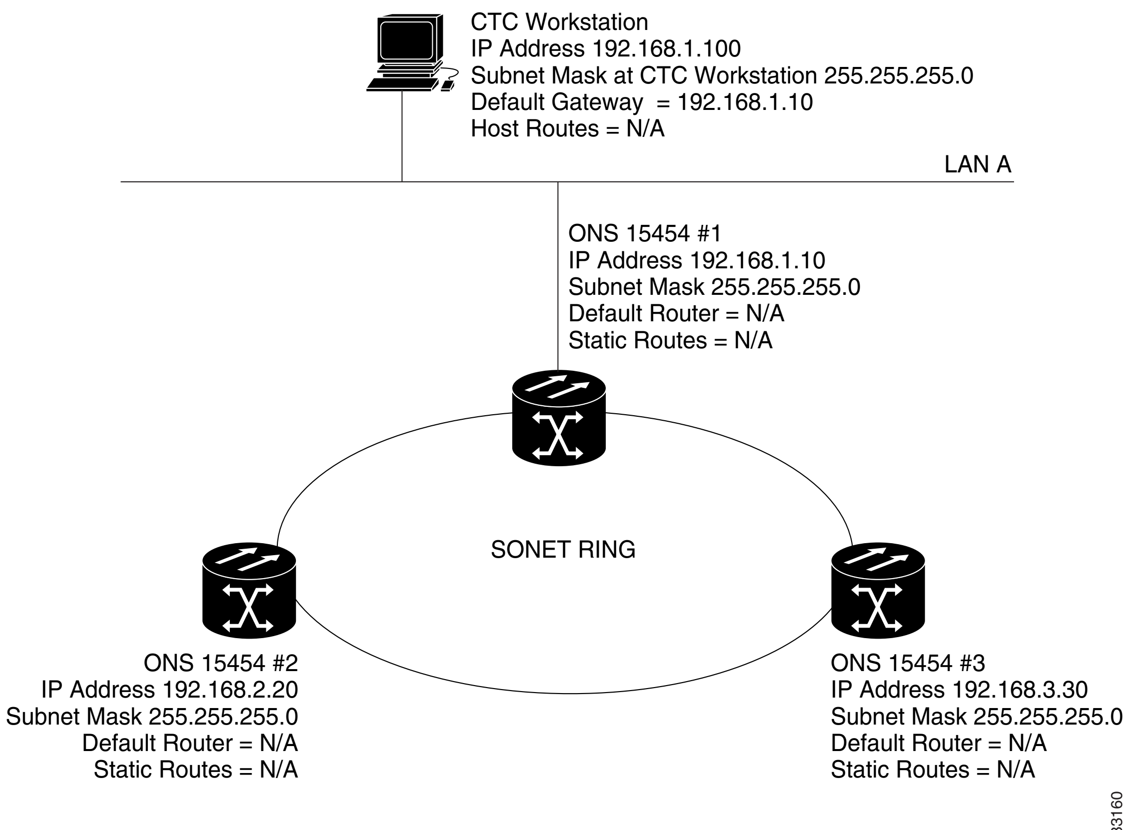
ARP matches higher-level IP addresses to the physical addresses of the destination host. It uses a lookup table (called ARP cache) to perform the translation. When the address is not found in the ARP cache, a broadcast is sent out on the network with a special format called the ARP request. If one of the machines on the network recognizes its own IP address in the request, it sends an ARP reply back to the requesting host. The reply contains the physical hardware address of the receiving host. The requesting host stores this address in its ARP cache so that all subsequent datagrams (packets) to this destination IP address can be translated to a physical address.

Proxy ARP enables one LAN-connected ONS 15454 to respond to the ARP request for ONS 15454s not connected to the LAN. (ONS 15454 Proxy ARP requires no user configuration.) For this to occur, the DCC-connected ONS 15454s must reside on the same subnet. When a LAN device sends an ARP request to an ONS 15454 that is not connected to the LAN, the gateway ONS 15454 returns its MAC address to the LAN device. The LAN device then sends the datagram for the remote ONS 15454 to the MAC address of the proxy ONS 15454. The proxy ONS 15454 uses its routing table to forward the datagram to the non-LAN ONS 15454.

10.2.4 Scenario 4: Default Gateway on CTC Computer

Scenario 4 is similar to Scenario 3, but nodes #2 and #3 reside on different subnets, 192.168.2.0 and 192.168.3.0, respectively (Figure 10-4). Node #1 and the CTC computer are on subnet 192.168.1.0. Proxy ARP is not used because the network includes different subnets. In order for the CTC computer to communicate with ONS 15454s #2 and #3, ONS 15454 #1 is entered as the default gateway on the CTC computer.

Figure 10-4 Scenario 4: Default gateway on a CTC computer



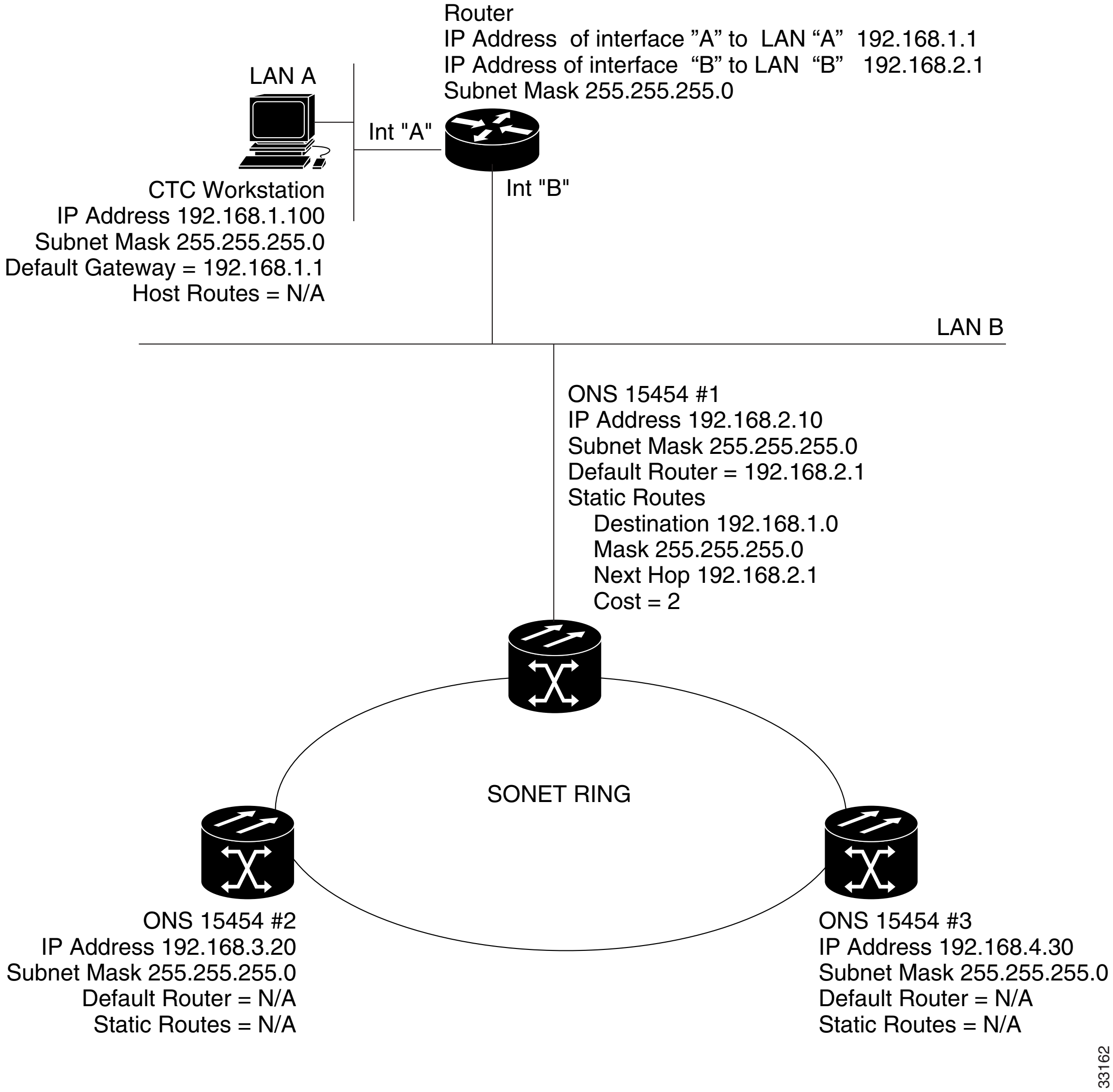
10.2.5 Scenario 5: Using Static Routes to Connect to LANs

Static routes are used for two purposes:

- To connect ONS 15454s to CTC sessions on one subnet connected by a router to ONS 15454s residing on another subnet. (These static routes are not needed if OSPF is enabled. Scenario 6 shows an OSPF example.)
- To enable multiple CTC sessions among ONS 15454s residing on the same subnet.

In Figure 10-5, one CTC residing on subnet 192.168.1.0 connects to a router through interface A. (The router is not set up with OSPF.) ONS 15454s residing on different subnets are connected through ONS 15454 #1 to the router through interface B. Because ONS 15454s #2 and #3 are on different subnets, proxy ARP does not enable ONS 15454 #1 as a gateway. To connect to CTC computers on LAN A, a static route is created on ONS 15454 #1.

Figure 10-5 Scenario 5: Static route with one CTC computer used as a destination

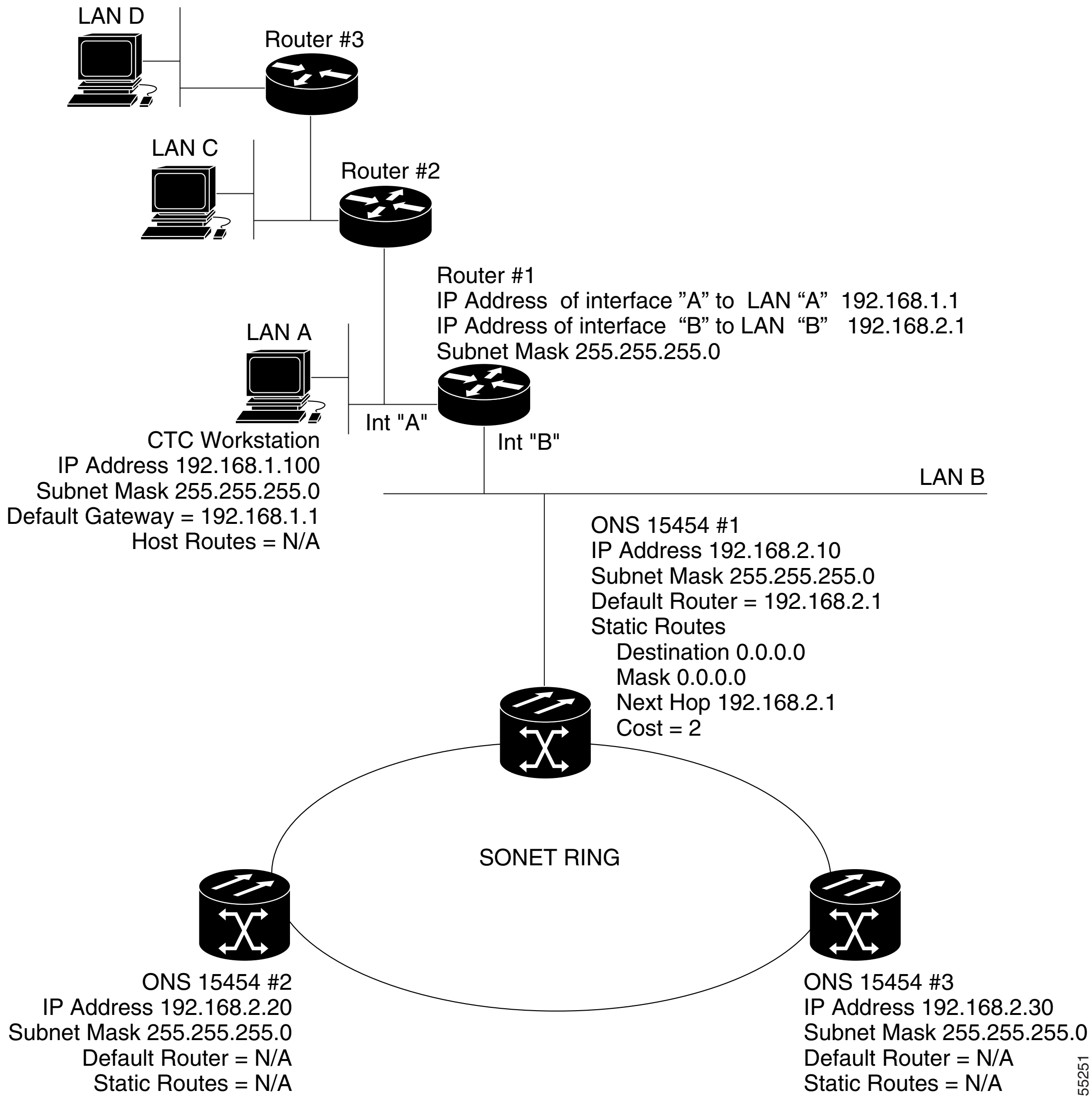


The destination and subnet mask entries control access to the ONS 15454s:

- If a single CTC computer is connected to router, enter the complete CTC "host route" IP address as the destination with a subnet mask of 255.255.255.255.
- If CTC computers on a subnet are connected to router, enter the destination subnet (in this example, 192.168.1.0) and a subnet mask of 255.255.255.0.
- If all CTC computers are connected to router, enter a destination of 0.0.0.0 and a subnet mask of 0.0.0.0. Figure 10-6 shows an example.

The IP address of router interface B is entered as the next hop, and the cost (number of hops from source to destination) is 2.

Figure 10-6 Scenario 5: Static route with multiple LAN destinations



10.2.6 Scenario 6: Using OSPF

Open Shortest Path First (OSPF) is a link state Internet routing protocol. Link state protocols use a "hello protocol" to monitor their links with adjacent routers and to test the status of their links to their neighbors. Link state protocols advertise their directly-connected networks and their active links. Each link state router captures the link state "advertisements" and puts them together to create a topology of the entire network or area. From this database, the router calculates a routing table by constructing a shortest path tree. Routes are continuously recalculated to capture ongoing topology changes.

ONS 15454s use the OSPF protocol in internal ONS 15454 networks for node discovery, circuit routing, and node management. You can enable OSPF on the ONS 15454s so that the ONS 15454 topology is sent to OSPF routers on a LAN. Advertising the ONS 15454 network topology to LAN routers eliminates the need to manually enter static routes for ONS 15454 subnetworks. Figure 10-7 shows the same network enabled for OSPF. Figure 10-8 shows the same network without OSPF. Static routes must be manually added to the router in order for CTC computers on LAN A to communicate with ONS 15454 #2 and #3 because these nodes reside on different subnets.

OSPF divides networks into smaller regions, called areas. An area is a collection of networked end systems, routers, and transmission facilities organized by traffic patterns. Each OSPF area has a unique ID number, known as the area ID, that can range from 0 to 4,294,967,295. Every OSPF network has one backbone area called "area 0." All other OSPF areas must connect to area 0.

When you enable an ONS 15454 OSPF topology for advertising to an OSPF network, you must assign an OSPF area ID to the ONS 15454 network. Coordinate the area ID number assignment with your LAN administrator. All DCC-connected ONS 15454s should be assigned the same OSPF area ID.

Figure 10-7 Scenario 6: OSPF enabled

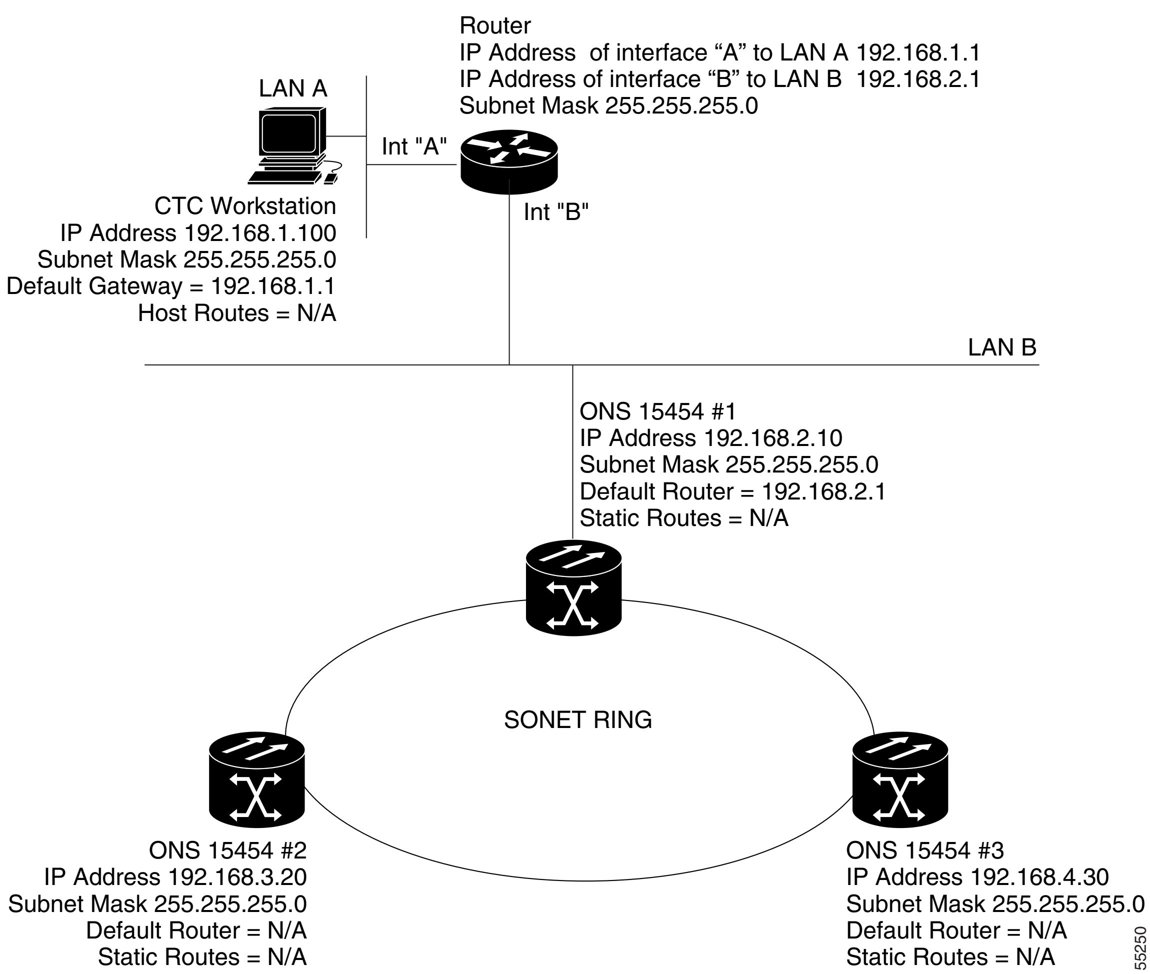
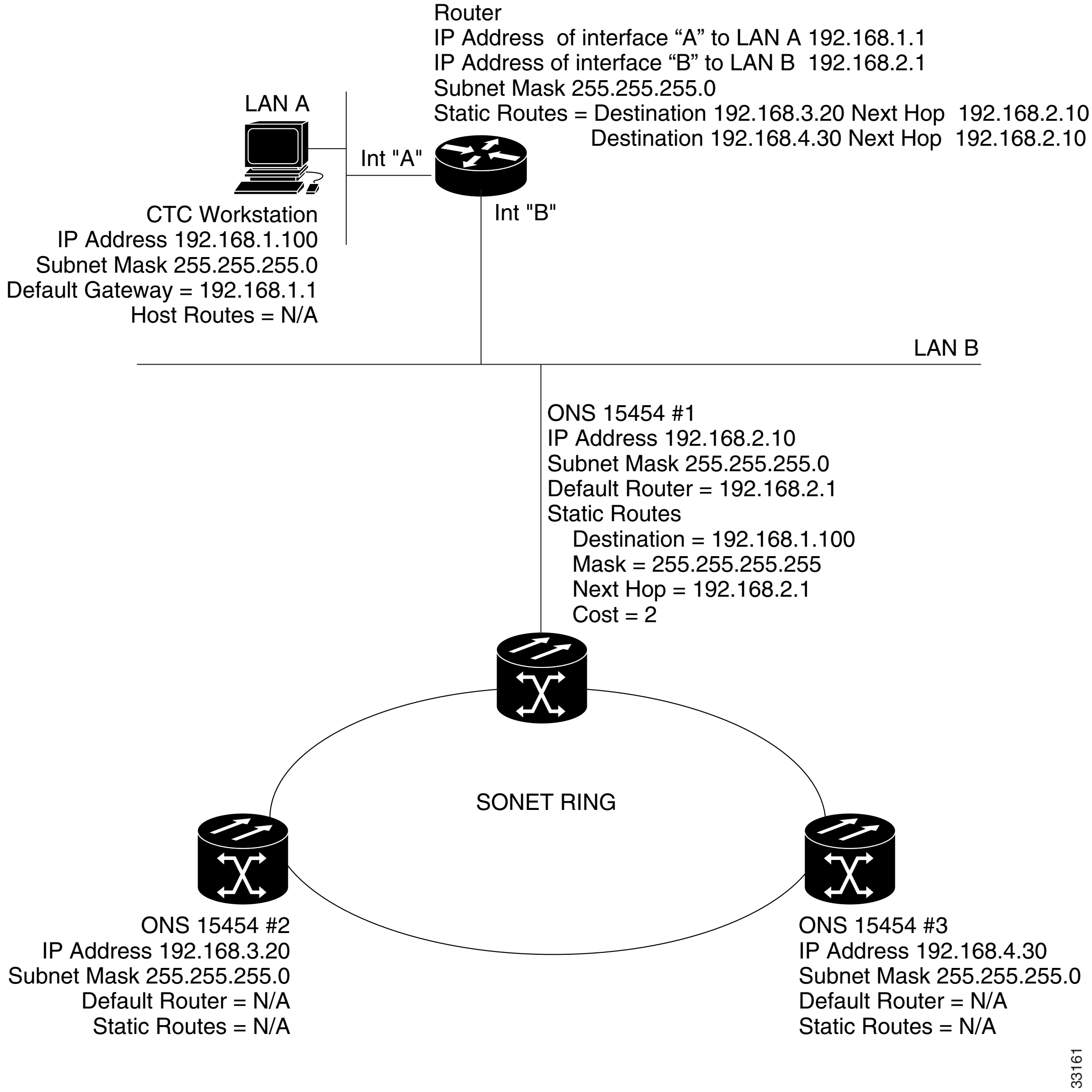


Figure 10-8 Scenario 6: OSPF not enabled



10.2.7 Scenario 7: Provisioning the ONS 15454 Proxy Server

The ONS 15454 proxy server is a set of functions that allows you to network ONS 15454s in environments where visibility and accessibility between ONS 15454s and CTC computers must be restricted. For example, you can set up a network so that field technicians and network operating center (NOC) personnel can both access the same ONS 15454s while preventing the field technicians from accessing the NOC LAN. To do this, one ONS 15454 is provisioned as a gateway NE (GNE) and the other ONS 15454s are provisioned as element NEs (ENEs). The GNE ONS 15454 tunnels connections between CTC computers and ENE ONS 15454s, providing management capability while preventing access for non-ONS 15454 management purposes.

The ONS 15454 proxy server performs the following tasks:

- Isolates DCC IP traffic from Ethernet (craft port) traffic and accepts packets based on filtering rules. The filtering rules (see Table 10-3 and Table 10-4) depend on whether the packet arrives at the ONS 15454 DCC or TCC+ Ethernet interface.
- Monitors ARP request packets on its Ethernet port. If the ARP request is from an address that is not on the current subnet, the ONS 15454 creates an entry its ARP table. The ARP entry allows the ONS 15454 to reply to an address over the local Ethernet so craft technicians can connect to ONS 15454s without changing the IP addresses of their computers.
- Processes SNTP/NTP requests. Element ONS 15454 NEs can derive time-of-day from an SNTP/NTP LAN server through the GNE ONS 15454.
- Process SNMPv1 traps. The GNE ONS 15454 receives SNMPv1 traps from the ENE ONS 15454s and forwards them to all provisioned SNMPv1 trap destinations.

The ONS 15454 proxy server is provisioned using three checkboxes on the Provisioning > Network > General tab (see Figure 10-9 on page 10-12):

- Craft Access Only—When enabled, the ONS 15454 neither installs nor advertises default or static routes. CTC computers can communicate with the ONS 15454, but they cannot communicate directly with any other DCC-connected ONS 15454.
- Enable Proxy—When enabled, the ONS 15454 serves as a proxy for connections between CTC clients and ONS 15454s that are DCC-connected to the proxy ONS 15454. The CTC client establishes connections to DCC-connected nodes through the proxy node. The CTC client can connect to nodes that it cannot directly reach from the host on which it runs. If *Enable Proxy* is off, the node does not proxy for any CTC clients, although any established proxy connections will continue until the CTC client exits.
- Enable Firewall—If selected, the node prevents IP traffic from being routed between the DCC and the LAN port. The ONS 15454 can communicate with machines connected to the LAN port or connected through the DCC. However, the DCC-connected machines cannot communicate with the LAN-connected machines, and the LAN-connected machines cannot communicate with the DCC-connected machines. A CTC client using the LAN to connect to the firewall-enabled node can use the proxy capability to manage the DCC-connected nodes that would otherwise be unreachable. A CTC client connected to a DCC-connected node can only manage other DCC-connected nodes and the firewall itself.

Figure 10-9 Proxy Server Gateway Settings

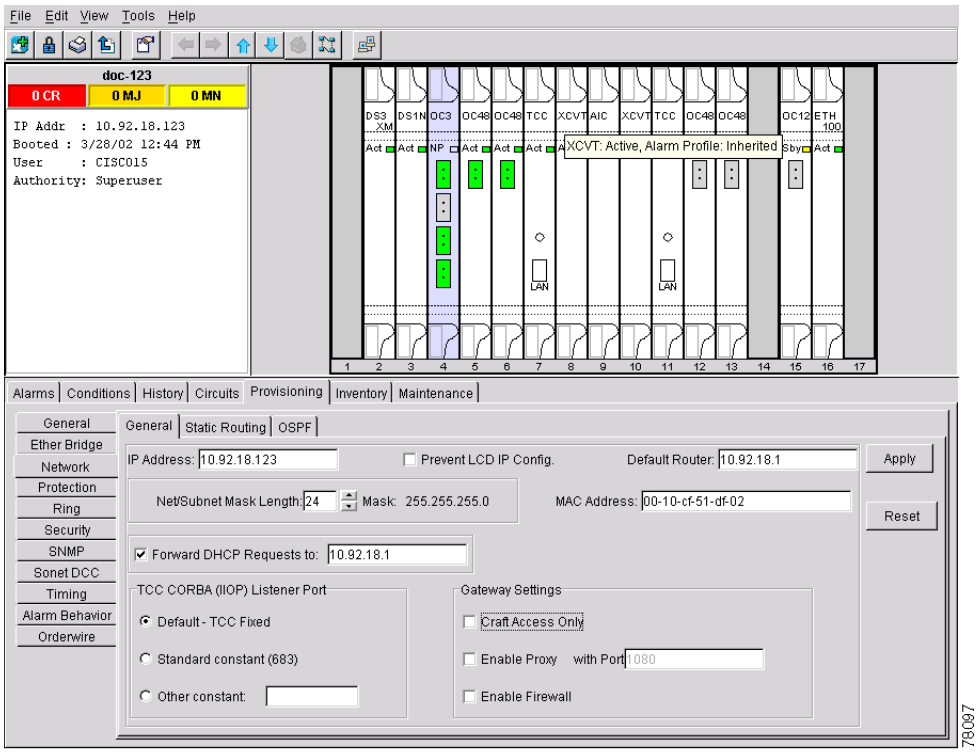


Figure 10-10 shows an ONS 15454 proxy server implementation. A GNE ONS 15454 is connected to a central office LAN and to ENE ONS 15454s. The central office LAN is connected to a NOC LAN, which has CTC computers. The NOC CTC computer and craft technicians must both be able to access the ONS 15454 ENEs. However, the craft technicians must be prevented from accessing or seeing the NOC or central office LANs.

In the example, the ONS 15454 GNE is assigned an IP address within the central office LAN and is physically connected to the LAN through its LAN port. ONS 15454 ENEs are assigned IP addresses that are outside the central office LAN and given private network IP addresses. If the ONS 15454 ENEs are co-located, the craft LAN ports could be connected to a hub. However, the hub should have no other network connections.

Figure 10-10 ONS 15454 Proxy Server with GNE and ENEs on the same subnet

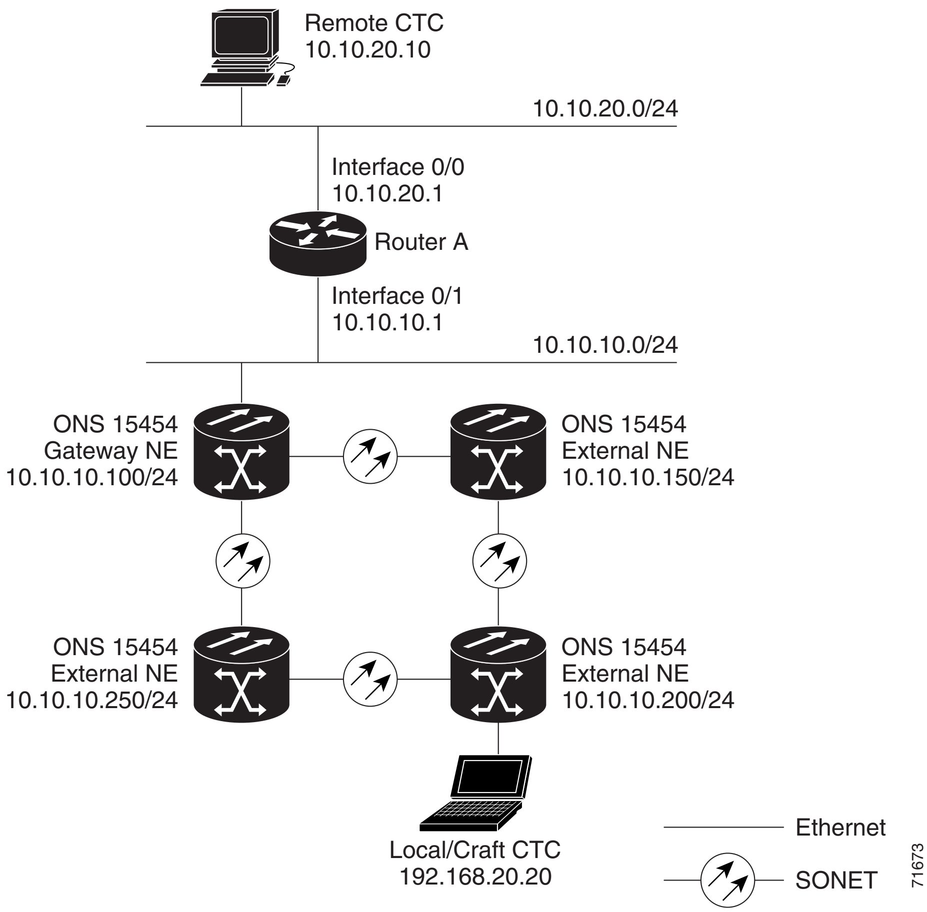


Table 10-2 shows recommended settings for ONS 15454 GNEs and ENEs in the configuration shown in Figure 10-10.

Table 10-2 ONS 15454 Gateway and Element NE Settings

Setting	ONS 15454 Gateway NE	ONS 15454 Element NE
Craft Access Only	Off	On
Enable Proxy	On	On
Enable Firewall	On	On
OSPF	Off	Off
SNTP Server (if used)	SNTP server IP address	Set to ONS 15454 GNE IP address
SNMP (if used)	SNMPv1 trap destinations	Set SNMPv1 trap destinations to ONS 15454 GNE

Figure 10-11 shows the same proxy server implementation with ONS 15454 ENEs on different subnets. Figure 10-12 shows the implementation with ONS 15454 ENEs in multiple rings. In each example, ONS 15454 GNEs and ENEs are provisioned with the settings shown in Table 10-2.

Figure 10-11 Scenario 7: ONS 15454 Proxy Server with GNE and ENEs on different subnets

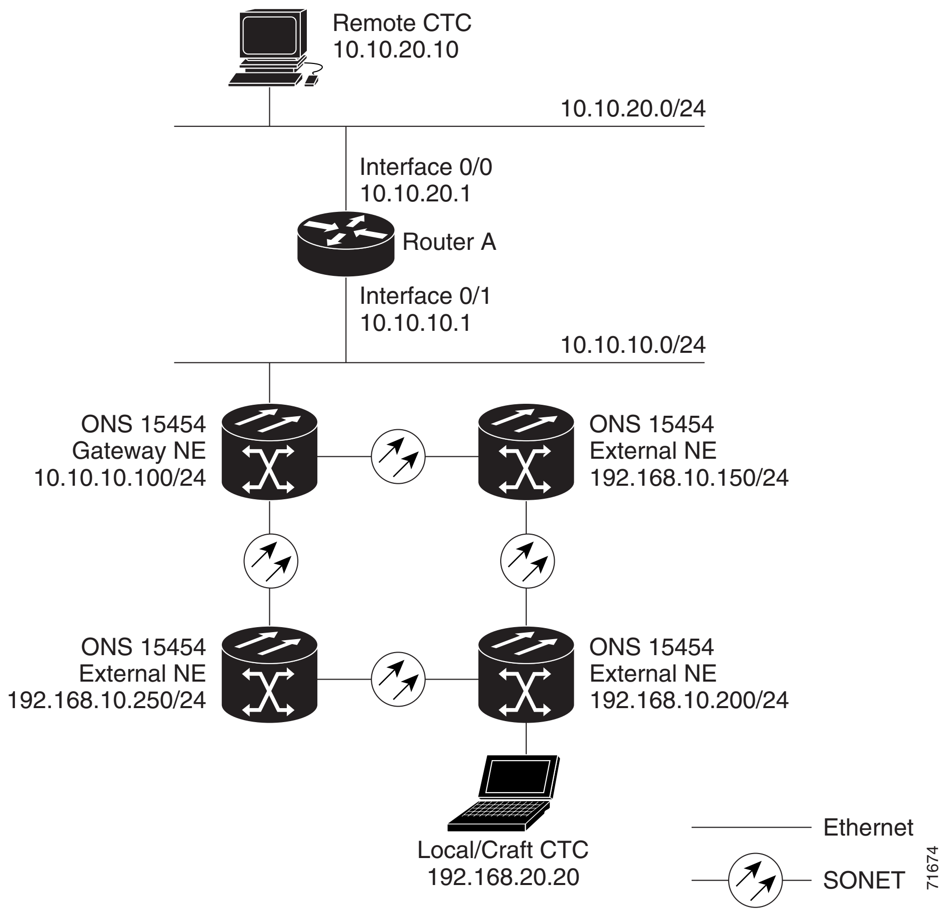


Figure 10-12 Scenario 7: ONS 15454 Proxy Server with ENEs on multiple rings

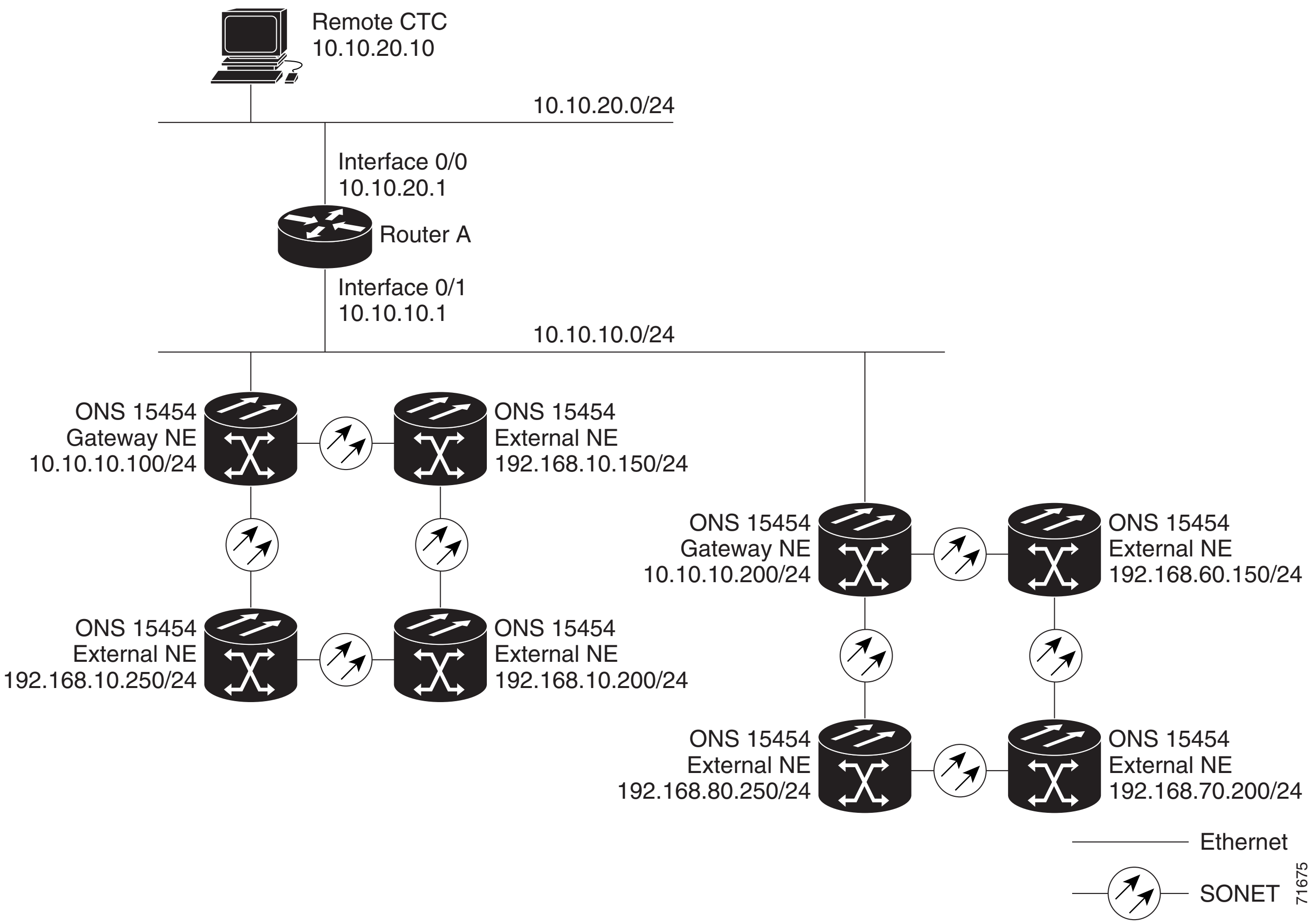


Table 10-3 shows the rules the ONS 15454 follows to filter packets when *Enable Firewall* is enabled. If the packet is addressed to the ONS 15454, additional rules, shown in Table 10-4, are applied. Rejected packets are silently discarded.

Table 10-3 Proxy Server Firewall Filtering Rules

Packets arriving at:	Are accepted if the IP destination address is:
TCC+ Ethernet Interface	• The ONS 15454 itself • The ONS 15454's subnet broadcast address • Within the 224.0.0.0/8 network (reserved network used for standard multicast messages) • subnet mask = 255.255.255.255
DCC Interface	• The ONS 15454 itself • An OSPF peer (another DCC-connected ONS 15454) • Within the 224.0.0.0/8 network

Table 10-4 Proxy Server Firewall Filtering Rules When Packet Addressed to ONS 15454

Packets Arrive At	Accepted	Rejected
TCC+ Ethernet Interface	• All UDP packets except those in the Rejected column	• UDP packets addressed to the SNMP trap relay port (391) are rejected
DCC Interface	• All UDP packets • All TCP packets except those in the Rejected column • OSPF packets • ICMP packets	• TCP packets addressed to the telnet port are rejected. • TCP packets addressed to the IO card telnet ports are rejected. • TCP packets addressed to the proxy server port are rejected. • All packets other than UDP, TCP, OSPF, ICMP

If you implement the proxy server, keep the following rules in mind:

1. All DCC-connected ONS 15454s on the same Ethernet segment must have the same *Craft Access Only* setting. Mixed values will produce unpredictable results, and may leave some nodes unreachable through the shared Ethernet segment.
2. All DCC-connected ONS 15454s on the same Ethernet segment must have the same *Enable Firewall* setting. Mixed values will produce unpredictable results. Some nodes may become unreachable.
3. All DCC-connected ONS 15454s in the same SDCC area must have the same *Enable Firewall* setting. Mixed values will produce unpredictable results. Some nodes may become unreachable.
4. If you enable *Enable Firewall,* always check *Enable Proxy*. If *Enable Proxy* is not enabled, CTC will not be able to see nodes on the DCC side of the ONS 15454.
5. If *Craft Access Only* is enabled, check *Enable Proxy*. If *Enable Proxy* is not enabled, CTC will not be able to see nodes on the DCC side of the ONS 15454.

If nodes become unreachable in cases 1, 2, and 3, you can correct the setting by performing one of the following:

- Disconnect the craft computer from the unreachable ONS 15454. Connect to the ONS 15454 through another ONS 15454 in the network that has a DCC connection to the unreachable ONS 15454.
- Disconnect the Ethernet cable from the unreachable ONS 15454. Connect a CTC computer directly to the ONS 15454.

10.3 Routing Table

ONS 15454 routing information is displayed on the Maintenance > Routing Table tabs (Figure 10-13). The routing table provides the following information:

- *Destination*—Displays the IP address of the destination network or host.
- *Mask*—Displays the subnet mask used to reach the destination host or network.
- *Gateway*—Displays the IP address of the gateway used to reach the destination network or host.
- *Usage*—Shows the number of times the listed route has been used.
- *Interface*—Shows the ONS 15454 interface used to access the destination. Values are:
  - cpm0—The ONS 15454 Ethernet interface, that is, the RJ-45 jack on the TCC+ and the LAN 1 pins on the backplane.
  - pdcc0—An SDCC interface, that is, an OC-N trunk card identified as the SDCC termination.
  - lo0—A loopback interface

Figure 10-13 Viewing the ONS 15454 routing table

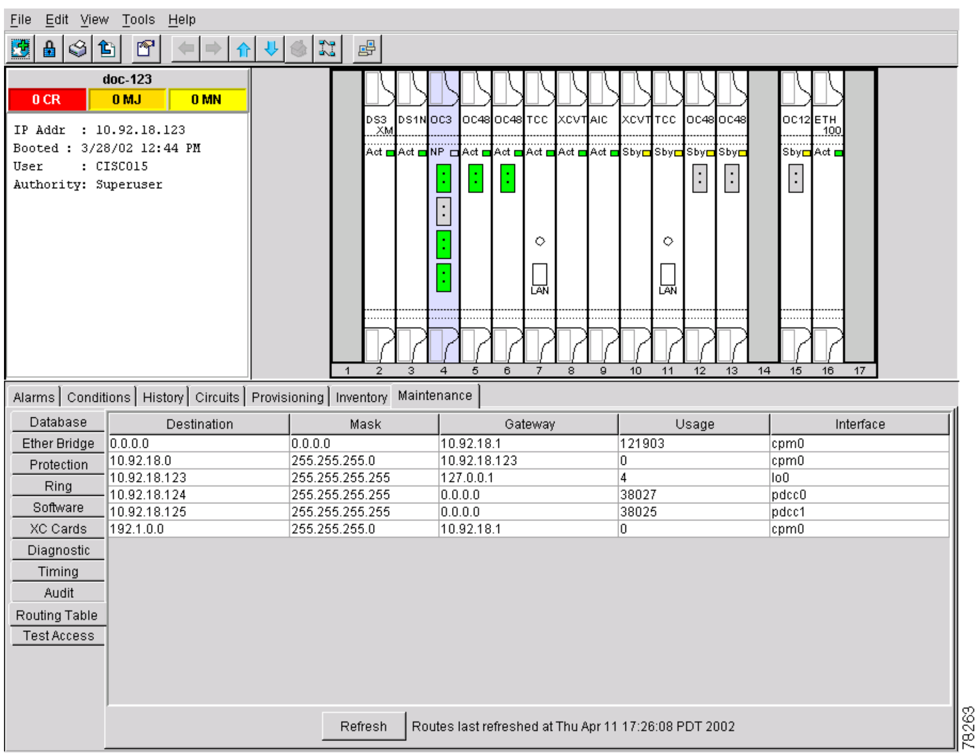


Table 10-5 shows sample routing entries for an ONS 15454.

Table 10-5 Sample Routing Table Entries

Entry	Destination	Mask	Gateway	Interface
1	0.0.0.0	0.0.0.0	172.20.214.1	cpm0
2	172.20.214.0	255.255.255.0	172.20.214.92	cpm0

Table 10-5 Sample Routing Table Entries (continued)

Entry	Destination	Mask	Gateway	Interface
3	172.20.214.92	255.255.255.255	127.0.0.1	lo0
4	172.20.214.93	255.255.255.255	0.0.0.0	pdcc0
5	172.20.214.94	255.255.255.255	172.20.214.93	pdcc0

Entry #1 shows the following:

- *Destination* (0.0.0.0) is the default route entry. All undefined destination network or host entries on this routing table will be mapped to the default route entry.
- *Mask* (0.0.0.0) is always 0 for the default route.
- *Gateway* (172.20.214.1) is the default gateway address. All outbound traffic that cannot be found in this routing table or is not on the node's local subnet will be sent to this gateway.
- *Interface* (cpm0) indicates that the ONS 15454 Ethernet interface is used to reach the gateway.

Entry #2 shows the following:

- *Destination* (172.20.214.0) is the destination network IP address.
- *Mask* (255.255.255.0) is a 24-bit mask, meaning all addresses within the 172.20.214.0 subnet can be a destination.
- *Gateway* (172.20.214.92) is the gateway address. All outbound traffic belonging to this network is sent to this gateway.
- *Interface* (cpm0) indicates that the ONS 15454 Ethernet interface is used to reach the gateway.

Entry #3 shows the following:

- *Destination* (172.20.214.92) is the destination host IP address.
- *Mask* (255.255.255.255) is a 32 bit mask, meaning only the 172.20.214.92 address is a destination.
- *Gateway* (127.0.0.1) is a loopback address. The host directs network traffic to itself using this address.
- *Interface* (lo0) indicates that the local loopback interface is used to reach the gateway.

Entry #4 shows the following:

- *Destination* (172.20.214.93) is the destination host IP address.
- *Mask* (255.255.255.255) is a 32 bit mask, meaning only the 172.20.214.93 address is a destination.
- *Gateway* (0.0.0.0) means the destination host is directly attached to the node.
- *Interface* (pdcc0) indicates that a SONET SDCC interface is used to reach the destination host.

Entry #5 shows a DCC-connected node that is accessible through a node that is not directly connected:

- *Destination* (172.20.214.94) is the destination host IP address.
- *Mask* (255.255.255.255) is a 32-bit mask, meaning only the 172.20.214.94 address is a destination.
- *Gateway* (172.20.214.93) indicates that the destination host is accessed through a node with IP address 172.20.214.93.
- *Interface* (pdcc0) indicates that a SONET SDCC interface is used to reach the gateway.

Circuits and Tunnels

This chapter explains Cisco ONS 15454 STS and VT circuits and VT and DCC tunnels. To provision circuits and tunnels, refer to the *Cisco ONS 15454 Procedure Guide*.

Chapter topics include:

11.1 Circuit Types

For an explanation and examples of circuits and VT tunnels, see the "Cross-Connect Card Capacities" section on page 11-2. You can create unidirectional or bidirectional, revertive or non-revertive circuits. You can have circuits routed automatically or you can manually route them. The auto range feature eliminates the need to individually build circuits of the same type; CTC can create additional sequential circuits if you specify the number of circuits you need and build the first circuit.

You can provision circuits at any of the following points:

- Before cards are installed. The ONS 15454 allows you to provision slots and circuits before installing the traffic cards. (To provision an empty slot, right-click it and select a card from the shortcut menu.) However, circuits will not carry traffic until you install the cards and place their ports in service.
- Cards are installed; ports are out of service. You must place the ports in service before circuits will carry traffic.

Note After cards are installed and their ports are placed in service, circuits will carry traffic as soon as the signal is received. In this chapter, "cross-connect" and "circuit" have the following meanings: Cross-connect refers to the connections that occur within a single ONS 15454 to allow a circuit to enter and exit an ONS 15454. Circuit refers to the series of connections from a traffic source (where traffic enters the ONS 15454 network) to the drop or destination (where traffic exits an ONS 15454 network).

11.2 Cross-Connect Card Capacities

The ONS 15454 XC, XCVT, and XC10G cards perform port-to-port time-division multiplexing (TDM).

- XCs perform STS switching
- XCVTs and XC10Gs perform STS and VT1.5 switching

XCs and XCVTs have capacity to terminate 288 STSs, or 144 STS cross-connections (each STS cross-connection uses two STS ports on the cross-connect card STS matrix). XC10Gs have capacity for 1152 STSs or 576 STS cross-connections. Table 11-1 shows STS capacities for the XC, XCVT, and XC10G cards.

Table 11-1 XC, XCVT, and XC10G Card STS Cross-Connect Capacities

Card	Total STSs	STS Cross-connects
XC	288	144
XCVT	288	144
XC10G	1152	576

11.2.1 VT1.5 Cross-Connects

XCVTs and XC10Gs can map up to 24 STSs for VT1.5 traffic. Because one STS can carry 28 VT1.5s, the XCVT and XC10G cards can terminate up to 672 VT1.5s or 336 VT1.5 cross-connects. However, to terminate 336 VT1.5 cross-connects:

- Each STS mapped for VT1.5 traffic must carry 28 VT1.5 circuits. If you assign each VT1.5 circuit to a different STS, the XCVT and XC10G VT1.5 cross-connect capacity will be reached after you create 12 VT1.5 circuits.
- ONS 15454s must be in a bidirectional line switched ring (BLSR). Source and drop nodes in UPSR or 1+1 (linear) protection have capacity for only 224 VT1.5 cross-connects because an additional STS is used for the protect path.

Table 11-2 shows the VT1.5 capacities for ONS 15454 cross-connect cards. All capacities assume each VT1.5-mapped STS carries 28 VT1.5 circuits.

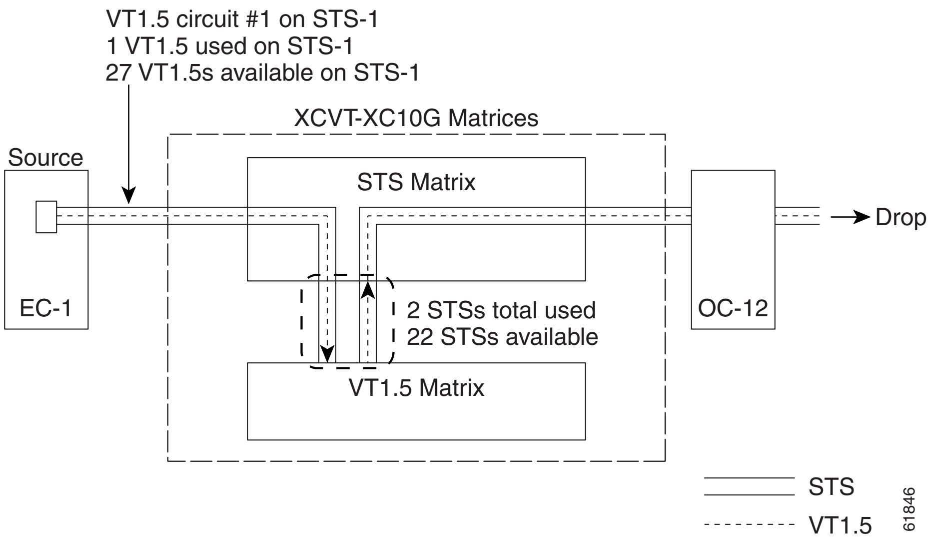
Table 11-2 XC, XCVT, and XC10G VT1.5 Capacities

Card	Total VT1.5s (BLSR)	VT1.5 Cross-Connect Capacity (BLSR)	VT1.5 Cross-Connect Capacity (UPSR or 1+1)
XC	0	0	0
XCVT	672	336	224
XC10G	672	336	224

Figure 11-1 shows the logical flow of a VT1.5 circuit through the XCVT/XC10G STS and VT matrices at a BLSR node. The circuit source is an EC-1 card using STS-1. After the circuit is created:

- Two of the 24 XCVT or XC10G STSs available for VT1.5 traffic are used (one STS for VT1.5 input into the VT matrix; one STS for VT1.5 output).
- 22 STSs are available for VT1.5 circuits.
- The STS-1 from the EC-1 card has capacity for 27 more VT1.5 circuits.

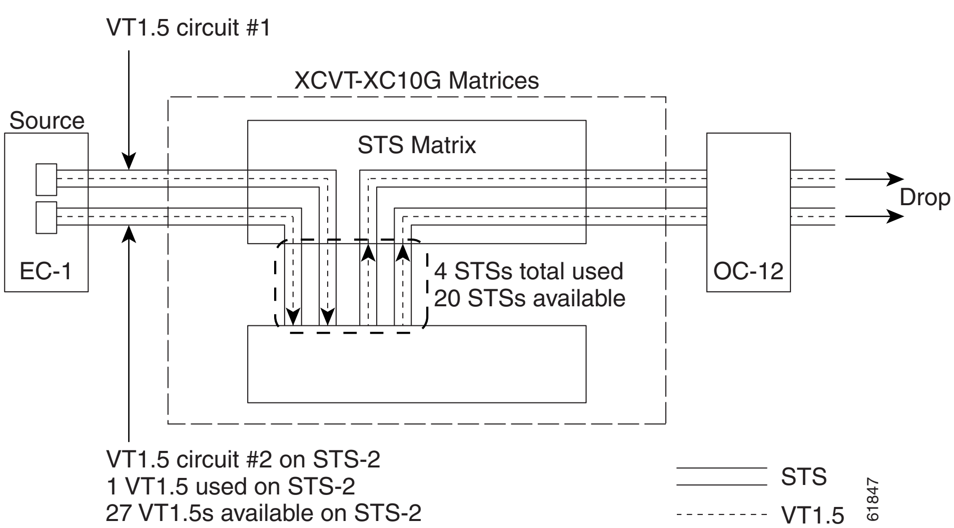
Figure 11-1 Example #1: A VT1.5 circuit in a BLSR



In Figure 11-2, a second VT1.5 circuit is created from the EC-1 card. In this example, the circuit is assigned to STS-2:

- Two more of the 24 STSs available for VT1.5 traffic are used.
- 20 STSs are available on the XCVT or XC10G for VT1.5 circuits.
- STS-2 can carry 27 additional VT1.5 circuits.

Figure 11-2 Example #2: Two VT1.5 circuits in a BLSR



If you create VT1.5 circuits on nodes in a UPSR or 1+1 protection, an additional STS is used for the protect path at the source and drop nodes. Figure 11-3 shows a VT1.5 circuit at a UPSR source node. When the circuit is completed:

- Three of the 24 STSs available for VT1.5 mapping on the XCVT or XC10G are used (one input and two outputs, one output for the working path and one output for the protect path).
- 21 STSs are available for VT1.5 circuits.

Figure 11-3 Example #3: VT1.5 circuit in a UPSR or 1+1 protection scheme

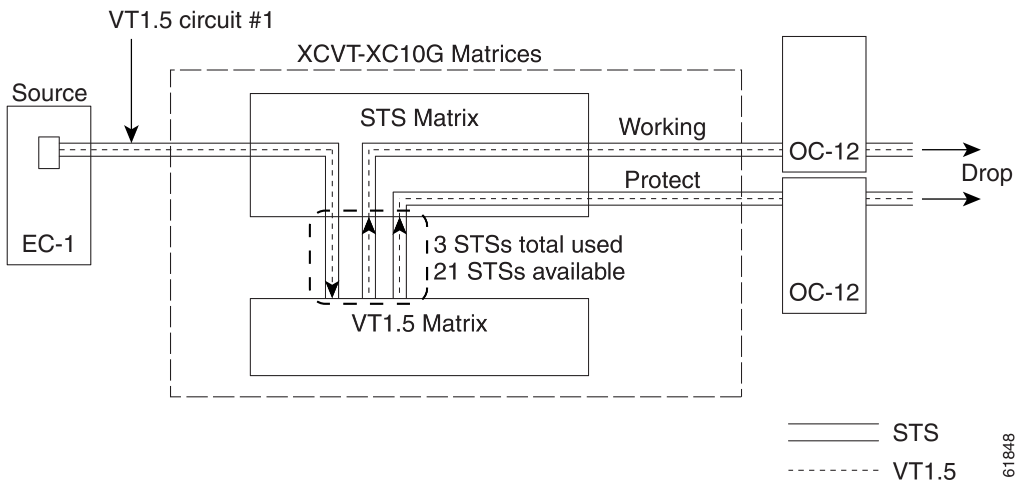
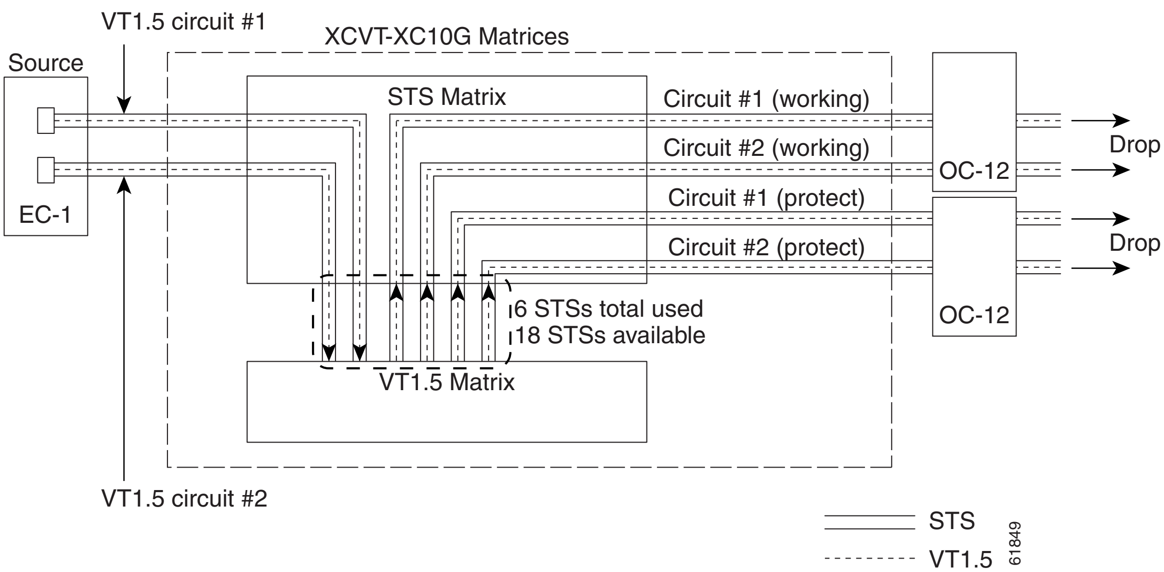


Figure 11-4 shows a second VT1.5 circuit that was created using STS-2. When the second VT1.5 circuit is created:

- Three more VT1.5-mapped STSs are used.
- 18 STSs are available on the XCVT or XC10G for VT1.5 circuits.

Figure 11-4 Example #4: Two VT1.5 circuits in UPSR or 1+1 protection scheme



Unless you create VT tunnels (see the "VT Tunnels" section on page 11-5), VT1.5 circuits use STSs on the XCVT/XC10G VT matrix at each node that the circuit passes through.

- Two STSs are used at each node in the Figure 11-1 example, and three STSs are used at each node in the Figure 11-3 example.
- In the Figure 11-2 example, three STSs are used at the source and drop nodes and four STSs are used at pass-through nodes. In Figure 11-4, six STSs are used at the source and drop nodes and four STSs at the pass-through nodes.

11.2.2 VT Tunnels

To maximize VT matrix resources, you can tunnel VT1.5 circuits through ONS 15454 pass-through nodes (nodes that are not a circuit source or drop). VT1.5 tunnels provide two benefits:

- They allow you to route VT1.5 circuits through ONS 15454s that have XC cards. (VT1.5 circuits require XCVT or XC10G cards at circuit source and drop nodes.)
- When tunneled through nodes with XCVT or XC10G cards, VT1.5 tunnels do not use VT matrix capacity, thereby freeing the VT matrix resources for other VT1.5 circuits.

Figure 11-5 shows a VT tunnel through the XCVT and XC10G matrices. No VT1.5-mapped STSs are used by the tunnel, which can carry 28 VT1.5s. However, the tunnel does use two STS matrix ports on each node that it passes through.

Figure 11-5 A VT1.5 tunnel

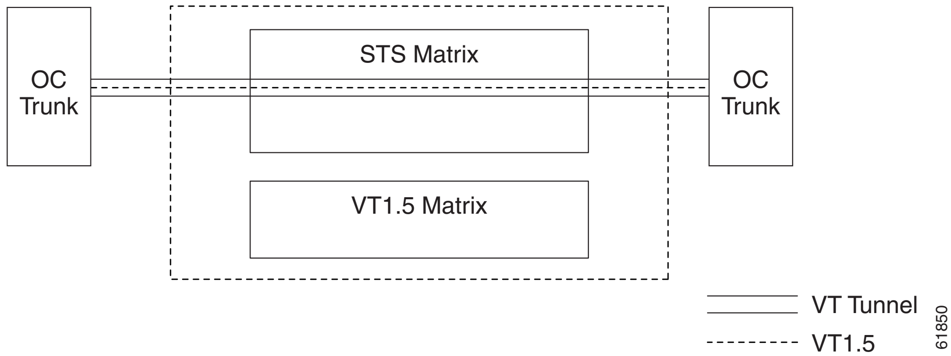


Figure 11-6 shows a six-node ONS 15454 ring with two VT tunnels. One tunnel carries VT1.5 circuits from Node 1 to Node 3. The second tunnel carries VT1.5 circuits from Node 1 to Node 4. Table 11-3 shows the VT1.5-mapped STS usage at each node in a ring based on protection scheme and use of VT tunnels. In the Figure 11-6 example, the circuit travels west through Nodes 2, 3, and 4. Subsequently, VT-mapped STS usage at these nodes is greater than at Nodes 5 and 6.

Figure 11-6 A six-node ring with two VT1.5 tunnels

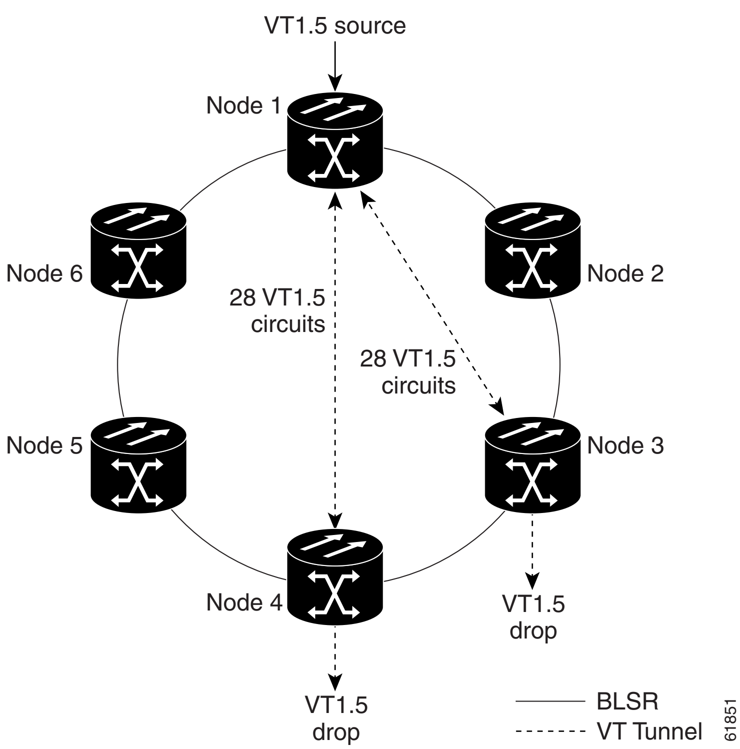


Table 11-3 VT1.5-Mapped STS Use in Figure 6-6

Node	VT Tunnel (BLSR)	VT Tunnel (UPSR, 1+1)	No VT Tunnel (BLSR)	No VT Tunnel (UPSR)	No VT Tunnel (1+1)
1	4	6	4	6	3
2	0	0	4	2	4
3	2	3	4	3	5
4	2	3	2	3	3
5	0	0	0	2	0
6	0	0	0	2	0

When planning VT1.5 circuits, weigh the benefits of using tunnels with the need to maximize STS capacity. For example, a VT1.5 tunnel between Node 1 and Node 4 passing (transparently) through Nodes 2 and Node 3 is advantageous if a full STS is used for Node 1 – Node 4 VT1.5 traffic (that is, the number of VT1.5 circuits between these nodes is close to 28). A VT tunnel is required if:

- Node 2 or Node 3 have XC cards, or
- All VT1.5-mappable STSs at Node 2 and Node 3 are in use.

However, if the Node 1 – Node 4 tunnel will carry only a few VT1.5 circuits, creating a regular VT1.5 circuit between Nodes 1, 2, 3, and 4 might maximize STS capacity.

When you create a VT1.5 circuit, CTC determines whether a tunnel already exists between source and drop nodes. If a tunnel exists, CTC checks the tunnel capacity. If the capacity is sufficient, CTC routes the circuit on the existing tunnel. If a tunnel does not exist, or if an existing tunnel does not have sufficient capacity, CTC displays a dialog box asking whether you want to create a tunnel. Before you create the tunnel, review the existing tunnel availability, keeping in mind future bandwidth needs. In some cases, you may want to manually route a circuit rather than create a new tunnel.

11.3 DCC Tunnels

SONET provides four data communications channels (DCCs) for network element operations, administration, maintenance, and provisioning: one on the SONET Section layer and three on the SONET Line layer. The ONS 15454 uses the Section DCC (SDCC) for ONS 15454 management and provisioning.

You can use the Line DCCs (LDCCs) and the SDCC (when the SDCC is not used for ONS 15454 DCC terminations) to tunnel third-party SONET equipment across ONS 15454 networks. A DCC tunnel end-point is defined by Slot, Port, and DCC, where DCC can be either the SDCC, Tunnel 1, Tunnel 2, or Tunnel 3 (LDCCs). You can link an SDCC to an LDCC (Tunnel 1, Tunnel 2, or Tunnel 3), and an LDCC to an SDCC. You can also link LDCCs to LDCCs and link SDCCs to SDCCs. To create a DCC tunnel, you connect the tunnel end points from one ONS 15454 optical port to another.

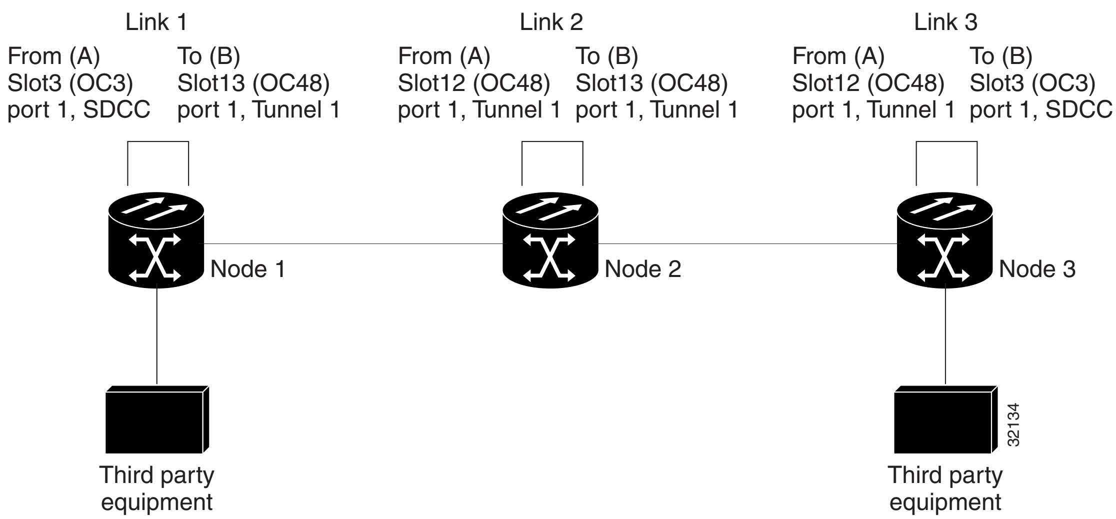
Each ONS 15454 can support up to 32 DCC tunnel connections. Table 11-4 shows the DCC tunnels that you can create.

Table 11-4 DCC Tunnels

DCC	SONET Layer	SONET Bytes	OC-3 (all ports)	OC-12, OC-48
SDCC	Section	D1 - D3	Yes	Yes
Tunnel 1	Line	D4 - D6	No	Yes
Tunnel 2	Line	D7 - D9	No	Yes
Tunnel 3	Line	D10 - D12	No	Yes

Figure 11-7 shows a DCC tunnel example. Third-party equipment is connected to OC-3 cards at Node 1/Slot 3/Port 1 and Node 3/Slot 3/Port 1. Each ONS 15454 node is connected by OC-48 trunk cards. In the example, three tunnel connections are created, one at Node 1 (OC-3 to OC-48), one at Node 2 (OC-48 to OC-48), and one at Node 3 (OC-48 to OC-3).

Figure 11-7 A DCC tunnel



When you create DCC tunnels, keep the following guidelines in mind:

- Each ONS 15454 can have up to 32 DCC tunnel connections.
- Each ONS 15454 can have up to 10 SDCC terminations.
- An SDCC that is terminated cannot be used as a DCC tunnel end-point.
- An SDCC that is used as an DCC tunnel end-point cannot be terminated.
- All DCC tunnel connections are bidirectional.

11.4 Multiple Drops for Unidirectional Circuits

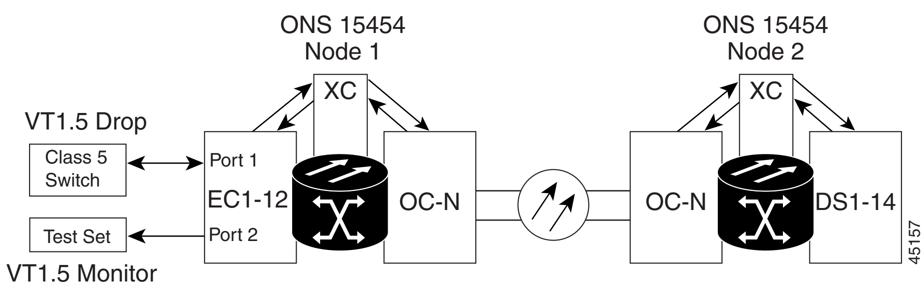
Unidirectional circuits can have multiple drops for use in broadcast circuit schemes. In broadcast scenarios, one source transmits traffic to multiple destinations, but traffic is not returned back to the source.

When you create a unidirectional circuit, the card that does not have its backplane Rx input terminated with a valid input signal generates a loss of service (LOS) alarm. To mask the alarm, create an alarm profile suppressing the LOS alarm and apply it to the port that does not have its Rx input terminated.

11.5 Monitor Circuits

You can set up secondary circuits to monitor traffic on primary bidirectional circuits. Figure 11-8 shows an example of a monitor circuit. At Node 1, a VT1.5 is dropped from Port 1 of an EC1-12 card. To monitor the VT1.5 traffic, test equipment is plugged into Port 2 of the EC1-12 card and a monitor circuit to Port 2 is provisioned in CTC. Circuit monitors are one-way. The monitor circuit in Figure 11-8 is used to monitor VT1.5 traffic received by Port 1 of the EC1-12 card.

Figure 11-8 A VT1.5 monitor circuit received at an EC1-12 port



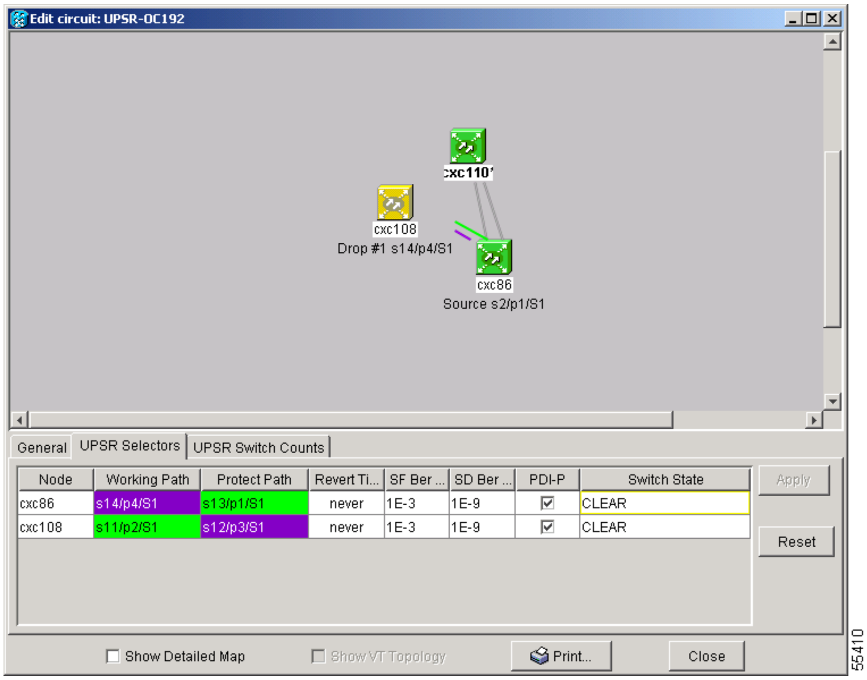
Note Monitor circuits cannot be used with EtherSwitch circuits.

11.6 UPSR Circuits

Use the Edit Circuits window to change UPSR selectors and switch protection paths (Figure 11-9). In this window, you can:

- View the UPSR circuit's working and protection paths
- Edit the reversion time
- Edit the Signal Fail/Signal Degrade thresholds
- Change PDI-P settings, perform maintenance switches on the circuit selector, and view switch counts for the selectors

Figure 11-9 Editing UPSR selectors



11.7 Path Trace

The SONET J1 Path Trace is a repeated, fixed-length string comprised of 64 consecutive J1 bytes. You can use the string to monitor interruptions or changes to circuit traffic. Table 11-5 shows the ONS 15454 cards that support path trace. DS-1 and DS-3 cards can transmit and receive the J1 field, while the EC-1, OC-3, OC-48AS, and OC-192 can only receive it. Cards not listed in the table do not support the J1 byte.

Table 11-5 ONS 15454 Cards Supporting J1 Path Trace

Card	Receive	Transmit
DS1-14	X	X
DS1N-14	X	X
DS3-12E	X	X
DS3N-12E	X	X
DS3XM-6X	X	X
EC1-12	X	
OC3 IR 4 1310	X	
OC48 IR/STM16 SH AS 1310	X	
OC48 LR/STM16 LH AS 1550	X	
OC192 LR/STM64 LH 1550	X	

The J1 path trace transmits a repeated, fixed-length string. If the string received at a circuit drop port does not match the string the port expects to receive, an alarm is raised. Two path trace modes are available:

- *Automatic*—The receiving port assumes the first J1 string it receives is the baseline J1 string.
- *Manual*—The receiving port uses a string that you manually enter as the baseline J1 string.

11.8 Automatic Circuit Routing

If you select automatic routing during circuit creation, Cisco Transport Controller (CTC) routes the circuit by dividing the entire circuit route into segments based on protection domains. For unprotected segments of protected circuits, CTC finds an alternate route to protect the segment in a virtual UPSR fashion. Each path segment is a separate protection domain, and each protection domain is protected in a specific fashion (virtual UPSR, BLSR, or 1+1).

The following list provides principles and charactistics of automatic circuit routing:

- Circuit routing tries to use the shortest path within the user-specified or network-specified constraints. VT tunnels are preferable for VT circuits because VT tunnels are considered shortcuts when CTC calculates a circuit path in path-protected mesh networks.
- If you do not choose Fully Path Protected during circuit creation, circuits may still contain protected segments. Because circuit routing always selects the shortest path, one or more links and/or segments may have some protection. CTC does not look at link protection while computing a path for unprotected circuits.
- Circuit routing will not use links that are down. If you want all links to be considered for routing, do not create circuits when a link is down.
- Circuit routing computes the shortest path when you add a new drop to an existing circuit. It tries to find a shortest path from the new drop to any nodes on the existing circuit.
- If the network has a mixture of VT-capable nodes and nodes that are not VT capable, depending on the route found, CTC will automatically force creation of a VT tunnel. Otherwise, CTC asks you whether a VT tunnel is needed.

11.8.1 Bandwidth Allocation and Routing

Within a given network, CTC will route circuits on the shortest possible path between source and destination based on the circuit attributes, such as protection and type. CTC will consider using a link for the circuit only if the link meets the following requirements:

- The link has sufficient bandwidth to support the circuit
- The link does not change the protection characteristics of the path
- The link has the required time slots to enforce the same time slot restrictions for BLSR

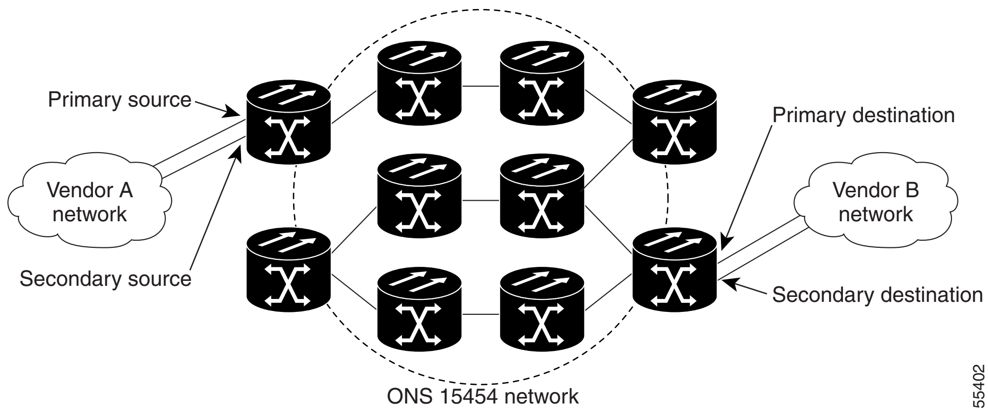
If CTC cannot find a link that meets these requirements, it displays an error

The same logic applies to VT circuits on VT tunnels. Circuit routing typically favors VT tunnels because, based on topology maintained by circuit routing, VT tunnels are shortcuts between a given source and destination. If the VT tunnel in the route is full (no more bandwidth), CTC asks whether you want to create an additional VT tunnel.

11.8.2 Secondary Sources and Drops

CTC supports secondary sources and drops. Secondary sources and drops typically interconnect two "foreign" networks, as shown in Figure 11-10. Traffic is protected while it goes through a network of ONS 15454s.

Figure 11-10 Secondary sources and drops



Several rules apply to secondary sources and drops:

- CTC does not allow a secondary destination for unidirectional circuits because you can always specify additional destinations (drops) after you create the circuit
- Primary and secondary sources should be on the same node
- Primary and secondary destinations should be on the same node
- The sources and drops cannot be DS-3, DS3XM, or DS-1 based STS-1s or VTs
- Secondary sources and destinations are permitted only for regular STS/VT connections (not for VT tunnels and multicard EtherSwitch circuits)
- For point-to-point (straight) Ethernet circuits, only SONET STS endpoints can be specified as multiple sources or drops

For bidirectional circuits, CTC creates a UPSR connection at the source node that allows traffic to be selected from one of the two sources on the ONS 15454 network. If you check the Fully Path Protected option during circuit creation, traffic is protected within the ONS 15454 network. At the destination, another UPSR connection is created to bridge traffic from the ONS 15454 network to the two destinations. A similar but opposite path exists for the reverse traffic flowing from the destinations to the sources.

For unidirectional circuits, a UPSR drop-and-continue connection is created at the source node.

11.9 Manual Circuit Routing

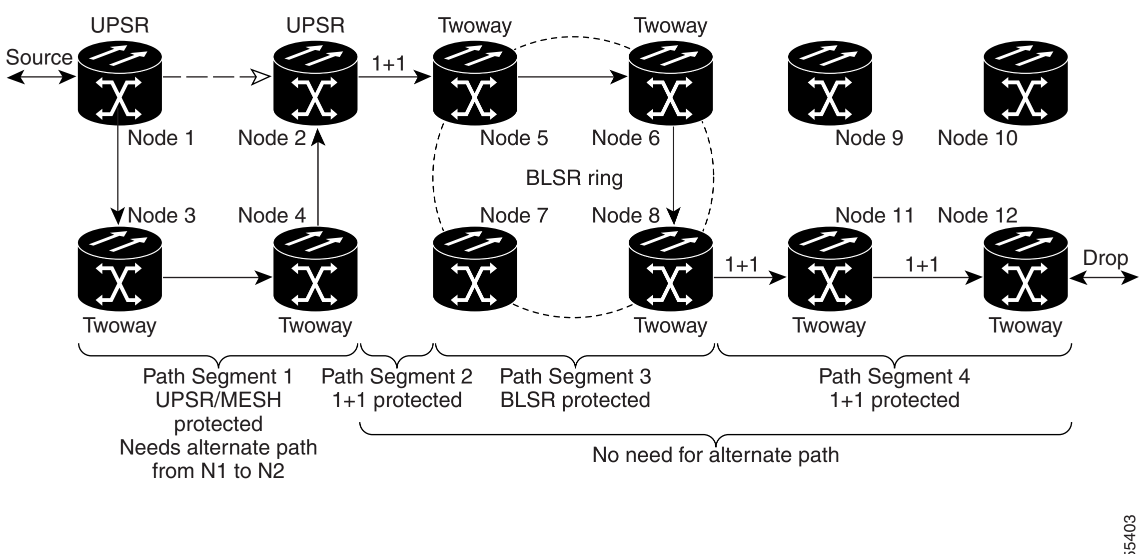
Routing circuits manually allows you to:

- Choose a specific path, not just the shortest path chosen by automatic routing
- Choose a specific STS/VT on each link along the route
- Create a shared packet ring for Multicard EtherSwitch circuits
- Choose a protected path for Multicard EtherSwitch circuits, allowing virtual UPSR segments

CTC imposes the following rules on manual routes:

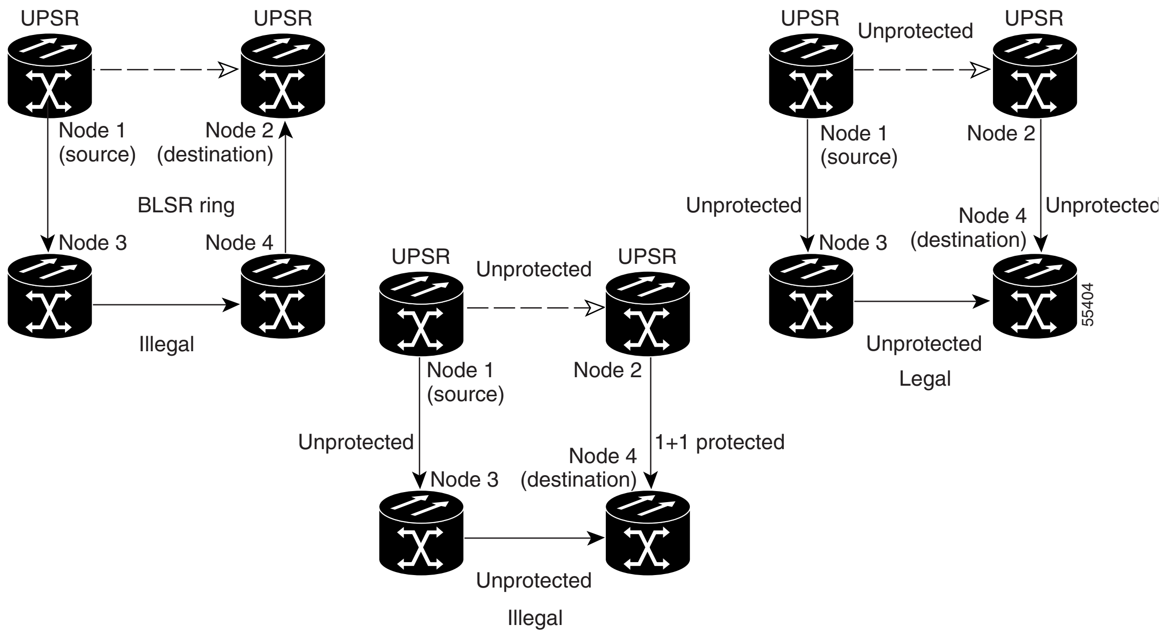
- All circuits, except Multicard EtherSwitch circuits in a shared packet ring, should have links with a direction that flows from source to destination. This is true for Multicard EtherSwitch circuits that are not in a shared packet ring.
- If you enabled Fully Path Protected, choose a diverse protect (alternate) path for every unprotected segment (Figure 11-11).

Figure 11-11 Alternate paths for virtual UPSR segments



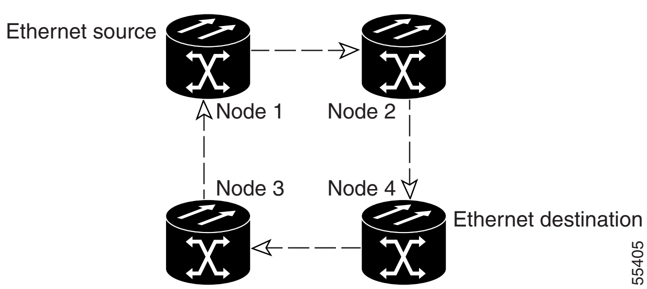
- For Multicard EtherSwitch circuits, the Fully Path Protected option is ignored.
- For a node that has a UPSR selector based on the links chosen, the input links to the UPSR selectors cannot be 1+1 or BLSR protected (see Figure 11-12). The same rule applies at the UPSR bridge.

Figure 11-12 Mixing 1+1 or BLSR protected links with a UPSR



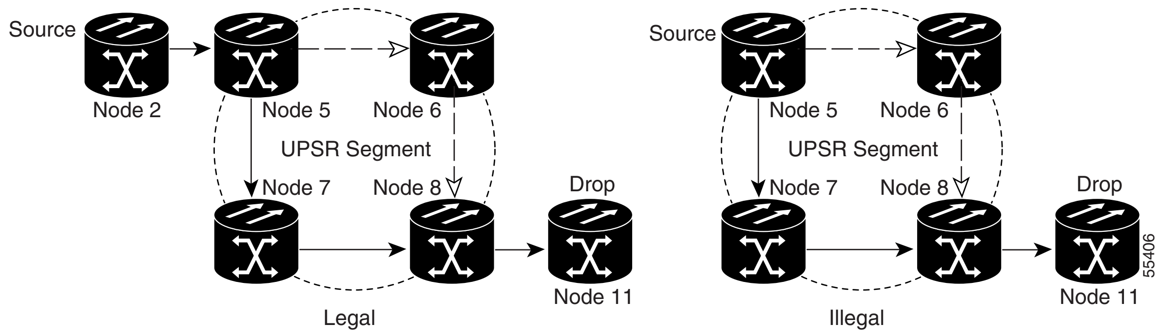
- Choose the links of Multicard EtherSwitch circuits in a shared packet ring to route from source to destination back to source (see Figure 11-13). Otherwise, a route (set of links) chosen with loops is invalid.

Figure 11-13 Ethernet shared packet ring routing



- Multicard EtherSwitch circuits can have virtual UPSR segments if the source or destination is not in the UPSR domain. This restriction also applies after circuit creation; therefore, if you create a circuit with UPSR segments, Ethernet node drops cannot exist anywhere on the UPSR segment (see Figure 11-14).

Figure 11-14 Ethernet and UPSR



- VT tunnels cannot be an endpoint of a UPSR segment. A UPSR segment endpoint is where the UPSR selector resides.

If Fully Path Protected is chosen, CTC verifies that the route selection is protected at all segments. A route can have multiple protection domains with each domain protected by a different mechanism.

The following tables summarize the available node connections. Any other combination is invalid and will generate an error.

Table 11-6 Bidirectional STS/VT/Regular Multicard EtherSwitch/Point-to-Point (straight) Ethernet Circuits

# of Inbound Links	# of Outbound Links	# of Sources	# of Drops	Connection Type
-	2	1	-	UPSR
2	-	-	1	UPSR
2	1	-	-	UPSR
1	2	-	-	UPSR
1	-	-	2	UPSR
-	1	2	-	UPSR
2	2	-	-	Double UPSR
2	-	-	2	Double UPSR
-	2	2	-	Double UPSR
1	1	-	-	Two Way
0 or 1	0 or 1	Ethernet Node Source	-	Ethernet
0 or 1	0 or 1	-	Ethernet Node Drop	Ethernet

Table 11-7 Unidirectional STS/VT Circuit

# of Inbound Links	# of Outbound Links	# of Sources	# of Drops	Connection Type
1	1	-	-	One way
1	2	-	-	UPSR Head End
-	2	1	-	UPSR Head End
2	-	-	1+	UPSR drop and continue

Table 11-8 Multicard Group Ethernet Shared Packet Ring Circuit

# of Inbound Links	# of Outbound Links	# of Sources	# of Drops	Connection Type
At intermediate nodes only				
2	1	-	-	UPSR
1	2	-	-	UPSR
2	2	-	-	Double UPSR
1	1	-	-	Two way
At source or destination nodes only				
1	1	-	-	Ethernet

Table 11-9 Bidirectional VT Tunnels

# of Inbound Links	# of Outbound Links	# of Sources	# of Drops	Connection Type
At intermediate nodes only				
2	1	-	-	UPSR
1	2	-	-	UPSR
2	2	-	-	Double UPSR
1	1	-	-	Two way
At source nodes only				
-	1	-	-	VT tunnel end point
At destination nodes only				
1	-	-	-	VT tunnel end point

Although virtual UPSR segments are possible in VT tunnels, VT tunnels are still considered unprotected. If you need to protect VT circuits either use two independent VT tunnels that are diversely routed or use a VT tunnel that is routed over only 1+1 or BLSR (or a mix) links.

11.10 Constraint-Based Circuit Routing

When you create circuits, you can choose Fully Protected Path to protect the circuit from source to destination. The protection mechanism used depends on the path CTC calculates for the circuit. If the network is comprised entirely of BLSR and/or 1+1 links, or the path between source and destination can be entirely protected using 1+1 and/or BLSR links, no PPMN (virtual UPSR) protection is used.

If virtual UPSR (PPMN) protection is needed to protect the path, set the level of node diversity for the PPMN portions of the complete path on the Circuit Creation dialog box:

- Required—Ensures that the primary and alternate paths of each PPMN domain in the complete path have a diverse set of nodes.
- Desired—CTC looks for a node diverse path; if a node diverse path is not available, CTC finds a link diverse path for each PPMN domain in the complete path.
- Don't Care—Creates only a link diverse path for each PPMN domain

When you choose automatic circuit routing during circuit creation, you have the option to require and/or exclude nodes and links in the calculated route. You can use this option to:

- Simplify manual routing, especially if the network is large and selecting every span is tedious. You can select a general route from source to destination and allow CTC to fill in the route details.
- Balance network traffic; by default CTC chooses the shortest path, which can load traffic on certain links while other links are either free or less used. By selecting a required node and/or a link, you force the CTC to use (or not use) an element, resulting in more efficent use of network resources.

CTC considers required nodes and links to be an ordered set of elements. CTC treats the source nodes of every required link as required nodes. When CTC calculates the path, it makes sure the computed path traverses the required set of nodes and links and does not traverse excluded nodes and links.

The required nodes and links constraint is only used during the primary path computation and only for PPMN domains/segments. The alternate path is computed normally; CTC uses excluded nodes/links when finding all primary and alternate paths on PPMNs.

Ethernet Operation

The Cisco ONS 15454 integrates Ethernet into a SONET time-division multiplexing (TDM) platform. The ONS 15454 supports both E series Ethernet cards and the G series Ethernet card. For more information on Ethernet cards, see Chapter 5, “Ethernet Cards.”

Chapter topics include:

12.1 G1000-4 Application

The G1000-4 card reliably transports Ethernet and IP data across a SONET backbone. The G1000-4 card maps up to four gigabit Ethernet interfaces onto a SONET transport network. A single card provides scalable and provisionable transport bandwidth at the signal levels up to STS-48c per card. The card provides line rate forwarding for all Ethernet frames (unicast, multicast, and broadcast) and can be configured to support Jumbo frames (defined as a maximum of 10,000 bytes).The G-series card incorporates features optimized for carrier-class applications such as:

- High Availability (including hitless (< 50 ms) performance under software upgrades and all types of SONET/SDH equipment protection switches)
- Hitless re-provisioning
- Support of Gigabit Ethernet traffic at full line rate
- Full TL1-based provisioning capability. Refer to the *Cisco ONS 15454 and Cisco ONS 15327 TL1 Command Guide* for G1000-4 TL1 provisioning commands.

The G1000-4 card allows an Ethernet private line service to be provisioned and managed very much like a traditional SONET or SDH line. G1000-4 card applications include providing carrier-grade Transparent LAN Services (TLS), 100 Mbps Ethernet private line services (when combined with an external 100 Mb Ethernet switch with Gigabit uplinks), and high availability transport for applications such as storage over MAN/WANs.

You can map the four ports on the G1000-4 independently to any combination of STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-24c, and STS-48c circuit sizes, provided the sum of the circuit sizes that terminate on a card do not exceed STS-48c.

To support a gigabit Ethernet port at full line rate, an STS circuit with a capacity greater or equal to 1Gbps (bidirectional 2 Gbps) is needed. An STS-24c is the minimum circuit size that can support a gigabit Ethernet port at full line rate.The G1000-4 supports a maximum of two ports at full line rate.

Ethernet cards may be placed in any of the 12 multipurpose card slots. In most configurations, at least two of the 12 slots need to be reserved for optical trunk cards, such as the OC-192 card. The reserved OC-N slots give the ONS 15454 a practical maximum of ten G1000-4 cards. The G1000-4 card requires the XC10G card to operate. The G1000-4 card is not compatible with XC or XCVT cards.

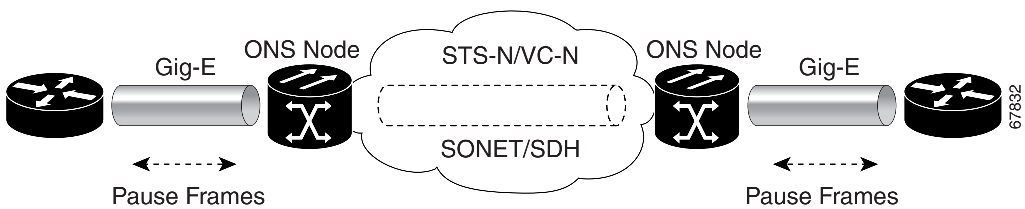
The G1000-4 transmits and monitors the SONET J1 Path Trace byte in the same manner as ONS 15454 DS-N cards. For more information, refer to the Provision Path Trace on Circuit Source and Destination Ports Procedure (DLP130) in the *Cisco ONS 15454 Procedure Guide*. For more information on Ethernet cards, refer to the Ethernet Cards Reference Chapter.

Note G-Series encapsulation is standard HDLC framing over SONET/SDH as described in RFC 1622 and RFC 2615 with the PPP protocol field set to the value specified in RFC 1841.

12.1.1 G1000-4 Example

Figure 12-1 shows an example of a G1000-4 application. In this example, data traffic from the Gigabit Ethernet port of a high-end router travels across the ONS 15454 point-to-point circuit to the Gigabit Ethernet port of another high-end router.

Figure 12-1 Data traffic using a G1000-4 point-to-point circuit



The G1000-4 card can carry over a SONET network any layer three protocol that can be encapsulated and transported over Gigabit Ethernet, such as IP or IPX. The data is transmitted on the Gigabit Ethernet fiber into the standard Cisco Gigabit Interface Converter (GBIC) on a G1000-4 card. The G1000-4 card transparently maps Ethernet frames into the SONET payload by multiplexing the payload onto a SONET OC-N card. When the SONET payload reaches the destination node, the process is reversed and the data is transmitted from the standard Cisco GBIC in the destination G1000-4 card onto the Gigabit Ethernet fiber.

The G1000-4 card discards certain types of erroneous Ethernet frames rather than transport them over SONET. Erroneous Ethernet frames include corrupted frames with CRC errors and under-sized frames that do not conform to the minimum 60-byte length Ethernet standard. The G1000-4 card forwards valid frames unmodified over the SONET network. Information in the headers is not affected by the encapsulation and transport. For example, packets with formats that include IEEE 802.1Q information will travel through the process unaffected.

12.1.2 802.3x Flow Control and Frame Buffering

The G1000-4 supports 802.3x flow control and frame buffering to reduce data traffic congestion. To buffer over-subscription, 512 kb of buffer memory is available for the receive and transmit channels on each port. When the buffer memory on the Ethernet port nears capacity, the ONS 15454 uses 802.3x flow control to send back a pause frame to the source at the opposite end of the Gigabit Ethernet connection.

The pause frame instructs that source to stop sending packets for a specific period of time. The sending station waits the requested time before sending more data. Figure 12-1 illustrates pause frames being sent from the ONS 15454s to the sources of the data. The G1000-4 card does not respond to pause frames received from client devices.

This flow-control mechanism matches the sending and receiving device throughput to that of the bandwidth of the STS circuit. For example, a router may transmit to the Gigabit Ethernet port on the G1000-4. This particular data rate may occasionally exceed 622 Mbps, but the ONS 15454 circuit assigned to the G1000-4 port may be only STS-12c (622.08 Mbps). In this example, the ONS 15454 sends out a pause frame and requests that the router delay its transmission for a certain period of time. With a flow control capability combined with the substantial per-port buffering capability, a private line service provisioned at less than full line rate capacity (STS-24c) is nevertheless very efficient because frame loss can be controlled to a large extent.

Some important characteristics of the flow control feature on the G1000-4 include:

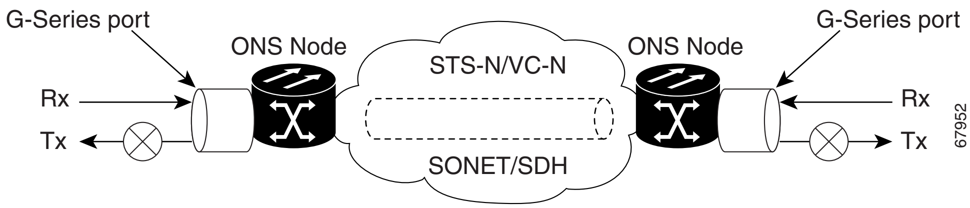
- The G1000-4 card only supports asymmetric flow control. Flow control frames are sent to the external equipment but no response from the external equipment is necessary or acted upon.
- Received flow control frames are quietly discarded. They are not forwarded onto the SONET path, and the G1000-4 card does not respond to the flow control frames.
- On the G1000-4 card, you can only enable flow control on a port when auto-negotiation is enabled on the device attached to that port. For more information, Refer to the Provision Path Trace on Circuit Source and Destination Ports (DLP130) in the *Cisco ONS 15454 Procedure Guide*.

Because of the above characteristics the link auto-negotiation and flow control capability on the attached Ethernet device must be correctly provisioned for successful link auto-negotiation and flow control on the G1000-4. If link auto-negotiation fails, the G1000-4 does not use flow control (default). Without flow control, traffic loss can occur if the input traffic rate is higher than the bandwidth of the circuit for an extended period of time.

12.1.3 Ethernet Link Integrity Support

The G1000-4 supports end-to-end Ethernet link integrity. This capability is integral to providing an Ethernet private line service and correct operation of layer 2 and layer 3 protocols on the attached Ethernet devices at each end. End-to-end Ethernet link integrity essentially means that if any part of the end-to-end path fails the entire path fails. Failure of the entire path is ensured by turning off the transmit lasers at each end of the path. The attached Ethernet devices recognize the disabled transmit laser as a loss of carrier and consequently an inactive link.

Figure 12-2 End-to-end Ethernet link integrity support



> **Note** Some network devices can be configured to ignore a loss of carrier condition. If such a device attaches to a G1000-4 card at one end then alternative techniques (such as use of layer 2 or layer 3 protocol keep alive messages) are required to route traffic around failures. The response time of such alternate techniques is typically much longer than techniques that use link state as indications of an error condition.

> **Note** Enabling or disabling port level flow control on the test set or other Ethernet device attached to the G1000-4 port can affect the transmit (TX) laser. This can result in uni-directional traffic flow, if flow control is not enabled on the test set or other Ethernet device.

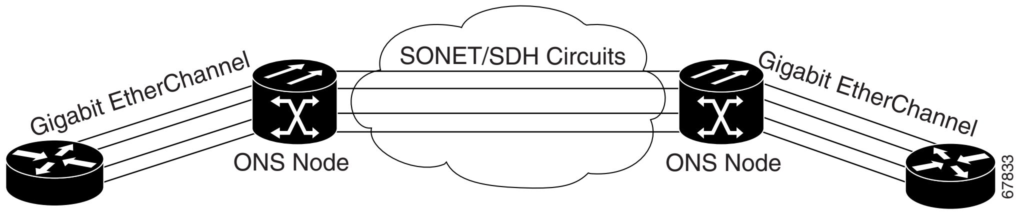
As shown in Figure 12-2, a failure at any point of the path (A, B, C, D or E) causes the G1000-4 card at each end to disable its TX transmit laser at their ends, which causes the devices at both ends to detect link down. If one of the Ethernet ports is administratively disabled or set in loopback mode, the port is considered a “failure” for the purposes of end-to-end link integrity because the end-to-end Ethernet path is unavailable. The port “failure” also cause both ends of the path to be disabled.

12.1.4 Gigabit EtherChannel/802.3ad Link Aggregation

The end-to-end Ethernet link integrity feature of the G1000-4 can be used in combination with Gigabit Ether Channel capability on attached devices. The combination provide an Ethernet traffic restoration scheme that has a faster response time than alternate techniques such as spanning tree re-routing, yet is more bandwidth efficient because spare bandwidth does not need to be reserved.

The G1000-4 supports all forms of Link Aggregation technologies including Gigabit EtherChannel (GEC) which is a Cisco proprietary standard as well as the IEEE 802.3ad standard. The end-to- end link integrity feature of the G1000-4 allows a circuit to emulate an Ethernet link. This allows all flavors of layer 2 and layer 3 re-routing, as well as technologies such as link aggregation, to work correctly with the G1000-4. The G1000-4 supports Gigabit EtherChannel (GEC), which is a Cisco proprietary standard similar to the IEEE link aggregation standard (IEEE 802.3ad). Figure 12-3 illustrates G1000-4 GEC support.

Figure 12-3 G1000-4 Gigabit EtherChannel (GEC) support



Although the G1000-4 card does not actively run GEC, it supports the end-to-end GEC functionality of attached Ethernet devices. If two Ethernet devices running GEC connect through G1000-4 cards to an ONS 15454 network, the ONS 15454 SONET side network is transparent to the EtherChannel devices. The EtherChannel devices operate as if they are directly connected to each other. Any combination of G1000-4 parallel circuit sizes can be used to support GEC throughput.

GEC provides line-level active redundancy and protection (1:1) for attached Ethernet equipment. It can also bundle parallel G1000-4 data links together to provide more aggregated bandwidth. Spanning Tree (STP) operates as if the bundled links are one link and permits GEC to utilize these multiple parallel paths. Without GEC, STP only permits a single non-blocked path. GEC can also provide G1000-4 card-level protection or redundancy because it can support a group of ports on different cards (or different nodes) so that if one port or card has a failure, then traffic is re-routed over the other port/card.

12.2 E Series Application

The E series cards incorporate layer 2 switching, while the G series card is a straight mapper card. The ONS 15454 E series cards include the E100T-12/E100T-G and E1000-2/E1000-2-G. E series cards support VLAN, IEEE 802.1Q, spanning tree, and IEEE 802.1D. An ONS 15454 holds a maximum of ten Ethernet cards, and you can insert Ethernet cards in any multipurpose slot. For more information on Ethernet cards, see the Ethernet Cards Reference Chapter.

The E100T-G is the functional equivalent of the E100T-12. An ONS 15454 using XC10G cards requires the G versions of the E series Ethernet cards. The E1000-2 is the functional equivalent of the E1000-2-G. An ONS 15454 using XC10G cards requires the G versions of the E series Ethernet cards.

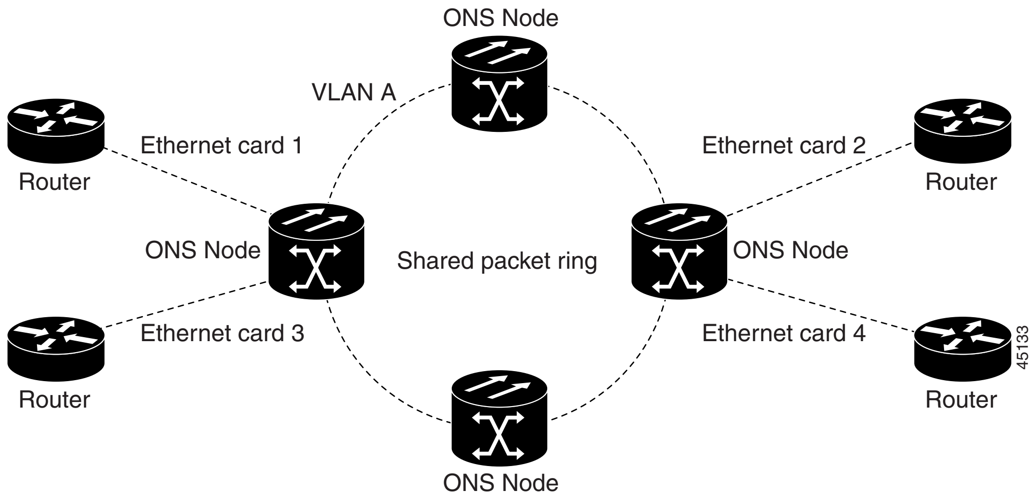
12.2.1 E Series Multicard and Single-Card EtherSwitch

The ONS 15454 enables multicard and single-card EtherSwitch modes for E series cards. At the Ethernet card view in CTC, click the Provisioning > Card tabs to reveal the Card Mode option.

12.2.1.1 E Series Multicard EtherSwitch

Multicard EtherSwitch provisions two or more Ethernet cards to act as a single layer 2 switch. It supports one STS-6c shared packet ring, two STS-3c shared packet rings, or six STS-1 shared packet rings. The bandwidth of the single switch formed by the Ethernet cards matches the bandwidth of the provisioned Ethernet circuit up to STS-6c worth of bandwidth.

Figure 12-4 A Multicard EtherSwitch configuration

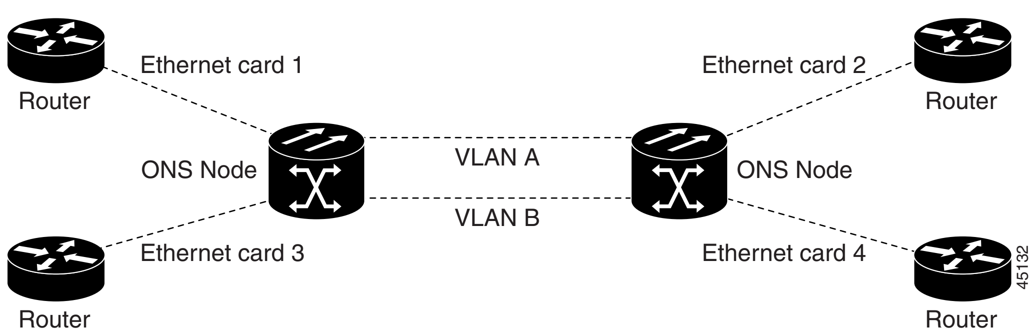


Caution Whenever you drop two STS-3c multicard EtherSwitch circuits onto an Ethernet card and delete only the first circuit, you should not provision STS-1 circuits to the card without first deleting the remaining STS-3c circuit. If you attempt to create a STS-1 circuit after deleting the first STS-3c circuit, the STS-1 circuit will not work and no alarms will indicate this condition. To avoid this condition, delete the second STS-3c prior to creating the STS-1 circuit.

12.2.1.2 E Series Single-Card EtherSwitch

Single-card EtherSwitch allows each Ethernet card to remain a single switching entity within the ONS 15454 shelf. This option allows a full STS-12c worth of bandwidth between two Ethernet circuit points. Figure 12-5 illustrates a single-card EtherSwitch configuration.

Figure 12-5 A Single-card EtherSwitch configuration



Seven scenarios exist for provisioning single-card EtherSwitch bandwidth:

1. STS 12c
2. STS 6c + STS 6c
3. STS 6c + STS 3c + STS 3c
4. STS 6c + 6 STS-1s

5. STS 3c + STS 3c +STS 3c +STS 3c
6. STS 3c +STS 3c + 6 STS-1s
7. 12 STS-1s

Note When configuring scenario 3, the STS 6c must be provisioned before either of the STS 3c circuits.

12.2.2 ONS 15454 E Series and ONS 15327 EtherSwitch Circuit Combinations

The following table shows the Ethernet circuit combinations available in ONS 15454 E series cards and ONS 15327s.

Table 12-1 ONS 15454 and ONS 15327 Ethernet Circuit Combinations

15327 Single-Card	15327 Multicard	15454 E Series Single-Card	15454 E Series Multicard
six STS-1s	three STS-1s	one STS 12c	six STS-1s
two STS 3cs	one STS 3c	two STS 6cs	two STS 3cs
one STS 6c		one STS 6c and two STS 3cs	one STS 6c
one STS 12c		one STS 6c and six STS-1s	
		four STS 3cs	
		two STS 3cs and six STS-1s	
		twelve STS-1s	

12.3 E Series Circuit Configurations

Ethernet circuits can link ONS nodes through point-to-point, shared packet ring, or hub and spoke configurations. Two nodes usually connect with a point-to-point configuration. More than two nodes usually connect with a shared packet ring configuration or a hub and spoke configuration. Ethernet manual cross-connects allow you to cross connect individual Ethernet circuits to an STS channel on the ONS 15454 optical interface and also to bridge non-ONS SONET network segments.

12.3.1 E-Series Circuit Protection

Different combinations of E-Series circuit configurations and SONET network topologies offer different levels of E-Series circuit protection. Table 12-2 details the available protection.

Table 12-2 Protection for E-Series Circuit Configurations

Configuration	UPSR	BLSR	1 + 1
Point-to-Point Multicard Etherswitch	None	SONET	SONET
Point-to-Point Single-Card Etherswitch	SONET	SONET	SONET
Shared Packet Ring Multicard Etherswitch	STP	SONET	SONET
Common Control Card Switch	STP	STP	STP

Note Before making Ethernet connections, choose a STS-1, STS-3c, STS-6c, or STS-12c circuit size.

Note When making an STS-12c Ethernet circuit, Ethernet cards must be configured as Single-card EtherSwitch. Multicard mode does not support STS-12c Ethernet circuits.

12.3.2 E Series Point-to-Point Ethernet Circuits

The ONS 15454 can set up a point-to-point (straight) Ethernet circuit as Single-card or Multicard. Multicard EtherSwitch limits bandwidth to STS-6c of bandwidth between two Ethernet circuit points, but allows adding nodes and cards and making a shared packet ring. Single-card EtherSwitch allows a full STS-12c of bandwidth between two Ethernet circuit points.

Figure 12-6 A Multicard EtherSwitch point-to-point circuit

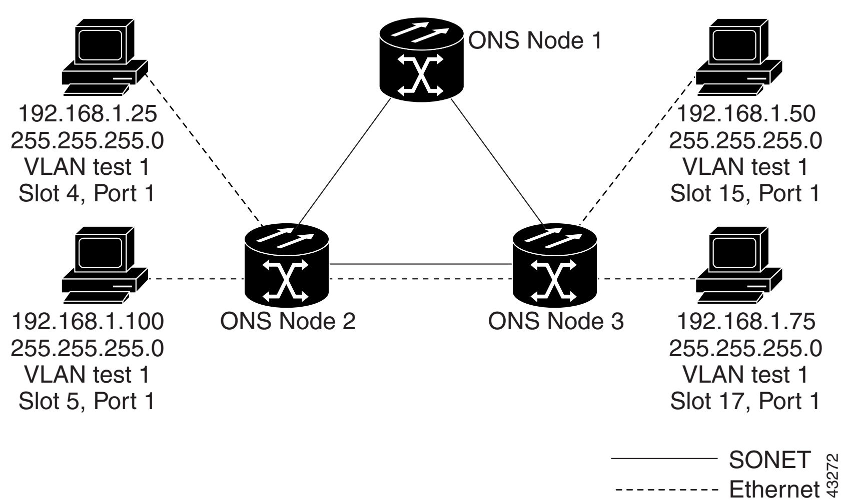
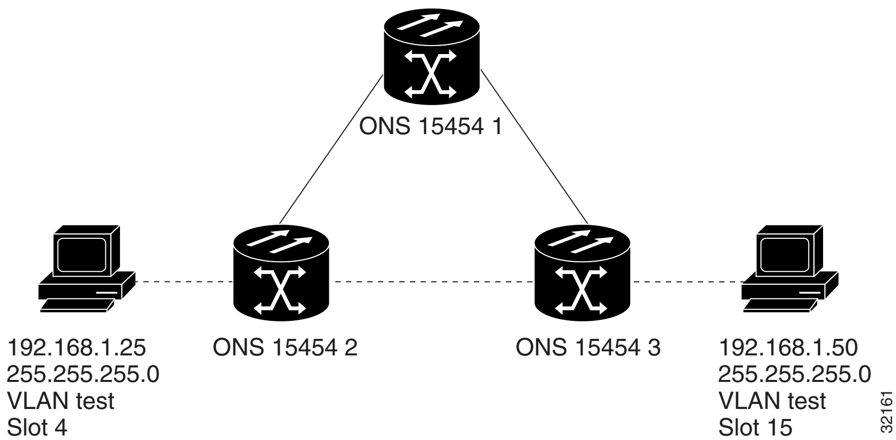


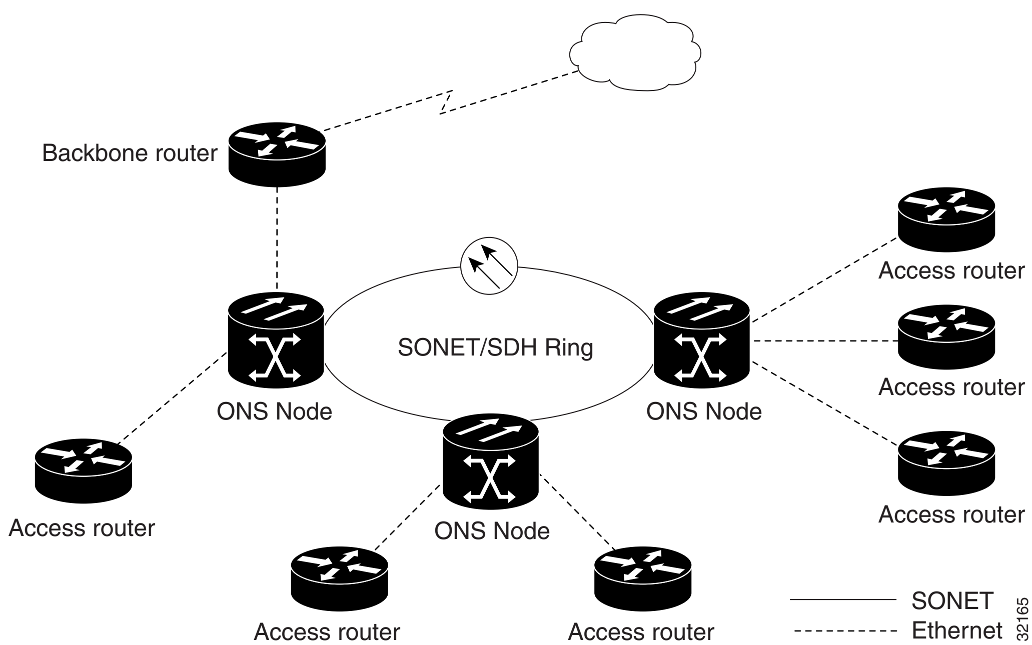
Figure 12-7 A Single-card Etherswitch point-to-point circuit



12.3.3 E Series Shared Packet Ring Ethernet Circuits

Figure 12-8 illustrates a shared packet ring. Your network architecture may differ from the example.

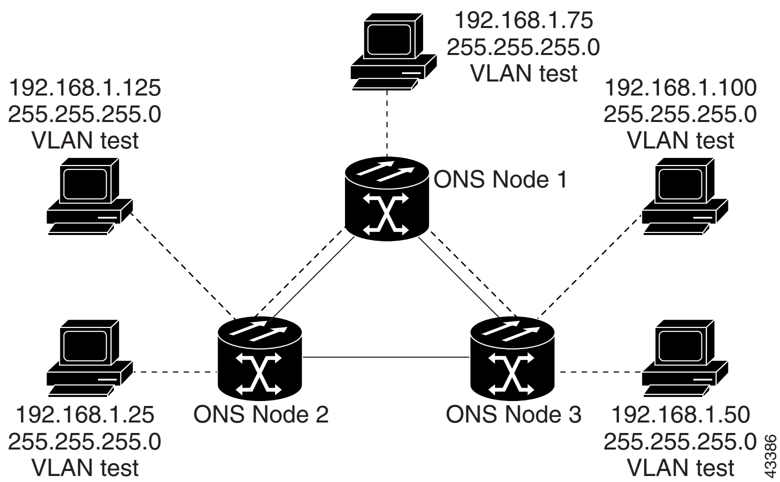
Figure 12-8 A shared packet ring Ethernet circuit



12.3.4 E Series Hub and Spoke Ethernet Circuit Provisioning

The hub and spoke configuration connects point-to-point circuits (the spokes) to an aggregation point (the hub). In many cases, the hub links to a high-speed connection and the spokes are Ethernet cards. Figure 12-9 illustrates a sample hub and spoke ring. Your network architecture may differ from the example.

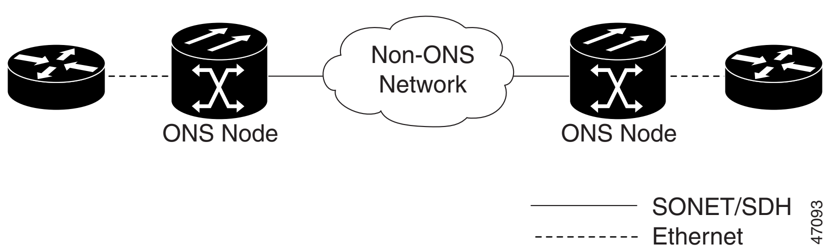
Figure 12-9 A Hub and Spoke Ethernet circuit



12.3.5 E Series Ethernet Manual Cross-Connects

ONS 15454s require end-to-end CTC visibility between nodes for normal provisioning of Ethernet circuits. When other vendors' equipment sits between ONS 15454s, OSI/TARP- based equipment does not allow tunneling of the ONS 15454 TCP/IP-based DCC. To circumvent this lack of continuous DCC, the Ethernet circuit must be manually cross connected to an STS channel riding through the non-ONS network. This allows an Ethernet circuit to run from ONS node to ONS node utilizing the non-ONS network.

Figure 12-10 Ethernet manual cross-connects



12.4 G1000-4 Circuit Configurations

This section explains G1000-4 point-to-point circuits and Ethernet manual cross-connects. Ethernet manual cross-connects allow you to cross connect individual Ethernet circuits to an STS channel on the ONS 15454 optical interface and also to bridge non-ONS SONET network segments.

12.4.1 G1000-4 Point-to-Point Ethernet Circuits

G1000-4 cards support point-to-point circuit configuration. Provisionable circuit sizes are STS 1, STS 3c, STS 6c, STS 9c, STS 12c, STS 24c and STS 48c. Each Ethernet port maps to a unique STS circuit on the SONET side of the G1000-4.

Figure 12-11 A G1000-4 point-to-point circuit

The G1000-4 supports any combination of up to four circuits from the list of valid circuit sizes, however the circuit sizes can add up to no more than 48 STSs. Due to hardware constraints, the initial release of this card (software release 3.2) imposes additional restrictions on the combinations of circuits that can be dropped onto a G1000-4 card. These restrictions are transparently enforced by the ONS 15454, and you do not need to keep track of restricted circuit combinations.

The restriction occurs when a single STS-24c is dropped on a card. In this instance, the remaining circuits on that card can be another single STS-24c or any combination of circuits of STS-12c size or less that add up to no more than 12 STSs (i.e. a total of 36 STSs on the card).

No circuit restrictions are present, if STS-24c circuits are not being dropped on the card. The full 48 STSs bandwidth can be used (for example using either a single STS-48c or 4 STS-12c circuits).

Note Since the restrictions only apply when STS-24cs are involved but do not apply to two STS-24c circuits on a card, you can easily minimize the impact of these restrictions. Group the STS-24c circuits together on a card separate from circuits of other sizes. The grouped circuits can be dropped on other G1000-4 cards on the ONS 15454.

Note The G1000-4 uses STS cross-connects only. No VT level cross-connects are used.

Note All SONET side STS circuits must be contiguous.

Caution G1000-4 circuits connect with OC-N cards or other G1000-4 cards. G1000-4 cards do not connect with E-series Ethernet cards.

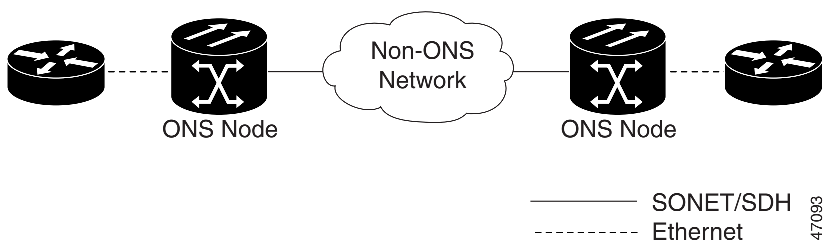
Caution The G1000-4 card requires the XC10G card to operate. The G1000-4 card is not compatible with XC or XCVT cards.

12.4.2 G1000-4 Manual Cross-Connects

ONS 15454s require end-to-end CTC visibility between nodes for normal provisioning of Ethernet circuits. When other vendors' equipment sits between ONS 15454s, OSI/TARP-based equipment does not allow tunneling of the ONS 15454 TCP/IP-based DCC. To circumvent a lack of continuous DCC, the Ethernet circuit must be manually cross connected to an STS channel riding through the non-ONS network. This allows an Ethernet circuit to run from ONS node to ONS node while utilizing the non-ONS network.

Note In this chapter, "cross-connect" and "circuit" have the following meanings: Cross-connect refers to the connections that occur within a single ONS 15454 to allow a circuit to enter and exit an ONS 15454. Circuit refers to the series of connections from a traffic source (where traffic enters the ONS 15454 network) to the drop or destination (where traffic exits an ONS 15454 network).

Figure 12-12 G1000-4 manual cross-connects



12.5 E Series VLAN Support

Users can provision up to 509 VLANs with the CTC software. Specific sets of ports define the broadcast domain for the ONS 15454. The definition of VLAN ports includes all Ethernet and packet-switched SONET port types. All VLAN IP address discovery, flooding, and forwarding is limited to these ports.

The ONS 15454 802.1Q-based VLAN mechanism provides logical isolation of subscriber LAN traffic over a common SONET transport infrastructure. Each subscriber has an Ethernet port at each site, and each subscriber is assigned to a VLAN. Although the subscriber's VLAN data flows over shared circuits, the service appears to the subscriber as a private data transport.

12.5.1 E Series Q-Tagging (IEEE 802.1Q)

IEEE 802.1Q allows the same physical port to host multiple 802.1Q VLANs. Each 802.1Q VLAN represents a different logical network.

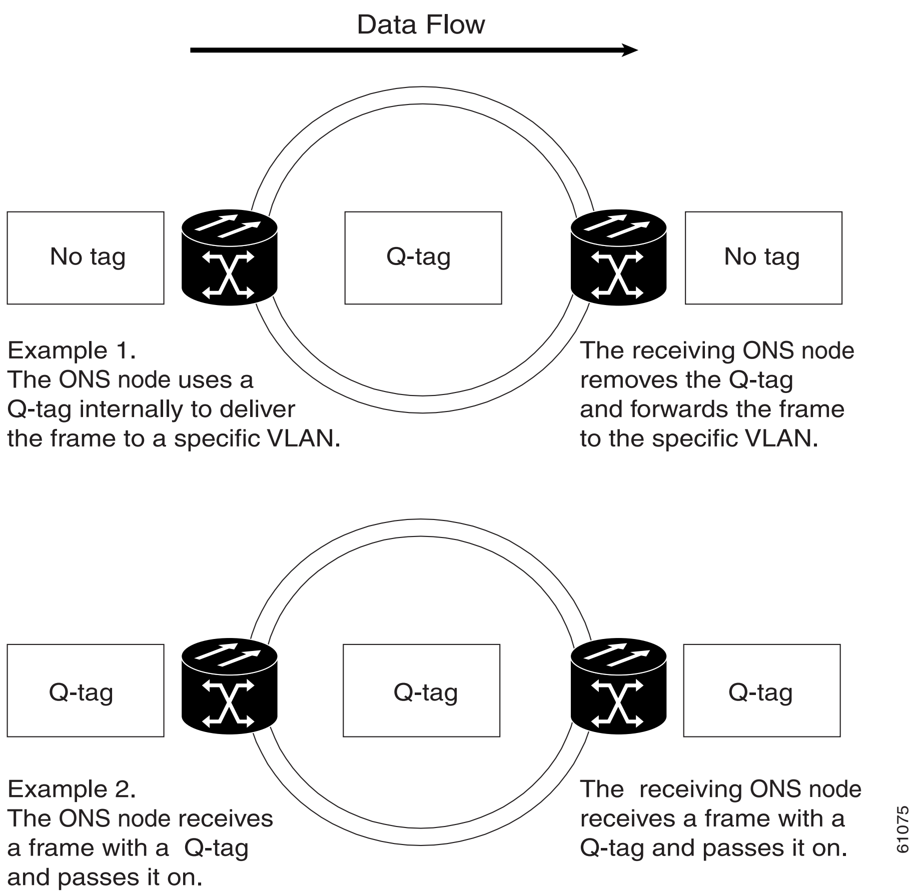
The ONS 15454 works with Ethernet devices that support IEEE 802.1Q and those that do not support IEEE 802.1Q. If a device attached to an ONS 15454 Ethernet port does not support IEEE 802.1Q, the ONS 15454 only uses Q-tags internally. The ONS 15454 associates these Q-tags with specific ports.

With Ethernet devices that do not support IEEE 802.1Q, the ONS 15454 takes non-tagged Ethernet frames that enter the ONS network and uses a Q-tag to assign the packet to the VLAN associated with the ONS network's ingress port. The receiving ONS node removes the Q-tag when the frame leaves the ONS network (to prevent older Ethernet equipment from incorrectly identifying the 8021.Q packet as an illegal frame). The ingress and egress ports on the ONS network must be set to Untag for the process to occur. Untag is the default setting for ONS ports. Example #1 in Figure 12-13 illustrates Q-tag use only within an ONS network.

With Ethernet devices that support IEEE 802.1Q, the ONS 15454 uses the Q-tag attached by the external Ethernet devices. Packets enter the ONS network with an existing Q-tag; the ONS 15454 uses this same Q-tag to forward the packet within the ONS network and leaves the Q-tag attached when the packet leaves the ONS network. Set both entry and egress ports on the ONS network to Tagged for this process to occur. Example #2 in Figure 12-13 illustrates the handling of packets that both enter and exit the ONS network with a Q-tag.

For more information about setting ports to Tagged and Untag, refer to the Provision E Series Ethernet Ports for VLAN Membership (DLP102) in the *Cisco ONS 15454 Procedures Guide*.

Figure 12-13 A Q-tag moving through a VLAN



12.5.2 E Series Priority Queuing (IEEE 802.1Q)

Note IEEE 802.1Q was formerly IEEE 802.1P.

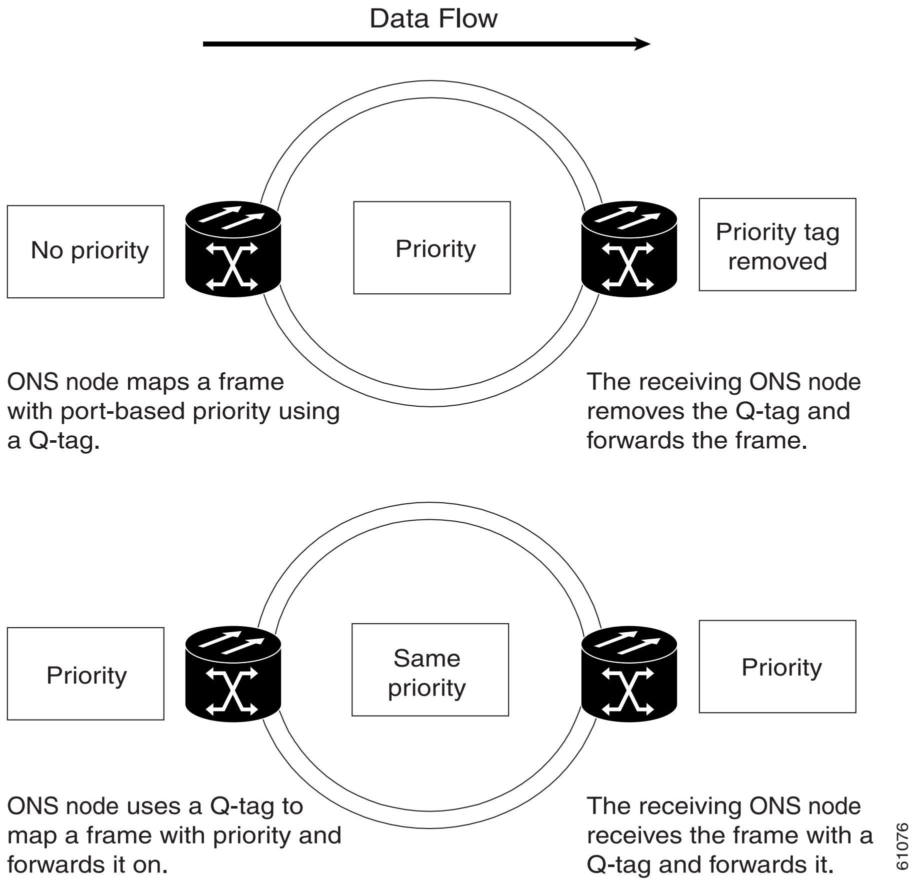
Networks without priority queuing handle all packets on a first-in-first-out basis. Priority queuing reduces the impact of network congestion by mapping Ethernet traffic to different priority levels. The ONS 15454 supports priority queuing. The ONS 15454 takes the eight priorities specified in IEEE 802.1Q and maps them to two queues (Table 12-3). Q-tags carry priority queuing information through the network.

The ONS 15454 uses a "leaky bucket" algorithm to establish a weighted priority (not a strict priority). A weighted priority gives high-priority packets greater access to bandwidth, but does not totally preempt low-priority packets. During periods of network congestion, roughly 70% of bandwidth goes to the high-priority queue and the remaining 30% goes to the low-priority queue. A network that is too congested will drop packets.

Table 12-3 Priority Queuing

User Priority	Queue	Allocated Bandwidth
0,1,2,3	Low	30%
4,5,6,7	High	70%

Figure 12-14 The priority queuing process



12.5.3 E Series VLAN Membership

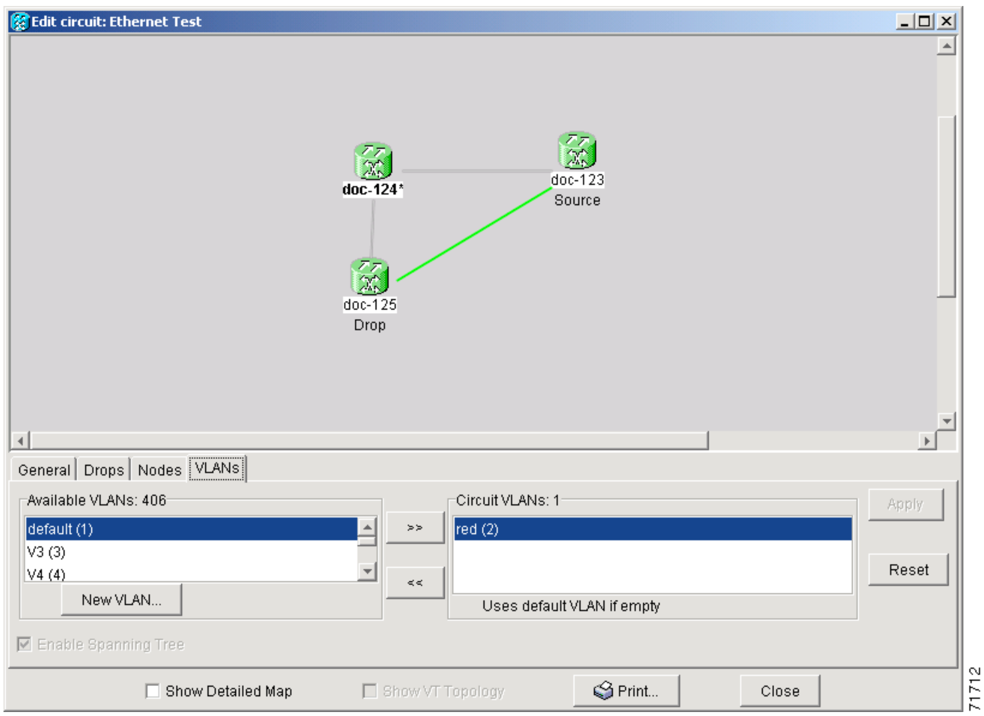
This section explains how to provision Ethernet ports for VLAN membership. For initial port provisioning (prior to provisioning VLAN membership) refer to the Provision E Series Ethernet Ports (DLP101) in the *Cisco ONS 15454 Procedures Guide*.

Caution ONS 15454s propagate VLANs whenever a node appears on the same network view of another node regardless of whether the nodes connect through DCC. For example, if two ONS 15454s without DCC connectivity belong to the same Login Node Group, then whenever CTC gets launched from within this login node group, VLANs propagate from one to another. This happens even though the ONS 15454s do not belong to the same SONET ring.

12.5.4 VLAN Counter

The ONS 15454 displays the number of VLANs used by circuits and the total number of VLANs available for use. To display the number of available VLANs and the number of VLANs used by circuits, click the **Circuits** tab and click an existing Ethernet circuit to highlight it. Click **Edit**. Click the **VLANs** tab.

Figure 12-15 Edit Circuit dialog featuring available VLANs



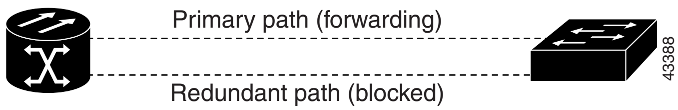
12.6 E Series Spanning Tree (IEEE 802.1D)

The Cisco ONS 15454 operates spanning tree protocol (STP) according to IEEE 802.1D when an Ethernet card is installed. STP operates over all packet-switched ports including Ethernet and OC-N ports. On Ethernet ports, STP is enabled by default but may be disabled with a check box under the Provisioning > Port tabs at the card-level view. A user can also disable or enable spanning tree on a circuit-by-circuit basis on unstitched Ethernet cards in a point-to-point configuration. However, turning off spanning tree protection on a circuit-by-circuit basis means that the ONS 15454 system is not protecting the Ethernet traffic on this circuit, and the Ethernet traffic must be protected by another mechanism in the Ethernet network. On OC-N interface ports, STP activates by default and cannot be disabled.

The Ethernet card can enable STP on the Ethernet ports to allow redundant paths to the attached Ethernet equipment. STP spans cards so that both equipment and facilities are protected against failure.

STP detects and eliminates network loops. When STP detects multiple paths between any two network hosts, STP blocks ports until only one path exists between any two network hosts (Figure 12-16). The single path eliminates possible bridge loops. This is crucial for shared packet rings, which naturally include a loop.

Figure 12-16 An STP blocked path



To remove loops, STP defines a tree that spans all the switches in an extended network. STP forces certain redundant data paths into a standby (blocked) state. If one network segment in the STP becomes unreachable, the spanning-tree algorithm reconfigures the spanning-tree topology and reactivates the blocked path to reestablish the link. STP operation is transparent to end stations, which do not discriminate between connections to a single LAN segment or to a switched LAN with multiple segments. The ONS 15454 supports one STP instance per circuit and a maximum of eight STP instances per ONS 15454.

Caution Multiple circuits with spanning tree protection enabled will incur blocking, if the circuits traverse a common card and uses the same VLAN.

12.6.1 E Series Multi-Instance Spanning Tree and VLANs

The ONS 15454 can operate multiple instances of STP to support VLANs in a looped topology. You can dedicate separate circuits across the SONET ring for different VLAN groups (i.e., one for private TLS services and one for Internet access). Each circuit runs its own STP to maintain VLAN connectivity in a multi-ring environment.

12.6.2 Spanning Tree on a Circuit-by-Circuit Basis

A user can also disable or enable spanning tree on a circuit-by-circuit basis on unstitched Ethernet cards in a point-to-point configuration. This feature allows customers to mix spanning tree protected circuits with unprotected circuits on the same card. It also allows two single-card E-series Ethernet cards on the same node to form an intranode circuit.

12.6.3 E Series Spanning Tree Parameters

Default spanning tree parameters are appropriate for most situations. Contact the Cisco Technical Assistance Center (TAC) at 1-877-323-7368 before you change the default STP parameters.

At the node view, click the **Maintenance** > **Etherbridge > Spanning Trees** tabs to view spanning tree parameters.

Table 12-4 Spanning Tree Parameters

BridgeID	ONS 15454 unique identifier that transmits the configuration bridge protocol data unit (BPDU); the bridge ID is a combination of the bridge priority and the ONS 15454 MAC address
TopoAge	Amount of time in seconds since the last topology change
TopoChanges	Number of times the spanning tree topology has been changed since the node booted up
DesignatedRoot	Identifies the spanning tree's designated root for a particular spanning tree instance
RootCost	Identifies the total path cost to the designated root
RootPort	Port used to reach the root
MaxAge	Maximum time that received-protocol information is retained before it is discarded
HelloTime	Time interval, in seconds, between the transmission of configuration BPDUs by a bridge that is the spanning tree root or is attempting to become the spanning tree root
HoldTime	Minimum time period, in seconds, that elapses during the transmission of configuration information on a given port
ForwardDelay	Time spent by a port in the listening state and the learning state

12.6.4 E Series Spanning Tree Configuration

To view the spanning tree configuration, at the node view click the **Provisioning>Etherbridge** tabs.

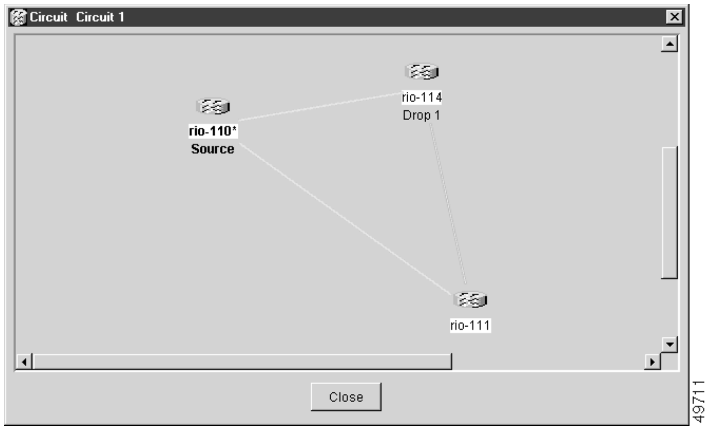
Table 12-5 Spanning Tree Configuration

Column	Default Value	Value Range
Priority	32768	0 - 65535
Bridge max age	20 seconds	6 - 40 seconds
Bridge Hello Time	2 seconds	1 - 10 seconds
Bridge Forward Delay	15 seconds	4 - 30 seconds

12.6.5 E Series Spanning Tree Map

The Circuit screen shows forwarding spans and blocked spans on the spanning tree map.

Figure 12-17 The spanning tree map on the circuit screen



Note Green represents forwarding spans and purple represents blocked (protect) spans. If you have a packet ring configuration, at least one span should be purple.

12.7 G1000-4 Performance and Maintenance Screens

CTC provides Ethernet performance information, including line-level parameters, the amount of port bandwidth used, and historical Ethernet statistics. CTC also includes spanning tree information, MAC address information, and the amount of circuit bandwidth used.

12.7.1 G1000-4 Ethernet Performance Screen

CTC provides Ethernet performance information that include line-level parameters, the amount of port bandwidth used, and historical Ethernet statistics.

12.7.1.1 Statistics Window

The Ethernet statistics screen lists Ethernet parameters at the line level. Display the CTC card view for the Ethernet card and click the **Performance** > **Statistics** tabs to display the screen.

Figure 12-18 G1000-4 Statistics window

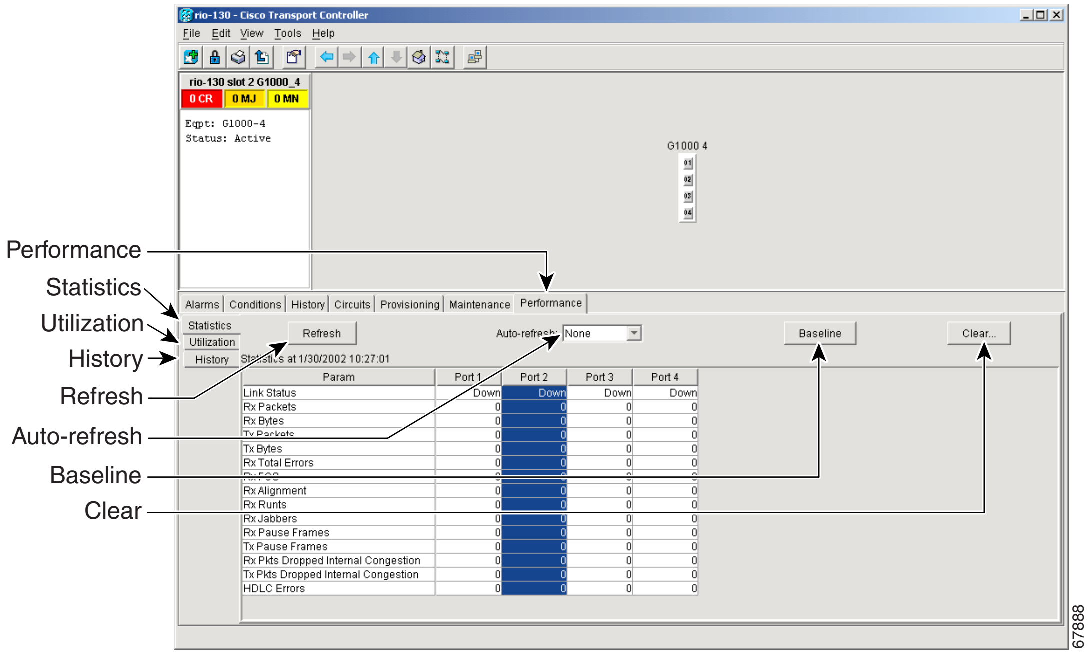


Table 12-6 G1000-4 Statistics Values

Baseline	Clicking Baseline resets the software counters (in that particular CTC client only) temporarily to zero without affecting the actual statistics on the card. From that point on, only the change (delta) in counters are displayed by this CTC. These new base lined counters display only as long as the user displays the Performance pane. If the user navigates to another pane and comes back to the Performance pane, the true actual statistics retained by the card display.
Refresh	Manually refreshes the statistics
Auto-Refresh	Sets a time interval for the automatic refresh of statistics
Clear	Resets the actual counters on the card to zero; this change is recognized by all management clients.

Note The CTC automatically refreshes the counter values once right after a Baseline operation, so if traffic is flowing during a baseline operation, some traffic counts may immediately be observed instead of zero counts.

Note The Clear button will not cause the G1000-4 card to reset. Provisioning, enabling, or disabling a G1000-4 port will not reset the statistics.

Note You can apply both the Baseline and the Clear functions to a single port or all ports on the card. To apply Baseline or Clear to a single port, click the port column to highlight the port and click the **Baseline** or **Clear** button.

Table 12-7 Ethernet Parameters

Parameter	Meaning
Link Status	Indicates whether the Ethernet link is receiving a valid Ethernet signal (carrier) from the attached Ethernet device; up means present, and down means not present
Rx Packets	Number of packets received since the last counter reset
Rx Bytes	Number of bytes received since the last counter reset
Tx Packets	Number of packets transmitted since the last counter reset
Tx Bytes	Number of bytes transmitted since the last counter reset
Rx Total Errors	Total number of receive errors
Rx FCS	Number of packets with a Frame Check Sequence (FCS) error. FCS errors indicate Frame corruption during transmission
Rx Alignment	Number of packets with alignment errors; alignment errors are received incomplete frames
Rx Runts	The total number of frames received that are less than 64 bytes in length and have a CRC error
Rx Jabbers	The total number of frames received that exceed the maximum 1548 bytes and contain CRC errors
Rx Giants	Number of packets received that are greater than 1548 bytes in length
Rx Pause Frames (G series only)	Number of received Ethernet 802.3x pause frames
Tx Pause Frames (G series only)	Number of transmitted 802.3x pause frames
Rx Pkts Dropped Internal Congestion (G series only)	Number of received packets dropped due to overflow in G1000-4 frame buffer
Tx Pkts Dropped Internal Congestion (G series only)	Number of transmit queue drops due to drops in the G1000-4 frame buffer
HDLC errors (G series only)	HDLC errors received from SONET/SDH (see note)

Note The HDLC errors counter should not be used to count the number of frames dropped due to HDLC errors as each frame can get fragmented into several smaller frames during HDLC error conditions and spurious HDLC frames can also generate. If these counters are incrementing at a time when there should be no SONET path problems that may indicate a problem with the quality of the SONET path. For example, a SONET protection switch causes a set of HLDC errors to generate. The actual values of these counters are less relevant than the fact they are changing.

12.7.1.2 Utilization Window

The Utilization subtab shows the percentage of current and past line bandwidth used by the Ethernet ports. Display the CTC card view and click the Performance and Utilization tabs to display the screen. From the Interval menu, choose a time segment interval. Valid intervals are 1 minute, 15 minutes, 1 hour, and 1 day. Press Refresh to update the data.

Note The G Series card does not display statistics on the Trunk Utilization screen, since the G Series card is not a layer two device or switch. The E Series cards is a layer two device or switch and supports the Trunk Utilization screen. The Trunk Utilization screen is similar to the Line Utilization screen, but Trunk Utilization shows the percentage of circuit bandwidth used rather than the percentage of line bandwidth.

12.7.1.3 Utilization Formula

Line utilization is calculated with the following formula:

((inOctets + outOctets) + (inPkts + outPkts) * 20)) * 8 / 100% interval * maxBaseRate * 2.

The interval is defined in seconds. maxBaseRate is defined by raw bits/second in one direction for the Ethernet port (i.e. 1 Gbps). maxBaseRate is multiplied by 2 in the denominator to determine the raw bit rate in both directions.

12.7.1.4 History Window

The Ethernet History subtab lists past Ethernet statistics. At the CTC card view, click the Performance tab and History subtab to view the screen. Choose the appropriate port from the Line menu and the appropriate interval from the Interval menu. Press Refresh to update the data.

12.7.2 G1000-4 Ethernet Maintenance Screen

When a G1000-4 card is installed in the ONS 15454, the Maintenance tab under CTC card view reveals a Maintenance screen with two tabs Loopback and Bandwidth**.** The Loopback screen allows you put an individual G1000-4 port into a Terminal (inward) loopback. The Bandwidth screen displays the amount of current STS bandwidth the card is using.

Figure 12-19 The G1000-4 Maintenance tab, including loopback and bandwidth information

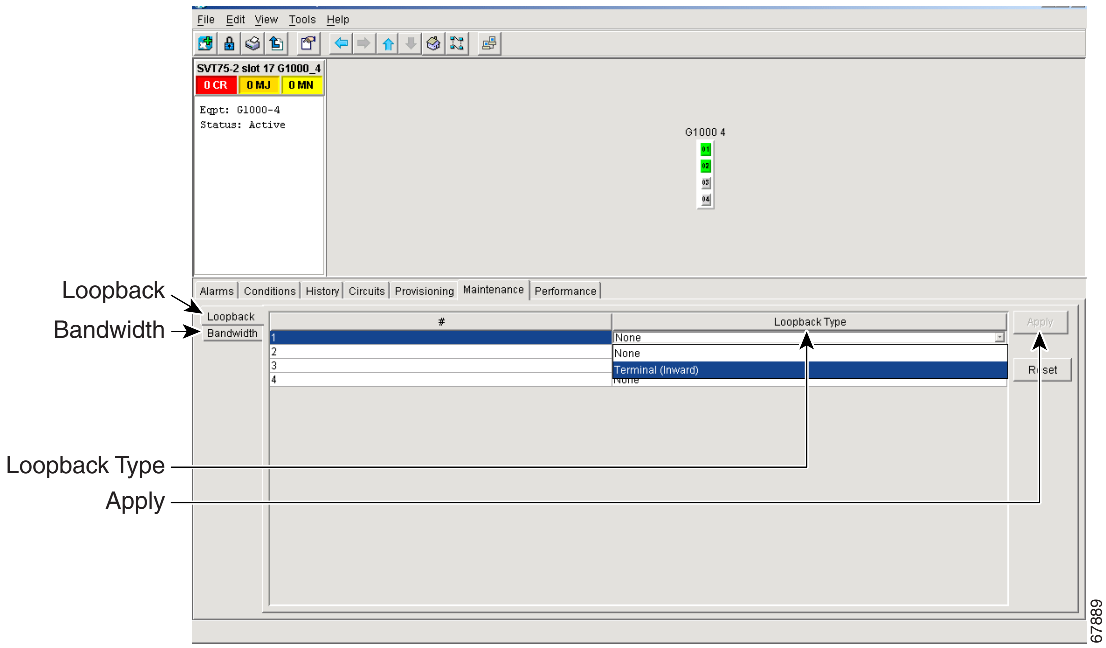


Table 12-8 G1000-4 Maintenance Screen Values

Loopback	Displays the Loopback status of the G1000-4 port
#	Specifies the specific port number on the G1000-4 card
Loopback Type	Allows you to configure a port for a Terminal (Inward) loopback or clear the current loopback (none)
Apply	Enables the Loopback configuration on the port
Bandwidth	Displays the amount of STS bandwidth provisioned for the G1000-4 card.

Caution Use Loopback only for the initial test and turn-up of the card and SONET network tests. Do not put the card in Loopback when the G1000-4 ports are in service and attached to a data network. Loopbacks can corrupt the forwarding tables used in data networking.

Note For more information about using loopbacks with the ONS 15454, refer to the *Cisco ONS 15454 Troubleshooting Guide*.

12.7.3 E-Series Ethernet Performance Screen

CTC provides Ethernet performance information that includes line-level parameters, the amount of port bandwidth used, and historical Ethernet statistics.

12.7.3.1 Statistics Window

The Ethernet statistics screen lists Ethernet parameters at the line level. Table 12-9 defines the parameters. Display the CTC card view for the Ethernet card and click the Performance > Statistics tabs to display the screen.

The Baseline button resets the statistics values on the Statistics screen to zero. The Refresh button manually refreshes statistics. Auto-Refresh sets a time interval for automatic refresh of statistics to occur.

The G1000-4 Statistics screen also has a Clear button. The Clear button sets the values on the card to zero. Using the Clear button will not cause the G1000-4 to reset.

Table 12-9 Ethernet Parameters

Parameter	Meaning
Link Status	Indicates whether link integrity is present; up means present, and down means not present
Rx Packets	Number of packets received since the last counter reset
Rx Bytes	Number of bytes received since the last counter reset
Tx Packets	Number of packets transmitted since the last counter reset
Tx Bytes	Number of bytes transmitted since the last counter reset
Rx Total Errors	Total number of receive errors
Rx FCS	Number of packets with a Frame Check Sequence (FCS) error. FCS errors indicate Frame corruption during transmission
Rx Alignment	Number of packets with alignment errors; alignment errors are received incomplete frames
Rx Runts	Number of packets received that are less than 64 bytes in length
Rx Giants	Number of packets received that are greater than 1518 bytes in length for untagged interfaces and 1522 bytes for tagged interfaces
Tx Collisions (E series only)	Number of transmit packets that are collisions; the port and the attached device transmitting at the same time caused collisions
Tx Excessive (E series only)	Number of consecutive collisions
Tx Deferred (E series only)	Number of packets deferred
Rx Pause Frames (G series only)	Number of received Ethernet 802.3x pause frames.
Tx Pause Frames (G series only)	Number of transmitted 802.3x pause frames.
Rx Pkts Dropped Internal Congestion (G series only)	Number of received packets dropped due to overflow in G1000-4 frame buffer.
Tx Pkts Dropped Internal Congestion (G series only)	Number of transmit que drops due to drops in G1000-4 frame buffer

12.7.3.2 Line Utilization Window

The Line Utilization window shows the percentage of line, or port, bandwidth used and the percentage used in the past. Display the CTC card view and click the Performance and Utilization tabs to display the screen. From the Interval menu, choose a time segment interval. Valid intervals are 1 minute, 15 minutes, 1 hour, and 1 day. Press Refresh to update the data.

12.7.3.3 E Series Utilization Formula

Line utilization is calculated with the following formula:

((inOctets + outOctets) + (inPkts + outPkts) * 20)) * 8 / 100 % interval * maxBaseRate * 2.

The interval is defined in seconds. maxBaseRate is defined by raw bits/second in one direction for the Ethernet port (i.e. 1 Gbps). maxBaseRate is multiplied by 2 in the denominator to determine the raw bit rate in both directions.

Table 12-10 maxRate for STS circuits

STS-1	51840000
STS-3c	155000000
STS-6c	311000000
STS-12c	622000000

Note Line utilization numbers express the average of ingress and egress traffic as a percentage of capacity.

12.7.3.4 History Window

The Ethernet History screen lists past Ethernet statistics. At the CTC card view, click the Performance tab and History subtab to view the screen. Choose the appropriate port from the Line menu and the appropriate interval from the Interval menu. Press Refresh to update the data. Table 12-9 defines the listed parameters.

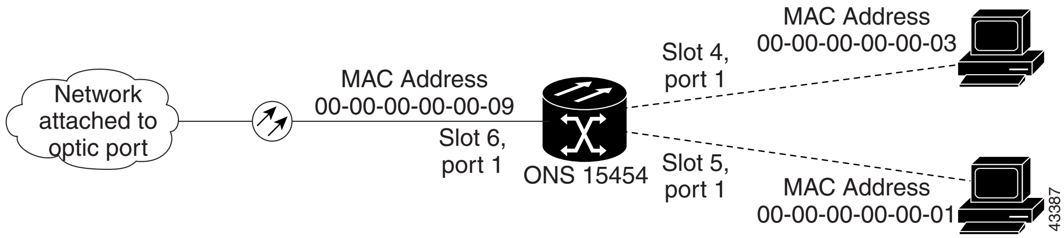
12.7.4 E-Series Ethernet Maintenance Screen

Display an E-series Ethernet card in CTC card view and choose the Maintenance tab to display MAC address and bandwidth information.

12.7.4.1 MAC Table Window

A MAC address is a hardware address that physically identifies a network device. The ONS 15454 MAC table, also known as the MAC forwarding table, will allow you to see all the MAC addresses attached to the enabled ports of an E series Ethernet card or an E series Ethernet Group. This includes the MAC address of the network device attached directly to the port and any MAC addresses on the network linked to the port. The MAC addresses table lists the MAC addresses stored by the ONS 15454 and the VLAN, Slot/Port/STS, and circuit that links the ONS 15454 to each MAC address (Figure 12-20). To retrieve the MAC address table through CTC, click the **Maintenance > EtherBridge** > **MAC Table** tabs, choose the appropriate Ethernet card or Ethergroup from the Layer 2 Domain pull-down menu, and click **Retrieve**. Click **Clear** to clear the highlighted rows and click **Clear All** to clear all displayed rows.

Figure 12-20 MAC addresses recorded in the MAC table



12.7.4.2 Trunk Utilization Window

The Trunk Utilization screen is similar to the Line Utilization screen, but Trunk Utilization shows the percentage of circuit bandwidth used rather than the percentage of line bandwidth used. Click the Maintenance > Ether Bridge > Trunk Utilization tabs to view the screen. Choose a time segment interval from the Interval menu.

Note The percentage shown is the average of ingress and egress traffic.

12.8 Remote Monitoring Specification Alarm Thresholds

The ONS 15454 features Remote Monitoring (RMON) that allows network operators to monitor the health of the network with a Network Management System (NMS).

One of the ONS 15454's RMON MIBs is the Alarm group. The alarm group consists of the alarmTable. An NMS uses the alarmTable to find the alarm-causing thresholds for network performance. The thresholds apply to the current 15-minute interval and the current 24-hour interval. RMON monitors several variables, such as Ethernet collisions, and triggers an event when the variable crosses a threshold during that time interval. For example, if a threshold is set at 1000 collisions and 1001 collisions occur during the 15-minute interval, an event triggers. CTC allows you to provision these thresholds for Ethernet statistics.

Note The following tables define the variables you can provision in CTC. For example, to set the collision threshold, choose **etherStatsCollisions** from the Variable menu.

Table 12-11 Ethernet Threshold Variables (MIBs)

Variable	Definition
iflnOctets	Total number of octets received on the interface, including framing octets
iflnUcastPkts	Total number of unicast packets delivered to an appropriate protocol

Table 12-11 Ethernet Threshold Variables (MIBs) (continued)

Variable	Definition
ifInMulticastPkts	Number of multicast frames received error free
ifInBroadcastPkts	The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were addressed to a broadcast address at this sub-layer
ifInDiscards	The number of inbound packets which were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol
iflnErrors	Number of inbound packets discarded because they contain errors
ifOutOctets	Total number of transmitted octets, including framing packets
ifOutUcastPkts	Total number of unicast packets requested to transmit to a single address
ifOutMulticastPkts	Number of multicast frames transmitted error free
ifOutBroadcastPkts	The total number of packets that higher-level protocols requested be transmitted, and which were addressed to a broadcast address at this sub-layer, including those that were discarded or not sent
ifOutDiscards	The number of outbound packets which were chosen to be discarded even though no errors had been detected to prevent their being transmitted
dot3statsAlignmentErrors	Number of frames with an alignment error, i.e., the length is not an integral number of octets and the frame cannot pass the Frame Check Sequence (FCS) test
dot3StatsFCSErrors	Number of frames with framecheck errors, i.e., there is an integral number of octets, but an incorrect Frame Check Sequence (FCS)
dot3StatsSingleCollisionFrames	Number of successfully transmitted frames that had exactly one collision
dot3StatsMutlipleCollisionFrame	Number of successfully transmitted frames that had multiple collisions
dot3StatsDeferredTransmissions	Number of times the first transmission was delayed because the medium was busy
dot3StatsLateCollision	Number of times that a collision was detected later than 64 octets into the transmission (also added into collision count)
dot3StatsExcessiveCollision	Number of frames where transmissions failed because of excessive collisions
dot3StatsCarrierSenseErrors	The number of transmission errors on a particular interface that are not otherwise counted.
dot3StatsSQETestErrors	A count of times that the SQE TEST ERROR message is generated by the PLS sublayer for a particular interface
etherStatsJabbers	Total number of Octets of data (including bad packets) received on the network
etherStatsUndersizePkts	Number of packets received with a length less than 64 octets

Table 12-11 Ethernet Threshold Variables (MIBs) (continued)

Variable	Definition
etherStatsFragments	Total number of packets that are not an integral number of octets or have a bad FCS, and that are less than 64 octets long
etherStatsPkts64Octets	Total number of packets received (including error packets) that were 64 octets in length
etherStatsPkts65to127Octets	Total number of packets received (including error packets) that were 65 – 172 octets in length
etherStatsPkts128to255Octets	Total number of packets received (including error packets) that were 128 – 255 octets in length
etherStatsPkts256to511Octets	Total number of packets received (including error packets) that were 256 – 511 octets in length
etherStatsPkts512to1023Octets	Total number of packets received (including error packets) that were 512 – 1023 octets in length
etherStatsPkts1024to1518Octets	Total number of packets received (including error packets) that were 1024 – 1518 octets in length
etherStatsJabbers	Total number of packets longer than 1518 octets that were not an integral number of octets or had a bad FCS
etherStatsCollisions	Best estimate of the total number of collisions on this segment
etherStatsCollisionFrames	Best estimate of the total number of frame collisions on this segment
etherStatsCRCAlignErrors	Total number of packets with a length between 64 and 1518 octets, inclusive, that had a bad FCS or were not an integral number of octets in length
receivePauseFrames (G series only)	The number of received 802.x pause frames
transmitPauseFrames(G series only)	The number of transmitted 802.x pause frames
receivePktsDroppedInternalCongestion(G series only)	The number of received frames dropped due to frame buffer overflow as well as other reasons
transmitPktsDroppedInternalCongestion(G series only)	The number of frames dropped in the transmit direction due to frame buffer overflow as well as other reasons
txTotalPkts	Total number of transmit packets
rxTotalPkts	Total number of receive packets

Performance Monitoring

Performance monitoring parameters (PMs) are used by service providers to gather, store, threshold, and report performance data for early detection of problems. In this chapter, PM parameters and concepts are defined for both electrical cards and optical cards in the Cisco ONS 15454.

For information about enabling and viewing PMs, refer to the *Cisco ONS 15454 Procedure Guide*.

Chapter topics include:

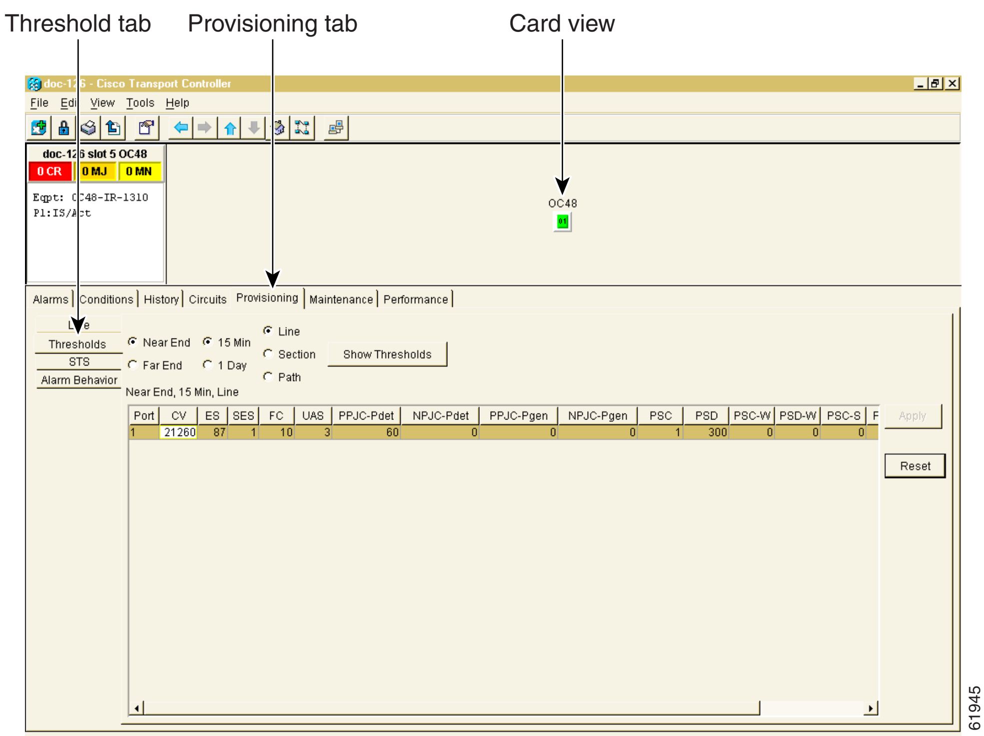
Note Additional PM information can also be found under Digital transmission surveillance, in Telcordia's GR-1230-CORE, GR-820-CORE, and GR-253-CORE documents and the ANSI document entitled *Digital Hierarchy - Layer 1 In-Service Digital Transmission Performance Monitoring.*

13.1 Threshold Reference

Thresholds are used to set error levels for each PM. You can program PM threshold ranges from the Provisioning > Threshold tabs on the card view. For procedures on provisioning card thresholds, such as line, path, and SONET thresholds, see the Card Provisioning Chapter.

During the accumulation cycle, if the current value of a performance monitoring parameter reaches or exceeds its corresponding threshold value, a threshold crossing alert (TCA) is generated by the node and sent to CTC. TCAs provide early detection of performance degradation. When a threshold is crossed, the node continues to count the errors during a given accumulation period. If 0 is entered as the threshold value, the performance monitoring parameter is disabled. Figure 13-1 shows the Provisioning > Threshold tabs for an OC-48 card.

Figure 13-1 Threshold tab for setting threshold values



Change the threshold if the default value does not satisfy your error monitoring needs. For example, customers with a critical DS1 installed for 911 calls must guarantee the best quality of service on the line; therefore, they lower all thresholds so that the slightest error raises a TCA.

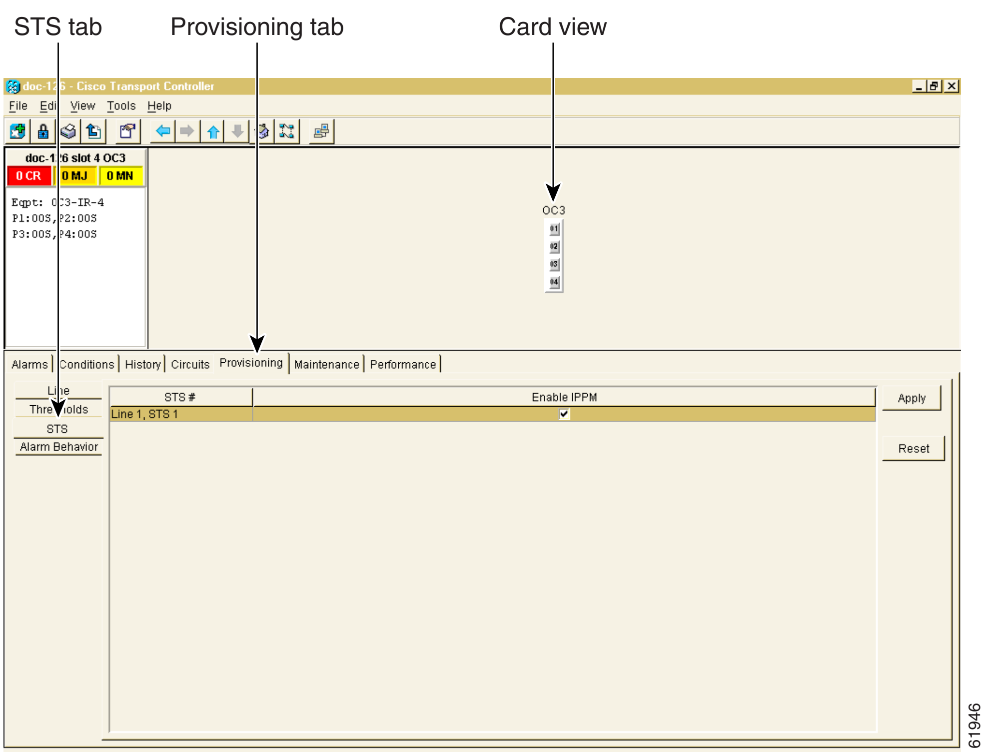
13.2 Intermediate-Path Performance Monitoring Reference

Intermediate-path performance monitoring (IPPM) allows transparent monitoring of a constituent channel of an incoming transmission signal by a node that does not terminate that channel. Many large ONS 15454 networks only use line terminating equipment (LTE) not path terminating equipment (PTE). Table 13-1 shows ONS 15454 cards that are considered LTEs. Figure 13-2 shows the Provisioning > STS tabs for an OC-3 card.

Table 13-1 Traffic Cards That Terminate the Line, Called LTEs

Line Terminating Equipment	
EC1-12	OC3 IR 4/STM1 SH 1310
OC12 IR/STM4 SH 1310	OC12 LR/STM4 LH 1310
OC12 LR/STM4 LH 1550	OC48 IR 1310
OC48 LR 1550	OC48 IR/STM16 SH AS 1310
OC48 LR/STM16 LH AS 1550	OC48 ELR/STM16 EH 100 GHz
OC48 ELR/STM16 EH 200 GHz	OC192 LR/STM64 LH 1550

Figure 13-2 STS tab for enabling IPPM



Software R3.0 and higher allows LTE cards to monitor near-end PM data on individual STS payloads by enabling IPPM. After enabling IPPM provisioning on the line card, service providers can monitor large amounts of STS traffic through intermediate nodes, thus making troubleshooting and maintenance activities more efficient.

IPPM occurs only on STS paths which have IPPM enabled, and TCAs are raised only for PM parameters on the selected IPPM paths. The monitored IPPMs are STS CV-P, STS ES-P, STS SES-P, STS UAS-P, and STS FC-P.

Note Far-end IPPM is not supported. However, SONET path PMs can be monitored by logging into the far-end node directly.

The ONS 15454 performs IPPM by examining the overhead in the monitored path and by reading all of the near-end path PMs in the incoming direction of transmission. The IPPM process allows the path signal to pass bidirectionally through the node completely unaltered.

For detailed information about specific PMs, locate the card name in the following sections and review the appropriate definition.

13.3 Pointer Justification Count Reference

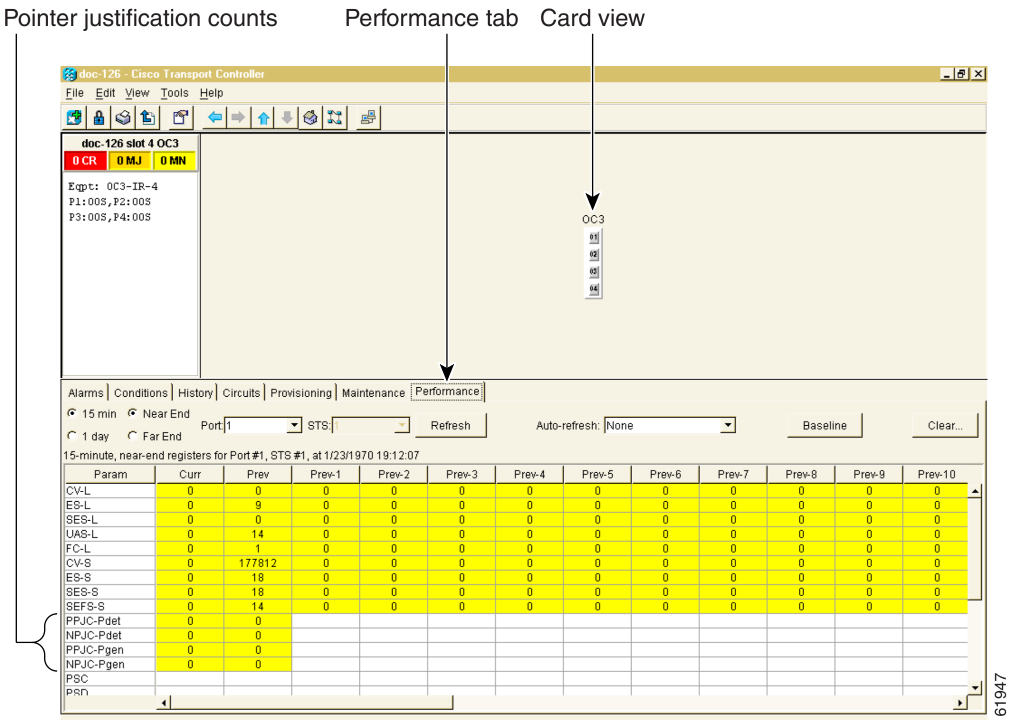
Pointers are used to compensate for frequency and phase variations. Pointer justification counts indicate timing errors on SONET networks. When a network is out of synch, jitter and wander occurs on the transported signal. Excessive wander can cause terminating equipment to slip. It also causes slips at the SDH and PDH boundaries.

Slips cause different effects in service: Voice service has intermittent audible clicks. Compressed voice technology has short transmission errors or dropped calls. Fax machines lose scanned lines or experience dropped calls. Digital video transmission has distorted pictures or frozen frames. Encryption service loses the encryption key causing data to be transmitted again.

Pointers provide a way to align the phase variations in STS and VT payloads. The STS payload pointer is located in the H1 and H2 bytes of the line overhead. Clocking differences are measured by the offset in bytes from the pointer to the first byte of the STS synchronous payload envelope (SPE) called the J1 byte. Clocking differences that exceed the normal range of 0 to 782 can cause data loss.

Figure 13-3 shows pointer justification count parameters on the Performance Monitoring screen. You can enable PPJC and NPJC performance monitoring parameters for LTE cards. See Table 13-1 on page 13-3 for a list of Cisco ONS 15454 LTE cards.

Figure 13-3 Viewing pointer justification count parameters



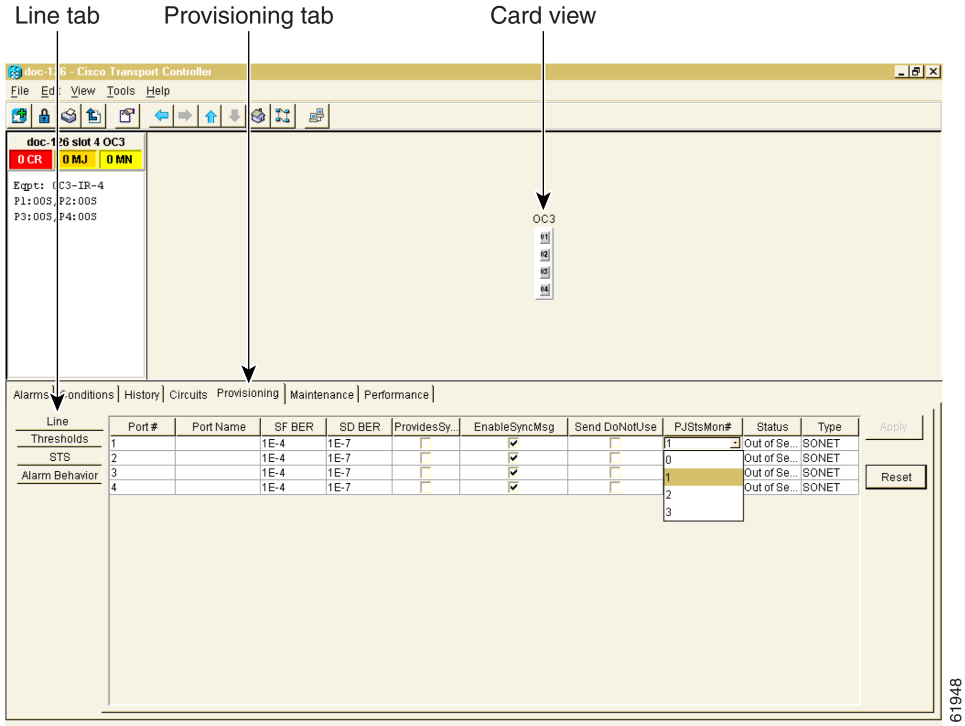
There are positive (PPJC) and negative (NPJC) pointer justification count parameters. PPJC is a count of path-detected (PPJC-Pdet) or path-generated (PPJC-Pgen) positive pointer justifications. NPJC is a count of path-detected (NPJC-Pdet) or path-generated (NPJC-Pgen) negative pointer justifications depending on the specific PM name.

A consistent pointer justification count indicates clock synchronization problems between nodes. A difference between the counts means the node transmitting the original pointer justification has timing variations with the node detecting and transmitting this count. Positive pointer adjustments occur when the frame rate of the SPE is too slow in relation to the rate of the STS 1.

For pointer justification count definitions, depending on the cards in use, see the "EC-1 Card Performance Monitoring Parameters" section on page 13-7, the "OC-3 Card Performance Monitoring Parameters" section on page 13-28, "OC-12 Card Performance Monitoring Parameters" section on page 13-33, or the OC-48 and OC-192 Card Performance Monitoring Parameters, page 13-38.

On CTC, the count fields for PPJC and NPJC PMs appear white and blank unless they are enabled on the Provisioning > Line tabs. Figure 13-4 shows the PJStsMon# menu on the Provisioning screen.

Figure 13-4 Line tab for enabling pointer justification count parameters



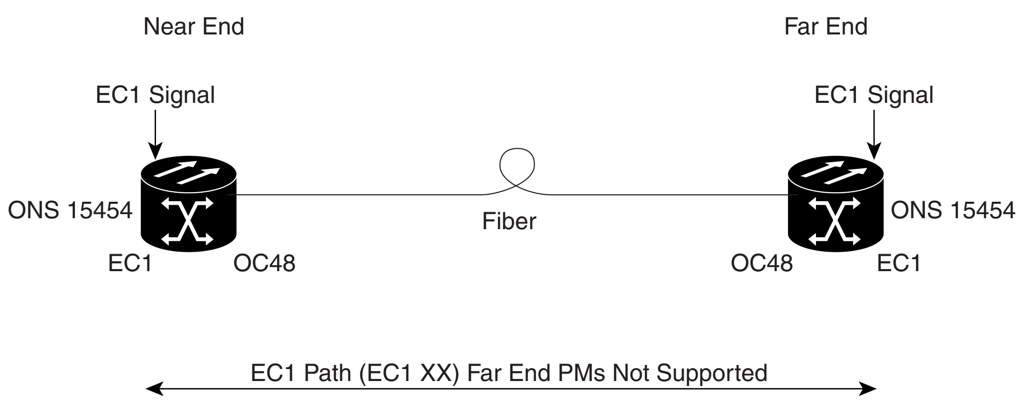
13.4 Performance Monitoring for Electrical Cards

The following sections define performance monitoring parameters for the EC1, DS1, DS1N, DS3, DS3N, DS3-12E, DS3N-12E, and DS3XM electrical cards.

13.4.1 EC-1 Card Performance Monitoring Parameters

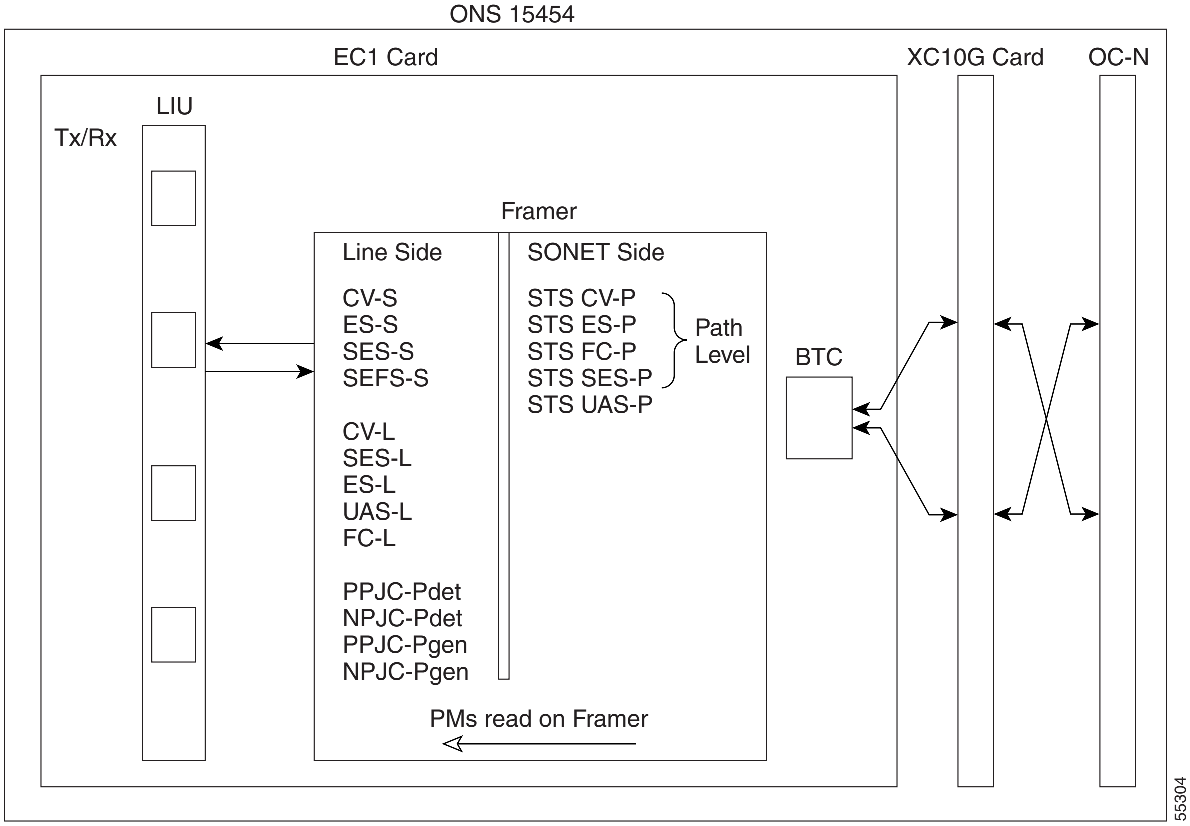
Figure 13-5 shows signal types that support far-end PMs. Far-end performance monitoring is not reported for EC1. Figure 13-6 shows where overhead bytes detected on the application specific integrated circuits (ASICs) produce performance monitoring parameters for the EC1 card.

Figure 13-5 Monitored signal types for the EC1 card



Note The XX in the illustration above represents all PMs listed below with the given prefix and/or suffix.

Figure 13-6 PM read points on the EC1 card



Note SONET path PMs will not count unless IPPM is enabled. For additional information, see Intermediate-Path Performance Monitoring Reference, page 13-3. Far-end IPPM is not supported. However, SONET path PMs can be monitored by logging into the far-end node directly.

Table 13-2 Near-End Section PMs for the EC1 Card

Parameter	Definition
CV-S	Section Coding Violation (CV-S) is a count of BIP errors detected at the section-layer (i.e. using the B1 byte in the incoming SONET signal). Up to eight section BIP errors can be detected per STS-N frame; each error increments the current CV-S second register.
ES-S	Section Errored Seconds (ES-S) is a count of the number of seconds when at least one section-layer BIP error was detected or an SEF or loss of signal (LOS) defect was present.

Table 13-2 Near-End Section PMs for the EC1 Card (continued)

Parameter	Definition
SES-S	Section Severely Errored Seconds (SES-S) is a count of the seconds when K (see GR-253-CORE for value) or more section-layer BIP errors were detected or a severely errored frame (SEF) or LOS defect was present.
SEFS-S	Section Severely Errored Framing Seconds (SEFS-S) is a count of the seconds when an SEF defect was present. An SEF defect is expected during most seconds where an LOS or loss of frame (LOF) defect is present. However, there may be situations when that is not the case, and the SEFS-S parameter is only incremented based on the presence of the SEF defect.

Table 13-3 Near-End Line Layer PMs for the EC1 Card

Parameter	Definition
CV-L	Near-End Line Code Violation (CV-L) is a count of BIP errors detected at the line-layer (i.e. using the B2 bytes in the incoming SONET signal). Up to 8 x N BIP errors can be detected per STS-N frame, with each error incrementing the current CV-L second register.
ES-L	Near-End Line Errored Seconds (ES-L) is a count of the seconds when at least one line-layer BIP error was detected or an alarm indication signal-line (AIS-L) defect was present.
SES-L	Near-End Line Severely Errored Seconds (SES-L) is a count of the seconds when K (see GR-253 for values) or more line-layer BIP errors were detected or an AIS-L defect was present.
UAS-L	Near-End Line Unavailable Seconds (UAS-L) is a count of the seconds when the line is unavailable. A line becomes unavailable when ten consecutive seconds occur that qualify as SES-Ls, and the line continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Ls.
FC-L	Near-End Line Failure Count (FC-L) is a count of the number of near-end line failure events. A failure event begins when an AIS-L failure or a lower-layer, traffic-related, near-end failure is declared. This failure event ends when the failure is cleared. A failure event that begins in one period and ends in another period is counted only in the period where it begins.

Table 13-4 Near-End SONET Path PMs for the EC1 Card

Parameter	Definition
Note SONET path PMs will not count unless IPPM is enabled. For additional information, see Intermediate-Path Performance Monitoring Reference, page 13-3. Far-end IPPM is not supported. However, SONET path PMs can be monitored by logging into the far-end node directly.	
STS CV-P	Near-End STS Path Coding Violations (CV-P) is a count of BIP errors detected at the STS path layer (i.e., using the B3 byte). Up to eight BIP errors can be detected per frame; each error increments the current CV-P second register.
STS ES-P	Near-End STS Path Errored Seconds (ES-P) is a count of the seconds when at least one STS path BIP error was detected. STS ES-P can also be caused by an AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect.
STS FC-P	Near-End STS Path Failure Counts (FC-P) is a count of the number of near-end STS path failure events. A failure event begins when an AIS-P failure, an LOP-P failure, a unequipped path (UNEQ-P) or a trace identifier mismatch (TIM-P) failure is declared. A failure event also begins if the STS PTE monitoring the path supports ERDI-P for that path. The failure event ends when these failures are cleared.
STS SES-P	Near-End STS Path Severely Errored Seconds (SES-P) is a count of the seconds when K (2400) or more STS path BIP errors were detected. STS SES-P can also be caused by an AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect.
STS UAS-P	Near-End STS Path Unavailable Seconds (UAS-P) is a count of the seconds when the STS path was unavailable. An STS path becomes unavailable when ten consecutive seconds occur that qualify as SES-Ps, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Ps.

Table 13-5 Near-End SONET Path BIP PMs for the EC1 Card

Parameter	Definition
Note On CTC, the count fields for PPJC and NPJC PMs appear white and blank unless they are enabled on the Provisioning > Line tabs.	
PPJC-Pdet	Positive Pointer Justification Count, STS Path Detected (PPJC-Pdet) is a count of the positive pointer justifications detected on a particular path in an incoming SONET signal.
NPJC-Pdet	Negative Pointer Justification Count, STS Path Detected (NPJC-Pdet) is a count of the negative pointer justifications detected on a particular path in an incoming SONET signal.

Table 13-5 Near-End SONET Path BIP PMs for the EC1 Card (continued)

Parameter	Definition
PPJC-Pgen	Positive Pointer Justification Count, STS Path Generated (PPJC-Pgen) is a count of the positive pointer justifications generated for a particular path to reconcile the frequency of the SPE with the local clock.
NPJC-Pgen	Negative Pointer Justification Count, STS Path Generated (NPJC-Pgen) is a count of the negative pointer justifications generated for a particular path to reconcile the frequency of the synchronous payload envelope (SPE) with the local clock.

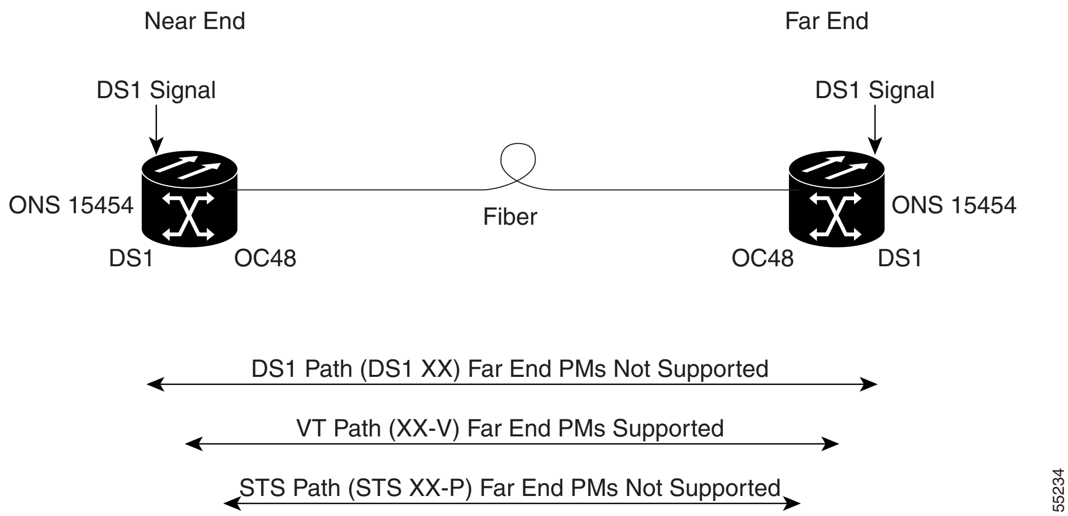
Table 13-6 Far-End Line Layer PMs for the EC-1 Card

Parameter	Definition
CV-L	Far-End Line Code Violation (CV-L) is a count of BIP errors detected by the far-end line terminating equipment (LTE) and reported back to the near-end LTE using the REI-L indication in the line overhead. For SONET signals at rates below OC-48, up to 8 x N BIP errors per STS-N frame can be indicated using the REI-L. For OC-48 signals, up to 255 BIP errors per STS-N frame can be indicated. The current CV-L second register is incremented for each BIP error indicated by the incoming REI-L.
ES-L	Far-End Line Errored Seconds (ES-L) is a count of the seconds when at least one line-layer BIP error was reported by the far-end LTE or an RDI-L defect was present.
SES-L	Far-End Line Severely Errored Seconds (SES-L) is a count of the seconds when K (see GR-253-CORE for values) or more line-layer BIP errors were reported by the far-end LTE or an RDI-L defect was present.
UAS-L	Far-End Line Unavailable Seconds (UAS-L) is a count of the seconds when the line is unavailable at the far end. A line becomes unavailable at the far end when ten consecutive seconds occur that qualify as SES-LFEs and it continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-LFEs.
FC-L	Far-End Line Failure Count (FC-L) is a count of the number of far-end line failure events. A failure event begins when RFI-L failure is declared, and it ends when the RFI-L failure clears. A failure event that begins in one period and ends in another period is counted only in the period where it began.

13.4.2 DS1 and DS1N Card Performance Monitoring Parameters

Figure 13-7 shows the signal types that support far-end PMs. Far-end VT and STS path performance monitoring is supported for the DS1 card. Far-end DS1 path performance monitoring is not supported for the DS1 card. Figure 13-8 shows where overhead bytes detected on the ASICs produce performance monitoring parameters for the DS1 and DS1N cards.

Figure 13-7 Monitored signal types for the DS1 and DS1N cards



Note The XX in the illustration above represents all PMs listed below with the given prefix and/or suffix.

Figure 13-8 PM read points on the DS1 and DS1N cards

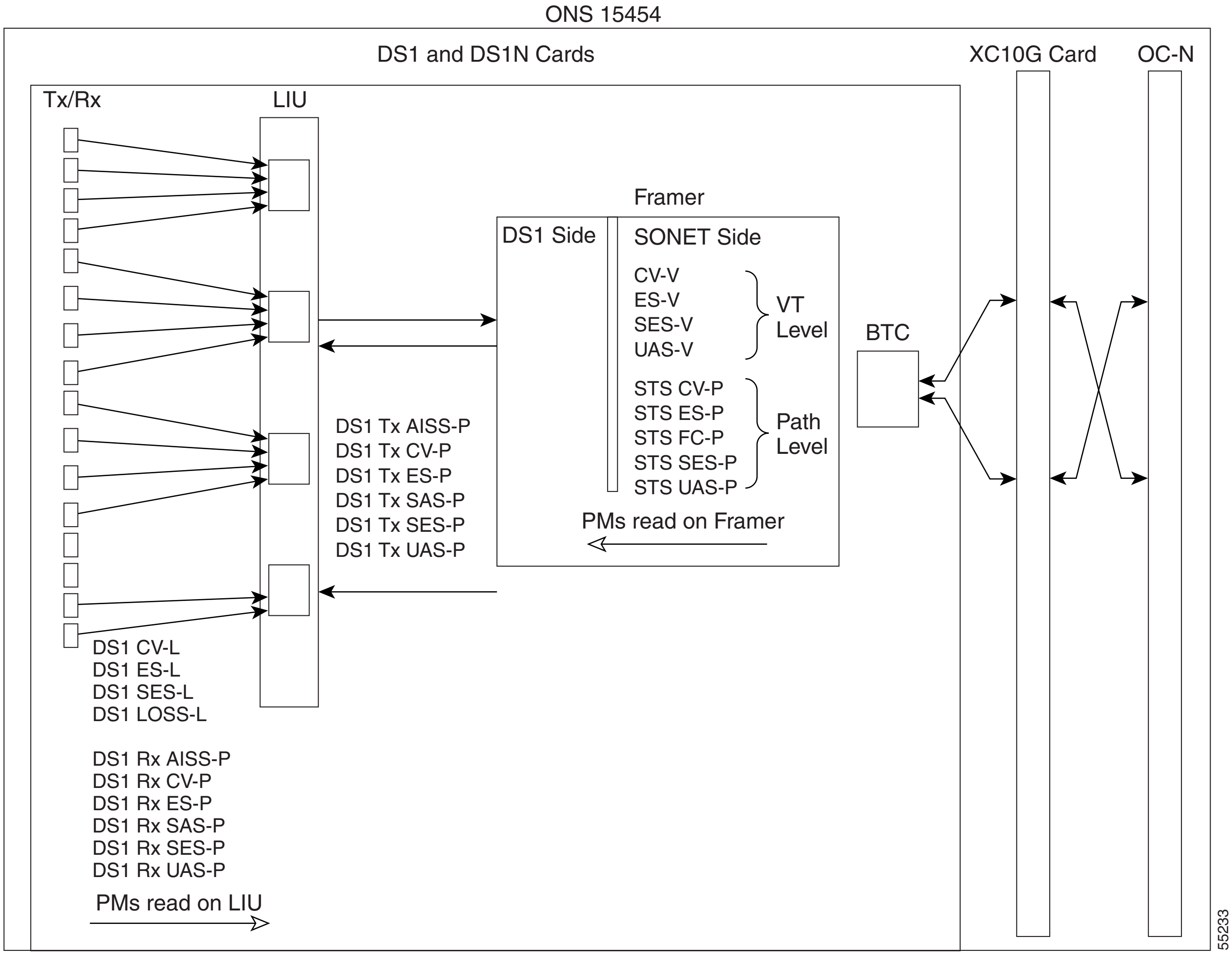


Table 13-7 DS1 Line PMs for the DS1 and DS1N Cards

Parameter	Definition
DS1 CV-L	Code Violation Line (CV-L) indicates the number of coding violations occurring on the line. This parameter is a count of bipolar violations (BPVs) and excessive zeros (EXZs) occurring over the accumulation period.
DS1 ES-L	Errored Seconds Line (ES-L) is a count of the seconds containing one or more anomalies (BPV + EXZ) and/or defects (loss of signal) on the line.
DS1 SES-L	Severely Errored Seconds Line (SES-L) is a count of the seconds containing more than a particular quantity of anomalies (BPV + EXZ ≥ 1544) and/or defects on the line.
DS1 LOSS-L	Loss of Signal Seconds Line (LOSS-L) is a count of one-second intervals containing one or more LOS defects.

Table 13-8 DS1 Receive Path PMs for the DS1 and DS1N Cards

Parameter	Definition
Note Under the Provisioning > Threshold tab, the DS1 and DS1N cards have user-defined thresholds for the DS1 receive (Rx) path PMs. In the Threshold tab they are displayed as CV, ES, SES, UAS, AISS, and SAS without the Rx prefix.	
DS1 Rx AISS-P	Receive Path Alarm Indication Signal (Rx AIS-P) means an alarm indication signal occurred on the receive end of the path. This parameter is a count of seconds containing one or more AIS defects.
DS1 Rx CV-P	Receive Path Code Violation (Rx CV-P) means a coding violation occurred on the receive end of the path. For DS1-ESF paths, this parameter is a count of detected CRC-6 errors. For the DS1-SF paths, the Rx CV-P parameter is a count of detected frame bit errors (FE).
DS1 Rx ES-P	Receive Path Errored Seconds (Rx ES-P) is a count of the seconds containing one or more anomalies and/or defects for paths on the receive end of the signal. For DS1-ESF paths, this parameter is a count of one-second intervals containing one or more CRC-6 errors, or one or more CS events, or one or more SEF or AIS defects. For DS1-SF paths, the Rx ES-P parameter is a count of one-second intervals containing one or more FE events, or one or more CS events, or one or more SEF or AIS defects.
DS1 Rx SAS-P	Receive Path Severely Errored Seconds Frame/Alarm Indication Signal (Rx SAS-P) is a count of one-second intervals containing one or more SEFs or one or more AIS defects on the receive end of the signal.
DS1 Rx SES-P	Receive Path Severely Errored Seconds (Rx SES-P) is a count of the seconds containing more than a particular quantity of anomalies and/or defects for paths on the receive end of the signal. For the DS1-ESF paths, this parameter is a count of seconds when 320 or more CRC-6 errors or one or more SEF or AIS defects occurred. For DS1-SF paths, an SES is a second containing either the occurrence of four FEs or one or more SEF or AIS defects.
DS1 Rx UAS-P	Receive Path Unavailable Seconds (Rx UAS-P) is a count of one-second intervals when the DS1 path is unavailable on the receive end of the signal. The DS1 path is unavailable when ten consecutive SESs occur. The ten SESs are included in unavailable time. Once unavailable, the DS1 path becomes available when ten consecutive seconds occur with no SESs. The ten seconds with no SESs are excluded from unavailable time.

Table 13-9 DS1 Transmit Path PMs for the DS1 and DS1N Cards

Parameter	Definition
Note Under the Performance tab, the displayed DS1 Tx path PM values are based on calculations performed by the card and therefore have no user-defined thresholds.	
DS1 Tx AISS-P	Transmit Path Alarm Indication Signal (Tx AIS-P) means an alarm indication signal occurred on the transmit end of the path. This parameter is a count of seconds containing one or more AIS defects.
DS1 Tx CV-P	Transmit Path Code Violation (Tx CV-P) means a coding violation occurred on the transmit end of the path. For DS1-ESF paths, this parameter is a count of detected CRC-6 errors. For the DS1-SF paths, the Tx CV-P parameter is a count of detected FEs.

Table 13-9 DS1 Transmit Path PMs for the DS1 and DS1N Cards (continued)

Parameter	Definition
DS1 Tx ES-P	Transmit Path Errored Seconds (Tx ES-P) is a count of the seconds containing one or more anomalies and/or defects for paths on the transmit end of the signal. For DS1-ESF paths, this parameter is a count of one-second intervals containing one or more CRC-6 errors, or one or more CS events, or one or more SEF or AIS defects. For DS1-SF paths, the Tx ES-P parameter is a count of one-second intervals containing one or more FE events, or one or more CS events, or one or more SEF or AIS defects.
DS1 Tx SAS-P	Transmit Path Severely Errored Seconds Frame/Alarm Indication Signal (Tx SAS-P) is a count of one-second intervals containing one or more SEFs or one or more AIS defects on the receive end of the signal.
DS1 Tx SES-P	Transmit Path Severely Errored Seconds (Tx SES-P) is a count of the seconds containing more than a particular quantity of anomalies and/or defects for paths on the transmit end of the signal. For the DS1-ESF paths, this parameter is a count of seconds when 320 or more CRC-6 errors or one or more SEF or AIS defects occurred. For DS1-SF paths, an SES is a second containing either the occurrence of four FEs or one or more SEF or AIS defects.
DS1 Tx UAS-P	Transmit Path Unavailable Seconds (Tx UAS-P) is a count of one-second intervals when the DS1 path is unavailable on the transmit end of the signal. The DS1 path is unavailable when ten consecutive SESs occur. The ten SESs are included in unavailable time. Once unavailable, the DS1 path becomes available when ten consecutive seconds occur with no SESs. The ten seconds with no SESs are excluded from unavailable time.

Table 13-10 VT Path PMs for the DS1 and DS1N Cards

Parameter	Definition
CV-V	Code Violation VT Layer (CV-V) is a count of the BIP errors detected at the VT path layer. Up to two BIP errors can be detected per VT superframe, with each error incrementing the current CV-V second register.
ES-V	Errored Seconds VT Layer (ES-V) is a count of the seconds when at least one VT Path BIP error was detected. An AIS-V defect (or a lower-layer, traffic-related, near-end defect) or an LOP-V defect can also cause an ES-V.
SES-V	Severely Errored Seconds VT Layer (SES-V) is a count of seconds when K (600) or more VT Path BIP errors were detected. SES-V can also be caused by an AIS-V defect (or a lower-layer, traffic-related, near-end defect) or an LOP-V defect.
UAS-V	Unavailable Second VT Layer (UAS-V) is a count of the seconds when the VT path was unavailable. A VT path becomes unavailable when ten consecutive seconds occur that qualify as SES-Vs, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Vs.

Table 13-11 SONET Path PMs for the DS1 and DS1N Cards

Parameter	Definition
STS CV-P	Near-End STS Path Coding Violations (CV-P) is a count of BIP errors detected at the STS path layer (i.e., using the B3 byte). Up to eight BIP errors can be detected per frame, with each error incrementing the current CV-P second register.
STS ES-P	Near-End STS Path Errored Seconds (ES-P) is a count of the seconds when at least one STS path BIP error was detected. An AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect can also cause an STS ES-P.
STS FC-P	Near-End STS Path Failure Counts (FC-P) is a count of the number of near-end STS path failure events. A failure event begins when an AIS-P failure, an LOP-P failure, a UNEQ-P, or a TIM-P failure is declared. A failure event also begins if the STS PTE that is monitoring the path supports ERDI-P for that path. The failure event ends when these failures are cleared.
STS SES-P	Near-End STS Path Severely Errored Seconds (SES-P) is a count of the seconds when K (2400) or more STS path BIP errors were detected. An AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect can also cause an STS SES-P.
STS UAS-P	Near-End STS Path Unavailable Seconds (UAS-P) is a count of the seconds when the STS path was unavailable. An STS path becomes unavailable when ten consecutive seconds occur that qualify as SES-Ps, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Ps.

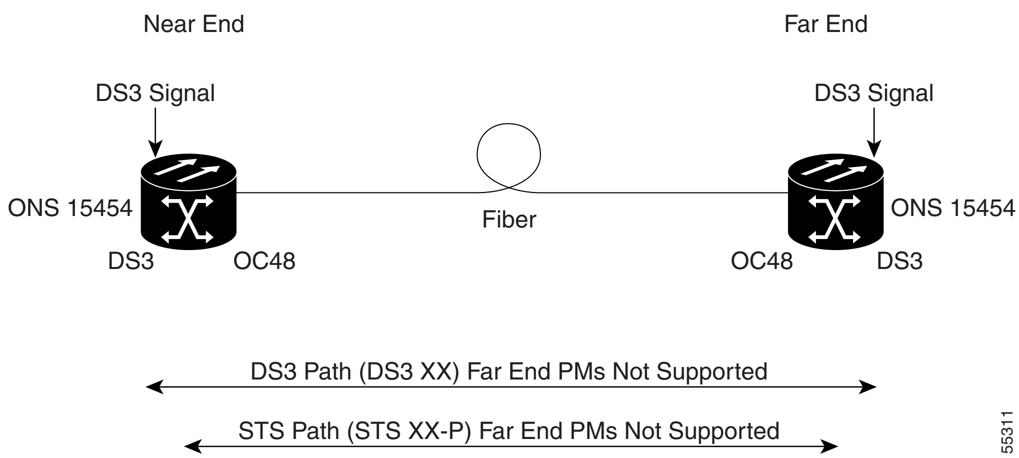
Table 13-12 Far-End VT Path PMs for the DS1 Card

Parameter	Definition
CV-V	Far-End VT Path Coding Violations (CV-VFE) is a count of the number of BIP errors detected by the far-end VT path terminating equipment (PTE) and reported back to the near-end VT PTE using the REI-V indication in the VT path overhead. Only one BIP error can be indicated per VT superframe using the REI-V bit. The current CV-VFE second register is incremented for each BIP error indicated by the incoming REI-V.
ES-V	Far-End VT Path Errored Seconds (ES-VFE) is a count of the seconds when at least one VT path BIP error was reported by the far-end VT PTE, or a one-bit RDI-V defect was present.
SES-V	Far-End VT Path Severely Errored Seconds (SES-VFE) is a count of the seconds when K (600) or more VT path BIP errors were reported by the far-end VT PTE or a one-bit RDI-V defect was present.
UAS-V	Far-End VT Path Unavailable Seconds (UAS-VFE) is a count of the seconds when the VT path is unavailable at the far-end. A VT path is unavailable at the far-end when ten consecutive seconds occur that qualify as SES-VFEs.

13.4.3 DS3 and DS3N Card Performance Monitoring Parameters

Figure 13-9 shows the signal types that support far-end PMs. Figure 13-10 shows where overhead bytes detected on the ASICs produce performance monitoring parameters for the DS3 and DS3N cards.

Figure 13-9 Monitored signal types for the DS3 and DS3N cards



Note The XX in the illustration above represents all PMs listed below with the given prefix and/or suffix.

Figure 13-10 PM read points on the DS3 and DS3N cards

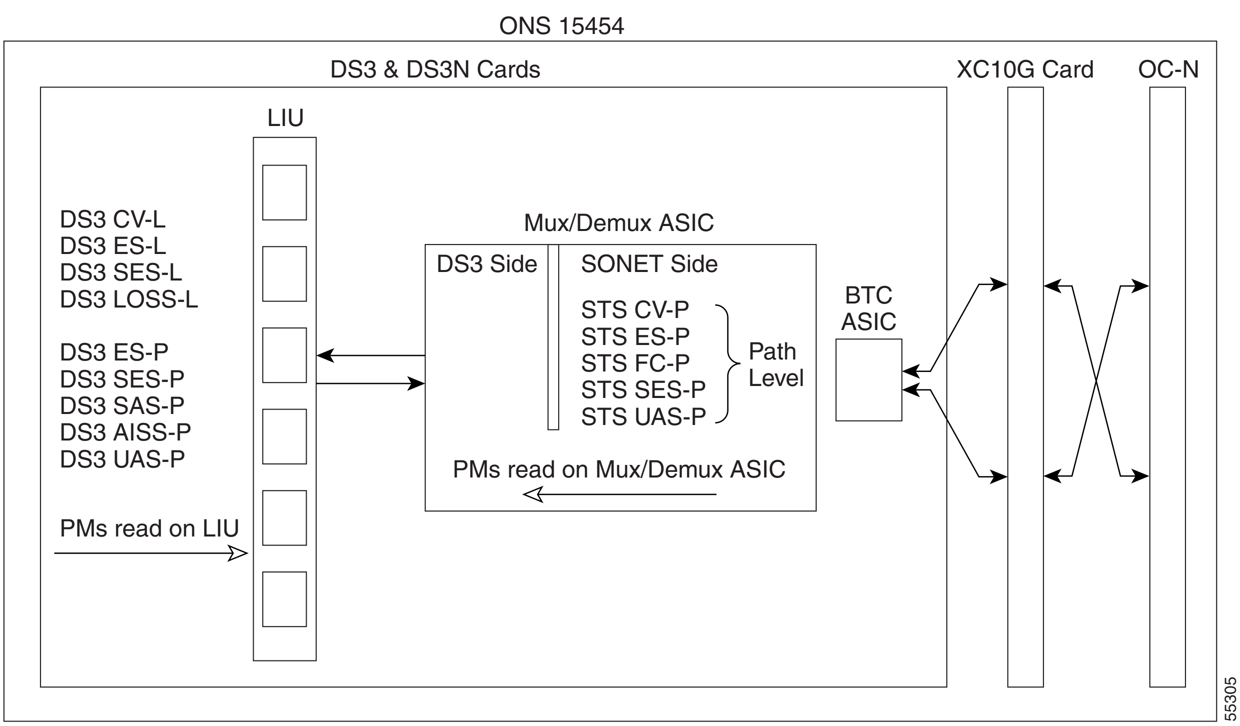


Table 13-13 Near-End DS3 Line PMs for the DS3 and DS3N Cards

Parameter	Definition
DS3 CV-L	Code Violation Line (CV-L) indicates the number of coding violations occurring on the line. This parameter is a count of bipolar violations (BPVs) and excessive zeros (EXZs) occurring over the accumulation period.
DS3 ES-L	Errored Seconds Line (ES-L) is a count of the seconds containing one or more anomalies (BPV + EXZ) and/or defects (loss of signal) on the line.
DS3 SES-L	Severely Errored Seconds Line (SES-L) is a count of the seconds containing more than a particular quantity of anomalies (BPV + EXZ ≥ 44) and/or defects on the line.
DS3 LOSS-L	Line Loss of Signal (LOSS-L) is a count of one-second intervals containing one or more LOS defects.

Table 13-14 Near-End DS3 Path PMs for the DS3 and DS3N Cards

Parameter	Definition
DS3 ES-P	Errored Seconds-Path (ES-P) is a count of one-second intervals containing one or more CRC-6 errors, or one or more CS events, or one or more SEF or AIS defects.
DS3 SES-P	Severely Errored Seconds-Path (SES-P) is a count of seconds where 320 or more CRC-6 errors occur or one or more SEF or AIS defects occur.
DS3 SAS-P	Severely Errored Frame/Alarm Indication Signal-Path (SAS-P) is a count of seconds containing one or more SEFs or one or more AIS defects.
DS3 AISS-P	Alarm Indication Signal Seconds-Path (AISS-P) is a count of seconds containing one or more AIS defects.
DS3 UAS-P	Unavailable Seconds-Path (UAS-P) is a count of one-second intervals during which the DS3 path is unavailable.

Table 13-15 Near-End SONET Path PMs for the DS3 and DS3N Cards

Parameter	Definition
STS CV-P	Near-End STS Path Coding Violations (CV-P) is a count of BIP errors detected at the STS path layer (i.e., using the B3 byte). Up to eight BIP errors can be detected per frame; each error increments the current CV-P second register.
STS ES-P	Near-End STS Path Errored Seconds (ES-P) is a count of the seconds when at least one STS path BIP error was detected. An AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect can also cause an STS ES-P.

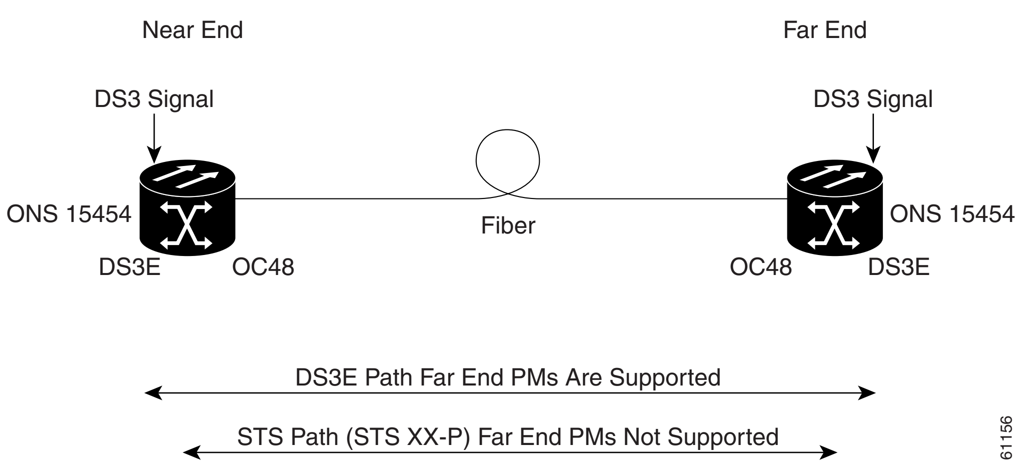
Table 13-15 Near-End SONET Path PMs for the DS3 and DS3N Cards (continued)

Parameter	Definition
STS FC-P	Near-End STS Path Failure Counts (FC-P) is a count of the number of near-end STS path failure events. A failure event begins when an AIS-P failure, an LOP-P failure, a UNEQ-P, or a TIM-P failure is declared. A failure event also begins if the STS PTE that is monitoring the path supports ERDI-P for that path. The failure event ends when these failures are cleared.
STS SES-P	Near-End STS Path Severely Errored Seconds (SES-P) is a count of the seconds when K (2400) or more STS path BIP errors were detected. An AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect can also cause an STS SES-P.
STS UAS-P	Near-End STS Path Unavailable Seconds (UAS-P) is a count of the seconds when the STS path was unavailable. An STS path becomes unavailable when ten consecutive seconds occur that qualify as SES-Ps, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Ps.

13.4.4 DS3-12E and DS3N-12E Card Performance Monitoring Parameters

Figure 13-11 shows the signal types that support far-end PMs. Figure 13-12 shows where overhead bytes detected on the ASICs produce performance monitoring parameters for the DS3-12E and DS3N-12E cards.

Figure 13-11 Monitored signal types for the DS3-12E and DS3N-12E cards



Note The XX in the illustration above represents all PMs listed below with the given prefix and/or suffix.

Figure 13-12 PM read points on the DS3-12E and DS3N-12E cards

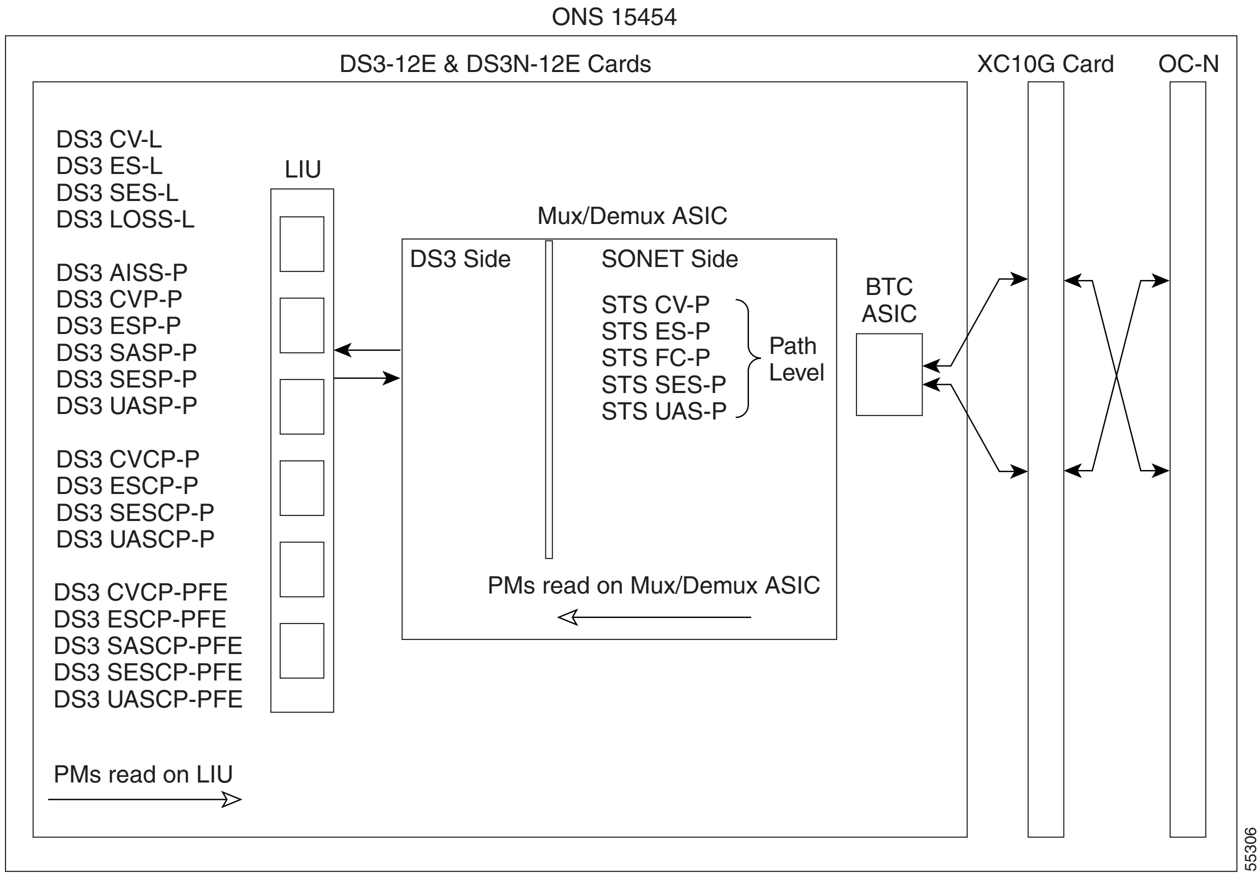


Table 13-16 Near-End DS3 Line PMs for the DS3-12E and DS3N-12E Cards

Parameter	Definition
DS3 CV-L	Code Violation Line (CV-L) indicates the number of coding violations occurring on the line. This parameter is a count of bipolar violations (BPVs) and excessive zeros (EXZs) occurring over the accumulation period.
DS3 ES-L	Errored Seconds Line (ES-L) is a count of the seconds containing one or more anomalies (BPV + EXZ) and/or defects (i.e. loss of signal) on the line.
DS3 SES-L	Severely Errored Seconds Line (SES-L) is a count of the seconds containing more than a particular quantity of anomalies (BPV + EXZ ≥ 44) and/or defects on the line.
DS3 LOSS-L	Line Loss of Signal (LOSS-L) is a count of one-second intervals containing one or more LOS defects.

Table 13-17 Near-End P-bit Path PMs for the DS3-12E and DS3N-12E Cards

Parameter	Definition
DS3 AISS-P	AIS Seconds Path (AISS-P) is a count of one-second intervals containing one or more AIS defects.
DS3 CVP-P	Code Violation Path (CVP-P) is a code violation parameter for M23 applications. CVP-P is a count of P-bit parity errors occurring in the accumulation period.
DS3 ESP-P	Errored Second Path (ESP-P) is a count of seconds containing one or more P-bit parity errors, one or more SEF defects, or one or more AIS defects.
DS3 SASP-P	SEF/AIS Seconds Path (SASP-P) is a count of one-second intervals containing one or more SEFs or one or more AIS defects on the path.
DS3 SESP-P	Severely Errored Seconds Path (DS3 SESP-P) is a count of seconds containing more than 44 P-bit parity violations, one or more SEF defects, or one or more AIS defects.
DS3 UASP-P	Unavailable Second Path (DS3 UASP-P) is a count of one-second intervals when the DS3 path is unavailable. A DS3 path becomes unavailable when ten consecutive SESP-Ps occur. The ten SESP-Ps are included in unavailable time. Once unavailable, the DS3 path becomes available when ten consecutive seconds with no SESP-Ps occur. The ten seconds with no SESP-Ps are excluded from unavailable time.

Table 13-18 Near-End CP-bit Path PMs for the DS3-12E and DS3N-12E Cards

Parameter	Definition
DS3 CVCP-P	Code Violation Path (CVCP-P) is a count of CP-bit parity errors occurring in the accumulation period.
DS3 ESCP-P	Errored Second Path (ESCP-P) is a count of seconds containing one or more CP-bit parity errors, one or more SEF defects, or one or more AIS defects. ESCP-P is defined for the C-bit parity application.
DS3 SESCP-P	Severely Errored Seconds Path (SESCP-P) is a count of seconds containing more than 44 CP-bit parity errors, one or more SEF defects, or one or more AIS defects.
DS3 UASCP-P	Unavailable Second Path (UASCP-P) is a count of one-second intervals when the DS3 path is unavailable. A DS3 path becomes unavailable when ten consecutive SESCP-Ps occur. The ten SESCP-Ps are included in unavailable time. Once unavailable, the DS3 path becomes available when ten consecutive seconds with no SESCP-Ps occur. The ten seconds with no SESCP-Ps are excluded from unavailable time.

Table 13-19 Near-End SONET Path PMs for the DS3-12E and DS3N-12E Cards

Parameter	Definition
STS CV-P	Near-End STS Path Coding Violations (CV-P) is a count of BIP errors detected at the STS path layer (i.e., using the B3 byte). Up to eight BIP errors can be detected per frame; each error increments the current CV-P second register.
STS ES-P	Near-End STS Path Errored Seconds (ES-P) is a count of the seconds when at least one STS path BIP error was detected. An AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect can also cause an STS ES-P.
STS FC-P	Near-End STS Path Failure Counts (FC-P) is a count of the number of near-end STS path failure events. A failure event begins when an AIS-P failure, an LOP-P failure, a UNEQ-P, or a TIM-P failure is declared. A failure event also begins if the STS PTE that is monitoring the path supports ERDI-P for that path. The failure event ends when these failures are cleared.
STS SES-P	Near-End STS Path Severely Errored Seconds (SES-P) is a count of the seconds when K (2400) or more STS path BIP errors were detected. An AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect can also cause an STS SES-P.
STS UAS-P	Near-End STS Path Unavailable Seconds (UAS-P) is a count of the seconds when the STS path was unavailable. An STS path becomes unavailable when ten consecutive seconds occur that qualify as SES-Ps, and continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Ps.

Table 13-20 Far-End CP-bit Path PMs for the DS3-12E and DS3N-12E Cards

Parameter	Definition
DS3 CVCP-P	Code Violation (CVCP-PFE) is a parameter that is counted when the three far-end block error (FEBE) bits in a M-frame are not all collectively set to 1.
DS3 ESCP-P	Errored Second (ESCP-PFE) is a count of one-second intervals containing one or more M-frames with the three FEBE bits not all collectively set to 1 or one or more far-end SEF/AIS defects.
DS3 SASCP-P	SEF/AIS Second (SASCP-PFE) is a count of one-second intervals containing one or more far-end SEF/AIS defects.

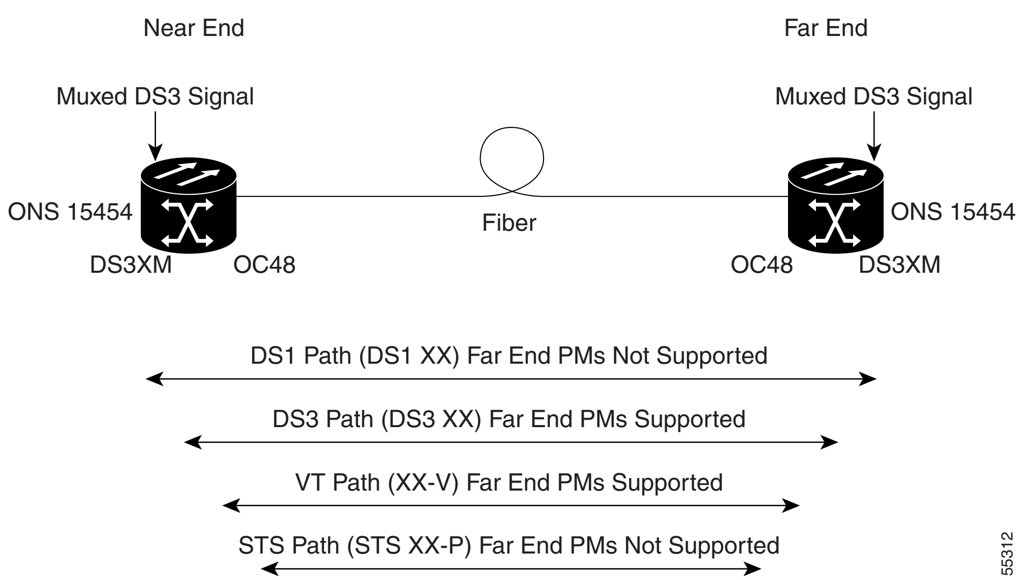
Table 13-20 Far-End CP-bit Path PMs for the DS3-12E and DS3N-12E Cards (continued)

Parameter	Definition
DS3 SESCP-P	Severely Errored Second (SESCP-PFE) is a count of one-second intervals containing one or more 44 M-frames with the three FEBE bits not all collectively set to 1 or one or more far-end SEF/AIS defects.
DS3 UASCP-P	Unavailable Second (UASCP-PFE) is a count of one-second intervals when the DS3 path becomes unavailable. A DS3 path becomes unavailable when ten consecutive far-end CP-bit SESs occur. The ten CP-bit SESs are included in unavailable time. Once unavailable, the DS3 path becomes available when ten consecutive seconds occur with no CP-bit SESs. The ten seconds with no CP-bit SESs are excluded from unavailable time.

13.4.5 DS3XM-6 Card Performance Monitoring Parameters

Figure 13-13 shows the signal types that support far-end PMs. Figure 13-14 shows where overhead bytes detected on the ASICs produce performance monitoring parameters for the DS3XM-6 card.

Figure 13-13 Monitored signal types for the DS3XM-6 card



Note The XX in the illustration above represents all PMs listed below with the given prefix and/or suffix.

Figure 13-14 PM read points on the DS3XM-6 card

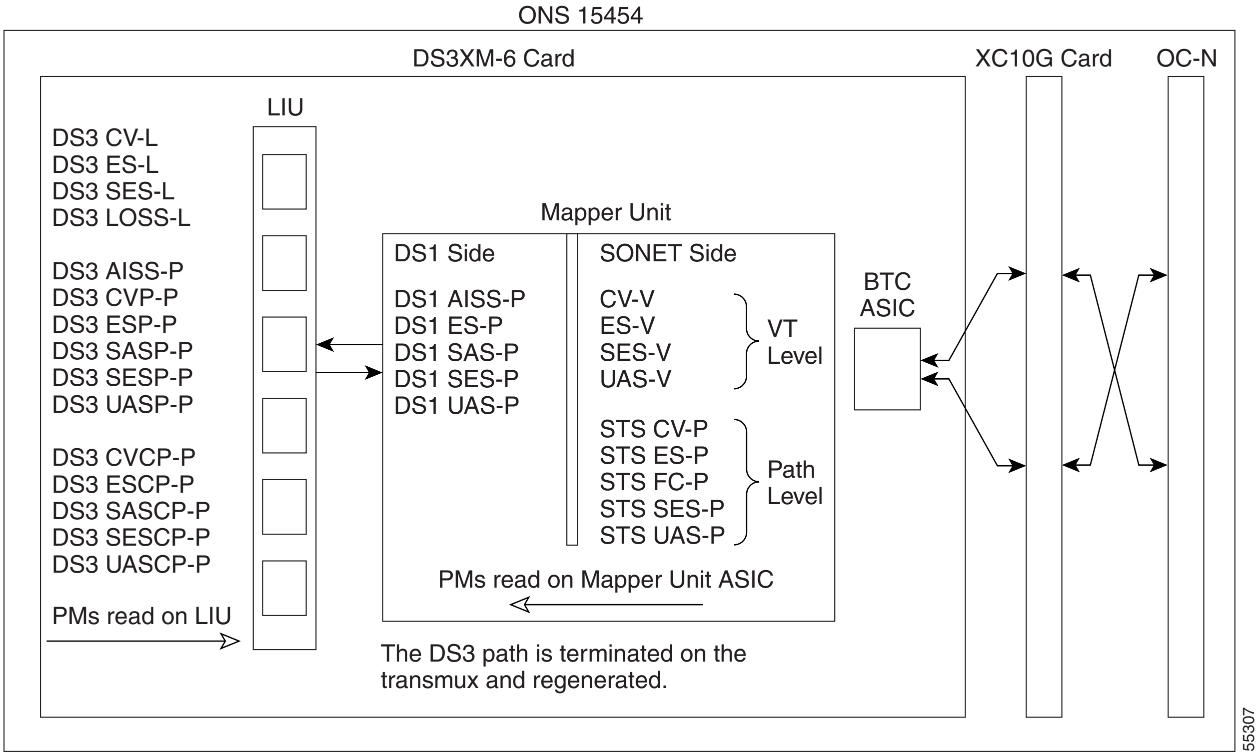


Table 13-21 Near-End DS3 Line PMs for the DS3XM-6 Card

Parameter	Definition
DS3 CV-L	Code Violation Line (CV-L) indicates the number of coding violations occurring on the line. This parameter is a count of bipolar violations (BPVs) and excessive zeros (EXZs) occurring over the accumulation period.
DS3 ES-L	Errored Seconds Line (ES-L) is a count of the seconds containing one or more anomalies (BPV + EXZ) and/or defects (i.e. LOS) on the line.
DS3 SES-L	Severely Errored Seconds Line (SES-L) is a count of the seconds containing more than a particular quantity of anomalies (BPV + EXZ ≥ 44) and/or defects on the line.
DS3 LOSS-L	Line Loss of Signal (LOSS-L) is a count of one-second intervals containing one or more LOS defects.

Table 13-22 Near-End P-bit Path PMs for the DS3XM-6 Card

Parameter	Definition
DS3 AISS-P	AIS Seconds Path (AISS-P) is a count of one-second intervals containing one or more AIS defects.
DS3 CVP-P	Code Violation Path (CVP-P) is a code violation parameter for M23 applications. CVP-P is a count of P-bit parity errors occurring in the accumulation period.

Table 13-22 Near-End P-bit Path PMs for the DS3XM-6 Card (continued)

Parameter	Definition
DS3 ESP-P	Errored Second Path (ESP-P) is a count of seconds containing one or more P-bit parity errors, one or more SEF defects, or one or more AIS defects.
DS3 SASP-P	SEF/AIS Seconds Path (SASP-P) is a count of one-second intervals containing one or more SEFs or one or more AIS defects on the path.
DS3 SESP-P	Severely Errored Seconds Path (SESP-P) is a count of seconds containing more than 44 P-bit parity violations, one or more SEF defects, or one or more AIS defects.
DS3 UASP-P	Unavailable Second Path (UASP-P) is a count of one-second intervals when the DS3 path is unavailable. A DS3 path becomes unavailable when ten consecutive SESP-Ps occur. The ten SESP-Ps are included in unavailable time. Once unavailable, the DS3 path becomes available when ten consecutive seconds with no SESP-Ps occur. The ten seconds with no SESP-Ps are excluded from unavailable time.

Table 13-23 Near-End CP-bit Path PMs for the DS3XM-6 Card

Parameter	Definition
DS3 CVCP-P	Code Violation Path (CVCP-P) is a count of CP-bit parity errors occurring in the accumulation period.
DS3 ESCP-P	Errored Second Path (ESCP-P) is a count of seconds containing one or more CP-bit parity errors, one or more SEF defects, or one or more AIS defects.
DS3 SASCP-P	SEF/AIS Second (SASCP-PFE) is a count of one-second intervals containing one or more near-end SEF/AIS defects.
DS3 SESCP-P	Severely Errored Seconds Path (SESCP-P) is a count of seconds containing more than 44 CP-bit parity errors, one or more SEF defects, or one or more AIS defects.
DS3 UASCP-P	Unavailable Seconds Path (DS3 UASCP-P) is a count of one-second intervals when the DS3 path is unavailable. A DS3 path becomes unavailable when ten consecutive SESCP-Ps occur. The ten SESCP-Ps are included in unavailable time. Once unavailable, the DS3 path becomes available when ten consecutive seconds with no SESCP-Ps occur. The ten seconds with no SESCP-Ps are excluded from unavailable time.

Table 13-24 Near-End DS1 Path PMs for the DS3XM-6 Card

Parameter	Definition
DS1 AISS-P	Alarm Indication Signal Path (AIS-P) means an AIS occurred on the path. This parameter is a count of seconds containing one or more AIS defects.
DS1 ES-P	Errored Seconds Path (ES-P) is a count of the seconds containing one or more anomalies and/or defects for paths. For DS1-ESF paths, this parameter is a count of one-second intervals containing one or more CRC-6 errors, or one or more CS events, or one or more SEF or AIS defects. For DS1-SF paths, the ES-P parameter is a count of one-second intervals containing one or more FE events, or one or more CS events, or one or more SEF or AIS defects.
DS1 SAS-P	Severely Errored Seconds Path Frame/Alarm Indication Signal (SAS-P) is a count of one-second intervals containing one or more SEFs or one or more AIS defects.
DS1 SES-P	Severely Errored Seconds Path (SES-P) is a count of the seconds containing more than a particular quantity of anomalies and/or defects for paths. For the DS1-ESF paths, this parameter is a count of seconds when 320 or more CRC-6 errors or one or more SEF or AIS defects occurs. For DS1-SF paths, an SES is a second containing either the occurrence of eight FEs, four FEs, or one or more SEF or AIS defects.
DS1 UAS-P	Unavailable Seconds Path (UAS-P) is a count of one-second intervals when the DS1 path is unavailable. The DS1 path is unavailable when ten consecutive SESs occur. The ten SESs are included in unavailable time. Once unavailable, the DS1 path becomes available when ten consecutive seconds occur with no SESs. The ten seconds with no SESs are excluded from unavailable time.

Table 13-25 Near-End VT PMs for the DS3XM-6 Card

Parameter	Definition
CV-V	Code Violation VT Layer (CV-V) is a count of the BIP errors detected at the VT path layer. Up to two BIP errors can be detected per VT superframe; each error increments the current CV-V second register.
ES-V	Errored Seconds VT Layer (ES-V) is a count of the seconds when at least one VT Path BIP error was detected. An AIS-V defect (or a lower-layer, traffic-related, near-end defect) or an LOP-V defect can also cause ES-V.
SES-V	Severely Errored Seconds VT Layer (SES-V) is a count of seconds when K (600) or more VT Path BIP errors were detected. An AIS-V defect (or a lower-layer, traffic-related, near-end defect) or an LOP-V defect can also cause SES-V.
UAS-V	Unavailable Seconds VT Layer (UAS-V) is a count of the seconds when the VT path was unavailable. A VT path becomes unavailable when ten consecutive seconds occur that qualify as SES-Vs and continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Vs.

Table 13-26 Near-End SONET Path PMs for the DS3XM-6 Card

Parameter	Definition
STS CV-P	Near-End STS Path Coding Violations (CV-P) is a count of BIP errors detected at the STS path layer (i.e., using the B3 byte). Up to eight BIP errors can be detected per frame; each error increments the current CV-P second register.
STS ES-P	Near-End STS Path Errored Seconds (ES-P) is a count of the seconds when at least one STS path BIP error was detected. An AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect can also cause an STS ES-P.
STS FC-P	Near-End STS Path Failure Counts (FC-P) is a count of the number of near-end STS path failure events. A failure event begins when an AIS-P failure, an LOP-P failure, a UNEQ-P, or a TIM-P failure is declared. A failure event also begins if the STS PTE that is monitoring the path supports ERDI-P for that path. The failure event ends when these failures are cleared.
STS SES-P	Near-End STS Path Severely Errored Seconds (SES-P) is a count of the seconds when K (2400) or more STS path BIP errors were detected. An AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect can also cause an STS SES-P.
STS UAS-P	Near-End STS Path Unavailable Seconds (UAS-P) is a count of the seconds when the STS path was unavailable. An STS path becomes unavailable when ten consecutive seconds occur that qualify as SES-Ps, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Ps.

Table 13-27 Far-End CP-bit Path PMs for the DS3XM-6 Card

Parameter	Definition
DS3 CVCP-P	Code Violation (CVCP-PFE) is a parameter that is counted when the three FEBE bits in a M-frame are not all collectively set to 1.
DS3 ESCP-P	Errored Second (ESCP-PFE) is a count of one-second intervals containing one or more M-frames with the three FEBE bits not all collectively set to 1 or one or more far-end SEF/AIS defects.
DS3 SASCP-P	SEF/AIS Second (SASCP-PFE) is a count of one-second intervals containing one or more far-end SEF/AIS defects.
DS3 SESCP-P	Severely Errored Second (SESCP-PFE) is a count of one-second intervals containing one or more 44 M-frames with the three FEBE bits not all collectively set to 1 or one or more far-end SEF/AIS defects.
DS3 UASCP-P	Unavailable Second (UASCP-PFE) is a count of one-second intervals when the DS3 path becomes unavailable. A DS3 path becomes unavailable when ten consecutive far-end CP-bit SESs occur. The ten CP-bit SESs are included in unavailable time. Once unavailable, the DS3 path becomes available when ten consecutive seconds with no CP-bit SESs occur. The ten seconds with no CP-bit SESs are excluded from unavailable time.

Table 13-28 Far-End VT PMs for the DS3XM-6 Card

Parameter	Definition
CV-V	Code Violation VT Layer (CV-V) is a count of the BIP errors detected at the VT path layer. Up to two BIP errors can be detected per VT superframe; each error increments the current CV-V second register.
ES-V	Errored Seconds VT Layer (ES-V) is a count of the seconds when at least one VT Path BIP error was detected. An AIS-V defect (or a lower-layer, traffic-related, near-end defect) or an LOP-V defect can also cause an ES-V.
SES-V	Severely Errored Seconds VT Layer (SES-V) is a count of seconds when K (600) or more VT Path BIP errors were detected. An AIS-V defect (or a lower-layer, traffic-related, near-end defect) or an LOP-V defect can also cause an SES-V.
UAS-V	Unavailable Second VT Layer (UAS-V) is a count of the seconds when the VT path was unavailable. A VT path becomes unavailable when ten consecutive seconds occur that qualify as SES-Vs and continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Vs.

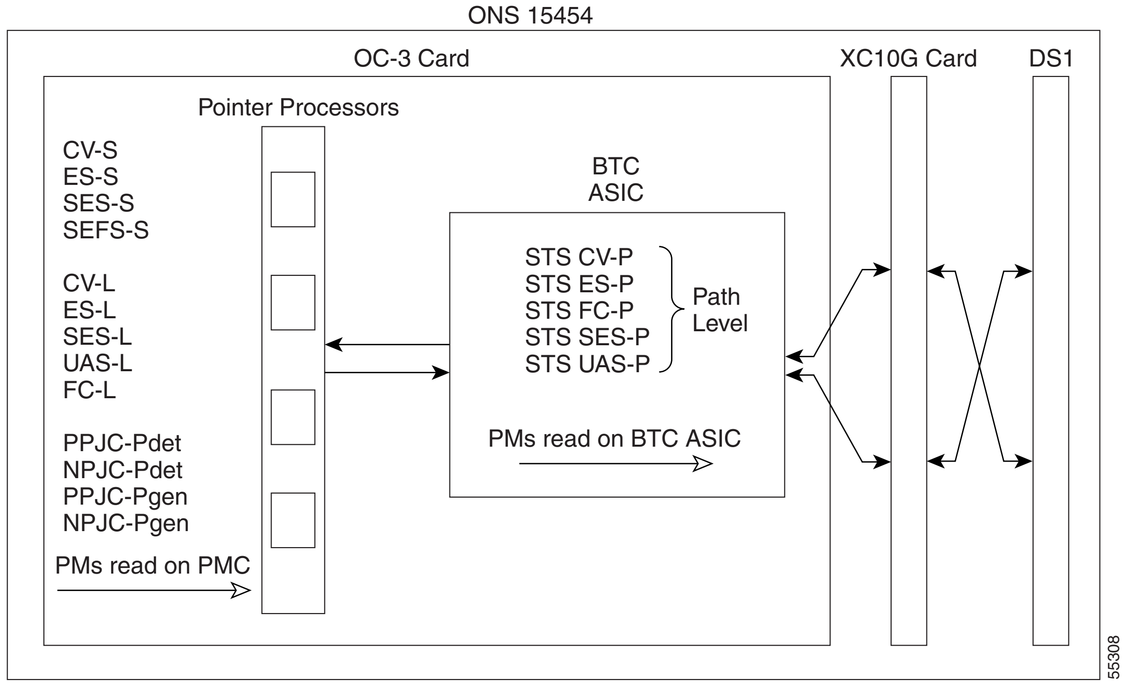
13.5 Performance Monitoring for Optical Cards

The following sections define performance monitoring parameters and definitions for the OC-3, OC-12, OC-48, and OC-192.

13.5.1 OC-3 Card Performance Monitoring Parameters

Figure 13-15 shows where overhead bytes detected on the ASICs produce performance monitoring parameters for the OC-3 card.

Figure 13-15 PM read points on the OC-3 card



Note For PM locations relating to protection switch counts, see the GR-253-CORE document.

Table 13-29 Near-End Section PMs for the OC-3 Card

Parameter	Definition
CV-S	Section Coding Violation (CV-S) is a count of BIP errors detected at the section-layer (i.e. using the B1 byte in the incoming SONET signal). Up to eight section BIP errors can be detected per STS-N frame, with each error incrementing the current CV-S second register.
ES-S	Section Errored Seconds (ES-S) is a count of the number of seconds when at least one section-layer BIP error was detected or an SEF or LOS defect was present.
SES-S	Section Severely Errored Seconds (SES-S) is a count of the seconds when K (see GR-253 for value) or more section-layer BIP errors were detected or an SEF or LOS defect was present.
SEFS-S	Section Severely Errored Framing Seconds (SEFS-S) is a count of the seconds when an SEF defect was present. An SEF defect is expected to be present during most seconds when an LOS or LOF defect is present. However, there can be situations when the SEFS-S parameter is only incremented based on the presence of the SEF defect.

Table 13-30 Near-End Line Layer PMs for the OC-3 Card

Parameter	Definition
CV-L	Near-End Line Code Violation (CV-L) is a count of BIP errors detected at the line-layer (i.e. using the B2 bytes in the incoming SONET signal). Up to 8 x N BIP errors can be detected per STS-N frame; each error increments the current CV-L second register.
ES-L	Near-End Line Errored Seconds (ES-L) is a count of the seconds when at least one line-layer BIP error was detected or an AIS-L defect was present.
SES-L	Near-End Line Severely Errored Seconds (SES-L) is a count of the seconds when K (see GR-253-CORE for values) or more line-layer BIP errors were detected or an AIS-L defect was present.
UAS-L	Near-End Line Unavailable Seconds (UAS-L) is a count of the seconds when the line is unavailable. A line becomes unavailable when ten consecutive seconds occur that qualify as SES-Ls, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Ls.
FC-L	Near-End Line Failure Count (FC-L) is a count of the number of near-end line failure events. A failure event begins when an AIS-L failure is declared or when a lower-layer traffic-related, near-end failure is declared. This failure event ends when the failure is cleared. A failure event that begins in one period and ends in another period is counted only in the period where it begins.

Table 13-31 Near-End Line Layer PMs for the OC-3 Cards

Parameter	Definition
For information about Troubleshooting UPSR switch counts, see the alarm troubleshooting information in the *Cisco ONS 15454 Troubleshooting Guide*. For information about creating circuits that perform a switch, see Chapter 11, "Circuits and Tunnels."	

Table 13-31 Near-End Line Layer PMs for the OC-3 Cards (continued)

Parameter	Definition
PSC (1+1 protection)	In a 1 + 1 protection scheme for a working card, Protection Switching Count (PSC) is a count of the number of times service switches from a working card to a protection card plus the number of times service switches back to the working card. For a protection card, PSC is a count of the number of times service switches to a working card from a protection card plus the number of times service switches back to the protection card. The PSC PM is only applicable if revertive line-level protection switching is used. **Note** BLSR is not supported on the OC-3 card; therefore, the PSC-W, PSC-S, and PSC-R PMs do not increment.
PSD	Protection Switching Duration (PSD) applies to the length of time, in seconds, that service is carried on another line. For a working line, PSD is a count of the number of seconds that service was carried on the protection line. For the protection line, PSD is a count of the seconds that the line was used to carry service. The PSD PM is only applicable if revertive line-level protection switching is used. **Note** BLSR is not supported on the OC-3 card; therefore, the PSD-W, PSD-S, and PSD-R PMs do not increment.

Table 13-32 Near-End SONET Path H-byte PMs for the OC-3 Card

Parameter	Definition
Note On CTC, the count fields for PPJC and NPJC PMs appear white and blank unless they are enabled on the Provisioning > Line tabs.	
PPJC-Pdet	Positive Pointer Justification Count, STS Path Detected (PPJC-Pdet) is a count of the positive pointer justifications detected on a particular path on an incoming SONET signal.
NPJC-Pdet	Negative Pointer Justification Count, STS Path Detected (NPJC-Pdet) is a count of the negative pointer justifications detected on a particular path on an incoming SONET signal.
PPJC-Pgen	Positive Pointer Justification Count, STS Path Generated (PPJC-Pgen) is a count of the positive pointer justifications generated for a particular path to reconcile the frequency of the SPE with the local clock.
NPJC-Pgen	Negative Pointer Justification Count, STS Path Generated (NPJC-Pgen) is a count of the negative pointer justifications generated for a particular path to reconcile the frequency of the synchronous payload envelope (SPE) with the local clock.

Table 13-33 Near-End SONET Path PMs for the OC-3 Card

Parameter	Definition
Note SONET path PMs will not count unless IPPM is enabled. For additional information, see Intermediate-Path Performance Monitoring Reference, page 13-3. Far-end IPPM is not supported. However, SONET path PMs can be monitored by logging into the far-end node directly.	
STS CV-P	Near-End STS Path Coding Violations (CV-P) is a count of BIP errors detected at the STS path layer (i.e., using the B3 byte). Up to eight BIP errors can be detected per frame; each error increments the current CV-P second register.
STS ES-P	Near-End STS Path Errored Seconds (ES-P) is a count of the seconds when one or more STS path BIP errors were detected. An AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect can also cause an STS ES-P.
STS FC-P	Near-End STS Path Failure Counts (FC-P) is a count of the number of near-end STS path failure events. A failure event begins with an AIS-P failure, an LOP-P failure, a UNEQ-P failure, or a TIM-P failure is declared, or if the STS PTE that is monitoring the path supports ERDI-P for that path. The failure event ends when these failures are cleared.
STS SES-P	Near-End STS Path Severely Errored Seconds (SES-P) is a count of the seconds when K (2400) or more STS path BIP errors were detected. An AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect can also cause an STS SES-P.
STS UAS-P	Near-End STS Path Unavailable Seconds (UAS-P) is a count of the seconds when the STS path was unavailable. An STS path becomes unavailable when ten consecutive seconds occur that qualify as SES-Ps, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Ps.

Table 13-34 Far-End Line Layer PMs for the OC-3 Card

Parameter	Definition
CV-L	Far-End Line Code Violation (CV-L) is a count of BIP errors detected by the far-end line terminating equipment (LTE) and reported back to the near-end LTE using the REI-L indication in the line overhead. For SONET signals at rates below OC-48, up to 8 x N BIP errors per STS-N frame can be indicated using the REI-L. For OC-48 signals, up to 255 BIP errors per STS-N frame can be indicated. The current CV-L second register is incremented for each BIP error indicated by the incoming REI-L.
ES-L	Far-End Line Errored Seconds (ES-L) is a count of the seconds when at least one line-layer BIP error was reported by the far-end LTE or an RDI-L defect was present.
SES-L	Far-End Line Severely Errored Seconds (SES-L) is a count of the seconds when K (see GR-253-CORE for values) or more line-layer BIP errors were reported by the far-end LTE or an RDI-L defect was present.

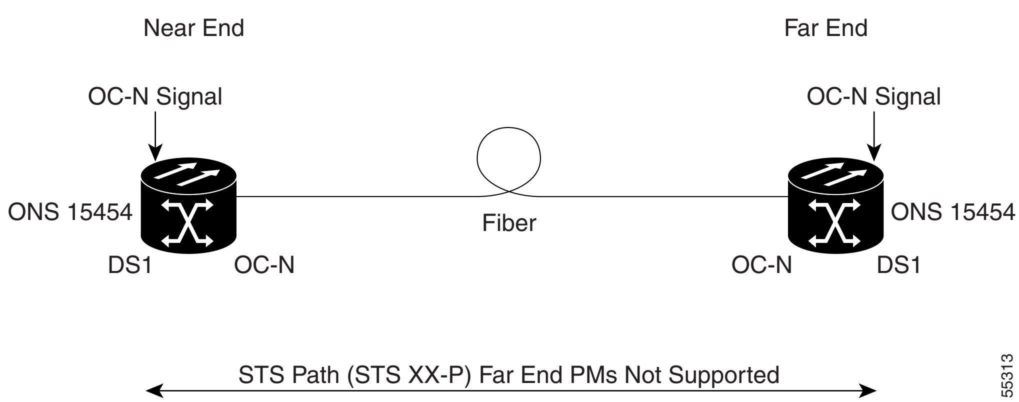
Table 13-34 Far-End Line Layer PMs for the OC-3 Card (continued)

Parameter	Definition
UAS-L	Far-End Line Unavailable Seconds (UAS-L) is a count of the seconds when the line is unavailable at the far end. A line becomes unavailable at the far end when ten consecutive seconds occur that qualify as SES-LFEs and it continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-LFEs.
FC-L	Far-End Line Failure Count (FC-L) is a count of the number of far-end line failure events. A failure event begins when RFI-L failure is declared, and it ends when the RFI-L failure clears. A failure event that begins in one period and ends in another period is counted only in the period where it began.

13.5.2 OC-12 Card Performance Monitoring Parameters

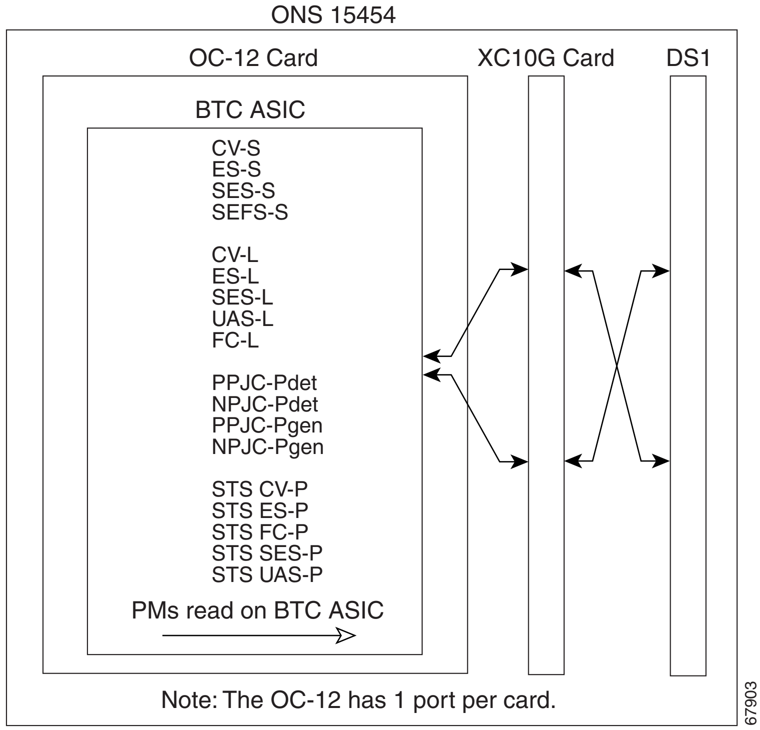
Figure 13-16 shows the signal types that support far-end PMs. Figure 13-17 shows where overhead bytes detected on the ASICs produce performance monitoring parameters for the OC-12 card.

Figure 13-16 Monitored signal types for the OC-12 card



Note PMs on the protect STS are not supported for BLSR. The XX in the illustration above represents all PMs listed below with the given prefix and/or suffix.

Figure 13-17 PM read points on the OC-12 card



Note For PM locations relating to protection switch counts, see the GR-1230-CORE document.

Table 13-35 Near-End Section PMs for the OC-12 Card

Parameter	Definition
CV-S	Section Coding Violation (CV-S) is a count of BIP errors detected at the section-layer (i.e. using the B1 byte in the incoming SONET signal). Up to eight section BIP errors can be detected per STS-N frame; each error increments the current CV-S second register.
ES-S	Section Errored Seconds (ES-S) is a count of the number of seconds when at least one section-layer BIP error was detected or an SEF or LOS defect was present.
SES-S	Section Severely Errored Seconds (SES-S) is a count of the seconds when K (see GR-253 for value) or more section-layer BIP errors were detected or an SEF or LOS defect was present.
SEFS-S	Section Severely Errored Framing Seconds (SEFS-S) is a count of the seconds when an SEF defect was present. An SEF defect is expected to be present during most seconds when an LOS or LOF defect is present. However, there may be situations when the SEFS-S parameter is only incremented based on the presence of an SEF defect.

Table 13-36 Near-End Line Layer PMs for the OC-12 Card

Parameter	Definition
CV-L	Near-End Line Code Violation (CV-L) is a count of BIP errors detected at the line-layer (i.e. using the B2 bytes in the incoming SONET signal). Up to 8 x N BIP errors can be detected per STS-N frame; each error increments the current CV-L second register.
ES-L	Near-End Line Errored Seconds (ES-L) is a count of the seconds when at least one line-layer BIP error was detected or an AIS-L defect was present.
SES-L	Near-End Line Severely Errored Seconds (SES-L) is a count of the seconds when K (see GR-253 for values) or more line-layer BIP errors were detected or an AIS-L defect was present.
UAS-L	Near-End Line Unavailable Seconds (UAS-L) is a count of the seconds when the line is unavailable. A line becomes unavailable when ten consecutive seconds occur that qualify as SES-Ls, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Ls.
FC-L	Near-End Line Failure Count (FC-L) is a count of the number of near-end line failure events. A failure event begins when an AIS-L failure or a lower-layer traffic-related, near-end failure is declared. This failure event ends when the failure is cleared. A failure event that begins in one period and ends in another period is counted only in the period where it begins.

Table 13-37 Near-End SONET Path H-byte PMs for the OC-12 Card

Parameter	Definition
Note On CTC, the count fields for PPJC and NPJC PMs appear white and blank unless they are enabled on the Provisioning > Line tabs.	
PPJC-Pdet	Positive Pointer Justification Count, STS Path Detected (PPJC-Pdet) is a count of the positive pointer justifications detected on a particular path on an incoming SONET signal.
NPJC-Pdet	Negative Pointer Justification Count, STS Path Detected (NPJC-Pdet) is a count of the negative pointer justifications detected on a particular path on an incoming SONET signal.
PPJC-Pgen	Positive Pointer Justification Count, STS Path Generated (PPJC-Pgen) is a count of the positive pointer justifications generated for a particular path to reconcile the frequency of the SPE with the local clock.
NPJC-Pgen	Negative Pointer Justification Count, STS Path Generated (PPJC-Pgen) is a count of the negative pointer justifications generated for a particular path to reconcile the frequency of the synchronous payload envelope (SPE) with the local clock.

Table 13-38 Near-End Line Layer PMs for the OC-12 Card

Parameter	Definition
For information about Troubleshooting UPSR switch counts, see the alarm troubleshooting information in the *Cisco ONS 15454 Troubleshooting Guide*. For information about creating circuits that perform a switch, see Chapter 11, "Circuits and Tunnels."	
PSC (BLSR)	For a protect line in a 2-fiber ring, Protection Switching Count (PSC) refers to the number of times a protection switch has occurred either to a particular span's line protection or away from a particular span's line protection. Therefore, if a protection switch occurs on a 2-fiber BLSR, the PSC of the protection span to which the traffic is switched will increment, and when the switched traffic returns to its original working span from the protect span, the PSC of the protect span will increment again. **Note** 4-fiber BLSR is not supported on the OC-12 card; therefore, the PSC-S, and PSC-R PMs do not increment.
PSC (1+1 protection)	In a 1 + 1 protection scheme for a working card, Protection Switching Count (PSC) is a count of the number of times service switches from a working card to a protection card plus the number of times service switches back to the working card. For a protection card, PSC is a count of the number of times service switches to a working card from a protection card plus the number of times service switches back to the protection card. The PSC PM is only applicable if revertive line-level protection switching is used.
PSD	For an active protection line in a 2-fiber BLSR, Protection Switching Duration (PSD) is a count of the number of seconds that the protect line is carrying working traffic following the failure of the working line. PSD increments on the active protect line and PSD-W increments on the failed working line. **Note** 4-fiber BLSR is not supported on the OC-12 card; therefore, the PSD-S, and PSD-R PMs do not increment.
PSC-W	For a working line in a 2-fiber BLSR, Protection Switching Count-Working (PSC-W) is a count of the number of times traffic switches away from the working capacity in the failed line and back to the working capacity after the failure is cleared. PSC-W increments on the failed working line and PSC increments on the active protect line.
PSD-W	For a working line in a 2-fiber BLSR, Protection Switching Duration-Working (PSD-W) is a count of the number of seconds that service was carried on the protection line. PSD-W increments on the failed working line and PSD increments on the active protect line.

Table 13-39 Near-End SONET Path PMs for the OC-12 Card

Parameter	Definition
Note SONET path PMs will not count unless IPPM is enabled. For additional information, see the "Intermediate-Path Performance Monitoring Reference" section on page 13-3. Far-end IPPM is not supported. However, SONET path PMs can be monitored by logging into the far-end node directly.	
STS CV-P	Near-End STS Path Coding Violations (CV-P) is a count of BIP errors detected at the STS path layer (i.e., using the B3 byte). Up to eight BIP errors can be detected per frame; each error increments the current CV-P second register.
STS ES-P	Near-End STS Path Errored Seconds (ES-P) is a count of the seconds when at least one STS path BIP error was detected. An AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect can also cause an STS ES-P.
STS FC-P	Near-End STS Path Failure Counts (FC-P) is a count of the number of near-end STS path failure events. A failure event begins with an AIS-P failure, an LOP-P failure, a UNEQ-P failure or a TIM-P failure is declared, or if the STS PTE that is monitoring the path supports ERDI-P for that path. The failure event ends when these failures are cleared.
STS SES-P	Near-End STS Path Severely Errored Seconds (SES-P) is a count of the seconds when K (2400) or more STS path BIP errors were detected. An AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect can also cause an STS SES-P.
STS UAS-P	Near-End STS Path Unavailable Seconds (UAS-P) is a count of the seconds when the STS path was unavailable. An STS path becomes unavailable when ten consecutive seconds occur that qualify as SES-Ps, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Ps.

Table 13-40 Far-End Line Layer PMs for the OC-12 Card

Parameter	Definition
CV-L	Far-End Line Code Violation (CV-L) is a count of BIP errors detected by the far-end line terminating equipment (LTE) and reported back to the near-end LTE using the REI-L indication in the line overhead. For SONET signals at rates below OC-48, up to 8 x N BIP errors per STS-N frame can be indicated using the REI-L. For OC-48 signals, up to 255 BIP errors per STS-N frame can be indicated. The current CV-L second register is incremented for each BIP error indicated by the incoming REI-L.
ES-L	Far-End Line Errored Seconds (ES-L) is a count of the seconds when at least one line-layer BIP error was reported by the far-end LTE or an RDI-L defect was present.
SES-L	Far-End Line Severely Errored Seconds (SES-L) is a count of the seconds when K (see GR-253-CORE for values) or more line-layer BIP errors were reported by the far-end LTE or an RDI-L defect was present.

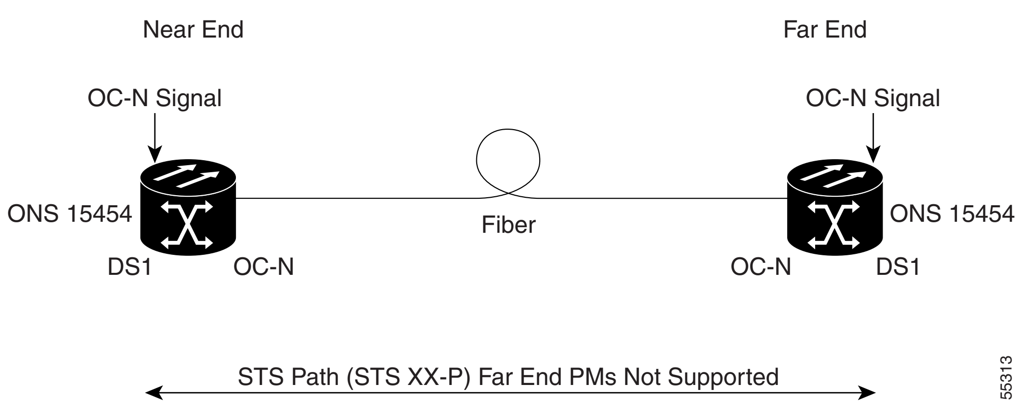
Table 13-40 Far-End Line Layer PMs for the OC-12 Card (continued)

Parameter	Definition
UAS-L	Far-End Line Unavailable Seconds (UAS-L) is a count of the seconds when the line is unavailable at the far end. A line becomes unavailable at the far end when ten consecutive seconds occur that qualify as SES-LFEs, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-LFEs.
FC-L	Far-End Line Failure Count (FC-L) is a count of the number of far-end line failure events. A failure event begins when RFI-L failure is declared and ends when the RFI-L failure clears. A failure event that begins in one period and ends in another period is counted only in the period where it began.

13.5.3 OC-48 and OC-192 Card Performance Monitoring Parameters

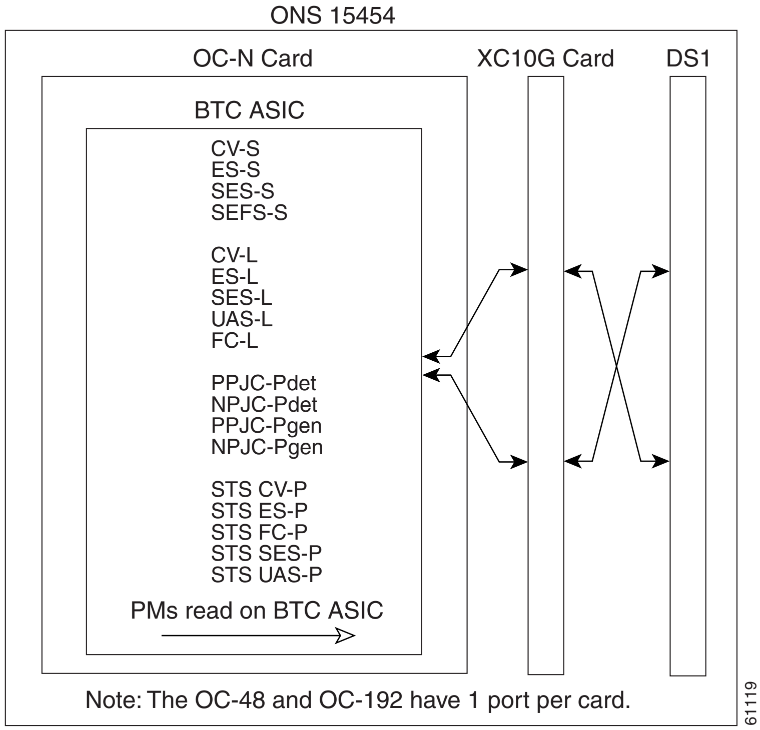
Figure 13-16 shows the signal types that support far-end PMs. Figure 13-17 shows where overhead bytes detected on the ASICs produce performance monitoring parameters for the OC-48 and OC-192 cards.

Figure 13-18 Monitored signal types for the OC-48 and OC-192 cards



Note PMs on the protect STS are not supported for BLSR. The XX in the illustration above represents all PMs listed below with the given prefix and/or suffix.

Figure 13-19 PM read points on the OC-48 and OC-192 cards



Note For PM locations relating to protection switch counts, see the GR-1230-CORE document.

Table 13-41 Near-End Section PMs for the OC-48 and OC-192 Cards

Parameter	Definition
CV-S	Section Coding Violation (CV-S) is a count of BIP errors detected at the section-layer (i.e. using the B1 byte in the incoming SONET signal). Up to eight section BIP errors can be detected per STS-N frame; each error increments the current CV-S second register.
ES-S	Section Errored Seconds (ES-S) is a count of the number of seconds when at least one section-layer BIP error was detected or an SEF or LOS defect was present.
SES-S	Section Severely Errored Seconds (SES-S) is a count of the seconds when K (see GR-253 for value) or more section-layer BIP errors were detected or an SEF or LOS defect was present.
SEFS-S	Section Severely Errored Framing Seconds (SEFS-S) is a count of the seconds when an SEF defect was present. An SEF defect is expected to be present during most seconds when an LOS or LOF defect is present. However, there may be situations when the SEFS-S parameter is only incremented based on the presence of an SEF defect.

Table 13-42 Near-End Line Layer PMs for the OC-48 and OC-192 Cards

Parameter	Definition
CV-L	Near-End Line Code Violation (CV-L) is a count of BIP errors detected at the line-layer (i.e. using the B2 bytes in the incoming SONET signal). Up to 8 x N BIP errors can be detected per STS-N frame; each error increments the current CV-L second register.
ES-L	Near-End Line Errored Seconds (ES-L) is a count of the seconds when at least one line-layer BIP error was detected or an AIS-L defect was present.
SES-L	Near-End Line Severely Errored Seconds (SES-L) is a count of the seconds when K (see GR-253 for values) or more line-layer BIP errors were detected or an AIS-L defect was present.
UAS-L	Near-End Line Unavailable Seconds (UAS-L) is a count of the seconds when the line is unavailable. A line becomes unavailable when ten consecutive seconds occur that qualify as SES-Ls, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Ls.
FC-L	Near-End Line Failure Count (FC-L) is a count of the number of near-end line failure events. A failure event begins when an AIS-L failure or a lower-layer traffic-related, near-end failure is declared. This failure event ends when the failure is cleared. A failure event that begins in one period and ends in another period is counted only in the period where it begins.

Table 13-43 Near-End SONET Path H-byte PMs for the OC-48 and OC-192 Cards

Parameter	Definition
Note On CTC, the count fields for PPJC and NPJC PMs appear white and blank unless they are enabled on the Provisioning > Line tabs.	
PPJC-Pdet	Positive Pointer Justification Count, STS Path Detected (PPJC-Pdet) is a count of the positive pointer justifications detected on a particular path on an incoming SONET signal.
NPJC-Pdet	Negative Pointer Justification Count, STS Path Detected (NPJC-Pdet) is a count of the negative pointer justifications detected on a particular path on an incoming SONET signal.
PPJC-Pgen	Positive Pointer Justification Count, STS Path Generated (PPJC-Pgen) is a count of the positive pointer justifications generated for a particular path to reconcile the frequency of the SPE with the local clock.
NPJC-Pgen	Negative Pointer Justification Count, STS Path Generated (PPJC-Pgen) is a count of the negative pointer justifications generated for a particular path to reconcile the frequency of the synchronous payload envelope (SPE) with the local clock.

Table 13-44 Near-End Line Layer PMs for the OC-48 and OC-192 Cards

Parameter	Definition
For information about Troubleshooting UPSR switch counts, see the alarm troubleshooting information in the *Cisco ONS 15454 Troubleshooting Guide*. For information about creating circuits that perform a switch, see Chapter 11, "Circuits and Tunnels."	
PSC (BLSR)	For a protect line in a 2-fiber ring, Protection Switching Count (PSC) refers to the number of times a protection switch has occurred either to a particular span's line protection or away from a particular span's line protection. Therefore, if a protection switch occurs on a 2-fiber BLSR, the PSC of the protection span to which the traffic is switched will increment, and when the switched traffic returns to its original working span from the protect span, the PSC of the protect span will increment again.
PSC (1+1 protection)	In a 1 + 1 protection scheme for a working card, Protection Switching Count (PSC) is a count of the number of times service switches from a working card to a protection card plus the number of times service switches back to the working card. For a protection card, PSC is a count of the number of times service switches to a working card from a protection card plus the number of times service switches back to the protection card. The PSC PM is only applicable if revertive line-level protection switching is used.
PSD	For an active protection line in a 2-fiber BLSR, Protection Switching Duration (PSD) is a count of the number of seconds that the protect line is carrying working traffic following the failure of the working line. PSD increments on the active protect line and PSD-W increments on the failed working line.
PSC-W	For a working line in a 2-fiber BLSR, Protection Switching Count-Working (PSC-W) is a count of the number of times traffic switches away from the working capacity in the failed line and back to the working capacity after the failure is cleared. PSC-W increments on the failed working line and PSC increments on the active protect line. For a working line in a 4-fiber BLSR, PSC-W is a count of the number of times service switches from a working line to a protection line plus the number of times it switches back to the working line. PSC-W increments on the failed line and PSC-R or PSC-S increments on the active protect line.
PSD-W	For a working line in a 2-fiber BLSR, Protection Switching Duration-Working (PSD-W) is a count of the number of seconds that service was carried on the protection line. PSD-W increments on the failed working line and PSD increments on the active protect line.
PSC-S	In a 4-fiber BLSR, Protection Switching Count-Span (PSC-S) is a count of the number of times service switches from a working line to a protection line plus the number of times it switches back to the working line. A count is only incremented if span switching is used.
PSD-S	In a 4-fiber BLSR, Protection Switching Duration-Span (PSD-S) is a count of the seconds that the protection line was used to carry service. A count is only incremented if span switching is used.

Table 13-44 Near-End Line Layer PMs for the OC-48 and OC-192 Cards (continued)

Parameter	Definition
PSC-R	In a 4-fiber BLSR, Protection Switching Count-Ring (PSC-R) is a count of the number of times service switches from a working line to a protection line plus the number of times it switches back to a working line. A count is only incremented if ring switching is used.
PSD-R	In a 4-fiber BLSR, Protection Switching Duration-Ring (PSD-R) is a count of the seconds that the protection line was used to carry service. A count is only incremented if ring switching is used.

Table 13-45 Near-End SONET Path PMs for the OC-48 and OC-192 Cards

Parameter	Definition
Note SONET path PMs will not count unless IPPM is enabled. For additional information, see the "Intermediate-Path Performance Monitoring Reference" section on page 13-3. Far-end IPPM is not supported. However, SONET path PMs can be monitored by logging into the far-end node directly.	
STS CV-P	Near-End STS Path Coding Violations (CV-P) is a count of BIP errors detected at the STS path layer (i.e., using the B3 byte). Up to eight BIP errors can be detected per frame; each error increments the current CV-P second register.
STS ES-P	Near-End STS Path Errored Seconds (ES-P) is a count of the seconds when at least one STS path BIP error was detected. An AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect can also cause an STS ES-P.
STS FC-P	Near-End STS Path Failure Counts (FC-P) is a count of the number of near-end STS path failure events. A failure event begins with an AIS-P failure, an LOP-P failure, a UNEQ-P failure or a TIM-P failure is declared, or if the STS PTE that is monitoring the path supports ERDI-P for that path. The failure event ends when these failures are cleared.
STS SES-P	Near-End STS Path Severely Errored Seconds (SES-P) is a count of the seconds when K (2400) or more STS path BIP errors were detected. An AIS-P defect (or a lower-layer, traffic-related, near-end defect) or an LOP-P defect can also cause an STS SES-P.
STS UAS-P	Near-End STS Path Unavailable Seconds (UAS-P) is a count of the seconds when the STS path was unavailable. An STS path becomes unavailable when ten consecutive seconds occur that qualify as SES-Ps, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-Ps.

Table 13-46 Far-End Line Layer PMs for the OC-48 and OC-192 Cards

Parameter	Definition
CV-L	Far-End Line Code Violation (CV-L) is a count of BIP errors detected by the far-end line terminating equipment (LTE) and reported back to the near-end LTE using the REI-L indication in the line overhead. For SONET signals at rates below OC-48, up to 8 x N BIP errors per STS-N frame can be indicated using the REI-L. For OC-48 signals, up to 255 BIP errors per STS-N frame can be indicated. The current CV-L second register is incremented for each BIP error indicated by the incoming REI-L.
ES-L	Far-End Line Errored Seconds (ES-L) is a count of the seconds when at least one line-layer BIP error was reported by the far-end LTE or an RDI-L defect was present.
SES-L	Far-End Line Severely Errored Seconds (SES-L) is a count of the seconds when K (see GR-253-CORE for values) or more line-layer BIP errors were reported by the far-end LTE or an RDI-L defect was present.
UAS-L	Far-End Line Unavailable Seconds (UAS-L) is a count of the seconds when the line is unavailable at the far end. A line becomes unavailable at the far end when ten consecutive seconds occur that qualify as SES-LFEs, and it continues to be unavailable until ten consecutive seconds occur that do not qualify as SES-LFEs.
FC-L	Far-End Line Failure Count (FC-L) is a count of the number of far-end line failure events. A failure event begins when RFI-L failure is declared and ends when the RFI-L failure clears. A failure event that begins in one period and ends in another period is counted only in the period where it began.

CHAPTER 14

SNMP

This chapter explains Simple Network Management Protocol (SNMP) as implemented by the Cisco ONS 15454.

For SNMP set up information, refer to the *Cisco ONS 15454 Procedure Guide*.

Chapter topics include:

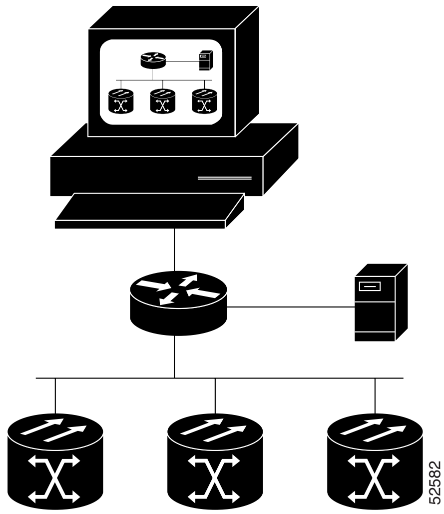
14.1 SNMP Overview

SNMP is an application-layer communication protocol that allows network devices to exchange management information. SNMP enables network administrators to manage network performance, find and solve network problems, and plan network growth.

The ONS 15454 uses SNMP to provide asynchronous event notification to a network management system (NMS). ONS SNMP implementation uses standard Internet Engineering Task Force (IETF) MIBs to convey node-level inventory, fault, and performance management information for generic read-only management of DS-1, DS-3, SONET, and Ethernet technologies. SNMP allows limited management of the ONS 15454 by a generic SNMP manager, for example HP OpenView Network Node Manager (NNM) or Open Systems Interconnection (OSI) NetExpert.

The Cisco ONS 15454 supports SNMP Version 1 (SNMPv1) and SNMP Version 2c (SNMPv2c). Both versions share many features, but SNMPv2c includes additional protocol operations. This chapter describes both versions and explains how to configure SNMP on the ONS 15454. Figure 14-1 illustrates a basic network managed by SNMP.

Figure 14-1 A basic network managed by SNMP

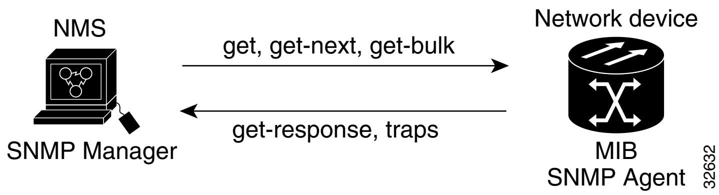


14.2 SNMP Basic Components

An SNMP-managed network consists of three primary components: managed devices, agents, and management systems. A managed device is a network node that contains an SNMP agent and resides on an SNMP-managed network. Managed devices collect and store management information and use SNMP to make this information available to management systems that use SNMP. Managed devices include routers, access servers, switches, bridges, hubs, computer hosts, and network elements such as an ONS 15454.

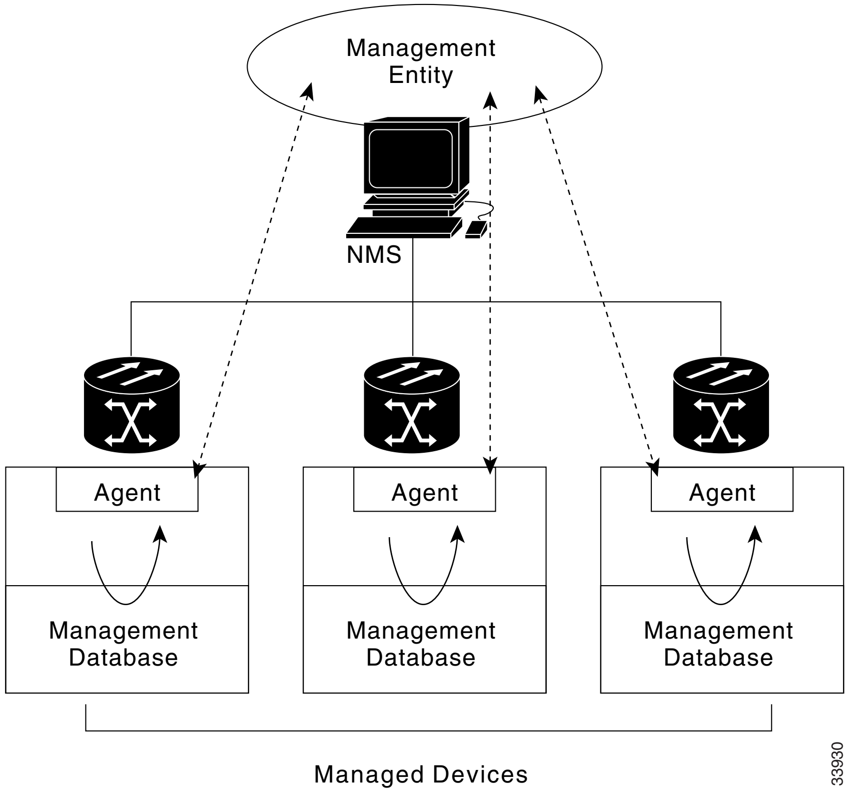
An agent is a software module that resides in a managed device. An agent has local knowledge of management information and translates that information into a form compatible with SNMP. The SNMP agent gathers data from the MIB, which is the repository for device parameter and network data. The agent can also send traps, or notification of certain events, to the manager. Figure 14-2 illustrates these SNMP operations.

Figure 14-2 An SNMP agent gathering data from an MIB and sending traps to the manager



A management system such as HP OpenView executes applications that monitor and control managed devices. Management systems provide the bulk of the processing and memory resources required for network management. One or more management systems must exist on any managed network. Figure 14-3 illustrates the relationship between the three key SNMP components.

Figure 14-3 Example of the primary SNMP components



14.3 SNMP Support

The ONS 15454 supports SNMP v1 and v2c traps and get requests. The SNMP MIBs in the ONS 15454 define alarms, traps, and status. Through SNMP, NMS applications can query a management agent using a supported MIB. The functional entities include Ethernet switches and SONET multiplexers. Refer to the *Cisco ONS 15454 Procedure Guide* for the Setup SNMP Support procedure.

14.4 SNMP Management Information Bases

A management information base (MIB) is a hierarchically-organized collection of information. Network-management protocols, such as SNMP, gain access to MIBs. MIBs consist of managed objects and are identified by object identifiers.

The ONS 15454 SNMP agent communicates with an SNMP management application using SNMP messages. Table 14-1 describes these messages.

Table 14-1 SNMP Message Types

Operation	Description
get-request	Retrieves a value from a specific variable
get-next-request	Retrieves the value following the named variable; this operation is often used to retrieve variables from within a table. With this operation, an SNMP manager does not need to know the exact variable name. The SNMP manager searches sequentially to find the needed variable from within the MIB.
get-response	The reply to a get-request, get-next-request, get-bulk-request, or set-request sent by an NMS
get-bulk-request	Similar to a get-next-request, but this operation fills the get-response with up to the max-repetition number of get-next interactions
set-request	Set-request processing is enabled to provide RMON MIB.
trap	An unsolicited message sent by an SNMP agent to an SNMP manager indicating that an event has occurred

A managed object (sometimes called a MIB object) is one of any specific characteristics of a managed device. Managed objects consist of one or more object instances (variables). Table 14-2 lists the IETF standard MIBs implemented in the ONS 15454 SNMP Agent.

The ONS 15454 MIBs are included on the software CD that ships with the ONS 15454. Compile these MIBs in the following order. If you do not follow the order, one or more MIB files might not compile.

1. CERENT-GLOBAL-REGISTRY.mib
2. CERENT-TC.mib
3. CERENT-454.mib
4. CERENT-GENERIC.mib

If you cannot compile the ONS 15454 MIBs, call the Technical Assistance Center (TAC) at 1-877-323-7368.

Table 14-2 IETF Standard MIBs Implemented in the ONS 15454 SNMP Agent

RFC#	Module Name	Title/Comments
1213 +1907	RFC1213-MIB, SNMPV2-MIB	MIB-II from RFC1213 with enhancement from RFC1907 for v2
1253	OSPF-MIB	Open shortest path first
1493	BRIDGE-MIB	Bridge/Spanning Tree (SNMPv1 MIB)
1757	RMON-MIB	Remote monitoring (RMON) Ethernet
2021	RMON2-MIB	Remote monitoring 2 (RMON2) Ethernet
2737	ENTITY-MIB	Entity MIB using SMI v2 (version II)
2233	IF-MIB	Interface evolution (enhances MIB-II)
2358	Etherlike-MIB	Ethernet-like interface (SNMPv2 MIB)
2495	DS1-MIB	DS-1/E1
2496	DS3-MIB	DS-3/E3

Table 14-2 IETF Standard MIBs Implemented in the ONS 15454 SNMP Agent (continued)

RFC#	Module Name	Title/Comments
2558	SONET-MIB	SONET
2674	P-BRIDGE-MIB, Q-BRIDGE-MIB	P-Bridge and Q-Bridge MIB

14.5 SNMP Traps

The ONS 15454 can receive SNMP requests from a number of SNMP managers and send traps to eleven trap receivers. The ONS 15454 generates all alarms and events as SNMP traps.

The ONS 15454 generates traps containing an object ID that uniquely identifies the alarm. An entity identifier uniquely identifies the entity that generated the alarm (slot, port, STS, VT, BLSR, STP, etc.). The traps give the severity of the alarm (critical, major, minor, event, etc.) and indicate whether the alarm is service affecting or non-service affecting. The traps also contain a date/time stamp that shows the date and time the alarm occurred. The ONS 15454 also generates a trap for each alarm when the alarm condition clears.

Each SNMP trap contains eleven variable bindings listed in Table 14-3 for the ONS 15454. Table 14-4 lists the variable bindings for the ONS 15327.

Table 14-3 SNMP Trap Variable Bindings for ONS 15454

Number	Name	Description
1	cerent454AlarmTable	This table holds all the currently-raised alarms. When an alarm is raised, it appears as a new entry in the table. When an alarm is cleared, it is removed from the table and all the subsequent entries move up by one row.
2	cerent454AlarmIndex	This variable uniquely identifies each entry in an alarm table. When an alarm in the alarm table clears, the alarm indexes change for each alarm located subsequent to the cleared alarm.
3	cerent454AlarmObjectType	This variable provides the entity type that raised the alarm. The NMS should use this value to decide which table to poll for further information about the alarm.
4	cerent454AlarmSlotNumber	This variable indicates the slot of the object that raised the alarm. If a slot is not relevant to the alarm, the slot number is zero.
5	cerent454AlarmPortNumber	This variable provides the port of the object that raised the alarm. If a port is not relevant to the alarm, the port number is zero.
6	cerent454AlarmLineNumber	This variable provides the object line that raised the alarm. If a line is not relevant to the alarm, the line number is zero.

Table 14-3 SNMP Trap Variable Bindings for ONS 15454 (continued)

Number	Name	Description
7	cerent454AlarmObjectIndex	Every alarm is raised by an object entry in a specific table. This variable is the index of the objects in each table; if the alarm is interface related, this is the index of the interfaces in the interface table.
8	cerent454AlarmType	This variable provides the exact alarm type.
9	cerent454AlarmState	This variable specifies alarm severity and service-affecting status. Severities are minor, major and critical. Service- affecting statuses are service-affecting and non-service affecting.
10	cerent454AlarmTimeStamp	This variable gives the time when the alarm occurred. The value is the number of the ticks that has lapsed since 1/1/1970.
11	cerent454AlarmObjectName	This variable gives the TL1-style user-visible name which uniquely identifies an object in the system.

Table 14-4 SNMP Trap Variable Bindings used in ONS 15327

Number	Name	Description
1	cerentGenericAlarmTable	This table holds all the currently-raised alarms. When an alarm is raised, it appears as a new entry in the table. When an alarm is cleared, it is removed from the table and all the subsequent entries move up by one row.
2	cerentGenericAlarmIndex	This variable uniquely identifies each entry in an alarm table. When an alarm in the alarm table clears, the alarm indexes change for each alarm located subsequent to the cleared alarm.
3	cerentGenericAlarmObjectType	This variable provides the entity type that raised the alarm. The NMS should use this value to decide which table to poll for further information about the alarm.
4	cerentGenericAlarmSlotNumber	This variable indicates the slot of the object that raised the alarm. If a slot is not relevant to the alarm, the slot number is zero.
5	cerentGenericAlarmPortNumber	This variable provides the port of the object that raised the alarm. If a port is not relevant to the alarm, the port number is zero.
6	cerentGenericAlarmLineNumber	This variable provides the object line that raised the alarm. If a line is not relevant to the alarm, the line number is zero.
7	cerentGenericAlarmObjectIndex	Every alarm is raised by an object entry in a specific table. This variable is the index of the objects in each table; if the alarm is interface related, this is the index of the interfaces in the interface table.

Table 14-4 SNMP Trap Variable Bindings used in ONS 15327 (continued)

Number	Name	Description
8	cerentGenericAlarmType	This variable provides the exact alarm type.
9	cerentGenericAlarmState	This variable specifies alarm severity and service-affecting status. Severities are minor, major and critical. Service- affecting statuses are service-affecting and non-service affecting.
10	cerentGenericAlarmTimeStamp	This variable gives the time when the alarm occurred. The value is the number of the ticks that has lapsed since 1/1/1970.
11	cerentGenericAlarmObjectName	This variable gives the TL1-style user-visible name which uniquely identifies an object in the system.

The ONS 15454 supports the generic and IETF traps listed in Table 14-5.

Table 14-5 Traps Supported in the ONS 15454

Trap	From RFC#	Description
ColdStart	RFC1213-MIB	Agent up, cold start
WarmStart	RFC1213-MIB	Agent up, warm start
AuthenticationFailure	RFC1213-MIB	Community string does not match
NewRoot	RFC1493/ BRIDGE-MIB	Sending agent is the new root of the spanning tree
TopologyChange	RFC1493/ BRIDGE-MIB	A port in a bridge has changed from Learning to Forwarding or Forwarding to Blocking
EntConfigChange	RFC2037/ ENTITY-MIB	The entLastChangeTime value has changed
ds1xLineStatusChange	RFC2495/ DS1-MIB	A dsx1LineStatusChange trap is sent when the value of an instance dsx1LineStatus changes. The trap can be used by an NMS to trigger polls. When the line status change results from a higher-level line status change (ex. DS-3), no traps for the DS-1 are sent.
dsx3LineStatusChange	RFC2496/ DS3-MIB	A dsx3LineStatusLastChange trap is sent when the value of an instance of dsx3LineStatus changes. This trap can be used by an NMS to trigger polls. When the line status change results in a lower-level line status change (ex. DS-1), no traps for the lower-level are sent.
risingAlarm	RFC1757/ RMON-MIB	The SNMP trap that is generated when an alarm entry crosses the rising threshold and the entry generates an event that is configured for sending SNMP traps.
fallingAlarm	RFC1757/ RMON-MIB	The SNMP trap that is generated when an alarm entry crosses the falling threshold and the entry generates an event that is configured for sending SNMP traps.

14.6 SNMP Community Names

You can provision community names for all SNMP requests from the SNMP Trap Destination dialog box in CTC. In effect, SNMP considers any request valid that uses a community name matching a community name on the list of provisioned SNMP trap destinations. Otherwise, SNMP considers the request invalid and drops it.

If an SNMP request contains an invalid community name, the request silently drops and the MIB variable (snmpInBadCommunityNames) increments. All MIB variables managed by the agent grant access to all SNMP requests containing a validated community name.

14.7 SNMP Remote Network Monitoring

The ONS 15454 incorporates Remote Network Monitoring (RMON) to allow network operators to monitor the ONS 15454 Ethernet cards. This feature is not apparent to the typical CTC user, because RMON interoperates with an NMS. However, with CTC you can provision the RMON alarm thresholds, see the *Cisco ONS 15454 Procedure Guide*. CTC also monitors the five RMON groups implemented by the ONS 15454.

ONS 15454 RMON implementation is based on the IETF-standard MIB Request for Comment (RFC)1757. The ONS 15454 implements five groups from the standard MIB: Ethernet Statistics, History Control, Ethernet History, Alarm, and Event.

14.7.1 Ethernet Statistics Group

The Ethernet Statistics group contains the basic statistics for each monitored subnetwork in a single table named etherstats.

14.7.2 History Control Group

The History Control group defines sampling functions for one or more monitor interfaces. RFC 1757 defines the historyControlTable.

14.7.3 Ethernet History Group

The ONS 15454 implements the etherHistoryTable as defined in RFC 1757, within the bounds of the historyControlTable.

14.7.4 Alarm Group

The Alarm group consists of a single alarm table. This table provides the network performance alarm thresholds for the network management application. With CTC, you can provision the thresholds in the table.

14.7.5 Event Group

The Event group consists of two tables, eventTable and logTable. The eventTable is read-only. The ONS 15454 implements the logTable as specified in RFC 1757.

APPENDIX A

Regulatory and Compliance Requirements

This appendix lists customer, industry, and government requirements met by the Cisco ONS 15454. Installation warnings are also included.

Regulatory Compliance

Table A-1 Standards

Discipline	Country	Specification
EMC Emissions (Class A)	Canada	ICES-003 Issue 3, 1997 Telcordia GR-1089-CORE
	USA	Telcordia GR-1089-CORE 47CFR15
	Japan	VCCI V3/2000.04
	Korea	CISPR22
	Mexico	EN55022
	Europe	EN 300-386-TC
EMC Immunity	Canada	Telcordia GR-1089-CORE
	USA	Telcordia GR-1089-CORE
	Japan	Not Applicable
	Korea	CISPR24
	Europe	EN50082-2, EN 300-386-TC
	Mexico	EN55024

Table A-1 Standards (continued)

Discipline	Country	Specification
Safety	Canada	CAN/CSA-C22.2 No. 950-95, 3rd Ed. Telcordia GR-1089-CORE Telcordia GR-63-CORE
	USA	UL 1950, 3rd Ed. Telcordia GR-1089-CORE Telcordia GR-63-CORE
	Europe	IEC60950/EN60950, 3rd Ed.
	Japan	EN60950 (to A4)
	Korea	EN60950 (to A4)
	Mexico	Certified
Telecommunications	Japan	Blue Book 1996, Green Book 1997
	Canada	Not Applicable
	USA	Not Applicable
	Europe	No requirement
	Korea	OC12, OC48
	Mexico	Certified
Environmental	Canada USA	Telcordia GR-63-CORE NEBS
		Cisco Mechanical Environmental Design and Qualification Guideline ENG-3396
Structural Dynamics (Mechanical)	Canada USA	Telcordia GR-63-CORE NEBS
		Cisco Mechanical Environmental Design and Qualification Guideline ENG-3396
		AT&T Network Equipment Development Standards (NEDS)
Power & Grounding	Global	SBC Local Exchange Carriers, Network Equipment Power, Grounding, Environmental, and Physical Design Requirements, TP76200MP

Japan Approvals

Table A-2 Card Approvals

Card	Certificate Number
15454-DS1-14	L02-0014
15454-DS3E-12	L02-0013
DS3N-12	L00-0285
15454-OC3-4IR 1310	L00-0265

Table A-2 Card Approvals (continued)

Card	Certificate Number
15454-OC12IR 1310	L00-0266
15454-OC48IR 1310	L00-0267
15454-OC48IR 1310AS	L02-0012

Label Information

The following labels are applicable for use in Japan.

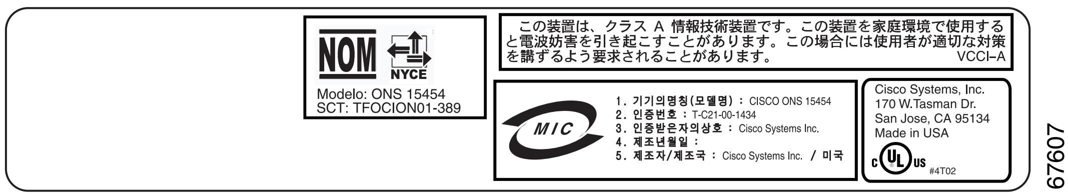


Figure A-1 Electrical Card 15454-DS1-14

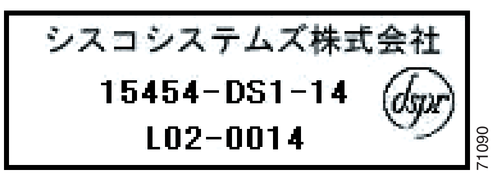


Figure A-2 Electrical Card 15454-DS3E-12

Figure A-3 Electrical Card 15454-DS3N-12

Figure A-4 Optical Card 15454-OC3-4IR1310

Figure A-5 Optical Card 15454-OC12IR1310

Figure A-6 Optical Card 15454-OC48IR1310

Figure A-7 Optical Card 15454-OC48IR1310AS

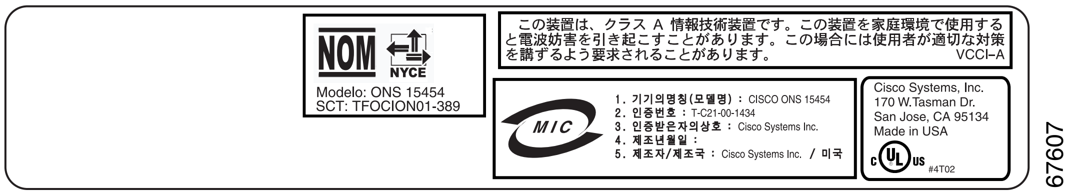
Korea Approvals

Table A-3 Certification of Information and Communication Equipment

Model	Certificate Number
ONS 15454	T-C21-00-1434

Korea Labels

Figure A-8 Korea Label



Class A Notice

Warning **This is a Class A Information Product. When used in residential environment, it may cause radio frequency interference. Under such circumstances, the user may be requested to take appropriate countermeasures.**

警告使用者 這是甲類資訊產品，在居住環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

この装置は、クラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

Installation Warnings

Install the ONS 15454 in compliance with your local and national electrical codes:

- United States: National Fire Protection Association (NFPA) 70; United States National Electrical Code
- Canada: Canadian Electrical Code, Part I, CSA C22.1
- Other countries: If local and national electrical codes are not available, refer to IEC 364, Part 1 through Part 7.

Warning **Read the installation instructions before you connect the system to its power source.**

Waarschuwing **Raadpleeg de installatie-aanwijzingen voordat u het systeem met de voeding verbindt.**

Varoitus **Lue asennusohjeet ennen järjestelmän yhdistämistä virtalähteeseen.**

Attention **Avant de brancher le système sur la source d'alimentation, consulter les directives d'installation.**

Warnung **Lesen Sie die Installationsanweisungen, bevor Sie das System an die Stromquelle anschließen.**

Avvertenza **Consultare le istruzioni di installazione prima di collegare il sistema all'alimentatore.**

Advarsel **Les installasjonsinstruksjonene før systemet kobles til strømkilden.**

Aviso **Leia as instruções de instalação antes de ligar o sistema à sua fonte de energia.**

¡Advertencia! **Ver las instrucciones de instalación antes de conectar el sistema a la red de alimentación.**

Varning! **Läs installationsanvisningarna innan du kopplar systemet till dess strömförsörjningsenhet.**

警告 システムを電源に接続する前に、インストレーションについての説明書を必ずお読みください。

DC Power Disconnection Warning

Warning **Before performing any of the following procedures, ensure that power is removed from the DC circuit. To ensure that all power is OFF, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the OFF position, and tape the switch handle of the circuit breaker in the OFF position.**

Waarschuwing **Voordat u een van de onderstaande procedures uitvoert, dient u te controleren of de stroom naar het gelijkstroom circuit uitgeschakeld is. Om u ervan te verzekeren dat alle stroom UIT is geschakeld, kiest u op het schakelbord de stroomverbreker die het gelijkstroom circuit bedient, draait de stroomverbreker naar de UIT positie en plakt de schakelaarhendel van de stroomverbreker met plakband in de UIT positie vast.**

Varoitus **Varmista, että tasavirtapiirissä ei ole virtaa ennen seuraavien toimenpiteiden suorittamista. Varmistaaksesi, että virta on KATKAISTU täysin, paikanna tasavirrasta huolehtivassa kojetaulussa sijaitseva suojakytkin, käännä suojakytkin KATKAISTU-asentoon ja teippaa suojakytkimen varsi niin, että se pysyy KATKAISTU-asennossa.**

Attention **Avant de pratiquer l'une quelconque des procédures ci-dessous, vérifier que le circuit en courant continu n'est plus sous tension. Pour en être sûr, localiser le disjoncteur situé sur le panneau de service du circuit en courant continu, placer le disjoncteur en position fermée (OFF) et, à l'aide d'un ruban adhésif, bloquer la poignée du disjoncteur en position OFF.**

Warnung Vor Ausführung der folgenden Vorgänge ist sicherzustellen, daß die Gleichstromschaltung keinen Strom erhält. Um sicherzustellen, daß sämtlicher Strom abgestellt ist, machen Sie auf der Schalttafel den Unterbrecher für die Gleichstromschaltung ausfindig, stellen Sie den Unterbrecher auf AUS, und kleben Sie den Schaltergriff des Unterbrechers mit Klebeband in der AUS-Stellung fest.

Avvertenza Prima di svolgere una qualsiasi delle procedure seguenti, verificare che il circuito CC non sia alimentato. Per verificare che tutta l'alimentazione sia scollegata (OFF), individuare l'interruttore automatico sul quadro strumenti che alimenta il circuito CC, mettere l'interruttore in posizione OFF e fissarlo con nastro adesivo in tale posizione.

Advarsel Før noen av disse prosedyrene utføres, kontroller at strømmen er frakoblet likestrømkretsen. Sørg for at all strøm er slått AV. Dette gjøres ved å lokalisere strømbryteren på brytertavlen som betjener likestrømkretsen, slå strømbryteren AV og teipe bryterhåndtaket på strømbryteren i AV-stilling.

Aviso Antes de executar um dos seguintes procedimentos, certifique-se que desligou a fonte de alimentação de energia do circuito de corrente contínua. Para se assegurar que toda a corrente foi DESLIGADA, localize o disjuntor no painel que serve o circuito de corrente contínua e coloque-o na posição OFF (Desligado), segurando nessa posição a manivela do interruptor do disjuntor com fita isoladora.

¡Advertencia! Antes de proceder con los siguientes pasos, comprobar que la alimentación del circuito de corriente continua (CC) esté cortada (OFF). Para asegurarse de que toda la alimentación esté cortada (OFF), localizar el interruptor automático en el panel que alimenta al circuito de corriente continua, cambiar el interruptor automático a la posición de Apagado (OFF), y sujetar con cinta la palanca del interruptor automático en posición de Apagado (OFF).

Varning! Innan du utför någon av följande procedurer måste du kontrollera att strömförsörjningen till likströmskretsen är bruten. Kontrollera att all strömförsörjning är BRUTEN genom att slå AV det överspänningsskydd som skyddar likströmskretsen och tejpa fast överspänningsskyddets omkopplare i FRÅN-läget.

DC Power Connection Warning

Warning After wiring the DC power supply, remove the tape from the circuit breaker switch handle and reinstate power by moving the handle of the circuit breaker to the ON position.

Waarschuwing Nadat de bedrading van de gelijkstroom voeding aangebracht is, verwijdert u het plakband van de schakelaarhendel van de stroomverbreker en schakelt de stroom weer in door de hendel van de stroomverbreker naar de AAN positie te draaien.

Varoitus Yhdistettyäsi tasavirtalähteen johdon avulla poista teippi suojakytkimen varresta ja kytke virta uudestaan kääntämällä suojakytkimen varsi KYTKETTY-asentoon.

Attention Une fois l'alimentation connectée, retirer le ruban adhésif servant à bloquer la poignée du disjoncteur et rétablir l'alimentation en plaçant cette poignée en position de marche (ON).

Warnung **Nach Verdrahtung des Gleichstrom-Netzgeräts entfernen Sie das Klebeband vom Schaltergriff des Unterbrechers und schalten den Strom erneut ein, indem Sie den Griff des Unterbrechers auf EIN stellen.**

Avvertenza **Dopo aver eseguito il cablaggio dell’alimentatore CC, togliere il nastro adesivo dall’interruttore automatico e ristabilire l’alimentazione spostando all'interruttore automatico in posizione ON.**

Advarsel **Etter at likestrømsenheten er tilkoblet, fjernes teipen fra håndtaket på strømbryteren, og deretter aktiveres strømmen ved å dreie håndtaket på strømbryteren til PÅ-stilling.**

Aviso **Depois de ligar o sistema de fornecimento de corrente contínua, retire a fita isoladora da manivela do disjuntor, e volte a ligar a corrente ao deslocar a manivela para a posição ON (Ligado).**

¡Advertencia! **Después de cablear la fuente de alimentación de corriente continua, retirar la cinta de la palanca del interruptor automático, y restablecer la alimentación cambiando la palanca a la posición de Encendido (ON).**

Varning! **När du har kopplat ledningarna till strömförsörjningsenheten för inmatad likström tar du bort tejpen från överspänningsskyddets omkopplare och slår på strömmen igen genom att ställa överspänningsskyddets omkopplare i TILL-läget.**

Power Supply Disconnection Warning

Warning **Before working on a chassis or working near power supplies, unplug the power cord on AC units; disconnect the power at the circuit breaker on DC units.**

Waarschuwing **Voordat u aan een frame of in de nabijheid van voedingen werkt, dient u bij wisselstroom toestellen de stekker van het netsnoer uit het stopcontact te halen; voor gelijkstroom toestellen dient u de stroom uit te schakelen bij de stroomverbreker.**

Varoitus **Kytke irti vaihtovirtalaitteiden virtajohto ja katkaise tasavirtalaitteiden virta suojakytkimellä, ennen kuin teet mitään asennuspohjalle tai työskentelet virtalähteiden läheisyydessä.**

Attention **Avant de travailler sur un châssis ou à proximité d'une alimentation électrique, débrancher le cordon d'alimentation des unités en courant alternatif ; couper l'alimentation des unités en courant continu au niveau du disjoncteur.**

Warnung **Bevor Sie an einem Chassis oder in der Nähe von Netzgeräten arbeiten, ziehen Sie bei Wechselstromeinheiten das Netzkabel ab bzw. schalten Sie bei Gleichstromeinheiten den Strom am Unterbrecher ab.**

Avvertenza **Prima di lavorare su un telaio o intorno ad alimentatori, scollegare il cavo di alimentazione sulle unità CA; scollegare l'alimentazione all’interruttore automatico sulle unità CC.**

Advarsel **Før det utføres arbeid på kabinettet eller det arbeides i nærheten av strømforsyningsenheter, skal strømledningen trekkes ut på vekselstrømsenheter og strømmen kobles fra ved strømbryteren på likestrømsenheter.**

Aviso **Antes de trabalhar num chassis, ou antes de trabalhar perto de unidades de fornecimento de energia, desligue o cabo de alimentação nas unidades de corrente alternada; desligue a corrente no disjuntor nas unidades de corrente contínua.**

¡Advertencia! **Antes de manipular el chasis de un equipo o trabajar cerca de una fuente de alimentación, desenchufar el cable de alimentación en los equipos de corriente alterna (CA); cortar la alimentación desde el interruptor automático en los equipos de corriente continua (CC).**

Varning! **Innan du arbetar med ett chassi eller nära strömförsörjningsenheter skall du för växelströmsenheter dra ur nätsladden och för likströmsenheter bryta strömmen vid överspänningsskyddet.**

警告 シャーシの取り扱いや電源まわりの作業を行う前に、AC装置の電源コードを抜いてください。DC装置では遮断器の電源を切り離してください。

Outside Line Connection Warning

Warning **Metallic interfaces for connection to outside plant lines (such as T1/E1/T3/E3 etc.) must be connected through a registered or approved device such as CSU/DSU or NT1.**

Waarschuwing **Metaalhoudende interfaces bestemd voor aansluiting op fabrieksleidingen buiten (zoals T1/E1/T3/E3 etc.) dienen aangesloten te worden m.b.v. een geregistreerd of goedgekeurd apparaat zoals CSU/DSU of NT1.**

Varoitus **Laitoksen ulkopuolisten linjojen (T1/E1/T3/E3 jne.) kytkentään tarkoitetut metalliset rajapinnat on kytkettävä rekisteröidyn tai hyväksytyn laitteen, kuten CSU/DSU tai NT1, kautta.**

Attention **Les interfaces métalliques destinées à une connexion à des lignes extérieures au site (par exemple : T1/E1/T3/E3, etc.) doivent être raccordées sur un appareil homologué ou approuvé tel que CSU/DSU ou NT1.**

Warnung **Metallische Schnittstellen für die Verbindung mit Leitungen außerhalb der Anlagen (wie z.B. T1/E1/T3/E3 usw.) müssen durch ein registriertes oder zugelassenes Gerät wie CSU/DSU oder NT1 angeschlossen werden.**

Avvertenza **Le interfacce metalliche per la connessione a linee di impianti esterni (come T1/E1/T3/E3 ecc.) devono essere connesse mediante un dispositivo registrato o approvato, come per esempio CSU/DSU (Channel Service Unit/Data Service Unit) o NT1 (Network Terminator).**

Advarsel	**Metallgrensesnitt for kopling til eksterne anleggslinjer (for eksempel T1/E1/T3/E3 osv.) skal koples gjennom en registrert eller godkjent enhet, for eksempel CSU/DSU eller NT1.**
Aviso	**As interfaces metálicas para conexão com as linhas externas (como T1/E1/T3/E3 etc) devem ser conectadas através de um dispositivo aprovado ou certificado como CSU/DSU ou NT1.**
¡Advertencia!	**Las interfaces metálicas destinadas a las conexiones de líneas exteriores (por ejemplo, T1/E1/T3/E3, etc.) deben conectarse mediante un dispositivo registrado o aprobado como, por ejemplo, CSU/DSU o NT1.**
Varning!	**Metallkontakter för anslutning till utomhusledningar (t.ex. T1/E1/T3/E3 m.fl.) måste anslutas via en registrerad eller godkänd enhet, t.ex. CSU/DSU eller NT1.**

Class 1 Laser Product Warning

Warning	**Class 1 laser product.**
Waarschuwing	**Klasse-1 laser produkt.**
Varoitus	**Luokan 1 lasertuote.**
Attention	**Produit laser de classe 1.**
Warnung	**Laserprodukt der Klasse 1.**
Avvertenza	**Prodotto laser di Classe 1.**
Advarsel	**Laserprodukt av klasse 1.**
Aviso	**Produto laser de classe 1.**
¡Advertencia!	**Producto láser Clase I.**
Varning!	**Laserprodukt av klass 1.**

警告 第 1 種レーザー製品

경고 1급 레이저 제품.

Class I and Class 1M Laser Warning

Warning **Class I (21 CFR 1040.10 and 1040.11) and Class 1M (IEC 60825-1 2001-01) laser products.**

Waarschuwing **Laserproducten van Klasse I (21 CFR 1040.10 en 1040.11) en Klasse 1M (IEC 60825-1 2001-01).**

Varoitus **Luokan I (21 CFR 1040.10 ja 1040.11) ja luokan 1M (IEC 60825-1 2001-01) lasertuotteita.**

Attention **Produits laser catégorie I (21 CFR 1040.10 et 1040.11) et catégorie 1M (IEC 60825-1 2001-01).**

Warnung **Laserprodukte der Klasse I (21 CFR 1040.10 und 1040.11) und Klasse 1M (IEC 60825-1 2001-01).**

Avvertenza **Prodotti laser di Classe I (21 CFR 1040.10 e 1040.11) e Classe 1M (IEC 60825-1 2001-01).**

Advarsel **Klasse I (21 CFR 1040.10 og 1040.11) og klasse 1M (IEC 60825-1 2001-01) laserprodukter.**

Aviso **Produtos laser Classe I (21 CFR 1040.10 e 1040.11) e Classe 1M (IEC 60825-1 2001-01).**

¡Advertencia! **Productos láser de Clase I (21 CFR 1040.10 y 1040.11) y Clase 1M (IEC 60825-1 2001-01).**

Varning! **Laserprodukter av Klass I (21 CFR 1040.10 och 1040.11) och Klass 1M (IEC 60825-1 2001-01).**

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.**

Waarschuwing **Dit toestel is bedoeld voor installatie op plaatsen met beperkte toegang. Een plaats met beperkte toegang is een plaats waar toegang slechts door servicepersoneel verkregen kan worden door middel van een speciaal instrument, een slot en sleutel, of een ander veiligheidsmiddel, en welke beheerd wordt door de overheidsinstantie die verantwoordelijk is voor de locatie.**

Varoitus **Tämä laite on tarkoitettu asennettavaksi paikkaan, johon pääsy on rajoitettua. Paikka, johon pääsy on rajoitettua, tarkoittaa paikkaa, johon vain huoltohenkilöstö pääsee jonkin erikoistyökalun, lukkoon sopivan avaimen tai jonkin muun turvalaitteen avulla ja joka on paikasta vastuussa olevien toimivaltaisten henkilöiden valvoma.**

Attention **Cet appareil est à installer dans des zones d'accès réservé. Ces dernières sont des zones auxquelles seul le personnel de service peut accéder en utilisant un outil spécial, un mécanisme de verrouillage et une clé, ou tout autre moyen de sécurité. L'accès aux zones de sécurité est sous le contrôle de l'autorité responsable de l'emplacement.**

Warnung Diese Einheit ist zur Installation in Bereichen mit beschränktem Zutritt vorgesehen. Ein Bereich mit beschränktem Zutritt ist ein Bereich, zu dem nur Wartungspersonal mit einem Spezialwerkzeugs, Schloß und Schlüssel oder anderer Sicherheitsvorkehrungen Zugang hat, und der von dem für die Anlage zuständigen Gremium kontrolliert wird.

Avvertenza Questa unità deve essere installata in un'area ad accesso limitato. Un'area ad accesso limitato è un'area accessibile solo a personale di assistenza tramite un'attrezzo speciale, lucchetto, o altri dispositivi di sicurezza, ed è controllata dall'autorità responsabile della zona.

Advarsel Denne enheten er laget for installasjon i områder med begrenset adgang. Et område med begrenset adgang gir kun adgang til servicepersonale som bruker et spesielt verktøy, lås og nøkkel, eller en annen sikkerhetsanordning, og det kontrolleres av den autoriteten som er ansvarlig for området.

Aviso Esta unidade foi concebida para instalação em áreas de acesso restrito. Uma área de acesso restrito é uma área à qual apenas tem acesso o pessoal de serviço autorizado, que possua uma ferramenta, chave e fechadura especial, ou qualquer outra forma de segurança. Esta área é controlada pela autoridade responsável pelo local.

¡Advertencia! Esta unidad ha sido diseñada para instalarse en áreas de acceso restringido. Área de acceso restringido significa un área a la que solamente tiene acceso el personal de servicio mediante la utilización de una herramienta especial, cerradura con llave, o algún otro medio de seguridad, y que está bajo el control de la autoridad responsable del local.

Varning! Denna enhet är avsedd för installation i områden med begränsat tillträde. Ett område med begränsat tillträde får endast tillträdas av servicepersonal med ett speciellt verktyg, lås och nyckel, eller annan säkerhetsanordning, och kontrolleras av den auktoritet som ansvarar för området.

Ground Connection Warning

Warning When installing the unit, always make the ground connection first and disconnect it last.

Waarschuwing Bij de installatie van het toestel moet de aardverbinding altijd het eerste worden gemaakt en het laatste worden losgemaakt.

Varoitus Laitetta asennettaessa on maahan yhdistäminen aina tehtävä ensiksi ja maadoituksen irti kytkeminen viimeiseksi.

Attention Lors de l'installation de l'appareil, la mise à la terre doit toujours être connectée en premier et déconnectée en dernier.

Warnung Der Erdanschluß muß bei der Installation der Einheit immer zuerst hergestellt und zuletzt abgetrennt werden.

Avvertenza In fase di installazione dell'unità, eseguire sempre per primo il collegamento a massa e disconnetterlo per ultimo.

Advarsel **Når enheten installeres, må jordledningen alltid tilkobles først og frakobles sist.**

Aviso **Ao instalar a unidade, a ligação à terra deverá ser sempre a primeira a ser ligada, e a última a ser desligada.**

¡Advertencia! **Al instalar el equipo, conectar la tierra la primera y desconectarla la última.**

Varning! **Vid installation av enheten måste jordledningen alltid anslutas först och kopplas bort sist.**

Qualified Personnel Warning

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

Waarschuwing **Installatie en reparaties mogen uitsluitend door getraind en bevoegd personeel uitgevoerd worden.**

Varoitus **Ainoastaan koulutettu ja pätevä henkilökunta saa asentaa tai vaihtaa tämän laitteen.**

Avertissement **Tout installation ou remplacement de l'appareil doit être réalisé par du personnel qualifié et compétent.**

Achtung **Gerät nur von geschultem, qualifiziertem Personal installieren oder auswechseln lassen.**

Avvertenza **Solo personale addestrato e qualificato deve essere autorizzato ad installare o sostituire questo apparecchio.**

Advarsel **Kun kvalifisert personell med riktig opplæring bør montere eller bytte ut dette utstyret.**

Aviso **Este equipamento deverá ser instalado ou substituído apenas por pessoal devidamente treinado e qualificado.**

¡Atención! **Estos equipos deben ser instalados y reemplazados exclusivamente por personal técnico adecuadamente preparado y capacitado.**

Varning **Denna utrustning ska endast installeras och bytas ut av utbildad och kvalificerad personal.**

Invisible Laser Radiation Warning (other versions available)

Warning **Because invisible laser radiation may be emitted from the aperture of the port when no cable is connected, avoid exposure to laser radiation and do not stare into open apertures.**

Waarschuwing **Omdat er onzichtbare laserstraling uit de opening van de poort geëmitteerd kan worden wanneer er geen kabel aangesloten is, dient men om blootstelling aan laserstraling te vermijden niet in de open openingen te kijken.**

Varoitus **Kun porttiin ei ole kytketty kaapelia, portin aukosta voi vuotaa näkymätöntä lasersäteilyä. Älä katso avoimiin aukkoihin, jotta et altistu säteilylle.**

Attention **Etant donné qu'un rayonnement laser invisible peut être émis par l'ouverture du port quand aucun câble n'est connecté, ne pas regarder dans les ouvertures béantes afin d'éviter tout risque d'exposition au rayonnement laser.**

Warnung **Aus der Öffnung des Ports kann unsichtbare Laserstrahlung austreten, wenn kein Kabel angeschlossen ist. Kontakt mit Laserstrahlung vermeiden und nicht in offene Öffnungen blicken.**

Avvertenza **Poiché quando nessun cavo è collegato alla porta, da quest'ultima potrebbe essere emessa radiazione laser invisibile, evitare l'esposizione a tale radiazione e non fissare con gli occhi porte a cui non siano collegati cavi.**

Advarsel **Usynlige laserstråler kan sendes ut fra åpningen på utgangen når ingen kabel er tilkoblet. Unngå utsettelse for laserstråling og se ikke inn i åpninger som ikke er tildekket.**

Aviso **Evite uma exposição à radiação laser e não olhe através de aberturas expostas, porque poderá ocorrer emissão de radiação laser invisível a partir da abertura da porta, quando não estiver qualquer cabo conectado.**

¡Advertencia! **Cuando no esté conectado ningún cable, pueden emitirse radiaciones láser invisibles por el orificio del puerto. Evitar la exposición a radiaciones láser y no mirar fijamente los orificios abiertos.**

Varning! **Osynliga laserstrålar kan sändas ut från öppningen i porten när ingen kabel är ansluten. Undvik exponering för laserstrålning och titta inte in i ej täckta öppningar.**

More Than One Power Supply

Warning **This unit has more than one power supply connection; all connections must be removed completely to completely remove power from the unit.**

Waarschuwing **Deze eenheid heeft meer dan één stroomtoevoerverbinding; alle verbindingen moeten volledig worden verwijderd om de stroom van deze eenheid volledig te verwijderen.**

Varoitus **Tässä laitteessa on useampia virtalähdekytkentöjä. Kaikki kytkennät on irrotettava kokonaan, jotta virta poistettaisiin täysin laitteesta.**

Attention **Cette unité est équipée de plusieurs raccordements d'alimentation. Pour supprimer tout courant électrique de l'unité, tous les cordons d'alimentation doivent être débranchés.**

Warnung **Diese Einheit verfügt über mehr als einen Stromanschluß; um Strom gänzlich von der Einheit fernzuhalten, müssen alle Stromzufuhren abgetrennt sein.**

Avvertenza **Questa unità ha più di una connessione per alimentatore elettrico; tutte le connessioni devono essere completamente rimosse per togliere l'elettricità dall'unità.**

Advarsel **Denne enheten har mer enn én strømtilkobling. Alle tilkoblinger må kobles helt fra for å eliminere strøm fra enheten.**

Aviso **Este dispositivo possui mais do que uma conexão de fonte de alimentação de energia; para poder remover a fonte de alimentação de energia, deverão ser desconectadas todas as conexões existentes.**

¡Advertencia! **Esta unidad tiene más de una conexión de suministros de alimentación; para eliminar la alimentación por completo, deben desconectarse completamente todas las conexiones.**

Varning! **Denna enhet har mer än en strömförsörjningsanslutning; alla anslutningar måste vara helt avlägsnade innan strömtillförseln till enheten är fullständigt bruten.**

Unterminated Fiber Warning

Warning **Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments or performance of procedures other than those specified may result in hazardous radiation exposure.**

Waarschuwing **Er kunnen onzichtbare laserstralen worden uitgezonden vanuit het uiteinde van de onafgebroken vezelkabel of connector. Niet in de straal kijken of deze rechtstreeks bekijken met optische instrumenten. Als u de laseruitvoer met bepaalde optische instrumenten bekijkt (zoals bijv. een oogloep, vergrootgras of microscoop) binnen een afstand van 100 mm kan dit gevaar voor uw ogen opleveren. Het gebruik van regelaars of bijstellingen of het uitvoeren van procedures anders dan opgegeven kan leiden tot blootstelling aan gevaarlijke straling.**

Varoitus **Päättämättömän kuitukaapelin tai -liittimen päästä voi tulla näkymätöntä lasersäteilyä. Älä tuijota sädettä tai katso sitä suoraan optisilla välineillä. Lasersäteen katsominen tietyillä optisilla välineillä (esim. suurennuslasilla tai mikroskoopilla) 10 cm:n päästä tai sitä lähempää voi olla vaarallista silmille. Säätimien tai säätöjen käyttö ja toimenpiteiden suorittaminen ohjeista poikkeavalla tavalla voi altistaa vaaralliselle säteilylle.**

Attention **Des émissions de radiations laser invisibles peuvent se produire à l'extrémité d'un câble en fibre ou d'un raccord sans terminaison. Ne pas fixer du regard le rayon ou l'observer directement avec des instruments optiques. L'observation du laser à l'aide certains instruments optiques (loupes et microscopes) à une distance inférieure à 100 mm peut poser des risques pour les yeux. L'utilisation de commandes, de réglages ou de procédures autres que ceux spécifiés peut entraîner une exposition dangereuse à des radiations.**

Warnung **Eine unsichtbare Laserstrahlung kann vom Ende des nicht angeschlossenen Glasfaserkabels oder Steckers ausgestrahlt werden. Nicht in den Laserstrahl schauen oder diesen mit einem optischen Instrument direkt ansehen. Ein Betrachten des Laserstrahls mit bestimmten optischen Instrumenten, wie z.B. Augenlupen, Vergrößerungsgläsern und Mikroskopen innerhalb eines Abstands von 100 mm kann für das Auge gefährlich sein. Die Verwendung von nicht spezifizierten Steuerelementen, Einstellungen oder Verfahrensweisen kann eine gefährliche Strahlenexposition zur Folge haben.**

Avvertenza **L'estremità del connettore o del cavo ottico senza terminazione può emettere radiazioni laser invisibili. Non fissare il raggio od osservarlo in modo diretto con strumenti ottici. L'osservazione del fascio laser con determinati strumenti ottici (come lupette, lenti di ingrandimento o microscopi) entro una distanza di 100 mm può provocare danni agli occhi. L'adozione di controlli, regolazioni o procedure diverse da quelle specificate può comportare il pericolo di esposizione a radiazioni.**

Advarsel **Usynlig laserstråling kan emittere fra enden av den ikke-terminerte fiberkabelen eller koblingen. Ikke se inn i strålen og se heller ikke direkte på strålen med optiske instrumenter. Observering av laserutgang med visse optiske instrumenter (for eksempel øyelupe, forstørrelsesglass eller mikroskoper) innenfor en avstand på 100 mm kan være farlig for øynene. Bruk av kontroller eller justeringer eller utførelse av prosedyrer som ikke er spesifiserte, kan resultere i farlig strålingseksponering.**

Aviso **Radiação laser invisível pode ser emitida pela ponta de um conector ou cabo de fibra não terminado. Não olhe fixa ou diretamente para o feixe ou com instrumentos ópticos. Visualizar a emissão do laser com certos instrumentos ópticos (por exemplo, lupas, lentes de aumento ou microscópios) a uma distância de 100 mm pode causar riscos à visão. O uso de controles, ajustes ou desempenho de procedimentos diferentes dos especificados pode resultar em exposição prejudicial de radiação.**

¡Advertencia! **El extremo de un cable o conector de fibra sin terminación puede emitir radiación láser invisible. No se acerque al radio de acción ni lo mire directamente con instrumentos ópticos. La exposición del ojo a una salida de láser con determinados instrumentos ópticos (por ejemplo, lupas y microscopios) a una distancia de 100 mm puede comportar lesiones oculares. La aplicación de controles, ajustes y procedimientos distintos a los especificados puede comportar una exposición peligrosa a la radiación.**

Varning! **Osynlig laserstrålning kan komma från änden på en oavslutad fiberkabel eller -anslutning. Titta inte rakt in i strålen eller direkt på den med optiska instrument. Att titta på laserstrålen med vissa optiska instrument (t.ex. lupper, förstoringsglas och mikroskop) från ett avstånd på 100 mm kan skada ögonen. Om andra kontroller eller justeringar än de angivna används, eller om andra processer än de angivna genomförs, kan skadlig strålning avges.**

Laser Activation Warning

Warning **The laser is on when the card is booted and the safety key is in the on position (labeled 1). The port does not have to be in service for the laser to be on. The laser is off when the safety key is off (labeled 0).**

Waarschuwing **De laser is aan zodra de kaart is opgestart en de veiligheidssleutel in de AAN-positie is (gelabeld 1). De poort hoeft niet in dienst te zijn om de laser aan te zetten. De laser is uit wanneer de veiligheidssleutel uit is (gelabeld 0).**

Varoitus **Laser on päällä, kun kortti käynnistetään ja turva-avain on päällä (1) -asennossa. Laser voi olla päällä, vaikka portti ei olekaan käytössä. Laser on pois päältä, kun turva-avain on pois (0) -asennossa.**

Attention **Le laser est allumé dès le démarrage de la carte et lorsque la clé de sûreté est en position allumée (ou 1). Il n'est pas nécessaire que le port soit en service pour que le laser soit allumé. Le laser est éteint lorsque la clé de sûreté est en position éteinte (ou 0).**

Warnung **Der Laser ist eingeschaltet, wenn die Karte geladen wurde und der Sicherheitsschlüssel eingeschaltet ist (mit 1 bezeichnete Stellung). Der Port muss nicht in Betrieb sein, wenn der Laser eingeschaltet ist. Der Laser ist ausgeschaltet, wenn sich der Sicherheitsschlüssel in der Aus-Stellung (mit 0 bezeichnet) befindet.**

Avvertenza **Il laser è attivato quando la scheda è inserita e la chiave di sicurezza è in posizione ON (indicata con I). Per l'attivazione del laser non è necessario che la porta sia in funzione. Il laser è disattivato quando la chiave di sicurezza è su OFF (indicata con 0).**

Advarsel **Laseren er aktivert når kortet er på plass og sikkerhetstasten er i på-stilling (merket 1). Porten trenger ikke å være aktiv selv om laseren er på. Laseren er av når sikkerhetstasten er i av-stilling (merket 0).**

Aviso **O laser está ativado quando a placa é reiniciada e a chave de segurança está na posição on (ou 1). A porta não precisa estar em atividade para o acionamento do laser. O laser está desativado quando a chave de segurança está na posição off (ou 0).**

¡Advertencia! **El láser está encendido cuando la tarjeta ha arrancado y la llave de seguridad se encuentra en la posición ON (etiquetada 1). No es necesario que el puerto esté en funcionamiento para que el láser pueda funcionar. El láser está apagado cuando la llave de seguridad se encuentra en la posición OFF (etiquetada 0).**

Varning! **Lasern är på när kortet är igångsatt och säkerhetsnyckeln är i läget På (markerat med 1). Porten behöver inte vara igång för att lasern ska vara på. Lasern är av när säkerhetsnyckeln är i läget Av (markerat med 0).**

GLOSSARY

Numerics

1:1 protection

An electrical card protection scheme that pairs a working card with a protect card of the same type in an adjacent slot (DS-1 and DS-3 speeds). If the working card fails, the traffic from the working card switches to the protect card. When the failure on the working card is resolved, traffic reverts to the working card.

1+1 protection

An optical (OC-N) card protection scheme that pairs a single working port/card with a single dedicated protect port/card. All OC-N cards can use this protection type (OC-3, OC-12, OC-48, and OC-192 speeds).

1:N protection

An electrical card protection scheme that allows a single protect card to provide protection for several working cards (DS-1 and DS-3 speeds). If a working card fails, the traffic from the working card switches to the protect card.When the failure on the working card is resolved, traffic reverts to the working card.

10BaseT

Standard 10 Mbps local area network over unshielded twisted pair copper wire.

100BaseT

Standard 100 Mbps local ethernet network.

100BaseTX

Specification of 100BaseT that supports full duplex operation.

A

Access drop

Points where network devices can access the network.

ACO

Alarm cutoff.

Active card

A card that is working or carrying traffic. A card provisioned as working can be an active card or, after a protection switch, a protect card can be an active card.

ACT/STBY

Active/Standby.

Address mask

Bit combination used to describe the portion of an IP address that refers to the network or subnet and the portion that refers to the host. Sometimes referred to as mask. See also *subnet mask*.

ADM

(Add/drop multiplexers). Linear ADMs allow signals to be added to a SONET span or dropped from a SONET span. An ADM has three or more nodes.

Agent

1. 1. Generally, software that processes queries and returns replies on behalf of an application.
2. 2. In a network management system, a process that resides in all managed devices and reports the values of specified variables to management stations.

AIC

Alarm Interface Controller.

AID

(Access Identifier). An access code used in TL1 messaging that identifies and addresses specific objects within the ONS 15454. These objects include individual pieces of equipment, transport spans, access tributaries, and others. See also *TID*.

AIP

Alarm Interface Panel.

AIS

Alarm Indication Signal.

AIS-L

Line Alarm Indication Signal.

AMI

(Alternate Mark Inversion). Line-code format used on T1 circuits that transmits ones by alternate positive and negative pulses. Zeroes are represented by 01 during each bit cell and ones are represented by 11 or 00, alternately, during each bit cell. AMI requires that the sending device maintain ones density. Ones density is not maintained independently of the data stream. Sometimes called binary-coded alternate mark inversion.

ANSI

American National Standards Institute.

APS

(Automatic Protection Switching). SONET switching mechanism that routes traffic from working lines to protect lines if a line card failure or fiber cut occurs.

ARP

Address Resolution Protocol.

APSB

Alarm Protection Switching Byte.

ATAG

(Autonomous Message Tag). ATAG is used for TL1 message sequencing. See also *CTAG*.

ATM

Asynchronous Transfer Mode.

AWG

American Wire Gauge

B

B8ZS

(Binary 8-zero Substitution). A line-code type, used on T1 circuits, that substitutes a special code whenever 8 consecutive zeros are sent over the link. This code is then interpreted at the remote end of the connection. This technique guarantees ones density independent of the data stream. Sometimes called bipolar 8-zero substitution.

Backbone

The part of the network that carries the heaviest traffic or joins LANs together.

BER

(Bit Error Rate). Ratio of received bits that contain errors.

BIC

Backplane Interface Connector.

BIP

Bit Interleaved Parity.

Bit rate

Speed at which bits are transmitted, usually expressed in bits per second.

BITS

(Building Integrated Timing Supply). A single building master timing supply that minimizes the number of synchronization links entering an office. Sometimes referred to as a Synchronization Supply Unit.

BLSR

(Bidirectional Line Switched Ring). SONET ring architecture that provides working and protection fibers between nodes. If the working fiber between nodes is cut, traffic is automatically routed onto the protection fiber. See also *UPSR*.

Blue band

Dense Wavelength Division Multiplexing (DWDM) wavelengths are broken into two distinct bands: red and blue. DWDM cards for the ONS 15454 SDH operate on wavelengths between 1530.33nm and 1542.94nm in the blue band. The blue band is the lower frequency band.

BNC

Bayonet Neill-Concelman (coaxial cable bayonet-locking connector).

BPDU

Bridge Protocol Data Unit.

Bridge

Device that connects and passes packets between two network segments that use the same communications protocol. In general, a bridge will filter, forward, or flood an incoming frame based on the MAC address of that frame. See also *MAC address*.

Broadcast

Data packet that will be sent to all nodes on a network. Broadcasts are identified by a broadcast address. Compare with *multicast* and *unicast*. See also *Broadcast address*.

Broadcast address

Special address reserved for sending a message to all stations. Generally, a broadcast address is a MAC destination address of all ones. See also *MAC address.*

Broadcast storm

Undesirable network event in which many broadcasts are sent simultaneously across all network segments. A broadcast storm uses substantial network bandwidth and, typically, causes network time-outs.

Bus

Common physical signal path composed of wires or other media across which signals can be sent from one part of a computer to another.

C

C2 byte

The C2 byte is the signal label byte in the STS path overhead. This byte tells the equipment what the SONET payload envelope contains and how it is constructed. See also *SONET.*

CAT 5

Category 5 (cabling).

CCITT

Comité Consultatif International Télégraphique et Téléphoniques. (Formerly ITU.)

CEO

Central Office Environment.

CEV

Controlled Environment Vaults.

CLEI

Common Language Equipment Identifier code.

CLNP

Correctionless Network Protocol.

cm

Centimeter.

CMIP

Common Management Information Protocol.

COE

Central Office Environment.

Collision

In Ethernet, the result of two nodes transmitting simultaneously. The frames from each device impact and are damaged when they meet on the physical media.

Concatenation

A mechanism for allocating contiguous bandwidth for payload transport. Through the use of Concatenation Pointers, multiple OC-1s can be linked together to provide contiguous bandwidth through the network, from end to end.

CORBA

Common Object Request Broker Architecture.

CPE

Customer Premise Environments.

Crosspoint

A set of physical or logical contacts that operate together to extend the speech and signal channels in a switching network.

CTAG

(Correlation Tag). A unique identifier given to each input command by the TL1 operator. When the ONS 15454 system responds to a specific command, it includes the command's CTAG in the reply. This eliminates discrepancies about which response corresponds to which command. See also *ATAG*.

CTC

(Cisco Transport Controller). A Java-based graphical user interface (GUI) that allows operations, administration, maintenance, and provisioning (OAM&P) of the ONS 15454 using an Internet browser.

CTM

(Cisco Transport Manager). A Java-based network management tool used to support large networks of Cisco 15000-class D

DCC

(Data Communications Channel). Used to transport information about operation, administration, maintenance, and provisioning (OAM&P) over a SONET interface. DCC can be located in SDCC or LDCC. See also *LDCC* and *SDCC*.

DCN

Data Communications Network.

DCS

Distributed Communications System.

Default router

If the ONS 15454 must communicate with a device on a network to which the ONS 15454 is not connected, packets are sent to this router to be distributed.

Demultiplex

To separate multiple multiplexed input streams from a common physical signal back into multiple output streams. Compare *Multiplexing*.

Destination

The endpoint where traffic exits an ONS 15454 network. Endpoints can be paths (STS or STS/VT for optical card endpoints), ports (for electrical circuits, such as DS1, VT, DS3, STS), or cards (for circuits on DS1 and Ethernet cards). See also STS, and *VT*.

DRAM

Dynamic Random-Access Memory.

Drop

See *Destination*.

DS-1

Digital Signal Level One.

DS1-14

Digital Signal Level One (14 ports).

DS1N-14

Digital Signal Level One (N-14 ports).

DS-3

Digital Signal Level Three.

DS3-12

Digital Signal Level Three (12 ports).

DS3N-12

Digital Signal Level Three (N-12 ports).

DS3XM-6

Digital Service, level 3 Trans-Multiplexer 6 ports.

DSX

(Digital Signal Cross-Connect Frame). A manual bay or panel where different electrical signals are wired. A DSX permits cross-connections by patch cords and plugs.

DWDM

(Dense Wave Division Multiplexing). A technology that increases the information carrying capacity of existing fiber optic infrastructure by transmitting and receiving data on different light wavelengths. Many of these wavelengths can be combined on a single strand of fiber.

E

EDFA

(Erbium Doped Fiber Amplifier). A type of fiber optical amplifier that transmits a light signal through a section of erbium-doped fiber and amplifies the signal with a laser pump diode. EDFA is used in transmitter booster amplifiers, in-line repeating amplifiers, and in receiver preamplifiers.

EFCA

Electrical Facility Connection Assembly.

EFT

Electrical Fast Transient/Burst.

EIA

(Electrical Interface Assemblies). Provides backplane connection points for the DS-1, DS-3, and EC-1 cards.

ELR

Extended Long Reach.

EMC

Electromagnetic compatibility.

EMI

(Electromagnetic Interference). Interference by electromagnetic signals that can cause reduced data integrity and increased error rates on transmission channels.

EML

Element Manager Layer.

EMS

Element Management System.

Envelope

The part of messaging that varies in composition from one transmittal step to another. It identifies the message originator and potential recipients, documents its past, directs its subsequent movement by the Message Transfer System (MTS), and characterizes its content.

EOW

(Engineered Orderwire). A permanently connected voice circuit between selected stations for technical control purposes.

ERDI

Enhanced Remote Defect Indicator.

ES

Errored Seconds.

ESD

Electrostatic Discharge.

ESF

Extended Super Frame.

Ethernet switch

A type of Ethernet LAN device that increases aggregate LAN bandwidth by allowing simultaneous switching of packets between switch ports. Ethernet switches subdivide previously shared LAN segments into multiple networks with fewer stations per network.

ETSI

European Telecommunications Standards Institute.

Extended SNCP

(Extended Subnetwork Connection Protection). Extended SNCP extends the protection scheme of a subnetwork connection protection ring (SNCP) beyond the basic ring configuration to the meshed architecture of several interconnecting rings. See *SNCP*.

External timing reference

A timing reference obtained from a source external to the communications system, such as one of the navigation systems. Many external timing references are referenced to Coordinated Universal Time (UTC).

F

Falling threshold

A falling threshold is the counterpart to a rising threshold. When the number of occurrences drops below a falling threshold, this triggers an event to reset the rising threshold. See also *rising threshold*.

FC

Failure count.

FDDI

(Fiber Distributed Data Interface). LAN standard, defined by ANSI X3T9.5, specifying a 100-Mbps token-passing network using fiber optic cable, with transmission distances of up to 2 km. FDDI uses a dual-ring architecture to provide redundancy.

FE

Frame Bit Errors.

FG1

Frame Ground #1 (pins are labeled “FG1,” “FG2,” etc.)

FMEC

Front Mount Electrical Connection.

Frame

Logical grouping of information sent as a data link layer unit over a transmission medium. Often refers to the header and trailer, used for synchronization and error control that surrounds the user data contained in the unit.

FSB

Field Service Bulletin.

G

Gateway

An electronic repeater device that intercepts and steers electrical signals from one network to another.

GBIC

(Gigabit Interface Converter). A hot-swappable input/output device that plugs into a Gigabit Ethernet port to link the port with the fiber optic network.

Gbps

Gigabits per second.

GBps

Gigabytes per second.

GR-153-CORE

General Requirements #253 Council of Registrars.

GR-1089

General Requirements #1089.

GUI

Graphical User Interface.

H

Hard reset

The physical removal and insertion of a TCC+ card, also known as reseating a card or performing a card pull.

HDLC

(High-Level Data Link Control). Bit-oriented, synchronous, data-link layer protocol developed by ISO. HDLC specifies a data encapsulation method on synchronous serial links using frame characters and checksums.

high-speed slots

Slots 5, 6, 12 and 13 in th e ONS 15454 shelf. High-speed slots can host all ONS 15454 traffic cards except the four-port OC-12 card (OC12/STM4-4 card). See also *multispeed slots*.

Host number

Part of IP address used to address an individual host within the network or subnetwork.

Hot swap

The process of replacing a failed component while the rest of the system continues to function normally.

I

IEC

1. 1. InterExchange Carrier.
2. 2. International Electrotechnical Commission.

IEEE

Institute of Electrical and Electronics Engineers.

IETF

Internet Engineering Task Force.

Input alarms

Used for external sensors such as open doors, temperature sensors, flood sensors, and other environmental conditions.

I/O

Input/Output.

IP

(Internet Protocol). Network layer protocol in the TCP/IP stack offering a connectionless internetwork service. IP provides features for addressing, type-of-service specification, fragmentation and reassembly, and security.

IPPM

Intermediate-Path Performance Monitoring.

IP address

32-bit address assigned to host using TCP/IP. An IP address belongs to one of five classes (A, B, C, D, or E) and is written as 4 octets separated by periods (dotted decimal format). Each address consists of a network number, an optional subnetwork number, and a host number.

ITU-T

International Telecommunication Union - Telecommunication Standards Sector.

J

JRE

Java Runtime Environment.

K

K bytes

Automatic protection-switching bytes located in the SONET line overhead and monitored by equipment for an indication to switch to protection.

L

LAN

(Local Area Network). High-speed, low error data network covering a relatively small geographic area. LANs connect workstations, peripherals, terminals, and other devices in a single building or other geographically limited area. Ethernet, FDDI, and Token Ring are widely used LAN technologies.

LCD

(Liquid Crystal Display). An alphanumeric display using liquid crystal sealed between two pieces of glass. LCDs conserve electricity.

LDCC

Line Data Communication Channel.

Line layer

Refers to the segment between two SONET devices in the circuit. The line layer deals with SONET payload transport, and its functions include multiplexing and synchronization. Sometimes called a maintenance span.

Line terminating equipment (LTE)

Refers to line cards which terminate the line signal in the ONS 15454.

Line timing mode

A node that derives its clock from the SONET lines.

Link budget

The difference between the output power and receiver power of an optical signal expressed in dB. Link refers to an optical connection and all of its component parts (optical transmitters, repeaters, receivers, and cables).

Link integrity

The network communications channel has link integrity if it is intact.

LOF

Loss of Frame.

Loopback test

Test that sends signals then directs them back toward their source from some point along the communications path. Loopback tests are often used to test network interface usability.

LOP

Loss of Pointer.

LOS

Loss of Signal.

LOW

(Local Orderwire). A communications circuit between a technical control center and selected terminal or repeater locations.

LTE

Line Terminating Equipment.

LVDS

Low-Voltage Differential Signal.

M

MAC

Media Access Control.

MAC address

Standardized data link layer address that is required for every port or device that connects to a LAN. Other devices in the network use these addresses to locate specific ports in the network and to create and update routing tables and data structures. MAC addresses are six bytes long and are controlled by the IEEE. Also known as the hardware address, MAC-layer address, and physical address.

Maintenance user

A security level that limits user access to maintenance options only. See also *Superuser*, *Provisioning User*, and *Retrieve User*.

Managed device

A network node that contains an SNMP agent and resides on a managed network. Managed devices include routers, access servers, switches, bridges, hubs, computer hosts, and printers.

Managed object

In network management, a network device that can be managed by a network management protocol. Sometimes called an MIB object.

Mapping

A logical association between one set of values, such as addresses on one network, with quantities or values of another set, such as devices on another network.

Mbps

Megabits per second.

MBps

Megabytes per second.

MHz

Megahertz.

MIB

(Management Information Base). Database of network management information that is used and maintained by a network management protocol such as SNMP or CMIP. The value of a MIB object can be changed or retrieved using SNMP or CMIP commands, usually through a GUI network management system. MIB objects are organized in a tree structure that includes public (standard) and private (proprietary) branches.

MIME

Multipurpose Internet Mail Extensions.

MS

Multiplex Section.

MS-FERF

Multiplex Section Far-end Receive Failure.

MSP

Multiplex Section Protection.

MS-SPRing

(Multiplex Section Shared Protection Ring.) SDH ring architecture that provides working and protection fibers between nodes. If the working fiber between nodes is cut, traffic is automatically rerouted onto the protection fiber.

Multicast

Single packets copied by the network and sent to a specific subset of network addresses.

Multiplex payload

Generates section and line overhead, and converts electrical/optical signals when the electrical/optical card is transmitting.

Multiplexing

Scheme that allows multiple signals to be transmitted simultaneously across a single physical channel. Compare *Demultiplex.*

Multispeed slots

Slots 1 through 4 and 14 through 17 in the ONS 15454 shelf. Mulitspeed slots can host any ONS 15454 traffic card except the non-AS (any-slot) OC-48s and the OC-192 card. The OC-48 AS (any-slot) card can use a multispeed slot (the OC48IR 1310, OC48LR 1550, and OC48ELR 1550 cannot). See also *multispeed slots.*

Mux/Demux

Multiplexer/Demultiplexer.

Muxed

Multiplexed. See *Multiplexing*.

N

NE

(Network Element). In an Operations Support System, a single piece of telecommunications equipment used to perform a function or service integral to the underlying network.

NEBS

Network Equipment-Building Systems.

NEL

Network Element Layer.

Network number

Part of an IP address that specifies the network where the host belongs.

NML

Network Management Layer.

NMS

(Network Management System). System that executes applications that monitor and control managed devices. NMSs provide the bulk of the processing and memory resources required for network management.

Node

Endpoint of a network connection or a junction common to two or more lines in a network. Nodes can be processors, controllers, or workstations. Nodes, which vary in routing and other functional capabilities, can be interconnected by links, and serve as control points in the network. Node is sometimes used generically to refer to any entity that can access a network. In this manual the term "node" usually refers to an ONS 15454.

O

OAM&P

(Operations, Administration, Maintenance, and Provisioning). Provides the facilities and personnel required to manage a network.

OC

Optical carrier.

OOS AS

Out of Service Assigned.

Optical amplifier

A device that amplifies an optical signal without converting the signal from optical to electrical and back again to optical energy.

Optical receiver

An opto-electric circuit that detects incoming lightwave signals and converts them to the appropriate signal for processing by the receiving device.

Orderwire

Equipment that establishes voice contact between a central office and carrier repeater locations. See *Local orderwire*.

OSI

Open Systems Interconnection.

OSPF

Open Shortest Path First.

OSS

Operations Support System.

OSS/NMS

Operations Support System/Network Management System.

Output contacts (controls)

Triggers that drive visual or audible devices such as bells and lights. Output contacts can control other devices such as generators, heaters, and fans.

P

Passive devices

Components that do not require external power to manipulate or react to electronic output. Passive devices include capacitors, resisters, and coils.

Path Layer

The segment between the originating equipment and the terminating equipment. This path segment may encompass several consecutive line segments or segments between two SONET devices.

Payload

Portion of a cell, frame, or packet that contains upper-layer information (data).

PCM

Pulse Code Modulation.

PCMCIA

Personal Computer Memory Card International Association.

PCN

Product Change Notice(s).

PDI-P

STS Payload Defect Indication - Path.

Ping

(Packet internet grouper). ICMP echo message and its reply. Often used in IP networks to test the reachability of a network device.

Pointer justification

In SONET, the mechanism used to compensate for frequency and phase variations. Pointer justification counts indicate timing errors on SONET networks.

POP

Point of Presence.

PM

Performance Monitoring.

PPMN

(Path-Protected Mesh Network). PPMN extends the protection scheme of a unidirectional path switched ring (UPSR) beyond the basic ring configuration to the meshed architecture of several interconnecting rings.

Priority queuing

Routing feature that divides data packets into two queues: one low-priority and one high-priority.

Protect card

A card in a protection pair or scheme that is provisioned as a protect card to the working card. If the working card fails, the protect card becomes active. See also *working card*.

Provisioning user

A security level that allows the user to access only provisioning and maintenance options in CTC. See also *Superuser*, *Maintenance user,* and *Retrieve user.*

PSC

Protection-Switching Count.

PSD

Protection-Switching Duration.

PTE

Path-Terminating Equipment.

Q

Queue

In routing, a backlog of packets waiting to be forwarded over a router interface.

R

RAM

Random Access Memory.

RDI-L

Remote Defect Indication - Line.

Red band

DWDM wavelengths are broken into two distinct bands: red and blue. The red band is the higher frequency band. The red band DWDM cards for the ONS 15454 SDH operate on wavelengths between 1547.72nm and 1560.61nm.

RES

Reserved.

Retrieve user

A security level that allows the user to retrieve and view CTC information but not set or modify parameters. See also *Superuser*, *Maintenance user*, and *Provisioning user*.

Revertive switching

A process that sends electrical interfaces (traffic) back to the original working card after the card comes back online.

Rising threshold

The number of occurrences (collisions) that must be exceeded to trigger an event.

RJ-45

Registered Jack #45 (8-pin).

RMA

Return Materials Authorization.

RMON

(Remote Network Monitoring). Allows network operators to monitor the health of the network with a Network Management System (NMS). RMON watches several variables, such as Ethernet collisions, and triggers an event when a variable crosses a threshold in the specified time interval.

RS-232

Recommended Standard #232 (ANSI Electrical Interface for Serial Communication).

Rx

Receive.

S

SCI

Serial Communication Interface.

SCL

System Communications Link.

SDCC

Section Data Communication Channel.

SDH

(Synchronous Digital Hierarchy). European standard that defines a set of rate and format standards that are transmitted using optical signals over fiber. SDH is similar to SONET, with a basic SDH rate of 155.52 Mbps. Compare *SONET*.

SEF

Severely Errored Frame.

SELV

Safety Extra-Low Voltage.

SES

Severely Errored Seconds.

SF

Super Frame.

SML

Service Management Layer.

SMF

Single Mode Fiber.

SNCP

(Subnetwork Connection Protection Ring). Path-switched SDH rings that employ redundant, fiber-optic transmission facilities in a pair configuration. One fiber transmits in one direction and the backup fiber transmits in the other. If the primary ring fails, the backup takes over.

SNMP

(Simple Network Management Protocol). Network management protocol used almost exclusively in TCP/IP networks. SNMP monitors and controls network devices and manages configurations, statistics collection, performance, and security.

SNTP

(Simple Network Time Protocol). Using an SNTP server ensures that all ONS 15454 network nodes use the same date and time reference. The server synchronizes alarm timing during power outages or software upgrades.

Soft reset

A soft reset reloads the operating system, application software, etc., and reboots the TCC+ card. It does not initialize the ONS 15454 ASIC hardware.

SONET

(Synchronous Optical Network). High-speed synchronous network specification developed by Telcordia Technologies, Inc. and designed to run on optical fiber. STS-1 is the basic building block of SONET. Approved as an international standard in 1988.

Source

The endpoint where traffic enters an ONS 15454 network. Endpoints can be a path (STS or STS/VT for optical card endpoints), port (for electrical circuits, such as DS1, VT, DS3, STS), or card (for circuits on DS1 and Ethernet cards). See also *STS* and *VT*.

Span

An optical path between two nodes.

Spanning tree

A loop-free subset of a network topology. See also *STA* and *STP*.

SPE

(Synchronous Payload Envelope). A SONET term describing the envelope that carries the user data or payload.

SSM

(Synchronous Status Messaging). A SONET protocol that communicates information about the quality of the timing source using the S1 byte of the line overhead.

STA

(Spanning-Tree Algorithm). An algorithm used by the spanning tree protocol to create a spanning tree. See also *Spanning tree* and *STP*.

Standby card

A card that is not active or carrying traffic. A standby card can be a protect card or, after a protection switch, a working card can be a standby card.

Static route

A route that is manually entered into a routing table. Static routes take precedence over routes chosen by all dynamic routing protocols.

STP

1. 1. Shielded Twisted Pair.
2. 2. Spanning Tree Protocol. Bridge protocol that uses the spanning-tree algorithm to enable a learning bridge to dynamically work around loops in a network topology by creating a spanning tree. See also *Spanning tree and STA*.

STS

(Synchronous Transport Signal, used generically when speaking of SONET signals.)

STS-1

(Synchronous Transport Signal Level 1). Basic building block signal of SONET, operating at 51.84 Mbps for transmission over OC-1 fiber. Faster SONET rates are defined as STS-*n*, where *n* is a multiple of 51.84 Mbps. See also *SONET*.

Subnet mask

32-bit address mask used in IP to indicate the bits of an IP address that are used for the subnet address. Sometimes referred to simply as mask. See also *IP address mask* and *IP address*.

Subnetwork

In IP networks, a network confined to a particular subnet address. Subnetworks are networks segmented by a network administrator in order to provide a multilevel, hierarchical routing structure while shielding the subnetwork from the addressing complexity of attached networks. Sometimes called a subnet.

Subtending rings

SONET rings that incorporate nodes that are also part of an adjacent SONET ring.

Superuser

A security level that can perform all of the functions of the other security levels as well as set names, passwords, and security levels for other users. A superuser is usually the network element administrator. See also *Retrieve user*, *Maintenance user*, and *Provisioning user.*

SWS

SONET WAN switch.

SXC

SONET Cross Connect ASIC.

T

T1

T1 transmits DS-1-formatted data at 1.544 Mbps through the telephone-switching network using AMI or B8ZS coding. See also *AMI*, *B8ZS*, and *DS-1*.

TAC

Technical Assistance Center.

Tag

Identification information, including a number plus other information.

TBOS

Telemetry Byte-Oriented Serial protocol.

TCA

Threshold Crossing Alert.

TCC+

Timing Communications and Control + Card

TCP/IP

Transmission Control Protocol/Internet Protocol

TDM

(Time Division Multiplexing). Allocates bandwidth on a single wire for information from multiple channels based on preassigned time slots. Bandwidth is allocated to each channel regardless of whether the station has data to transmit.

TDS

Time-Division Switching.

Telcordia

(Telcordia Technologies, Inc., formerly named Bellcore). Eighty percent of the U.S. telecommunications network depends on software invented, developed, implemented, or maintained by Telcordia.

TID

(Target Identifier). Identifies the particular network element (in this case, the ONS 15454) where each TL1 command is directed. The TID is a unique name given to each system at installation. See also *AID*.

TL1

Transaction Language 1.

TLS

(Transparent LAN Service). Provides private network service across a SONET backbone.

TMN

Telecommunications Management Network.

Transponder

Optional devices of a DWDM system providing the conversion of one optical wavelength to a precision narrow band wavelength. See also *DWDM*.

Trap

Message sent by an SNMP agent to an NMS (CTM), console, or terminal to indicate the occurrence of a significant event, such as an exceeded threshold. See also *CTM*.

Tributary

The lower-rate signal directed into a multiplexer for combination (multiplexing) with other low rate signals to form an aggregate higher rate level.

Trunk

Network traffic travels across this physical and logical connection between two switches. A backbone is composed of a number of trunks. See also *Backbone*.

TSA

Time-Slot Assignment.

TSI

Time-Slot Interchange.

Tunneling

Architecture that is designed to provide the services necessary to implement any standard point-to-point encapsulation scheme.

Tx

Transmit.

U

UAS

Unavailable Seconds.

UDP/IP

User Datagram Protocol/Internet Protocol.

UID

User Identifier.

Unicast

The communication of a single source to a single destination.

UPSR

(Unidirectional Path Switched Ring). Path-switched SONET rings that employ redundant, fiber- optic transmission facilities in a pair configuration. One fiber transmits in one direction and the backup fiber transmits in the other. If the primary ring fails, the backup takes over. See also *BLSR*.

Upstream

Set of frequencies used to send data from a subscriber to the head end.

UTC

Universal-Time Coordinated.

UTP

Unshielded Twisted Pair.

V

VDC

Volts Direct Current.

Virtual fiber

A fiber that carries signals at different rates and uses the same fiber optic cable.

Virtual ring

Entity in a source-route bridging (SRB) network that logically connects two or more physical rings together either locally or remotely. The concept of virtual rings can be expanded across router boundaries.

Virtual wires

Virtual wires route external alarms to one or more alarm collection centers across the SONET transport network.

VLAN

(Virtual LAN). Group of devices located on a number of different LAN segments that are configured (using management software) to communicate as if they were attached to the same wire. Because VLANs are based on logical instead of physical connections, they are extremely flexible.

VPN

(Virtual Private Network). Enables IP traffic to travel securely over a public TCP/IP network by encrypting all traffic from one network to another. A VPN uses “tunneling” to encrypt all information at the IP level. See also *Tunneling*.

VT

(Virtual Tributary). A structure designed for the transport and switching of sub-DS3 payloads. See also *Tributary*.

VT1.5

Virtual Tributary that equals 1.544 Mbps.

VT layer

The VT layer or electrical layer occurs when the SONET signal is broken down into an electrical signal.

VT tunnel

VT tunnels allow electrical circuits to pass through ONS 15454 nodes without using ONS 15454 cross-connect card capacity.

W

W

Watts.

WAN

Wide Area Network.

Working card

A card that is provisioned as an active, primary card. Traffic cards in a protection pair are provisioned as working or protect See also *Protect card*.

X

XC

Cross Connect

XCVT

Cross Connect Virtual Tributary.

X.25

Protocol providing devices with direct connections to a packet-switched network.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